

Computer Science and Engineering (Cyber Security)

Computer Science and Engineering (Cyber Security)

CURRICULUM FROM SEMESTERS I TO VIII

Every course of B. Tech. Programme shall be placed in one of the nine categories as listed in table below.

Sl. No	Category	Code	Credits
1	Humanities and Social Sciences including Management courses	HMC	5
2	Basic Science courses	BSC	26
3	Engineering Science Courses	ESC	22
4	Program Core Courses	PCC	79
5	Program Elective Courses	PEC	15
6	Open Elective Courses	OEC	3
7	Project work and Seminar	PWS	10
8	Mandatory Non-credit Courses (P/F) with grade	MCN	--
9	Mandatory Student Activities (P/F)	MSA	2
	Total Mandatory Credits		162
10	Value Added Course (Optional)	VAC	20

No semester shall have more than five lecture-based courses and two laboratory and/or drawing/seminar/project courses in the curriculum. Semester-wise credit distribution shall be as below:

Sem	1	2	3	4	5	6	7	8	Total
Credits	17	21	22	22	23	23	15	17	160
Activity Points	50				50				---
Credits for Activity	2								2
G. Total									162

Basic Science Courses: Mathematics, Physics, Chemistry, Biology for Engineers, Life Science etc

Engineering Science Courses: Engineering Graphics, Programming in C, Basics of Electrical and Electronics Engineering, Basics of Civil and Mechanical Engineering,

Computer Science and Engineering (Cyber Security)

Engineering Mechanics, Thermodynamics, Design Engineering, Materials Engineering, Workshops etc.

Humanities and Social Sciences including Management courses: English, Humanities, Professional Ethics, Management, Finance & Accounting, Life Skills, Professional Communication, Economics etc

Mandatory Non-credit Courses: Environmental Science, Constitution of India/Essence of Indian Knowledge Tradition, Industrial Safety Engineering, Disaster Management etc.

Course Code and Course Number

Each course is denoted by a unique code consisting of three alphabets followed by three numerals like **CSL 201**. The first two letter code refers to the department offering the course. CS stands for course in Computer Science & Engineering, course code MA refers to a course in Mathematics, course code ES refers to a course in Engineering Science etc. Third letter stands for the nature of the course as indicated in the following table.

Code	Description
T	Theory based courses (other than lecture hours, these courses can have tutorial and practical hours, e.g., L-T-P structures 3-0-0, 3-1-2, 3-0-2 etc.)
L	Laboratory based courses (where performance is evaluated primarily on the basis of practical or laboratory work with LTP structures like 0-0-3, 1-0-3, 0-1-3 etc.)
N	Non-credit courses
D	Project based courses (Major-, Mini- Projects)
Q	Seminar courses

Course Number is a three digit number and the first digit refers to the Academic year in which the course is normally offered, i.e. 1, 2, 3, or 4 for the B. Tech. Programme of four year duration. Of the other two digits, the last digit identifies whether the course is offered normally in the odd (odd number), even (non-zero even number) or in both the semesters (zero). The middle number could be any digit. CSL 201 is a laboratory course offered in Computer Science and Engineering department for third semester, MAT 101 is a course in Mathematics offered in the first semester, EET 344 is a theory course in Electrical Engineering offered in the sixth semester, PHT 110 is a course in Physics offered both the first and second semesters, EST 102 is a course in Basic Engineering offered by one or many departments in the second semester. These course numbers are to be given in the curriculum and syllabi.

Departments

Each course is offered by a Department and their two-letter course prefix is given in Table 2

Table 2: Departments and their codes

SL No	Department	Course Prefix	SL No	Department	Course Prefix
1	Aeronautical Engineering	AO	23	Electronics and Communication Engineering	EC
2	Agriculture Engineering	AG	24	Electronics and Computer Engineering	ER
3	Applied Electronics and Instrumentation	AE	25	Electrical and Computer Engineering	EO
4	Artificial Intelligence	AI	26	Electrical and Electronics Engineering	EE
5	Artificial Intelligence and Data Science	AD	27	Food Technology	FT
6	Artificial Engineering and Machine Learning	AM	28	Humanities	HU
7	Automobile Engineering	AU	29	Industrial Engineering	IE
8	Biomedical Engineering	BM	30	Information Technology	IT
9	Biotechnology	BT	31	Instrumentation & Control	IC
10	Chemical Engineering	CH	32	Mandatory Courses	MC
11	Chemistry	CY	33	Mathematics	MA
12	Civil Engineering	CE	34	Mechanical Engineering	ME
13	Civil and Environmental Engineering	CN	35	Mechatronics	MR
14	Computer Science and Business Systems	CB	36	Metallurgy	MT
15	Computer Science and Design	CX	37	Mechanical (Auto)	MU
16	Computer Science and Engineering	CS	38	Mechanical (Prod)	MP
17	Computer Science and Engineering (Artificial Intelligence)	CA	39	Naval & Ship Building	SB
18	Computer Science and Engineering (Artificial Intelligence and Machine Learning)	CM	40	Physics	PH
19	Computer Science and Engineering (Data Science)	CD	41	Polymer Engineering	PO
20	Computer Science and Engineering (Cyber Security)	CC	42	Production Engineering	PE
21	Cyber Physical Systems	CP	43	Robotics and Automation	RA
22	Electronics & Biomedical	EB	44	Safety & Fire Engineering	FS

SEMESTER I
Computer Science and Engineering (Cyber Security)

SLOT	COURSE NO.	COURSES	L-T-P	HOURS	CREDIT
A	MAT 101	LINEAR ALGEBRA AND CALCULUS	3-1-0	4	4
B 1/2	PHT 100	ENGINEERING PHYSICS A	3-1-0	4	4
	CYT 100	ENGINEERING CHEMISTRY	3-1-0	4	4
C 1/2	EST 100	ENGINEERING MECHANICS	2-1-0	3	3
	EST 110	ENGINEERING GRAPHICS	2-0-2	4	3
D 1/2	EST 120	BASICS OF CIVIL & MECHANICAL ENGINEERING	4-0-0	4	4
	EST 130	BASICS OF ELECTRICAL & ELECTRONICS ENGINEERING	4-0-0	4	4
E	HUN 101	LIFE SKILLS	2-0-2	4	--
S 1/2	PHL 120	ENGINEERING PHYSICS LAB	0-0-2	2	1
	CYL 120	ENGINEERING CHEMISTRY LAB	0-0-2	2	1
T 1/2	ESL 120	CIVIL & MECHANICAL WORKSHOP	0-0-2	2	1
	ESL 130	ELECTRICAL & ELECTRONICS WORKSHOP	0-0-2	2	1
TOTAL				23/24	17

Computer Science and Engineering (Cyber Security)

SEMESTER II

SLOT	COURSE NO.	COURSES	L-T-P	HOURS	CREDIT
A	MAT 102	VECTOR CALCULUS DIFFERENTIAL EQUATIONS AND TRANSFORMS	3-1-0	4	4
B 1/2	PHT 100	ENGINEERING PHYSICS A	3-1-0	4	4
	CYT 100	ENGINEERING CHEMISTRY	3-1-0	4	4
C 1/2	EST 100	ENGINEERING MECHANICS	2-1-0	3	3
	EST 110	ENGINEERING GRAPHICS	2-0-2	4	3
D 1/2	EST 120	BASICS OF CIVIL & MECHANICAL ENGINEERING	4-0-0	4	4
	EST 130	BASICS OF ELECTRICAL & ELECTRONICS ENGINEERING	4-0-0	4	4
E	HUT 102	PROFESSIONAL COMMUNICATION	2-0-2	4	--
F	EST 102	PROGRAMMING IN C	2-1-2	5	4
S 1/2	PHL 120	ENGINEERING PHYSICS LAB	0-0-2	2	1
	CYL 120	ENGINEERING CHEMISTRY LAB	0-0-2	2	1
T 1/2	ESL 120	CIVIL & MECHANICAL WORKSHOP	0-0-2	2	1
	ESL 130	ELECTRICAL & ELECTRONICS WORKSHOP	0-0-2	2	1
TOTAL				28/29	21

Computer Science and Engineering (Cyber Security)

NOTE:

1. Engineering Physics A and Engineering Chemistry shall be offered in both semesters. Institutions can advise students belonging to about 50% of the number of branches in the Institution to opt for Engineering Physics A in S1 and Engineering Chemistry in S2 & vice versa. Students opting for Engineering Physics A in a semester should attend Physics Lab in the same semester and students opting for Engineering Chemistry in one semester should attend Engineering Chemistry Lab in the same semester
2. Engineering Mechanics and Engineering Graphics shall be offered in both semesters. Institutions can advise students belonging to about 50% of the number of branches in the Institution to opt for Engineering Mechanics in S1 and Engineering Graphics in S2 & vice versa.
3. Basics of Civil & Mechanical Engineering and Basics of Electrical & Electronics Engineering shall be offered in both semesters. Basics of Civil & Mechanical Engineering contain equal weightage for Civil Engineering and Mechanical Engineering. Slot for the course is D with CIE marks of 25 each and ESE marks of 50 each. Students belonging to branches of AEI, EI, BME, ECE, EEE, ICE, CSE, IT, RA can choose this course in S1.

Basics of Electrical & Electronics Engineering contain equal weightage for Electrical Engineering and Electronics Engineering. Slot for the course is D with CIE marks of 25 each and ESE marks of 50 each. Students belonging to AERO, AUTO, CE, FSE, IE, ME, MECHATRONICS, PE, METALLURGY, BT, BCE, CHEM, FT, POLY can choose this course in S1. Students having Basics of Civil & Mechanical Engineering in one semester should attend Civil & Mechanical Workshop in the same semester and students having Basics of Electrical & Electronics Engineering in a semester should attend Electrical & Electronics Workshop in the same semester.

4. LIFE SKILLS

Life skills are those competencies that provide the means for an individual to be resourceful and positive while taking on life's vicissitudes. Development of one's personality by being aware of the self, connecting with others, reflecting on the abstract and the concrete, leading and generating change, and staying rooted in time-tested values and principles is being aimed at. This course is designed to enhance the employability and maximize the potential of the students by introducing them to the principles that underlie personal and professional success, and help them acquire the skills needed to apply these principles in their lives and careers.

5. PROFESSIONAL COMMUNICATION

Objective is to develop in the under-graduate students of engineering a level of competence in English required for independent and effective communication for their professional needs.

Coverage: Listening, Barriers to listening, Steps to overcome them, Purposive listening

practice, Use of technology in the professional world. Speaking, Fluency & accuracy in speech, Positive thinking, Improving self-expression, Tonal variations, Group discussion practice, Reading, Speed reading practice, Use of extensive readers, Analytical and critical reading practice, Writing Professional Correspondence, Formal and informal letters, Tone in formal writing, Introduction to reports. Study Skills, Use of dictionary, thesaurus etc., Importance of contents page, cover & back pages, Bibliography, Language Lab.

Computer Science and Engineering (Cyber Security)

SEMESTER III

SLOT	COURSE NO.	COURSES	L-T-P	HOURS	CREDIT
A	MAT 203	DISCRETE MATHEMATICAL STRUCTURES	3-1-0	4	4
B	CST 201	DATA STRUCTURES	3-1-0	4	4
C	CST 203	LOGIC SYSTEM DESIGN	3-1-0	4	4
D	CST 205	OBJECT ORIENTED PROGRAMMING USING JAVA	3-1-0	4	4
E (1/2)	EST 200	DESIGN & ENGINEERING	2-0-0	2	2
	HUT 200	PROFESSIONAL ETHICS	2-0-0	2	2
F	MCN 201	SUSTAINABLE ENGINEERING	2-0-0	2	--
S	CSL 201	DATA STRUCTURES LAB	0-0-3	3	2
T	CSL 203	OBJECT ORIENTED PROGRAMMING LAB (IN JAVA)	0-0-3	3	2
R/M	VAC	Remedial/Minor course	3-1-0	4	4
TOTAL				26*	22/26
* Excluding Hours to be engaged for Remedial/Minor course.					

Computer Science and Engineering (Cyber Security)

SEMESTER IV

SLOT	COURSE NO.	COURSES	L-T-P	HOURS	CREDIT
A	MAT 266	MATHEMATICAL FOUNDATIONS FOR SECURITY SYSTEMS	3-1-0	4	4
B	CST 202	COMPUTER ORGANISATION AND ARCHITECTURE	3-1-0	4	4
C	CST 204	DATABASE MANAGEMENT SYSTEMS	3-1-0	4	4
D	CST 206	OPERATING SYSTEMS	3-1-0	4	4
E (1/2)	EST 200	DESIGN & ENGINEERING	2-0-0	2	2
	HUT 200	PROFESSIONAL ETHICS	2-0-0	2	2
F	MCN 202	CONSTITUTION OF INDIA	2-0-0	2	--
S	CCL 202	SCRIPTING LANGUAGES FOR SECURITY	0-0-3	3	2
T	CCL 204	OS AND DBMS LAB	0-0-3	3	2
R/M/ H	VAC	Remedial/Minor/Honours course	3-1-0	4	4
TOTAL				26*	22/26
* Excluding Hours to be engaged for Remedial/Minor/Honours course.					

NOTE:

- Design & Engineering and Professional Ethics shall be offered in both S3 and S4. Institutions can advise students belonging to about 50% of the number of branches in the Institution to opt for Design & Engineering in S3 and Professional Ethics in S4 & vice versa.
- *All Institutions should keep 4 hours exclusively for Remedial class/Minor course (Thursdays from 3 to 5 PM and Fridays from 2 to 4 PM). If a student does not opt for minor programme, he/she can be given remedial class.

Computer Science and Engineering (Cyber Security)

SEMESTER V

SLOT	COURSE NO.	COURSES	L-T-P	HOURS	CREDIT
A	CST 301	FORMAL LANGUAGES AND AUTOMATA THEORY	3-1-0	4	4
B	CST 303	COMPUTER NETWORKS	3-1-0	4	4
C	CCT 305	SYSTEMS & NETWORK SECURITY	3-1-0	4	4
D	CCT 307	APPLIED CRYPTOGRAPHY	3-1-0	4	4
E	CST 309	MANAGEMENT OF SOFTWARE SYSTEMS	3-0-0	3	3
F	MCN 301	DISASTER MANAGEMENT	2-0-0	2	--
S	CCL 331	CRYPTOGRAPHY LAB	0-0-4	4	2
T	CCL 333	SYSTEM & NETWORK SECURITY LAB	0-0-4	4	2
R/M/H	VAC	Remedial/Minor/Honours course*	2-0-0	4	4
TOTAL				29*	23/27
* Excluding Hours to be engaged for Remedial/Minor/Honours course.					

NOTE:

- *All Institutions should keep 4 hours exclusively for Remedial class/Minor/ Honours course (Tuesdays from 3 to 5 PM and Wednesdays from 3 to 5 PM). If a student does not opt for minor/honours programme, he/she can be given remedial class.

Computer Science and Engineering (Cyber Security)

SEMESTER VI

SLOT	COURSE NO.	COURSES	L-T-P	HOURS	CREDIT
A	CST 302	COMPILER DESIGN	3-1-0	4	4
B	CCT 304	CYBER FORENSICS	3-1-0	4	4
C	CST 306	ALGORITHM ANALYSIS AND DESIGN	3-1-0	4	4
D	CST ---	PROGRAM ELECTIVE I	2-1-0	3	3
E	HUT 300	INDUSTRIAL ECONOMICS & FOREIGN TRADE	3-0-0	3	3
F	CCT 308	COMPREHENSIVE COURSE WORK	1-0-0	1	1
S	CCL 332	CYBER FORENSICS LAB	0-0-3	3	2
T	CCD 334	MINIPROJECT	0-0-3	3	2
R/M/H	VAC	Remedial/Minor/Honours course*	3-1-0	4	4
TOTAL				25*	23/27
* Excluding Hours to be engaged for Remedial/Minor/Honours course.					

Note:

Electives: This curriculum envisages to offer a learner an opportunity to earn proficiency in one of the four trending areas in Computer Science, namely Security in Big Data, Machine Learning, Computer Programming and Formal Methods in Software Engineering . Three courses each from the above areas are included through Elective Courses in different Elective Buckets. For example, a learner who is interested in the **Security in Big Data** area may opt to take the elective courses - **Storage Management & Security** from Elective-I in S6, **Introduction to BigData Technology** from Elective-II in S7 and **Big Data Security** from Elective-IV in S8. The Department may offer Elective Courses to enable students to utilize this opportunity, depending on the availability of faculty. The courses included from these areas under various Elective Buckets are shown in the table below.

Computer Science and Engineering (Cyber Security)

Different Specializations introduced through various Elective Buckets				
Bucket	Specialisation	Semester		
		S6	S7	S8
1	Big Data and Security	STORAGE MANAGEMENT & SECURITY (E-I)	INTRODUCTION TO BIG DATA TECHNOLOGY (E-II)	BIG DATA SECURITY (E-IV)
2	Machine Learning	FOUNDATIONS OF MACHINE LEARNING (E-I)	MACHINE LEARNING (E-II)	DEEP LEARNING (E-III)
3	Computer Programming	PROGRAMMING IN R (E-I)	WEB PROGRAMMING (E-II)	PROGRAMMING PARADIGMS (E-III)
4	Formal Methods in Software Engineering	AUTOMATED VERIFICATION(E-I)	MODEL BASED SOFTWARE DEVELOPMENT(E-II)	SOFTWARE TESTING (E-V)

PROGRAM ELECTIVE I

SLOT	COURSE NO.	COURSES	L-T-P	HOURS	CREDIT
D	CST 312	FOUNDATIONS OF MACHINE LEARNING	2-1-0	3	3
	CST 322	DATA ANALYTICS	2-1-0		
	CCT 332	STORAGE MANAGEMENT & SECURITY	2-1-0		
	CST 342	AUTOMATED VERIFICATION	2-1-0		
	CCT 352	MALWARE FORENSICS	2-1-0		
	CDT 362	PROGRAMMING IN R	2-1-0		
	CST 372	DATA AND COMPUTER COMMUNICATION	2-1-0		

Computer Science and Engineering (Cyber Security)

COURSES TO BE CONSIDERED FOR COMPREHENSIVE COURSE WORK

i MATHEMATICAL FOUNDATIONS FOR SECURITY SYSTEMS
ii DATA STRUCTURES
iii OPERATING SYSTEMS
iv COMPUTER NETWORKS
v DATABASE MANAGEMENT SYSTEMS
vi APPLIED CRYPTOGRAPHY

NOTE:

1. *All Institutions should keep 4 hours exclusively for Remedial class/Minor/Honours course (Tuesdays from 3 to 5 PM and Wednesdays from 2 to 4 PM). If a student does not opt for minor/honours programme, he/she can be given remedial class.
2. Comprehensive Course Work: The comprehensive course work in the sixth semester of study shall have a written test of 50 marks. The written examination will be of objective type similar to the GATE examination and will be conducted by the University. Syllabus for comprehensive examination shall be prepared by the respective BoS choosing the above listed 6 core courses studied from semesters 3 to 5. The pass minimum for this course is 25. The course should be mapped with a faculty and classes shall be arranged for practicing questions based on the core courses listed in the curriculum.
3. Mini project: It is introduced in the sixth semester with a specific objective to strengthen the understanding of student's fundamentals through effective application of theoretical concepts. Mini project can help to boost their skills and widen the horizon of their thinking. The ultimate aim of an engineering student is to resolve a problem by applying theoretical knowledge. Doing more projects increases problem-solving skills. Student Groups with 3 or 4 members should identify a topic of interest in consultation with Faculty/Advisor. Review the literature and gather information pertaining to the chosen topic. State the objectives and develop a methodology to achieve the objectives. Carryout the design/fabrication or develop codes/programs to achieve the objectives. Demonstrate the novelty of the project through the results and outputs. The progress of the mini project is evaluated based on a minimum of two reviews. The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The product has to be

Computer Science and Engineering (Cyber Security)

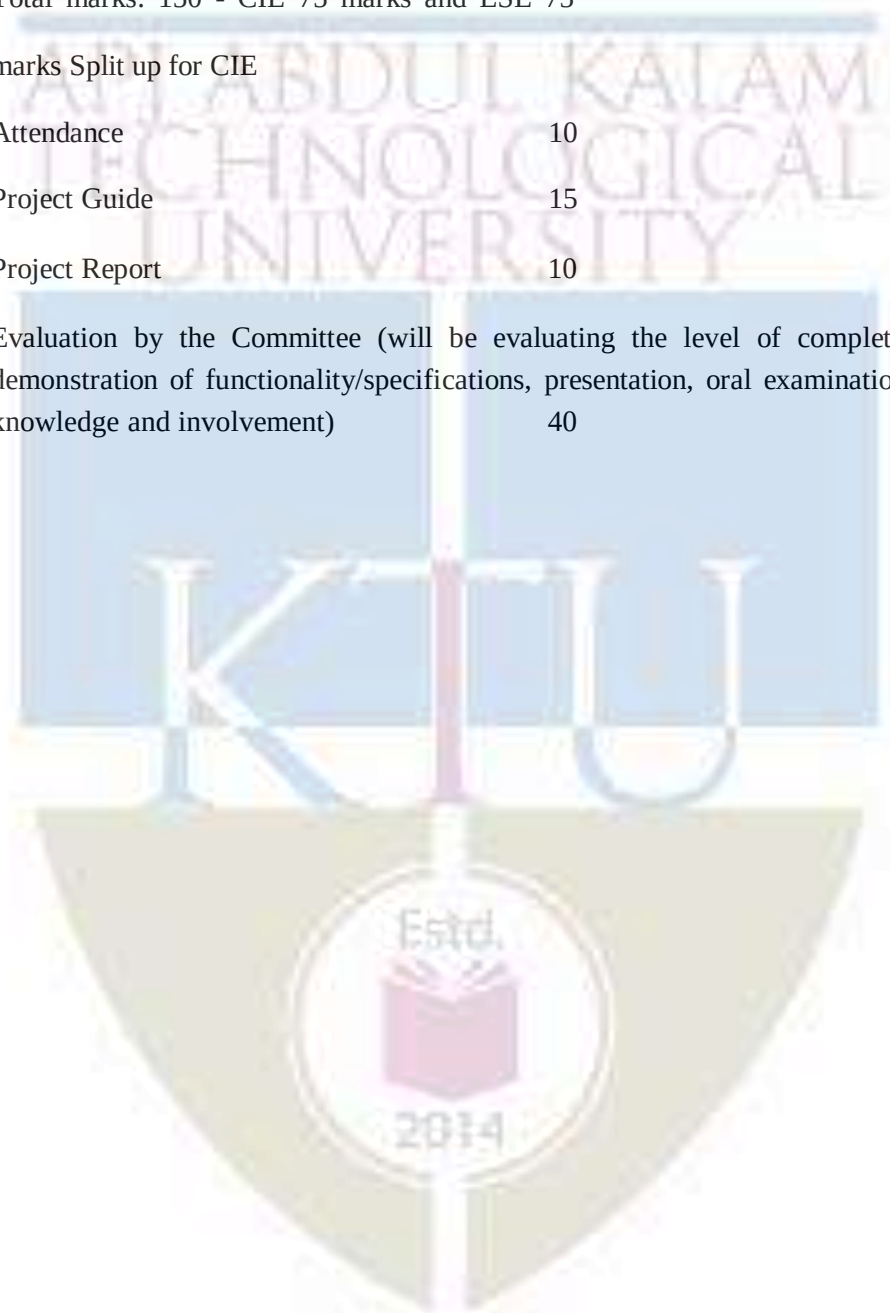
demonstrated for its full design specifications. Innovative design concepts, reliability considerations, aesthetics/ergonomic aspects taken care of in the project shall be given due weight. The internal evaluation will be made based on the product, the report and a viva-voce examination, conducted internally by a 3 member committee appointed by Head of the Department comprising HoD or a senior faculty member, Mini Project coordinator for that program and project guide.

Total marks: 150 - CIE 75 marks and ESE 75

marks Split up for CIE

Attendance	10
Project Guide	15
Project Report	10

Evaluation by the Committee (will be evaluating the level of completion and demonstration of functionality/specifications, presentation, oral examination, work knowledge and involvement) 40



Computer Science and Engineering (Cyber Security)

SEMESTER VII

SLOT	COURSE NO.	COURSES	L-T-P	HOURS	CREDIT
A	CCT 401	ETHICAL HACKING	2-1-0	3	3
B	CCT ---	PROGRAM ELECTIVE II	2-1-0	3	3
C	CCT ---	OPEN ELECTIVE	2-1-0	3	3
D	MCN 401	INDUSTRIAL SAFETY ENGINEERING	2-1-0	3	---
S	CCL 411	ETHICAL HACKING LAB	0-0-3	3	2
T	CCQ 413	SEMINAR	0-0-3	3	2
U	CCD 415	PROJECT PHASE I	0-0-6	6	2
R/M/H	VAC	Remedial/Minor/Honours course*	3-1-0	4	4
TOTAL				24*	15/19
* Excluding Hours to be engaged for Remedial/Minor/Honours course.					

PROGRAM ELECTIVE II

SLOT	COURSE NO.	COURSES	L-T-P	HOURS	CREDIT
B	CST 413	MACHINE LEARNING	2-1-0	3	3
	CCT 423	INTRUSION DETECTION & PREVENTION SYSTEM	2-1-0		
	CCT 433	CLOUD COMPUTING & SECURITY	2-1-0		
	CCT 443	MODEL BASED SOFTWARE DEVELOPMENT			
	CST 453	INTRODUCTION TO BIG DATA TECHNOLOGY	2-1-0		
	CST 463	WEB PROGRAMMING	2-1-0		
	CST 473	NATURAL LANGUAGE PROCESSING	2-1-0		

Computer Science and Engineering (Cyber Security)

OPEN ELECTIVE

The open elective is offered in semester 7. Each program should specify the courses (maximum 5) they would like to offer as electives for other programs. The courses listed below are offered by the Department of **COMPUTER SCIENCE & ENGINEERING** for students of other undergraduate branches except for students of Computer Science & Engineering and Information Technology departments offered in the colleges under KTU.

SLOT	COURSE NO.	COURSES	L-T-P	HOURS	CREDIT
B	CST 415	INTRODUCTION TO MOBILE COMPUTING	2-1-0	3	3
	CST 425	INTRODUCTION TO DEEP LEARNING	2-1-0		
	CST 435	COMPUTER GRAPHICS	2-1-0		
	CST 445	iv PYTHON FOR ENGINEERS	2-1-0		
	CST 455	v OBJECT ORIENTED CONCEPTS	2-1-0		

NOTE :

1. *All Institutions should keep 4 hours exclusively for Remedial class/Minor/Honours course (Mondays from 10 to 12 and Wednesdays from 10 to 12 Noon). If a student does not opt for minor/honours programme, he/she can be given remedial class.
2. Seminar: To encourage and motivate the students to read and collect recent and reliable information from their area of interest confined to the relevant discipline from technical publications including peer reviewed journals, conference, books, project reports etc., prepare a report based on a central theme and present it before a peer audience. Each student shall present the seminar for about 20 minutes duration on the selected topic. The report and the presentation shall be evaluated by a team of faculty members comprising Academic coordinator for that program, seminar coordinator and seminar guide based on style of presentation, technical content, adequacy of references, depth of knowledge and overall quality of the report.

Total marks: 100, only CIE, minimum required to pass 50

Attendance	10
Seminar Diary	10
Guide	20
Report	20
Presentation	40

3. Project Phase I: The course 'Project Work' is mainly intended to evoke the innovation and invention skills in a student. The course will provide an opportunity to synthesize and apply the knowledge and analytical skills learned, to be developed as a prototype or simulation. The project extends to 2 semesters and will be evaluated in the 7th and 8th semester separately, based on the achieved objectives. One third of the project credits shall be completed in 7th semester and two third in 8th semester. It is recommended that the projects may be finalized in the thrust areas of the respective engineering stream or as interdisciplinary projects. Importance should be given to address societal problems and developing indigenous technologies. The assignment to normally include:

- Literature study/survey of published literature on the assigned topic
- Formulation of objectives
- Formulation of hypothesis/ design/ methodology
- Formulation of work plan and task allocation.
- Block level design documentation
- Seeking project funds from various agencies
- Preliminary Analysis/Modeling/Simulation/Experiment/ Design/Feasibility study
- Preparation of Phase 1 report

Total marks: 100, only CIE, minimum required to pass 50

Guide	30
Interim evaluation by the Evaluation committee	20
Final evaluation by the Evaluation committee	30
Phase – I Report (By Evaluation committee)	20

The evaluation committee comprises HoD or a senior faculty member, Project coordinator and project supervisor.

Computer Science and Engineering (Cyber Security)

SEMESTER VIII

SLOT	COURSE NO.	COURSES	L-T-P	HOURS	CREDIT
A	CCT 402	BIOMETRIC SECURITY	2-1-0	3	3
B	CCT ---	PROGRAM ELECTIVE III	2-1-0	3	3
C	CCT ---	PROGRAM ELECTIVE IV	2-1-0	3	3
D	CCT ---	PROGRAM ELECTIVE V	2-1-0	3	3
T	CCT 404	COMPREHENSIVE COURSE VIVA	1-0-0	1	1
U	CCD 416	PROJECT PHASE II	0-0-12	12	4
R/M/H	VAC	Remedial/Minor/Honours course	3-1-0	4	4
TOTAL				25*	17/21
* Excluding Hours to be engaged for Remedial/Minor/Honours course.					

PROGRAM ELECTIVE III

SLOT	COURSE NO.	COURSES	L-T-P	HOURS	CREDIT
B	CST414	DEEP LEARNING	2-1-0	3	3
	CST 424	PROGRAMMING PARADIGMS	2-1-0		
	CCT 434	STENOGRAPHY AND DIGITAL WATERMARKING	2-1-0		
	CST 444	SOFT COMPUTING	2-1-0		
	CST 454	FUZZY SET THEORY AND APPLICATIONS	2-1-0		
	CST 464	EMBEDDED SYSTEMS	2-1-0		
	CST 474	COMPUTER VISION	2-1-0		

Computer Science and Engineering (Cyber Security)

PROGRAM ELECTIVE IV

SLOT	COURSE NO.	COURSES	L-T-P	HOURS	CREDIT
C	CCT 416	CYBER LAW	2-1-0	3	3
	CST 426	CLIENT SERVER ARCHITECTURE	2-1-0		
	CST 436	PARALLEL COMPUTING	2-1-0		
	CST 446	DATA COMPRESSION TECHNIQUES	2-1-0		
	CCT 456	BIG DATA SECURITY	2-1-0		
	CST 466	DATA MINING	2-1-0		
	CST 476	MOBILE COMPUTING	2-1-0		

PROGRAM ELECTIVE V

SLOT	COURSE NO.	COURSES	L-T-P	HOURS	CREDIT
D	CST 418	i HIGH PERFORMANCE COMPUTING	2-1-0	3	3
	CST 428	ii BLOCK CHAIN TECHNOLOGIES	2-1-0		
	CST 438	iii IMAGE PROCESSING TECHNIQUE	2-1-0		
	CST 448	iv INTERNET OF THINGS	2-1-0		
	CST 458	v SOFTWARE TESTING	2-1-0		
	CST 468	vi BIOINFORMATICS	2-1-0		
	CST 478	vii COMPUTATIONAL LINGUISTICS	2-1-0		

Computer Science and Engineering (Cyber Security)

NOTE:

1. *All Institutions should keep 4 hours exclusively for Remedial class/Minor/Honours course (Mondays from 10 to 12 and Wednesdays from 10 to 12 PM). If a student does not opt for minor/honours programme, he/she can be given remedial class.
2. Comprehensive Viva Voce: The comprehensive viva voce in the eighth semester of study shall have a viva voce for 50 marks. The viva voce shall be conducted based on the core subjects studied from third to eighth semester. The viva voce will be conducted by the same three member committee assigned for final project phase II evaluation towards the end of the semesters. The pass minimum for this course is 25. The course should be mapped with a faculty and classes shall be arranged for practicing questions based on the core courses listed in the curriculum. The mark will be treated as internal and should be uploaded along with internal marks of other courses.
3. **Project Phase II:** The objective of Project Work Phase II & Dissertation is to enable the student to extend further the investigative study taken up in Project Phase I, either fully theoretical/practical or involving both theoretical and practical work, under the mentoring of a Project Guide from the Department alone or jointly with a Supervisor drawn from R&D laboratory/Industry. This is expected to provide a good training for the student(s) in R&D work and technical leadership. The assignment shall normally include:
 - In depth study of the topic assigned in the light of the Report prepared in Phase I;
 - Review and finalization of the Approach to the Problem relating to the assigned topic;
 - Detailed Analysis/Modeling/Simulation/Design/Problem Solving/Experiment as needed;
 - Final development of product/process, testing, results, conclusions and future directions;
 - Preparing a paper for Conference presentation/Publication in Journals, if possible;
 - Preparing a Dissertation in the standard format for being evaluated by the Department;
 - Final Presentation before the concerned evaluation committee

Total marks: 150, only CIE, minimum required to pass 75

Guide	30

Interim evaluation, 2 times in the semester by a committee	50

Quality of the report evaluated by the above committee	30

(The evaluation committee comprises HoD or a senior faculty member, Project coordinator and project supervisor).

Final evaluation by the final evaluation committee	40

(The final evaluation committee comprises Project coordinator, expert from Industry/ research Institute and a senior faculty from a sister department. The same committee will conduct Comprehensive for 50 marks).

MINOR

Minor is an additional credential a student may earn if she/he does 20 credits worth of additional learning in a discipline other than her/his major discipline of B.Tech. degree. The objective is to permit a student to customize their Engineering degree to suit their specific interests. Upon completion of an Engineering Minor, a student will be better equipped to perform interdisciplinary research and will be better employable. Engineering Minors allow a student to gain interdisciplinary experience and exposure to concepts and perspectives that may not be a part of their major degree programs.

The academic units offering minors in their discipline will prescribe the set of courses and/or other activities like projects necessary for earning a minor in that discipline. A specialist bucket of 3-6 courses is identified for each Minor. Each bucket may rest on one or more foundation courses. A bucket may have sequences within it, i.e., advanced courses may rest on basic courses in the bucket. She/he accumulates credits by registering for the required courses, and if the requirements for a particular minor are met within the time limit for the course, the minor will be awarded. This will be mentioned in the Degree Certificate as “Bachelor of Technology in xxx with Minor in yyy”. The fact will also be reflected in the consolidated grade card, along with the list of courses taken. If one specified course cannot be earned during the course of the programme, that minor will not be awarded. The individual course credits earned, however, will be reflected in the consolidated grade card.

(i) The curriculum/syllabus committee/BoS shall prepare syllabus for courses to be included in the curriculum from third to eight semesters for all branches. The minor courses shall be identified by M slot courses.

(ii) Registration is permitted for Minor at the beginning of third semester. Total credits required to award B. Tech with Minor is 182 (162 + 20)

(iii) Out of the 20 Credits, 12 credits shall be earned by undergoing a minimum of three courses, of which one course shall be a mini project based on the chosen area. They can do Mini project either in S7 or in S8. The remaining 8 credits could be acquired through 2 MOOCs recommended by the Board of Studies and approved by the Academic Council or 2 courses from the minor buckets listed here. The classes for Minor shall be conducted along with regular classes and no extra time shall be required for conducting the courses.

(iv) There won't be any supplementary examination for the courses chosen for Minor.

(v) On completion of the program, “Bachelor of Technology in xxx with Minor in yyy” will be awarded if the registrant earn 20 credits from the minor courses.

(vi) The registration for minor program will commence from semester 3 and all the academic units offering minors in their discipline should prescribe set of such courses. The courses shall be grouped into maximum of 5 buckets. The bucket of courses may have sequences within it, i.e., advanced courses may rest on basic courses in the bucket. Reshuffling of courses between various buckets will not be allowed. There is option to skip any two courses listed here and to opt for equivalent MOOC courses approved by the Academic Council. In any case, they should carry out a mini project based on the chosen area in S7 or S8. For example: Students who have registered for **B.Tech Minor**

Computer Science and Engineering (Cyber Security)
in Computer Science & Engineering (Cyber Security) can opt to study the courses listed below:

HONOURS

Honours is an additional credential a student may earn if she/he opts for the extra 20 credits needed for this in her/his own discipline. Honours is not indicative of a class. The University is providing this option for academically extra brilliant students to acquire Honours. Honours is intended for a student to *gain expertise/get specialized* in an area inside his/her major B.Tech discipline and to enrich knowledge in emerging/advanced areas in the concerned branch of engineering. It is particularly suited for students aiming to pursue higher studies. Upon completion of Honours, a student will be better equipped to perform research in her/his branch of engineering. On successful accumulation of credits at the end of the programme, this will be mentioned in the Degree Certificate as “Bachelor of Technology in xxx, with Honours.” The fact will also be reflected in the consolidated grade card, along with the list of courses taken. If a student is not earning credits for any one of the specified course for getting Honours, she/he is not entitled to get Honours. The individual course credits earned, however, will be reflected in the consolidated grade card.

The courses shall be grouped into maximum of 3 buckets, each bucket representing a particular specialization in the branch. The students shall select only the courses from same bucket in all semesters. It means that the specialization is to be fixed by the student and cannot be changed subsequently. The internal evaluation, examination and grading shall be exactly as for other mandatory courses. The Honours courses shall be identified by H slot courses.

- (i) The curriculum/syllabus committee/BoS shall prepare syllabus for courses to be included in the curriculum from fourth to eight semesters for all branches. The Honours courses shall be identified by H slot courses.
- (ii) Registration is permitted for Honours at the beginning of fourth semester. Total credits required is 182 (162 + 20).
- (iii) Out of the 20 Credits, 12 credits shall be earned by undergoing a minimum of three courses, of which one course shall be a mini project based on the chosen area. The remaining 8 credits could be acquired through 2 MOOCs recommended by the Board of studies and approved by the Academic Council or 2 courses from the same bucket as the above 3 courses. The classes for Honours shall be conducted along with regular classes and no extra time shall be required for conducting the courses. The students should earn a grade of ‘C’ or better for all courses under Honours.
- (iv) There won’t be any supplementary examination for the courses chosen for Honours.
- (v) On successful accumulation of credits at the end of the programme, “Bachelor of Technology in xxx, with Honours” will be awarded if overall CGPA is greater than

or equal to 8.5, earned a grade of 'C' or better for all courses chosen for Honours and there is no history of 'F' Grade in the entire span of the BTech Course.

- Students who have registered for **B.Tech in Computer Science and Engineering(Cyber Security) with Honours** can opt to study the courses listed in one of the buckets shown below:

HONOURS BUCKETS													
S E M E S T E R	BUCKET-1				BUCKET-2				BUCKET-3				
	Specialization - Security in Network Applications				Specialization Machine Learning				Specialization – Computer Vision				
	COURSE NO	COURSE NAME	CREDITS	CREDITS	COURSE NO	COURSE NAME	CREDITS	CREDITS	COURSE NO	COURSE NAME	CREDITS	CREDITS	
S4	CCT 292	SECURE MOBILE APPLICATION DEVELOPMENT	4	4	CST 294	COMPUTATIONAL FUNDAMENTALS FOR MACHINE LEARNING	4	4	ADT 296	ADVANCED TOPICS IN COMPUTER GRAPHICS	4	4	
S5	CCT 393	WEB APPLICATION SECURITY	4	4	CST 395	NEURAL NETWORKS AND DEEP LEARNING	4	4	ADT 397	ADVANCED CONCEPTS IN COMPUTER VISION	4	4	
S6	CCT 394	WIRELESS AND EMAIL SECURITY	4	4	CST 396	ADVANCED TOPICS IN MACHINE LEARNING	4	4	AIT 398	IMAGE AND VIDEO PROCESSING	4	4	
S7	CCT 495	BLOCKCHAIN AND CRYPTOCURRENCY	4	4	CST 497	REINFORCEMENT LEARNING	4	4	ADT 499	SURVEILLANCE VIDEO ANALYTICS	4	4	
S8	CCD 496	MINI PROJECT	4	4	CCD 496	MINI PROJECT	4	4	CCD 496	MINI PROJECT	4	4	
Note: Name of the specialization shall be mentioned in the Honours Degree to be awarded													

Computer Science and Engineering (Cyber Security)

INDUCTION PROGRAM

There will be three weeks induction program for first semester students. It is a unique three-week immersion Foundation Programme designed specifically for the fresher's which includes a wide range of activities right from workshops, lectures and seminars to sports tournaments, social works and much more. The programme is designed to mould students into well-rounded individuals, aware and sensitized to local and global conditions and foster their creativity, inculcate values and ethics, and help students to discover their passion. Foundation Programme also serves as a platform for the fresher's to interact with their batch-mates and seniors and start working as a team with them. The program is structured around the following five themes:

The programme is designed keeping in mind the following objectives:

- **Values and Ethics:** Focus on fostering a strong sense of ethical judgment and moral fortitude.
- **Creativity:** Provide channels to exhibit and develop individual creativity by expressing themselves through art, craft, music, singing, media, dramatics, and other creative activities.
- **Leadership, Communication and Teamwork:** Develop a culture of teamwork and group communication.
- **Social Awareness:** Nurture a deeper understanding of the local and global world and our place in it as concerned citizens of the world.
- **Physical Activities & Sports:** Engage students in sports and physical activity to ensure healthy physical and mental growth.



SEMESTER I

MAT 101	LINEAR ALGEBRA AND CALCULUS	CATEGORY	L	T	P	CREDIT	Year of Introduction
		BSC	3	1	0	4	2019

Preamble: This course introduces students to some basic mathematical ideas and tools which are at the core of any engineering course. A brief course in Linear Algebra familiarises students with some basic techniques in matrix theory which are essential for analysing linear systems. The calculus of functions of one or more variables taught in this course are useful in modelling and analysing physical phenomena involving continuous change of variables or parameters and have applications across all branches of engineering.

Prerequisite: A basic course in one-variable calculus and matrix theory.

Course Outcomes: After the completion of the course the student will be able to

CO 1	solve systems of linear equations, diagonalize matrices and characterise quadratic forms
CO 2	compute the partial and total derivatives and maxima and minima of multivariable functions
CO 3	compute multiple integrals and apply them to find areas and volumes of geometrical shapes, mass and centre of gravity of plane laminas
CO 4	perform various tests to determine whether a given series is convergent, absolutely convergent or conditionally convergent
CO 5	determine the Taylor and Fourier series expansion of functions and learn their applications.

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	3	3	3	2	1			1	2		2
CO 2	3	3	3	3	2	1			1	2		2
CO 3	3	3	3	3	2	1			1	2		2
CO 4	3	2	3	2	1	1			1	2		2
CO 5	3	3	3	3	2	1			1	2		2

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination (Marks)
	Test 1 (Marks)	Test 2 (Marks)	
Remember	10	10	20
Understand	20	20	40
Apply	20	20	40
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE marks	ESE marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks

Continuous Assessment Test (2 numbers) : 25 marks

Assignment/Quiz/Course project : 15 marks

Assignments: Assignment should include specific problems highlighting the applications of the methods introduced in this course in science and engineering.

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

Course Outcome 1 (CO1): Solve systems of linear equations, diagonalize matrices and characterise quadratic forms

1. A is a real matrix of order 3×3 and $X = \begin{bmatrix} x \\ y \\ z \end{bmatrix}$. What can you say about the solution of $AX =$

0 if rank of A is 1? 2? 3?

2. Given $A = \begin{bmatrix} 3 & 0 & 2 \\ 0 & 2 & 0 \\ -2 & 0 & 0 \end{bmatrix}$, find an orthogonal matrix P that diagonalizes A.

3. Find out what type of conic section the following quadratic form represents

$$17x^2 - 30x_1x_2 + 17x_2^2 = 128$$

4. The matrix $A = \begin{bmatrix} -2 & 2 & -3 \\ 2 & 1 & -6 \\ -1 & -2 & 0 \end{bmatrix}$ has an eigen value 5 with corresponding Eigen vector $X =$

$$\begin{bmatrix} 1 \\ 2 \\ -1 \end{bmatrix}. \text{ Find } A^5 X$$

Course Outcome 2 (CO2): compute the partial and total derivatives and maxima and minima of multivariable functions

1. Find the slope of the surface $z = x^2y + 5y^3$ in the x-direction at the point (1,-2)

2. Given the function $w = xy + z$, use chain rule to find the instantaneous rate of change of w at each point along the curve $x = \cos t, y = \sin t, z = t$
3. Determine the dimension of rectangular box open at the top, having a volume 32 cubic ft and requiring the least amount of material for its construction.

Course Outcome 3 (CO3): compute multiple integrals and apply them to find areas and volumes of geometrical shapes, mass and centre of gravity of plane laminas.

1. Evaluate $\iint_D (x + 2y) dA$ where D is the region bounded by the parabolas $y = 2x^2$ and $y = 1 + x^2$
2. Explain how you would find the volume under the surface $z = f(x, y)$ and over a specific region D in the xy -plane using (i) double integral (ii) triple integral?
3. Find the mass and centre of gravity of a triangular lamina with vertices $(0,0)$, $(2,1)$, $(0,3)$ if the density function is $f(x, y) = x + y$
4. Use spherical coordinates to evaluate $\iiint_B (x^2 + y^2 + z^2)^3 dV$ where B is the unit ball defined by $B = \{(x, y, z): x^2 + y^2 + z^2 \leq 1\}$

Course Outcome 4 (CO4): perform various tests to determine whether a given series is convergent, absolutely convergent or conditionally convergent.

1. What is the difference between a sequence and a series and when do you say that they are convergent? Divergent?
2. Determine whether the series $\sum_{n=1}^{\infty} \frac{5}{2n^2 + 4n + 3}$ converges or diverges.
3. Is the series $\sum_{n=1}^{\infty} \frac{(-1)^{n-1}}{n}$ convergent? Absolutely convergent? Conditionally convergent?

Course Outcome 5 (CO5): determine the Taylor and Fourier series expansion of functions and learn their applications.

1. Assuming the possibility of expansion find the Maclaurin series expansion of $f(x) = (1 + x)^k$ for $|x| < 1$ where k is any real number. What happens if k is a positive integer?
2. Use Maclaurin series of $\ln(1 + x)$, $-1 < x \leq 1$ to find an approximate value of $\ln 2$.
3. Find the Fourier series of the function $f(x) = x^2$, $-2 \leq x < 2$, $f(x + 4) = f(x)$. Hence using Parseval's identity prove that $1 + \frac{1}{2^4} + \frac{1}{3^4} + \dots = \frac{\pi^4}{90}$
4. Expand the function $f(x) = x$ ($0 < x < 1/2$) into a (i) Fourier sine series (ii) Fourier cosine series.

Model Question paper

QP CODE:

PAGES:3

Reg No: _____

Name : _____

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY FIRST SEMESTER B.TECH DEGREE EXAMINATION,
MONTH & YEAR**

Course Code: MAT 101

Max. Marks: 100

Duration: 3 Hours

LINEAR ALGEBRA AND CALCULUS

(2019-Scheme)

(Common to all branches)

PART A

(Answer all questions, each question carries 3 marks)

1. Determine the rank of the matrix $A = \begin{bmatrix} 1 & 2 & -1 \\ -2 & -4 & 2 \\ 3 & 6 & -3 \end{bmatrix}$.
2. Write down the eigen values of $\begin{bmatrix} 2 & 0 \\ 0 & -1 \end{bmatrix}$. What are the eigen values of $P^{-1}AP$ where $P = \begin{bmatrix} -4 & 2 \\ 3 & -1 \end{bmatrix}$?
3. Find $f_x(1,3)$ and $f_y(1,3)$ for the function $f(x, y) = 2x^3y^2 + 2y + 4x$.
4. Show that the function $u(x, t) = \sin(x - ct)$ is a solution of the equation $\frac{\partial^2 u}{\partial t^2} = c^2 \frac{\partial^2 u}{\partial x^2}$.
5. Use double integral to find the area of the region enclosed between the parabolas $y = \frac{1}{2}x^2$ and the line $y = 2x$.
6. Use polar coordinates to evaluate the area of the region bounded by $x^2 + y^2 = 4$, the line $y = x$ and the y axis in the first quadrant.
7. Test the convergence of the series $\sum_{k=1}^{\infty} \frac{k}{k+1}$.
8. Test the convergence of the alternating series $\sum_{k=1}^{\infty} (-1)^{k+1} \frac{1}{k}$ using Leibnitz test.
9. Find the Taylor series expansion of $\sin \pi x$ about $x = \frac{1}{2}$.
10. Find the values to which the Fourier series of

$f(x) = x$ for $-\pi < x < \pi$, with $f(x + 2\pi) = f(x)$ converges

(10x3=30)

PART B

(Answer **one full** question from each module, each question carries **14** marks)

Module - I

11. (a) Solve the following system of equations

$$y + z - 2w = 0$$

$$2x - 3y - 3z + 6w = 2$$

$$4x + y + z - 2w = 4$$

- (b) Find the eigen values and eigen vectors of the matrix $\begin{bmatrix} -2 & 2 & -3 \\ 2 & 1 & -6 \\ -1 & -2 & 0 \end{bmatrix}$

12. (a) Diagonalize the matrix $\begin{bmatrix} -1 & 2 & -2 \\ 2 & 4 & 1 \\ 2 & 1 & 4 \end{bmatrix}$

- (b) What kind of conic section the quadratic form $3x_1^2 + 22x_1x_2 + 3x_2^2 = 0$ represents? Transform it to principal axes.

Module - II

13. (a) Find the local linear approximation to $f(x, y) = \sqrt{x^2 + y^2}$ at the point $(3, 4)$. Use it to approximate $f(3.04, 3.98)$

- (b) Let $w = \sqrt{x^2 + y^2 + z^2}$, $x = \cos\theta$, $y = \sin\theta$, $z = \tan\theta$. Use chain rule to find $\frac{dw}{d\theta}$ when $\theta = \frac{\pi}{4}$.

14. (a) Let $z = f(x, y)$ where $x = r\cos\theta$, $y = r\sin\theta$, prove that

$$\left(\frac{\partial z}{\partial x}\right)^2 + \left(\frac{\partial z}{\partial y}\right)^2 = \left(\frac{\partial z}{\partial r}\right)^2 + \frac{1}{r^2} \left(\frac{\partial z}{\partial \theta}\right)^2.$$

- (b) Locate all relative maxima, relative minima and saddle points

$$f(x, y) = xy + \frac{a^3}{x} + \frac{b^3}{y} \quad (a \neq 0, b \neq 0).$$

Module - III

15. (a) Evaluate $\iint_D (2x^2y + 9y^3) dx dy$ where D is the region bounded by $y = \frac{2}{3}x$ and $y = 2\sqrt{x}$

- (b) Evaluate $\int_0^4 \int_{\sqrt{y}}^2 e^{x^3} dx dy$ changing the order of integration.

16. (a) Find the volume of the solid bounded by the cylinder $x^2 + y^2 = 4$ and the planes $y + z = 4$ and $z = 0$.

- (b) Evaluate $\iiint \sqrt{1 - x^2 - y^2 - z^2} dx dy dz$, taken throughout the volume of the sphere $x^2 + y^2 + z^2 = 1$, by transforming to spherical polar coordinates

Module - IV

17. (a) Test the convergence of the series

$$(i) \quad \sum_{k=1}^{\infty} \frac{k^k}{k!} \quad (ii) \quad \sum_{k=2}^{\infty} \left(\frac{4k-5}{2k+1} \right)^k$$

- (b) Determine the convergence or divergence of the series $\sum_{k=1}^{\infty} (-1)^k \frac{(2k-1)!}{3^k}$

18. (a) Check whether the series $\sum_{k=1}^{\infty} (-1)^{k+1} \frac{(2k)!}{(3k-2)!}$ is absolutely convergent, conditionally convergent or divergent.

(b) Test the convergence of the series $1 + \frac{1.2}{1.3} + \frac{1.2.3}{1.3.5} + \frac{1.2.3.4}{1.3.5.7} + \dots$

Module - V

19. (a) Obtain the Fourier series of $f(x) = e^{-x}$, in the interval $0 < x < 2\pi$. with $f(x + 2\pi) = f(x)$. Hence deduce the value of $\sum_{n=2}^{\infty} \frac{(-1)^n}{1+n^2}$.

(b) Find the half range sine series of $f(x) = \begin{cases} \frac{2kL}{x} & \text{if } 0 < x < \frac{L}{2} \\ \frac{2k(L-x)}{L} & \text{if } \frac{L}{2} < x < L \end{cases}$

20. (a) Expand $(1+x)^{-2}$ as a Taylor series about $x=0$ and state the region of convergence of the series.

(b) Find the Fourier series for $f(x) = x^2$ in the interval $-\pi < x < \pi$

with $f(x + 2\pi) = f(x)$. Hence show that $\frac{1}{1^4} + \frac{1}{2^4} + \frac{1}{3^4} + \dots = \frac{\pi^4}{90}$. (14X5=70)

Syllabus

Module 1 (Linear algebra)

(Text 2: Relevant topics from sections 7.3, 7.4, 7.5, 8.1, 8.3, 8.4)

Systems of linear equations, Solution by Gauss elimination, row echelon form and rank of a matrix, fundamental theorem for linear systems (homogeneous and non-homogeneous, without proof), Eigen values and eigen vectors. Diagonalization of matrices, orthogonal transformation, quadratic forms and their canonical forms.

Module 2 (multivariable calculus-Differentiation)

(Text 1: Relevant topics from sections 13.3, 13.4, 13.5, 13.8)

Concept of limit and continuity of functions of two variables, partial derivatives, Differentials, Local Linear approximations, chain rule, total derivative, Relative maxima and minima, Absolute maxima and minima on closed and bounded set.

Module 3 (multivariable calculus-Integration)

(Text 1: Relevant topics from sections 14.1, 14.2, 14.3, 14.5, 14.6, 14.8)

Double integrals (Cartesian), reversing the order of integration, Change of coordinates (Cartesian to polar), finding areas and volume using double integrals, mass and centre of gravity of inhomogeneous laminas using double integral. Triple integrals, volume calculated as triple integral, triple integral in cylindrical and spherical coordinates (computations involving spheres, cylinders).

Module 4 (sequences and series)

(Text 1: Relevant topics from sections 9.1, 9.3, 9.4, 9.5, 9.6)

Convergence of sequences and series, convergence of geometric series and p-series(without proof), test of convergence (comparison, ratio and root tests without proof); Alternating series and Leibnitz test, absolute and conditional convergence.

Module 5 (Series representation of functions)

(Text 1: Relevant topics from sections 9.8, 9.9. Text 2: Relevant topics from sections 11.1, 11.2, 11.6)

Taylor series (without proof, assuming the possibility of power series expansion in appropriate domains), Binomial series and series representation of exponential, trigonometric, logarithmic functions (without proofs of convergence); Fourier series, Euler formulas, Convergence of Fourier series (without proof), half range sine and cosine series, Parseval's theorem (without proof).

Text Books

1. H. Anton, I. Biven, S. Davis, "Calculus", Wiley, 10th edition, 2015.
2. Erwin Kreyszig, Advanced Engineering Mathematics, 10th Edition, John Wiley & Sons, 2016.

Reference Books

1. J. Stewart, Essential Calculus, Cengage, 2nd edition, 2017
2. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.
3. Peter V. O'Neil, Advanced Engineering Mathematics, Cengage, 7th Edition, 2012
4. Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.
5. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36 Edition, 2010.

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	Linear Algebra (10 hours)	
1.1	Systems of linear equations, Solution by Gauss elimination	1
1.2	Row echelon form, finding rank from row echelon form, fundamental theorem for linear systems	3
1.3	Eigen values and eigen vectors	2
1.4	Diagonalization of matrices, orthogonal transformation, quadratic forms	4

	and their canonical forms.	
2	Multivariable calculus-Differentiation (8 hours)	
2.1	Concept of limit and continuity of functions of two variables, partial derivatives	2
2.2	Differentials, Local Linear approximations	2
2.3	Chain rule, total derivative	2
2.4	Maxima and minima	2
3	Multivariable calculus-Integration (10 hours)	
3.1	Double integrals (Cartesian)-evaluation	2
3.2	Change of order of integration in double integrals, change of coordinates (Cartesian to polar),	2
3.3	Finding areas and volumes, mass and centre of gravity of plane laminae	3
3.4	Triple integrals	3
4	Sequences and series (8 hours)	
4.1	Convergence of sequences and series, geometric and p-series	2
4.2	Test of convergence(comparison, ratio and root)	4
4.3	Alternating series and Leibnitz test, absolute and conditional convergence	2
5	Series representation of functions (9 hours)	
5.1	Taylor series, Binomial series and series representation of exponential, trigonometric, logarithmic functions;	3
5.2	Fourier series, Euler formulas, Convergence of Fourier series(Dirichlet's conditions)	3
5.3	Half range sine and cosine series, Parseval's theorem.	3

PHT 100	ENGINEERING PHYSICS A (FOR CIRCUIT BRANCHES)	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		BSC	3	1	0	4	2019

Preamble: The aim of the Engineering Physics Program is to offer students a solid background in the fundamentals of Physics and to impart that knowledge in engineering disciplines. The program is designed to develop scientific attitudes and enable the students to correlate the concepts of Physics with the core programmes

Prerequisite: Higher secondary level Physics, Mathematical course on vector calculus, differential equations and linear algebra

Course Outcomes: After the completion of the course the student will be able to

CO 1	Compute the quantitative aspects of waves and oscillations in engineering systems.
CO 2	Apply the interaction of light with matter through interference, diffraction and identify these phenomena in different natural optical processes and optical instruments.
CO 3	Analyze the behaviour of matter in the atomic and subatomic level through the principles of quantum mechanics to perceive the microscopic processes in electronic devices.
CO 4	Classify the properties of magnetic materials and apply vector calculus to static magnetic fields and use Maxwell's equations to diverse engineering problems
CO 5	Analyze the principles behind various superconducting applications, explain the working of solid state lighting devices and fibre optic communication system

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	2						1	2			1
CO 2	3	2						1	2			1
CO 3	3	2						1	2			1
CO 4	3	1						1	2			1
CO 5	3	1						1	2			1

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination (Marks)
	Test 1 (Marks)	Test 2 (Marks)	
Remember	15	15	30
Understand	25	25	50
Apply	10	10	20

Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE marks	ESE marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25 marks
Assignment/Quiz/Course project	: 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Explain the effect of damping force on oscillators.
2. Distinguish between transverse and longitudinal waves.
3. (a) Derive an expression for the fundamental frequency of transverse vibration in a stretched string.
(b) Calculate the fundamental frequency of a string of length 2 m weighing 6 g kept stretched by a load of 600 kg.

Course Outcome 2 (CO2):

1. Explain colours in thin films.
2. Distinguish between Fresnel and Fraunhofer diffraction.
3. (a) Explain the formation of Newton's rings and obtain the expression for radii of bright and dark rings in reflected system. Also explain how it is used to determine the wavelength of a monochromatic source of light.
(b) A liquid of refractive index μ is introduced between the lens and glass plate.

What happens to the fringe system? Justify your answer.

Course Outcome 3 (CO3):

1. Give the physical significance of wave function ?
2. What are excitons ?
3. (a) Solve Schrodinger equation for a particle in a one dimensional box and obtain its energy eigen values and normalised wave functions.
(b) Calculate the first three energy values of an electron in a one dimensional box of width $1 \text{ \AA}$ in electron volt.

Course Outcome 4 (CO4):

1. Compare displacement current and conduction current.
2. Mention any four properties of ferro magnetic materials.
3. (a) Starting from Maxwell's equations, derive the free space electromagnetic wave equation and show that velocity of electromagnetic wave is $1/(\mu_0 \epsilon_0)^{1/2}$
(b) An electromagnetic wave is described by $E = 100 \exp 8\pi i [10^{14} t - (10^6 z / 3)] \text{ V/m}$. Find the direction of propagation of the wave, speed of the wave and magnetic flux density in the wave.

Course Outcome 5 (CO5):

1. Explain the working of a solar cell.
2. Distinguish between Type I and Type II super conductors.
3. (a) Define numerical aperture and derive an expression for it.
(b) Explain the working of intensity modulated fibre optic sensor.

Model Question paper

QP CODE:

PAGES:3

Reg No: _____

Name : _____

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY FIRST SEMESTER B.TECH DEGREE EXAMINATION,
MONTH & YEAR**

Course Code: PHT 100

Course Name: Engineering Physics A

Max. Marks: 100

Duration: 3 Hours

PART A

Answer all Questions. Each question carries 3 Marks

1. Compare electrical and mechanical oscillators
2. Distinguish between longitudinal and transverse waves
3. Write a short note on antireflection coating.
4. Diffraction of light is not as evident in daily experience as that of sound waves. Give reason.
5. State and explain Heisenberg's Uncertainty principle. With the help of it explain natural line broadening.
6. Explain surface to volume ratio of nanomaterials.
7. State Faraday's laws of electromagnetic induction.
8. Compare displacement current and conduction current
9. List four important applications of superconductors.
10. Give the working principle of LED. (10x3=30)

PART B

Answer any one full question from each module. Each question carries 14 Marks

Module 1

11. (a) Derive the differential equation of damped harmonic oscillator and deduce its solution. Discuss the cases of over damped, critically damped and under damped cases. (10)
- (b) The frequency of a tuning fork is 500 Hz and its Q factor is 7×10^4 . Find the relaxation time. Also calculate the time after which its energy becomes 1/10 of its initial undamped value. (4)
12. (a) Derive an expression for the velocity of propagation of a transverse wave in a stretched string. Deduce laws of transverse vibrations. (10)
- (b) The equation of transverse vibration of a stretched string is given by $y = 0.00327 \sin (72.1x - 2.72t)$ m, in which the numerical constants are in S.I units. Evaluate (i) Amplitude (ii) Wavelength (iii) Frequency and (iv) Velocity of the wave. (4)

Module 2

13. (a) Explain the formation of Newton's rings and show that the radius of dark ring is proportional to the square root of natural numbers. How can we use Newton's rings experiment to determine the refractive index of a liquid. (10)
- (b) Two pieces of plane glass are placed together with a piece of paper between two at one end. Find the angle of the wedge in seconds if the film is viewed with a monochromatic light of wavelength $4800 \text{ \AA}$. Given $\beta = 0.0555 \text{ cm}$. (4)
14. (a) Explain the diffraction due to a plane transmission grating. Obtain the grating equation. (10)
- (b) A grating has 6000 lines per cm. Find the angular separation of the two yellow lines of mercury of wavelengths 577 nm and 579 nm in the second order. (4)

Module 3

15. (a) Derive time dependent and independent Schrodinger equations. (10)
- (b) An electron is confined to one dimensional potential box of length $2 \text{ \AA}$. Calculate the energies corresponding to the first and second quantum states in eV. (4)
16. (a) Classify nanomaterials based on dimensionality of quantum confinement and explain the following nanostructures. (i) nano sheets (ii) nano wires (iii) quantum dots. (10)
- (b) Find the de Broglie wavelength of electron whose kinetic energy is 15 eV. (4)

Module 4

17. (a) State Poynting's Theorem. Calculate the value of Poynting vector at the surface of the sun if the power radiated by the sun is $3.8 \times 10^{26} \text{ W}$ and its radius is $7 \times 10^8 \text{ m}$. (5)

(b) Distinguish between paramagnetic, diamagnetic and ferromagnetic materials. (9)

18.(a) Starting from Maxwell's Equations, derive electromagnetic wave equations in free space. (10)

(b) If the magnitude of $\mathbf{H}$ in a plane wave is 1 A/m, find the magnitude of $\mathbf{E}$ in free space. (4)

Module 5

19.(a) Show that superconductors are perfect diamagnets. Distinguish between Type I and Type II superconductors with suitable examples. (10)

(b) Write a short note on high temperature superconductors. (4)

20.(a) Define numerical aperture of an optic fibre and derive an expression for the NA of a step index fibre with a neat diagram. (10)

(b) Calculate the numerical aperture and acceptance angle of a fibre with a core refractive index of 1.54 and a cladding refractive index of 1.50 when the fibre is inside water of refractive index 1.33. (4) (14x5=70)

Syllabus

ENGINEERING PHYSICS A (FOR CIRCUIT BRANCHES)

Module 1

Oscillations and Waves

Harmonic oscillations, Damped harmonic motion-Derivation of differential equation and its solution, Over damped, Critically damped and Under damped Cases, Quality factor-Expression, Forced oscillations-Differential Equation-Derivation of expressions for amplitude and phase of forced oscillations, Amplitude Resonance-Expression for Resonant frequency, Quality factor and Sharpness of Resonance, Electrical analogy of mechanical oscillators

Wave motion- Derivation of one dimensional wave equation and its solution, Three dimensional wave equation and its solution (no derivation), Distinction between transverse and longitudinal waves, Transverse vibration in a stretched string, Statement of laws of vibration

Module 2

Wave Optics

Interference of light-Principle of superposition of waves, Theory of thin films - Cosine law (Reflected system), Derivation of the conditions of constructive and destructive Interference, Interference due to wedge shaped films -Determination of thickness and test for optical planeness, Newton's rings - Measurement of wavelength and refractive index, Antireflection coatings

Diffraction of light, Fresnel and Fraunhofer classes of diffraction, Diffraction grating-Grating equation, Rayleigh criterion for limit of resolution, Resolving and Dispersive power of a grating with expression (no derivation)

Module 3

Quantum Mechanics & Nanotechnology

Introduction for the need of Quantum mechanics, Wave nature of Particles, Uncertainty principle, Applications-Absence of electrons inside a nucleus and Natural line broadening mechanism, Formulation of time dependent and independent Schrodinger wave equations-Physical meaning of wave function, Particle in a one dimensional box- Derivation for normalised wave function and energy eigen values, Quantum Mechanical Tunnelling (Qualitative)

Introduction to nanoscience and technology, Increase in surface to volume ratio for nanomaterials, Quantum confinement in one dimension, two dimension and three dimension-Nano sheets, Nano wires and Quantum dots, Properties of nanomaterials-mechanical, electrical and optical, Applications of nanotechnology (qualitative ideas)

Module 4

Magnetism & Electro Magnetic Theory

Magnetic field and Magnetic flux density, Gauss's law for Magnetic flux density, Ampere's Circuital law, Faraday's law in terms of EMF produced by changing magnetic flux, Magnetic permeability and susceptibility, Classification of magnetic materials-para, dia and ferromagnetic materials

Fundamentals of vector calculus, concept of divergence, gradient and curl along with physical significance, Line, Surface and Volume integrals, Gauss divergence theorem & Stokes' theorem, Equation of continuity, Derivation of Maxwell's equations in vacuum, Comparison of displacement current with conduction current. Electromagnetic waves, Velocity of Electromagnetic waves in free space, Flow of energy and Poynting's vector (no derivation)

Module 5

Superconductivity & Photonics

Superconducting phenomena, Meissner effect and perfect diamagnetism, Types of superconductors-Type I and Type II, BCS Theory (Qualitative), High temperature superconductors-Applications of super conductivity

Introduction to photonics-Photonic devices-Light Emitting Diode, Photo detectors -Junction and PIN photodiodes, Solar cells-I-V Characteristics, Optic fibre-Principle of propagation of light, Types of fibres-Step index and Graded index fibres, Numerical aperture –Derivation, Fibre optic communication system (block diagram), Industrial, Medical and Technological applications of optical fibre, Fibre optic sensors-Intensity Modulated and Phase modulated sensors.

Text Books

1. M.N.Abadhanulu, P.G.Kshirsagar,TVS Arun Murthy "A Text book of Engineering Physics", S.Chand &Co., Revised Edition 2019
2. H.K.Malik , A.K. Singh, "Engineering Physics" McGraw Hill Education, Second Edition 2017

Reference Books

1. Arthur Beiser, "Concepts of Modern Physics ", Tata McGraw Hill Publications, 6th Edition 2003
2. D.K. Bhattacharya, Poonam Tandon, "Engineering Physics", Oxford University Press, 2015
3. Md.N.Khan & S.Panigrahi "Principles of Engineering Physics 1&2", Cambridge University Press, 2016
4. Aruldas G., "Engineering Physics", PHI Pvt. Ltd., 2015
5. Ajoy Ghatak, "Optics", Mc Graw Hill Education, Sixth Edition, 2017
6. T. Pradeep, "Nano:The Essentials", McGraw Hill India Ltd, 2007
7. Halliday, Resnick, Walker, "Fundamentals of Physics", John Wiley & Sons.Inc, 2001
8. David J Griffiths, "Introduction to Electrodynamics", Addison-Wesley publishing, 3rd Edition, 1999
9. Premlet B., "Advanced Engineering Physics", Phasor Books,10th edition,2017
10. I. Dominic and. A. Nahari, "A Text Book of Engineering physics", Owl Books Publishers, Revised edition, 2016

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	Oscillations and Waves (9 hours)	
1.1	Harmonic oscillations, Damped harmonic motion-Derivation of differential equation and its solution, Over damped, Critically damped and Under damped Cases, Quality factor-Expression	2 hrs
1.2	Forced oscillations-Differential Equation-Derivation of expressions for amplitude and phase of forced oscillations, Amplitude Resonance-Expression for Resonant frequency, Quality factor and Sharpness of Resonance, Electrical analogy of mechanical oscillators	3hrs
1.3	Wave motion- Derivation of one dimensional wave equation and its solution, Three dimensional wave equation and its solution (no derivation)	2 hrs
1.4	Distinction between transverse and longitudinal waves. Transverse vibration in a stretched string, Statement of laws of vibration	2 hrs
2	Wave Optics (9 hours)	
2.1	Interference of light-Principle of superposition of waves, Theory of thin films - Cosine law (Reflected system), Derivation of the conditions of constructive and destructive Interference	2 hrs
2.2	Interference due to wedge shaped films -Determination of thickness and test for optical planeness, Newton's rings - Measurement of wavelength and refractive index, Antireflection coatings	4 hr
2.3	Diffraction of light, Fresnel and Fraunhofer classes of diffraction, Diffraction grating-Grating equation	2 hrs
2.4	Rayleigh criterion for limit of resolution, Resolving and Dispersive power of a grating with expression (no derivation)	1 hr
3	Quantum Mechanics & Nanotechnology (9hours)	
3.1	Introduction for the need of Quantum mechanics, Wave nature of Particles, Uncertainty principle, Applications-Absence of electrons inside a nucleus and Natural line broadening mechanism	2 hrs
3.2	Formulation of time dependent and independent Schrodinger wave equations-Physical Meaning of wave function, Particle in a one dimensional box- Derivation for normalised wave function and energy eigen values, Quantum Mechanical Tunnelling (Qualitative)	4 hrs
3.3	Introduction to nanoscience and technology, Increase in surface to volume ratio for nanomaterials, Quantum confinement in one dimension, two dimension and three dimension-Nano sheets, Nano wires and Quantum dots	2 hrs
3.4	Properties of nanomaterials-mechanical, electrical and optical Applications of nanotechnology (qualitative ideas)	1 hr
4	Magnetism & Electro Magnetic Theory (9 hours)	
4.1	Magnetic field and Magnetic flux density, Gauss's law for Magnetic flux	2 hrs

	density, Ampere's Circuital law, Faraday's law in terms of EMF produced by changing magnetic flux	
4.2	Explanation for Magnetic permeability and susceptibility Classification of magnetic materials- para, dia and ferromagnetic materials	1 hr
4.3	Fundamentals of vector calculus, concept of divergence, gradient and curl along with physical significance, Line, Surface and Volume integrals, Gauss divergence theorem & Stokes' theorem	2 hrs
4.4	Equation of continuity, Derivation of Maxwell's equations in vacuum, Comparison of displacement current with conduction current. Electromagnetic waves, Velocity of Electromagnetic waves in free space, Flow of energy and Poynting's vector (no derivation)	4 hrs
5	Superconductivity & Photonics (9hours)	
5.1	Super conducting Phenomena, Meissner effect and perfect diamagnetism, Types of superconductors-Type I and Type II	2 hrs
5.2	BCS Theory (Qualitative), High temperature superconductors, Applications of super conductivity	2 hrs
5.3	Introduction to photonics-Photonic devices-Light Emitting Diode, Photo detectors -Junction and PIN photodiodes, Solar cells-I-V Characteristics	2 hrs
5.4	Optic fibre-Principle of propagation of light, Types of fibres-Step index and Graded index fibres, Numerical aperture –Derivation, Fibre optic communication system (block diagram), Industrial, Medical and Technological applications of optical fibre, Fibre optic sensors-Intensity Modulated and Phase modulated sensors	3 hrs

PHT 110	ENGINEERING PHYSICS B (FOR NON-CIRCUIT BRANCHES)	Category	L	T	P	CREDIT	Year of Introduction
		BSC	3	1	0	4	2019

Preamble: The aim of the Engineering Physics program is to offer students a solid background in the fundamentals of Physics and to impart that knowledge in engineering disciplines. The program is designed to develop scientific attitudes and enable the students to correlate the concepts of Physics with the core programmes

Prerequisite: Higher secondary level Physics, Mathematical course on vector calculus, differential equations and linear algebra

Course Outcomes: After the completion of the course the student will be able to

CO 1	Compute the quantitative aspects of waves and oscillations in engineering systems.
CO 2	Apply the interaction of light with matter through interference, diffraction and identify these phenomena in different natural optical processes and optical instruments.
CO 3	Analyze the behaviour of matter in the atomic and subatomic level through the principles of quantum mechanics to perceive the microscopic processes in electronic devices.
CO 4	Apply the knowledge of ultrasonics in non-destructive testing and use the principles of acoustics to explain the nature and characterization of acoustic design and to provide a safe and healthy environment
CO 5	Apply the comprehended knowledge about laser and fibre optic communication systems in various engineering applications

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	2						1	2			1
CO 2	3	2						1	2			1
CO 3	3	2						1	2			1
CO 4	3							1	2			1
CO 5	3	2						1	2			1

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination (Marks)
	Test 1 (Marks)	Test 2 (Marks)	
Remember	15	15	30
Understand	25	25	50

Apply	10	10	20
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE MARKS	ESE MARKS	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25 marks
Assignment/Quiz/Course project	: 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Explain the effect of damping force on oscillators.
2. Distinguish between transverse and longitudinal waves.
3. (a) Derive an expression for the fundamental frequency of transverse vibration in a stretched string.
(b) Calculate the fundamental frequency of a string of length 2 m weighing 6 g kept stretched by a load of 600 kg.

Course Outcome 2 (CO2):

1. Explain colours in thin films.
2. Distinguish between Fresnel and Fraunhofer diffraction.
3. (a) Explain the formation of Newton's rings and obtain the expression for radii of bright and dark rings in reflected system. Also explain how it is used to determine the wavelength of a monochromatic source of light.
(b) A liquid of refractive index μ is introduced between the lens and glass plate. What happens to the fringe system? Justify your answer.

Course Outcome 3 (CO3):

1. Give the physical significance of wave function?

2. What are excitons ?
3. (a) Solve Schrodinger equation for a particle in a one dimensional box and obtain its energy eigen values and normalised wave functions.
(b) Calculate the first three energy values of an electron in a one dimensional box of width $1 \text{ \AA}$ in electron volt.

Course Outcome 4 (CO4):

1. Explain reverberation and reverberation time.
2. How ultrasonic waves are used in non-destructive testing.
3. (a) With a neat diagram explain how ultrasonic waves are produced by a piezoelectric oscillator.
(b) Calculate frequency of ultrasonic waves that can be produced by a nickel rod of length 4 cm. (Young's Modulus = 207 G Pa, Density = 8900 Kg /m^3)

Course Outcome 5 (CO 5):

1. Distinguish between spontaneous emission and stimulated emission.
2. Explain optical resonators.
3. (a) Explain the construction and working of Ruby Laser.
(b) Calculate the numerical aperture and acceptance angle of a fibre with a core refractive index of 1.54 and a cladding refractive index of 1.50 when the fibre is inside water of refractive index 1.33.

Model Question paper

QP CODE:

PAGES:3

Reg No:_____

Name : _____

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY FIRST SEMESTER B.TECH DEGREE EXAMINATION,
MONTH & YEAR**

Course Code: PHT 110

Course Name: Engineering Physics B

Max.Marks: 100

Duration: 3 Hours

PART A

Answer all Questions. Each question carries 3 Marks

1. Compare electrical and mechanical oscillators.
2. Distinguish between longitudinal and transverse waves.
3. Write a short note on antireflection coating.
4. Diffraction of light is not as evident in daily experience as that of sound waves. Give reason.
5. State and explain Heisenberg's Uncertainty principle. With the help of it explain natural line broadening.
6. Explain surface to volume ratio of nanomaterials.
7. Define sound intensity level. Give the values of threshold of hearing and threshold of pain.
8. Describe the method of non-destructive testing using ultra sonic waves
9. Explain the condition of population inversion
10. Distinguish between step index and graded index fibre. (10x3=30)

PART B

Answer any one full question from each module. Each question carries 14 Marks

Module 1

11. (a) Derive the differential equation of damped harmonic oscillator and deduce its solution. Discuss the cases of over damped, critically damped and under damped cases. (10)

- (b) The frequency of a tuning fork is 500 Hz and its Q factor is 7×10^4 . Find the relaxation time. Also calculate the time after which its energy becomes $1/10$ of its initial undamped value. (4)
12. (a) Derive an expression for the velocity of propagation of a transverse wave in a stretched string. Deduce laws of transverse vibrations. (10)
- (b) The equation of transverse vibration of a stretched string is given by $y = 0.00327 \sin(72.1x - 2.72t)$ m, in which the numerical constants are in S.I units. Evaluate (i) Amplitude (ii) Wavelength (iii) Frequency and (iv) Velocity of the wave. (4)

Module 2

13. (a) Explain the formation of Newton's rings and show that the radius of dark ring is proportional to the square root of natural numbers. How can we use Newton's rings experiment to determine the refractive index of a liquid? (10)
- (b) Two pieces of plane glass are placed together with a piece of paper between two at one end. Find the angle of the wedge in seconds if the film is viewed with a monochromatic light of wavelength $4800 \text{ \AA}$. Given $\beta = 0.0555 \text{ cm}$. (4)
14. (a) Explain the diffraction due to a plane transmission grating. Obtain the grating equation. (10)
- (b) A grating has 6000 lines per cm. Find the angular separation of the two yellow lines of mercury of wavelengths 577 nm and 579 nm in the second order. (4)

Module 3

15. (a) Derive time dependent and independent Schrodinger equations. (10)
- (b) An electron is confined to one dimensional potential box of length $2 \text{ \AA}$. Calculate the energies corresponding to the first and second quantum states in eV. (4)
16. (a) Classify nanomaterials based on dimensionality of quantum confinement and explain the following nanostructures. (i) nano sheets (ii) nano wires (iii) quantum dots. (10)
- (b) Find the de Broglie wavelength of electron whose kinetic energy is 15 eV. (4)

Module 4

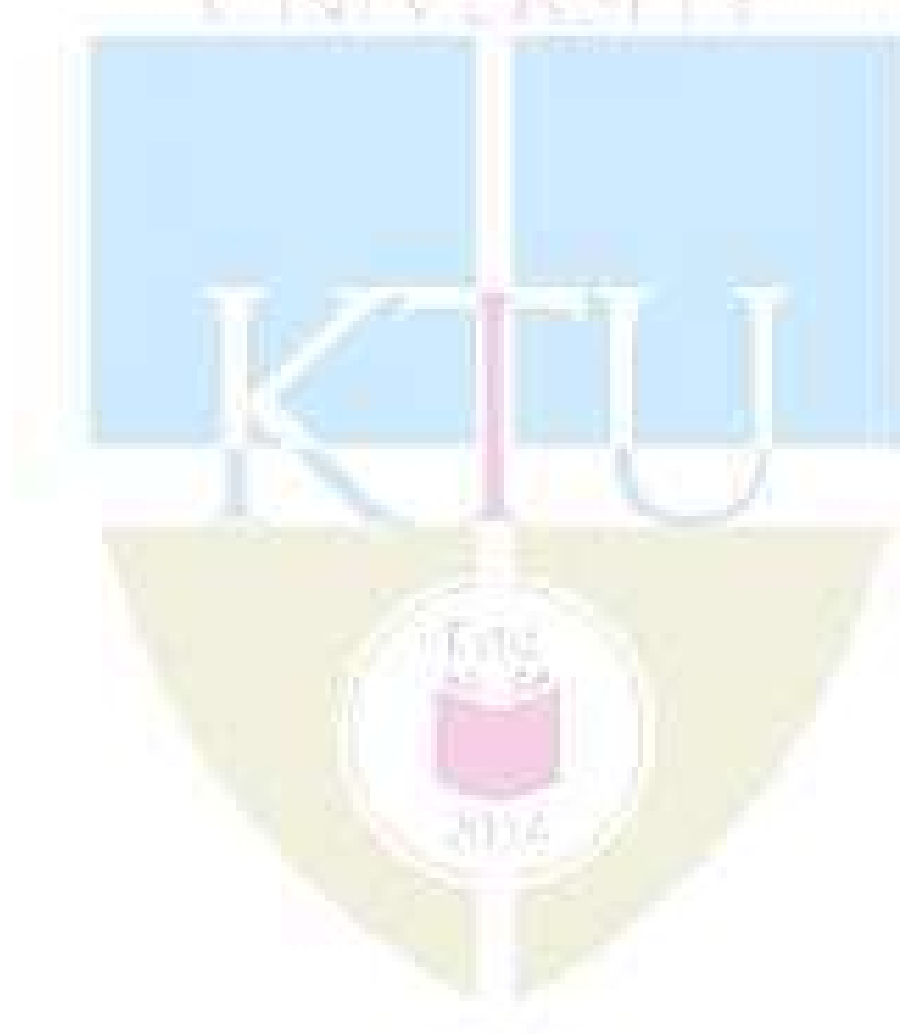
17. (a) Explain reverberation and reverberation time? What is the significance of Reverberation time. Explain the factors affecting the acoustics of a building and their corrective measures? (10)
- (b) The volume of a hall is 3000 m^3 . It has a total absorption of 100 m^2 sabine. If the hall is filled with audience who add another 80 m^2 sabine, then find the difference in reverberation time. (4)
18. (a) With a neat diagram explain how ultrasonic waves are produced by piezoelectric oscillator. Also discuss the piezoelectric method of detection of ultrasonic waves. (10)

- (b) An ultrasonic source of 0.09 MHz sends down a pulse towards the sea bed which returns after 0.55 sec. The velocity of sound in sea water is 1800 m/s. Calculate the depth of the sea and the wavelength of the pulse. (4)

Module 5

19. (a) Outline the construction and working of Ruby laser. (8)
- (b) What is the principle of holography? How is a hologram recorded? (6)
20. (a) Define numerical aperture of an optic fibre and derive an expression for the NA of a step index fibre with a neat diagram. (10)
- (b) An optical fibre made with core of refractive index 1.5 and cladding with a fractional index difference of 0.0006. Find refractive index of cladding and numerical aperture. (4)

(14x5=70)



SYLLABUS

ENGINEERING PHYSICS B (FOR NON-CIRCUIT BRANCHES)

Module 1

Oscillations and Waves

Harmonic oscillations, Damped harmonic motion-Derivation of differential equation and its solution, Over damped, Critically damped and Under damped Cases, Quality factor-Expression, Forced oscillations-Differential Equation-Derivation of expressions for amplitude and phase of forced oscillations, Amplitude Resonance-Expression for Resonant frequency, Quality factor and Sharpness of Resonance, Electrical analogy of mechanical oscillators

Wave motion- Derivation of one dimensional wave equation and its solution, Three dimensional wave equation and its solution (no derivation), Distinction between transverse and longitudinal waves, Transverse vibration in a stretched string, Statement of laws of vibration

Module 2

Wave Optics

Interference of light-Principle of superposition of waves, Theory of thin films - Cosine law (Reflected system), Derivation of the conditions of constructive and destructive Interference, Interference due to wedge shaped films -Determination of thickness and test for optical planeness, Newton's rings - Measurement of wavelength and refractive index, Antireflection coatings

Diffraction of light, Fresnel and Fraunhofer classes of diffraction, Diffraction grating-Grating equation, Rayleigh criterion for limit of resolution, Resolving and Dispersive power of a grating with expression (no derivation)

Module 3

Quantum Mechanics & Nanotechnology

Introduction for the need of Quantum mechanics, Wave nature of Particles, Uncertainty principle, Applications-Absence of electrons inside a nucleus and Natural line broadening Mechanism, Formulation of time dependent and independent Schrodinger wave equations-Physical Meaning of wave function, Particle in a one dimensional box- Derivation for normalised wave function and energy eigen values, Quantum Mechanical Tunnelling (Qualitative)

Introduction to nanoscience and technology, Increase in surface to volume ratio for nanomaterials, Quantum confinement in one dimension, two dimension and three dimension-Nano sheets, Nano wires and Quantum dots, Properties of nanomaterials-mechanical, electrical and optical, Applications of nanotechnology (qualitative ideas)

Module 4

Acoustics & Ultrasonics

Acoustics, Classification of sound-Musical sound-Noise, Characteristics of Musical Sounds-Pitch or frequency-Loudness or Intensity-Measurement of Intensity level-Decibel-Quality or timbre, Absorption coefficient, Reverberation-Reverberation time-Significance- Sabine's formula (no derivation), Factors affecting architectural acoustics and their remedies

Ultrasonics-Production- Magnetostriction effect and Piezoelectric effect, Magnetostriction oscillator and Piezoelectric oscillator -Working, Detection of ultrasonic waves - Thermal and Piezoelectric

methods, Ultrasonic diffractometer- Expression for the velocity of ultrasonic waves in a liquid , Applications of ultrasonic waves -SONAR,NDT and Medical

Module 5

Laser and Fibre optics

Properties of laser, Absorption and emission of radiation, Spontaneous and stimulated emission, Einstein's coefficients (no derivation), Population inversion, Metastable states, basic components of laser, Active medium, Pumping mechanism, Optical resonant cavity, working principle, Construction and working of Ruby laser and Helium neon laser ,Construction and working of semiconductor laser(Qualitative) ,Applications of laser, Holography, Difference between hologram and photograph, Recording of hologram and reconstruction of image, Applications

Optic fibre-Principle of propagation of light, Types of fibres-Step index and Graded index fibres, Numerical aperture –Derivation, Fibre optic communication system (block diagram), Industrial, Medical and Technological applications, Fibre optic sensors-Intensity Modulated and Phase modulated sensors

Text Books

1. M.N.Avadhanulu, P.G.Kshirsagar,TVS Arun Murthy "A Text book of Engineering Physics", S.Chand &Co., Revised Edition, 2019.
2. H.K.Malik , A.K. Singh, "Engineering Physics" McGraw Hill Education, Second Edition, 2017.

Reference Books

1. Arthur Beiser, "Concepts of Modern Physics ", Tata McGraw Hill Publications, 6th Edition 2003
2. D.K. Bhattacharya, Poonam Tandon, "Engineering Physics", Oxford University Press, 2015
3. Md.N.Khan & S.Panigrahi "Principles of Engineering Physics 1&2", Cambridge University Press, 2016
4. Aruldas G., "Engineering Physics", PHI Pvt. Ltd., 2015
5. Ajoy Ghatak, "Optics", Mc Graw Hill Education, Sixth Edition, 2017
6. T. Pradeep, "Nano:The Essentials", McGraw Hill India Ltd, 2007
7. B. B. Laud, "Lasers and Non linear optics", New age International Publishers, 2nd Edition ,2005
8. Premlet B., "Advanced Engineering Physics", Phasor Books,10th edition ,2017
9. I. Dominic and. A. Nahari, "A Text Book of Engineering physics", Owl Books Publishers, Revised edition, 2016

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	Oscillations and Waves (9 hours)	
1.1	Harmonic oscillations, Damped harmonic motion-Derivation of differential equation and its solution, Over damped, Critically damped and Under damped Cases, Quality factor-Expression	2 hrs
1.2	Forced oscillations-Differential Equation-Derivation of expressions for amplitude and phase of forced oscillations, Amplitude Resonance-Expression for Resonant frequency, Quality factor and Sharpness of Resonance, Electrical analogy of mechanical oscillators	3hrs
1.3	Wave motion- Derivation of one dimensional wave equation and its solution, Three dimensional wave equation and its solution (no derivation)	2 hrs
1.4	Distinction between transverse and longitudinal waves, Transverse vibration in a stretched string, Statement of laws of vibration	2 hrs
2	Wave Optics (9 hours)	
2.1	Interference of light-Principle of superposition of waves, Theory of thin films - Cosine law (Reflected system), Derivation of the conditions of constructive and destructive Interference	2 hrs
2.2	Interference due to wedge shaped films -Determination of thickness and test for optical planeness, Newton's rings - Measurement of wavelength and refractive index, Antireflection coatings	4 hrs
2.3	Diffraction of light, Fresnel and Fraunhofer classes of diffraction, Diffraction grating-Grating equation	2 hrs
2.4	Rayleigh criterion for limit of resolution, Resolving and Dispersive power of a grating with expression (no derivation)	1 hr
3	Quantum Mechanics & Nanotechnology (9hours)	
3.1	Introduction for the need of Quantum mechanics, Wave nature of Particles, Uncertainty principle, Applications-Absence of electrons inside a nucleus and Natural line broadening mechanism	2 hrs
3.2	Formulation of time dependent and independent Schrodinger wave equations-Physical Meaning of wave function, Particle in a one dimensional box- Derivation for normalised wave function and energy eigen values, Quantum Mechanical Tunnelling (Qualitative)	4 hrs
3.3	Introduction to nanoscience and technology, Increase in surface to volume ratio for nanomaterials, Quantum confinement in one dimension, two dimension and three dimension-Nano sheets, Nano wires and Quantum dots	2 hrs
3.4	Properties of nanomaterials-mechanical, electrical and optical Applications of nanotechnology (qualitative ideas)	1 hr
4	Acoustics & Ultrasonics (9hrs)	
4.1	Acoustics, Classification of sound-Musical sound-Noise, Characteristics	3 hrs

	of Musical Sounds-Pitch or frequency-Loudness or Intensity-Measurement of Intensity level-Decibel-Quality or timbre, Absorption coefficient, Reverberation-Reverberation time-Significance- Sabine's formula (no derivation)	
4.2	Factors affecting architectural acoustics and their remedies	1 hr
4.3	Ultrasonics-Production- Magnetostriction effect and Piezoelectric effect, Magnetostriction oscillator and Piezoelectric oscillator – Working, Detection of ultrasonic waves - Thermal and Piezoelectric methods	3hrs
4.4	Ultrasonic diffractometer- Expression for the velocity of ultrasonic waves in a liquid ,Applications of ultrasonic waves -SONAR,NDT and Medical.	2 hr
5	Laser and Fibre optics (9hours)	
5.1	Properties of laser, Absorption and emission of radiation, Spontaneous and stimulated emission, Einstein's coefficients (no derivation), Population inversion, Metastable states, basic components of laser, Active medium, Pumping mechanism, Optical resonant cavity, working principle	2 hrs
5.2	Construction and working of Ruby laser and Helium neon laser ,Construction and working of semiconductor laser(Qualitative) Applications of laser	3 hrs
5.3	Holography, Difference between hologram and photograph, Recording of hologram and reconstruction of image, Applications	1 hr
5.4	Optic fibre-Principle of propagation of light, Types of fibres-Step index and Graded index fibres, Numerical aperture –Derivation, Fibre optic communication system (block diagram), Industrial, Medical and Technological applications, Fibre optic sensors-Intensity Modulated and Phase modulated sensors	3 hrs

CYT 100	ENGINEERING CHEMISTRY	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		BSC	3	1	0	4	2019

Preamble: To enable the students to acquire knowledge in the concepts of chemistry for engineering applications and to familiarize the students with different application oriented topics like spectroscopy, electrochemistry, instrumental methods etc. Also familiarize the students with topics like mechanism of corrosion, corrosion prevention methods, SEM, stereochemistry, polymers, desalination etc., which enable them to develop abilities and skills that are relevant to the study and practice of chemistry.

Prerequisite: Concepts of chemistry introduced at the plus two levels in schools

Course outcomes: After the completion of the course the students will be able to

CO 1	Apply the basic concepts of electrochemistry and corrosion to explore its possible applications in various engineering fields.
CO 2	Understand various spectroscopic techniques like UV-Visible, IR, NMR and its applications.
CO 3	Apply the knowledge of analytical method for characterizing a chemical mixture or a compound. Understand the basic concept of SEM for surface characterisation of nanomaterials.
CO 4	Learn about the basics of stereochemistry and its application. Apply the knowledge of conducting polymers and advanced polymers in engineering.
CO 5	Study various types of water treatment methods to develop skills for treating wastewater.

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	1	2	1									
CO 2	1	1		1	2							
CO 3	1	1		1	2							
CO 4	2	1										
CO 5	1			1			3					

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	15	15	30
Understand	25	25	50
Apply	10	10	20
Analyse			
Evaluate			
Create			

End Semester Examination Pattern: There will be two parts- **Part A** and **Part B**. **Part A** contains **10** questions (**2** questions from each module), having **3** marks for each question. Students should answer **all** questions. **Part B** contains **2** questions from each module, of which student should answer any one. Each question can have maximum **2** subdivisions and carries **14** marks.

Course Level Assessment Questions

Course Outcome 1 (CO 1):

1. What is calomel electrode? Give the reduction reaction (3 Marks)
2. List three important advantages of potentiometric titration (3 Marks)
3. (a) Explain how electroless plating copper and nickel are carried out (10 Marks)
(b) Calculate the emf of the following cell at 30°C, $Zn / Zn^{2+} (0.1M) // Ag^+ (0.01M) // Ag$.
Given $E^0 Zn^{2+}/Zn = -0.76 V$, $E^0 Ag^+/Ag = 0.8 V$. (4 Marks)

Course Outcome 2 (CO 2)

1. State Beer Lambert's law (3 Marks)
2. List the important applications of IR spectroscopy (3 Marks)
3. (a) What is Chemical shift? What are factors affecting Chemical shift? How ^1H NMR spectrum of CH_3COCH_2Cl interpreted using the concept of chemical shift. (10 Marks)
(b) Calculate the force constant of HF molecule, if it shows IR absorption at 4138 cm^{-1} . Given that atomic masses of hydrogen and fluorine are 1u and 19u respectively. (4 Marks)

Course Outcome 3 (CO 3):

1. Distinguish between TGA and DTA (3 Marks)
2. Give two differences between GSC and GLC (3 Marks)

3. (a) Explain the principle, instrumentation and procedure of HPLC (10 Marks)

(b) Interpret TGA of $\text{CaC}_2\text{O}_4 \cdot \text{H}_2\text{O}$ (4 Marks)

Course Outcome 4 (CO 4):

1. Explain the geometrical isomerism in double bonds (3 Marks)

2. What are the rules of assigning R-S notation? (3 Marks)

3. (a) What are conducting polymers? How it is classified? Give the preparation of polyaniline (10 Marks)

(b) Draw the stereoisomers possible for $\text{CH}_3\text{-(CHOH)}_2\text{-COOH}$ (4 Marks)

Course Outcome 5 (CO 5):

1. What is degree of hardness? (3 Marks)

2. Define BOD and COD (3 Marks)

3. (a) Explain the EDTA estimation of hardness (10 Marks)

(b) Standard hard water contains 20 g of CaCO_3 per liter, 50 mL of this required 30 mL of EDTA solution, 50 mL of sample water required 20 mL of EDTA solution. 50 mL sample water after boiling required 14 mL EDTA solution. Calculate the temporary hardness of the given sample of water, in terms of ppm. (4 Marks)

MODEL QUESTION PAPER

Total Pages:

Reg No.: _____

Name: _____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
FIRST SEMESTER B.TECH DEGREE EXAMINATION

Course Code: CYT100,

Course Name: ENGINEERING CHEMISTRY

Max. Marks: 100

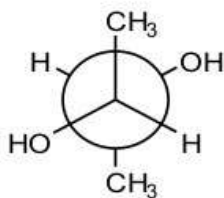
Duration: 3 Hours

PART A

Answer all questions, each carries 3 marks

		Marks
1	What is potentiometric titration? How the end point is determined graphically?	(3)
2	What is Galvanic series? How is it different from electrochemical series?	(3)
3	Which of the following molecules can give IR absorption? Give reason?	(3)
	(a) O_2 (b) H_2O (c) N_2 (d) HCl	
4	Which of the following molecules show UV-Visible absorption? Give reason.	(3)
	(a) Ethane (b) Butadiene (c) Benzene	

- 5 What are the visualization techniques used in TLC? (3)
- 6 Write the three important applications of nanomaterials. (3)
- 7 Draw the Fischer projection formula and find R-S notation of (3)



- 8 Write the structure of a) Polypyrrole b) Kevlar. (3)
- 9 What is break point chlorination? (3)
- 10 What is reverse osmosis? (3)

PART B

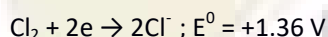
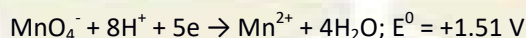
Answer any one full question from each module, each question carries 14 marks

Module 1

- 11 a) Give the construction of Li-ion cell. Give the reactions that take place at the electrodes during charging and discharging. What happens to anodic material when the cell is 100% charged. (10)
- b) Calculate the standard electrode potential of Cu, if its electrode potential at 25 °C is 0.296 V and the concentration of Cu^{2+} is 0.015 M. (4)

OR

- 12 a) Explain the mechanism of electrochemical corrosion of iron in oxygen rich and oxygen deficient acidic and basic environments. (10)
- b) Given below are reduction potentials of some species (4)



Use the above data to examine whether the acids, dil. HCl and dil. H_2SO_4 , can be used to provide acid medium in redox titrations involving KMnO_4 .

Module 2

- 13 a) What is spin-spin splitting? Draw the NMR spectrum of (i) $\text{CH}_3\text{CH}_2\text{CH}_2\text{Br}$ (ii) $\text{CH}_3\text{CH}(\text{Br})\text{CH}_3$. Explain how NMR spectrum can be used to identify the two isomers. (10)
- b) A dye solution of concentration 0.08M shows absorbance of 0.012 at 600 nm; while a test solution of same dye shows absorbance of 0.084 under same conditions. Find the concentration of the test solution. (4)

OR

- 14 a) Explain the basic principle of UV-Visible spectroscopy. What are the possible electronic transitions? Explain with examples. (10)
- b) Sketch the vibrational modes of CO_2 and H_2O . Which of them are IR active? (4)

Module 3

- 15 a) Explain the principle, instrumentation and procedure involved in gas chromatography. (10)
b) Explain the DTA of $\text{CaC}_2\text{O}_4 \cdot \text{H}_2\text{O}$ with a neat sketch. (4)

OR

- 16 a) Explain the various chemical methods used for the synthesis of nanomaterial (10)
b) How TGA is used to analyse the thermal stability of polymers? (4)

Module 4

- 17 a) What are conformers? Draw the *cis* and *trans* isomers of 1, 3-dimethylcyclohexane. (10)
Which conformer (chair form) is more stable in each case?
b) What is ABS? Give properties and applications. (4)

OR

- 18 a) Explain the various structural isomers with suitable example. (10)
b) What is OLED? Draw a labelled diagram. (4)

Module 5

- 19 a) What are ion exchange resins? Explain ion exchange process for removal of hardness of water? How exhausted resins are regenerated? (10)
b) 50 mL sewage water is diluted to 2000 mL with dilution water; the initial dissolved oxygen was 7.7 ppm. The dissolved oxygen level after 5 days of incubation was 2.4 ppm. Find the BOD of the sewage. (4)

OR

- 20 a) What are the different steps in sewage treatment? Give the flow diagram. Explain the working of trickling filter. (10)
b) Calculate the temporary and permanent hardness of a water sample which contains $[\text{Ca}^{2+}] = 160 \text{ mg/L}$, $[\text{Mg}^{2+}] = 192 \text{ mg/L}$ and $[\text{HCO}_3^-] = 122 \text{ mg/L}$. (4)

Syllabus

Module 1

Electrochemistry and Corrosion

Introduction - Differences between electrolytic and electrochemical cells - Daniel cell - redox reactions - cell representation. Different types of electrodes (brief) - Reference electrodes - SHE - Calomel electrode - Glass Electrode - Construction and Working. Single electrode potential - definition - Helmholtz electrical double layer - Determination of E^0 using calomel electrode. Determination of pH using glass electrode. Electrochemical series and its applications. Free energy and EMF - Nernst Equation - Derivation - single electrode and cell (Numericals) - Application - Variation of emf with temperature. Potentiometric titration - Introduction - Redox titration only. Lithium ion cell - construction and working. Conductivity- Measurement of conductivity of a solution (Numericals).

Corrosion-Electrochemical corrosion – mechanism. Galvanic series- cathodic protection - electroless plating –Copper and Nickel plating.

Module 2

Spectroscopic Techniques and Applications

Introduction- Types of spectrum - electromagnetic spectrum - molecular energy levels - Beer Lambert's law (Numericals). UV-Visible Spectroscopy – Principle - Types of electronic transitions - Energy level diagram of ethane, butadiene, benzene and hexatriene. Instrumentation of UV-Visible spectrometer and applications. IR-Spectroscopy – Principle - Number of vibrational modes - Vibrational energy states of a diatomic molecule and -Determination of force constant of diatomic molecule (Numericals) –Applications. ^1H NMR spectroscopy – Principle - Relation between field strength and frequency - chemical shift - spin-spin splitting (spectral problems) - coupling constant (definition) - applications of NMR- including MRI (brief).

Module 3

Instrumental Methods and Nanomaterials

Thermal analysis –TGA- Principle, instrumentation (block diagram) and applications – TGA of $\text{CaC}_2\text{O}_4 \cdot \text{H}_2\text{O}$ and polymers. DTA-Principle, instrumentation (block diagram) and applications - DTA of $\text{CaC}_2\text{O}_4 \cdot \text{H}_2\text{O}$. Chromatographic methods - Basic principles and applications of column and TLC- Retention factor. GC and HPLC-Principle, instrumentation (block diagram) - retention time and applications.

Nanomaterials - Definition - Classification - Chemical methods of preparation - Hydrolysis and Reduction - Applications of nanomaterials - Surface characterisation -SEM – Principle and instrumentation (block diagram).

Module 4

Stereochemistry and Polymer Chemistry

Isomerism-Structural, chain, position, functional, tautomerism and matamerism - Definition with examples - Representation of 3D structures-Newman, Sawhorse, Wedge and Fischer projection of substituted methane and ethane. Stereoisomerism - Geometrical isomerism in double bonds and cycloalkanes (cis-trans and E-Z notations). R-S Notation – Rules and examples - Optical isomerism, Chirality, Enantiomers and Diastereoisomers-Definition with examples. Conformational analysis of ethane, butane, cyclohexane, mono and di methyl substituted cyclohexane.

Copolymers - Definition - Types - Random, Alternating, Block and Graft copolymers - ABS - preparation, properties and applications. Kevlar-preparation, properties and applications. Conducting polymers - Doping - Polyaniline and Polypyrrole - preparation properties and applications. OLED - Principle, construction and advantages.

Module 5

Water Chemistry and Sewage Water Treatment

Water characteristics - Hardness - Types of hardness- Temporary and Permanent - Disadvantages of hard water -Units of hardness- ppm and mg/L -Degree of hardness (Numericals) - Estimation of

hardness-EDTA method (Numericals). Water softening methods-Ion exchange process-Principle, procedure and advantages. Reverse osmosis – principle, process and advantages. Municipal water treatment (brief) - Disinfection methods - chlorination, ozone and UV irradiation.

Dissolved oxygen (DO) -Estimation (only brief procedure-Winkler's method), BOD and COD- definition, estimation (only brief procedure) and significance (Numericals). Sewage water treatment - Primary, Secondary and Tertiary - Flow diagram -Trickling filter and UASB process.

Text Books

1. B. L. Tembe, Kamaluddin, M. S. Krishnan, "Engineering Chemistry (NPTEL Web-book)", 2018.
2. P. W. Atkins, "Physical Chemistry", Oxford University Press, 10th edn., 2014.

Reference Books

1. C. N. Banwell, "Fundamentals of Molecular Spectroscopy", McGraw-Hill, 4th edn., 1995.
2. Donald L. Pavia, "Introduction to Spectroscopy", Cengage Learning India Pvt. Ltd., 2015.
3. B. R. Puri, L. R. Sharma, M. S. Pathania, "Principles of Physical Chemistry", Vishal Publishing Co., 47th Edition, 2017.
4. H. H. Willard, L. L. Merritt, "Instrumental Methods of Analysis", CBS Publishers, 7th Edition, 2005.
5. Ernest L. Eliel, Samuel H. Wilen, "Stereo-chemistry of Organic Compounds", WILEY, 2008.
6. Raymond B. Seymour, Charles E. Carraher, "Polymer Chemistry: An Introduction", Marcel Dekker Inc; 4th Revised Edition, 1996.
7. MuhammedArif, Annette Fernandez, Kavitha P. Nair "Engineering Chemistry", Owl Books, 2019.
8. Ahad J., "Engineering Chemistry", Jai Publication, 2019.
9. Roy K. Varghese, "Engineering Chemistry", Crownplus Publishers, 2019.
10. Soney C. George, RinoLaly Jose, "Text Book of Engineering Chemistry", S. Chand & Company Pvt Ltd, 2019.

Course Contents and Lecture Schedule

No	Topic	No. of Lectures (hrs)
1	Electrochemistry and Corrosion	9
1.1	Introduction - Differences between electrolytic and electrochemical cells- Daniel cell - redox reactions - cell representation. Different types of electrodes (brief) - Reference electrodes- SHE - Calomel electrode - Glass Electrode - Construction and Working.	2
1.2	Single electrode potential – definition - Helmholtz electrical double layer - Determination of E^0 using calomel electrode. Determination of pH using glass electrode. Electrochemical series and its applications. Free energy and EMF - Nernst Equation – Derivation - single electrode and cell (Numericals) -Application -Variation of emf with temperature.	3
1.3	Potentiometric titration - Introduction -Redox titration only. Lithiumion cell - construction and working. Conductivity- Measurement of conductivity of a solution (Numericals).	2
1.4	Corrosion-Electrochemicalcorrosion – mechanism. Galvanic series- cathodic protection - electroless plating –Copper and Nickel plating.	2
2	Spectroscopic Techniques and Applications	9
2.1	Introduction- Types of spectrum - electromagnetic spectrum - molecular energy levels - Beer Lambert's law (Numericals).	2
2.2	UV-Visible Spectroscopy – Principle - Types of electronic transitions - Energy level diagram of ethane, butadiene, benzene and hexatriene. Instrumentation of UV-Visible spectrometer and applications.	2
2.3	IR-Spectroscopy – Principle - Number of vibrational modes -Vibrational energy states of a diatomic molecule and -Determination of force constant of diatomic molecule (Numericals) –Applications.	2
2.4	^1H NMR spectroscopy – Principle - Relation between field strength and frequency - chemical shift - spin-spin splitting (spectral problems) - coupling constant (definition) - applications of NMR- including MRI (brief).	3
3	Instrumental Methods and Nanomaterials	9
3.1	Thermal analysis –TGA- Principle, instrumentation (block diagram) and applications – TGA of $\text{CaC}_2\text{O}_4 \cdot \text{H}_2\text{O}$ and polymers. DTA-Principle, instrumentation (block diagram) and applications - DTA of $\text{CaC}_2\text{O}_4 \cdot \text{H}_2\text{O}$.	2

3.2	Chromatographic methods - Basic principles and applications of column and TLC-Retention factor.	2
3.3	GC and HPLC-Principle, instrumentation (block diagram) - retention time and applications.	2
3.4	Nanomaterials - Definition - Classification - Chemical methods of preparation - Hydrolysis and Reduction - Applications of nanomaterials - Surface characterisation -SEM – Principle and instrumentation (block diagram).	3
4	Stereochemistry and Polymer Chemistry	9
4.1	Isomerism-Structural, chain, position, functional, tautomerism and matamerism - Definition with examples - Representation of 3D structures-Newman, Sawhorse, Wedge and Fischer projection of substituted methane and ethane. Stereoisomerism - Geometrical isomerism in double bonds and cycloalkanes (cis-trans and E-Z notations).	2
4.2	R-S Notation – Rules and examples - Optical isomerism, Chirality, Enantiomers and Diastereoisomers-Definition with examples.	1
4.3	Conformational analysis of ethane, butane, cyclohexane, mono and di methyl substituted cyclohexane.	2
4.4	Copolymers - Definition - Types - Random, Alternating, Block and Graft copolymers - ABS - preparation, properties and applications. Kevlar-preparation, properties and applications. Conducting polymers - Doping -Polyaniline and Polypyrrole - preparation properties and applications. OLED - Principle, construction and advantages.	4
5	Water Chemistry and Sewage Water Treatment	9
5.1	Water characteristics - Hardness - Types of hardness- Temporary and Permanent - Disadvantages of hard water -Units of hardness- ppm and mg/L -Degree of hardness (Numericals) - Estimation of hardness-EDTA method (Numericals). Water softening methods-Ion exchange process-Principle, procedure and advantages. Reverse osmosis – principle, process and advantages.	3
5.2	Municipal water treatment (brief) - Disinfection methods - chlorination, ozone and UV irradiation.	2
5.3	Dissolved oxygen (DO) -Estimation (only brief procedure-Winkler's method), BOD and COD-definition, estimation (only brief procedure) and significance (Numericals).	2
5.4	Sewage water treatment - Primary, Secondary and Tertiary - Flow diagram - Trickling filter and UASB process.	2

EST 100	ENGINEERING MECHANICS	CATEGORY	L	T	P	CREDIT	Year of Introduction
		ESC	2	1	0	3	2019

Preamble: Goal of this course is to expose the students to the fundamental concepts of mechanics and enhance their problem-solving skills. It introduces students to the influence of applied force system and the geometrical properties of the rigid bodies while stationary or in motion. After this course students will be able to recognize similar problems in real-world situations and respond accordingly.

Prerequisite: Nil

Course Outcomes: After completion of the course the student will be able to:

CO 1	Recall principles and theorems related to rigid body mechanics
CO 2	Identify and describe the components of system of forces acting on the rigid body
CO 3	Apply the conditions of equilibrium to various practical problems involving different force system.
CO 4	Choose appropriate theorems, principles or formulae to solve problems of mechanics.
CO 5	Solve problems involving rigid bodies, applying the properties of distributed areas and masses

Mapping of course outcomes with program outcomes (Minimum requirement)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	2	2	-	-	-	-	-	-	-	-	-	-
CO 2	3	3	-	-	-	-	-	-	-	-	-	-
CO 3	3	3	-	-	-	-	-	-	-	-	-	-
CO 4	3	3	-	-	-	-	-	-	-	-	-	-
CO 5	3	3	-	-	-	-	-	-	-	-	-	-

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination (Marks)
	Test 1 (Marks)	Test 2 (Marks)	
Remember	10	10	15
Understand	10	10	15
Apply	30	30	70
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE marks	ESE marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25 marks
Assignment/Quiz/Course project	: 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions:

Part A

Course Outcome 1 (CO1): (One question from each module to meet the course objective 1: *To recall principles and theorems related to rigid body mechanics*)

1. Explain D'Alembert's principle
2. Distinguish static and dynamic friction
3. State and explain perpendicular axis theorem

Course Outcome 2 (CO2) (One question from each module to meet the course objective 2: *To identify and describe the components of system of forces acting on the rigid body*)

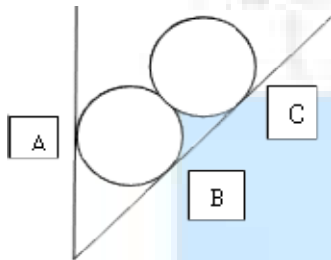
1. A simply supported beam AB of span 5 m is carrying point loads 5 kN, 3 kN and 2 kN at 1m, 3m and 4m respectively from support A. Calculate the support reaction at B.
2. A gymnast holding onto a bar, is suspended motionless in mid-air. The bar is supported by two ropes that attach to the ceiling. Diagram the forces acting on the combination of gymnast and bar
3. While you are riding your bike, you turn a corner following a circular arc. Illustrate the forces that act on your bike to keep you along the circular path ?

Part B

All the questions under this section shall assess the learning levels corresponding to the course outcomes listed below.

CO 3	To apply the conditions of equilibrium to various practical problems involving different force system.
CO 4	To choose appropriate theorems, principles or formulae to solve problems of mechanics.
CO 5	To solve problems involving rigid bodies, applying the properties of distributed areas and masses

1. Two rollers each of weight 100 N are supported by an inclined plane and a vertical wall. Find the reaction at the points of contact A, B, C. Assume all the surfaces to be smooth.

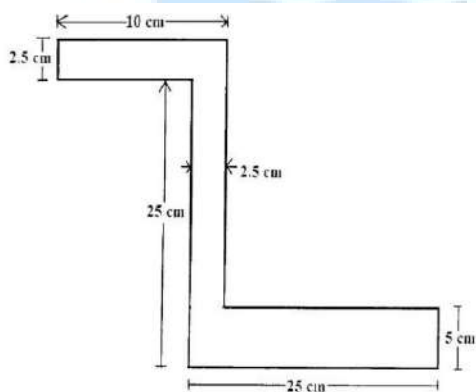


Course outcome identifier	Description of course outcome	Learning level assessed	Marks allocated
CO 3	To apply the conditions of equilibrium to various practical problems involving different force system.	Applying – (Sketch the free body diagram that represent equilibrium state of the body)	4
CO 4	To choose appropriate theorems, principles or formulae to solve problems of mechanics.	Applying (Choose the equations and formulae required for calculation)	4
CO 5	To solve problems involving rigid bodies, applying the properties of distributed areas and masses	Applying (Solve the problem based on the descriptions given in CO3 and CO4)	6
Total			14

2. A cylindrical disc, 50 cm diameter and cm thickness, is in contact with a horizontal conveyor belts running at uniform speeds of 5 m/s. Assuming there is no slip at points of contact determine (i) angular velocity of disc (ii) Angular acceleration of disc if velocity of conveyor changes to 8 m/s. Also compute the moment acting about the axis of the disc in both cases.

Course outcome identifier	Description of course outcome	Learning level assessed	Marks allocated
CO 3	To apply the conditions of equilibrium to various practical problems involving different force system.	Applying – (Sketch the free body diagram that represent state of the body)	4
CO 4	To choose appropriate theorems, principles or formulae to solve problems of mechanics.	Applying (Choose the equations and formulae required for calculation)	4
CO 5	To solve problems involving rigid bodies, applying the properties of distributed areas and masses	Applying (Solve the problem based on the descriptions given in CO3 and CO4)	6
Total			14

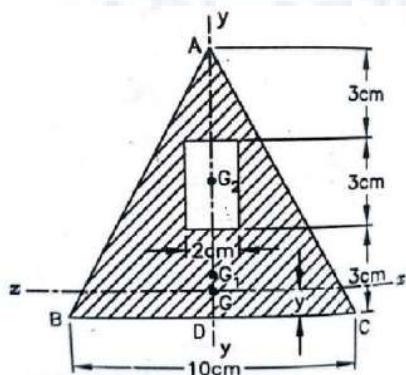
3. Determine the centroid of the given section



Course outcome identifier	Description of course outcome	Learning level assessed	Marks allocated
CO 3	To apply the conditions of equilibrium to various practical problems involving different force system.	Applying – (Illustrate the computation of centroid for the given geometrical shape)	4
CO 4	To choose appropriate theorems, principles or formulae to solve problems of mechanics.	Applying (Choose the equations and formulae required for calculation)	4
CO 5	To solve problems involving rigid bodies, applying the properties of distributed	Applying (Solve the problem based on the descriptions	6

	areas and masses	given in CO3 and CO4)	
Total			14

4. A rectangular hole is made in a triangular section as shown. Find moment of inertia about the section x-x passing through the CG of the section and parallel to BC.



Course outcome identifier	Description of course outcome	Learning level assessed	Marks allocated
CO 3	To apply the conditions of equilibrium to various practical problems involving different force system.	Applying – (Illustrate the computation of moment of inertia for the given geometrical shape)	4
CO 4	To choose appropriate theorems, principles or formulae to solve problems of mechanics.	Applying (Choose the equations and formulae required for calculation)	4
CO 5	To solve problems involving rigid bodies, applying the properties of distributed areas and masses	Applying (Solve the problem based on the descriptions given in CO3 and CO4)	6
Total			14

Model Question Paper

QP CODE:

Reg No.: _____

Name: _____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY FIRST SEMESTER B.TECH DEGREE EXAMINATION,
MONTH & YEAR

Course Code: EST 100

ENGINEERING MECHANICS

Max. Marks: 100

Duration: 3 hours

Part A

(Answer all questions; each question carries 3 marks)

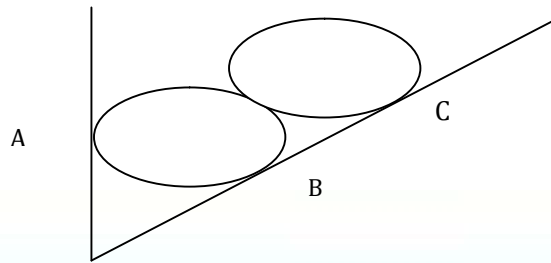
1. Explain D'Alembert's principle
2. Distinguish static and dynamic friction.
3. State and explain perpendicular axis theorem.
4. A simply supported beam AB of span 5 m is carrying point loads 5 kN, 3 kN and 2 kN at 1m, 3m and 4m respectively from support A. Calculate the support reaction at B.
5. A gymnast holding onto a bar, is suspended motionless in mid-air. The bar is supported by two ropes that attach to the ceiling. Diagram the forces acting on the combination of gymnast and bar
6. While you are riding your bike, you turn a corner following a circular arc. Illustrate the forces that act on your bike to keep you along the circular path ?
7. Compare damped and undamped free vibrations.
8. State the equation of motion of a rotating rigid body, rotating about its fixed axis.
9. Illustrate the significance of instantaneous centre in the analysis of rigid body undergoing rotational motion.
10. Highlight the principles of mechanics applied in the evaluation of elastic collision of rigid bodies.

PART B

(Answer **one full** question from each module, each question carries **14** marks)

Module -I

11. Two identical rollers each of weight 100 N are supported by an inclined plane, making an angle of 30° with the vertical, and a vertical wall. Find the reaction at the points of contact A, B, C. Assume all the surfaces to be smooth. (14 marks)

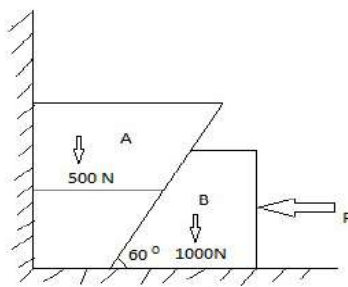


12. A string tied to a wall is made to pass over a pulley placed 2m away from it. A weight P is attached to the string such that the string stretches by 2m from the support on the wall to the location of attachment of weight. Determine the force P required to maintain 200 kg body in position for $\theta = 30^\circ$. The diameter of pulley B is negligible. (14 marks)

Module – 2

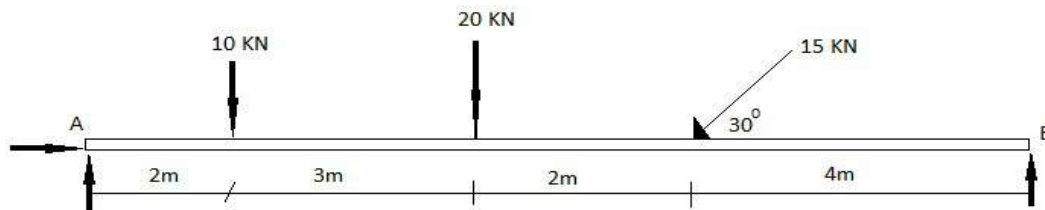
13. Two blocks A & B are resting against a wall and the floor as shown in figure below. Find the value of horizontal force P applied to the lower block that will hold the system in equilibrium. Coefficient of friction are : 0.25 at the floor, 0.3 at the wall and 0.2 between the blocks.

(14 marks)



14. A beam is hinged at A and roller supported at B. It is acted upon by loads as shown below. Find the reactions at A & B.

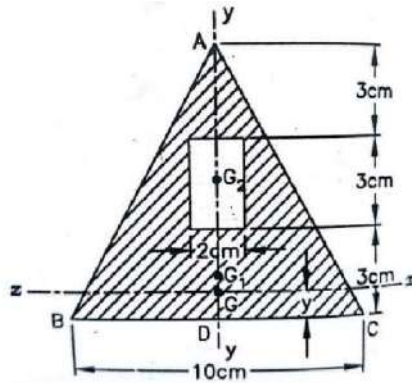
(14 marks)



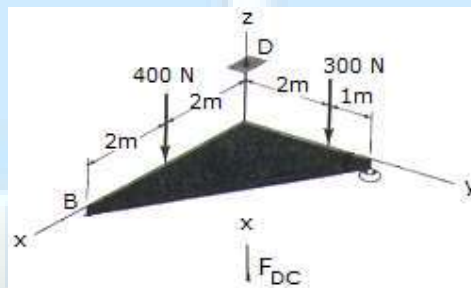
Module – 3

15. A rectangular hole is made in a triangular section as shown. Find moment of inertia about the section x-x passing through the CG of the section and parallel to BC.

(14 marks)



16. Support A has ball and socket connection. Roller support at B prevents motion in the $-z$ direction. Corner C is tied to D by a rope. The triangle is weightless. Determine the unknown force components acting at A, B, and C. (14 marks)



Module - 4

17. A cricket ball is thrown by a fielder from a height of 2m at an angle of 30° to the horizontal with an initial velocity of 20 m/s, hits the wickets at a height of 0.5 m from the ground. How far was the fielder from the wicket? (14 marks)

18. An engine of weight 500 kN pull a train weighing 1500 kN up an incline of 1 in 100. The train starts from rest and moves with constant acceleration against a resistance of 5 N/kN. It attains a maximum speed of 36 kmph in 1 km distance. Determine the tension in the coupling between train and engine and the traction force developed by the engine. (14marks)

Module – 5

19. A cylindrical disc, 50 cm diameter and 10 cm thickness having mass of 10 kg, is in contact with a horizontal conveyor belt running at uniform speeds of 5 m/s. Assuming there is no slip at points of contact determine (i) angular velocity of disc (ii) Angular acceleration of disc if velocity of conveyor changes to 8 m/s in 10 seconds. Also compute the moment acting about the axis of the disc in both cases. (14 marks)
20. A wheel rotating about fixed axis at 20 rpm is uniformly accelerated for 70 seconds during which time it makes 50 revolutions. Find the (i) angular velocity at the end of this interval and (ii) time required for the velocity to reach 100 revolutions per minute. (14 marks)

SYLLABUS

Module 1

Introduction to Engineering Mechanics-statics-basic principles of statics-Parallelogram law, equilibrium law, principles of superposition and transmissibility, law of action and reaction(review) free body diagrams.

Concurrent coplanar forces-composition and resolution of forces-resultant and equilibrium equations – methods of projections – methods of moments – Varignon's Theorem of moments.

Module 2

Friction – sliding friction - Coulomb's laws of friction – analysis of single bodies –wedges, ladder-analysis of connected bodies .

Parallel coplanar forces – couple - resultant of parallel forces – centre of parallel forces – equilibrium of parallel forces – Simple beam subject to concentrated vertical loads. General coplanar force system - resultant and equilibrium equations.

Module 3

Centroid of composite areas- – moment of inertia-parallel axis and perpendicular axis theorems. Polar moment of inertia, radius of gyration, mass moment of inertia-ring, cylinder and disc.

Theorem of Pappus Guldinus(demonstration only)

Forces in space - vectorial representation of forces, moments and couples –resultant and equilibrium equations – concurrent forces in space (simple problems only)

Module 4

Dynamics – rectilinear translation - equations of kinematics(review)

kinetics – equation of motion – D'Alembert's principle. – motion on horizontal and inclined surfaces, motion of connected bodies. Impulse momentum equation and work energy equation (concepts only).

Curvilinear translation - equations of kinematics –projectile motion(review), kinetics – equation of motion. Moment of momentum and work energy equation (concepts only).

Module 5

Rotation – kinematics of rotation- equation of motion for a rigid body rotating about a fixed axis – rotation under a constant moment.

Plane motion of rigid body – instantaneous centre of rotation (concept only).

Simple harmonic motion – free vibration –degree of freedom- undamped free vibration of spring mass system-effect of damping(concept only)

Text Books

1. Timoshenko and Young, Engineering Mechanics, McGraw Hill Publishers
2. Shames, I. H., Engineering Mechanics - Statics and Dynamics, Prentice Hall of India.
3. R. C. Hibbeler and Ashok Gupta, Engineering Mechanics, Vol. I statics, Vol II Dynamics, Pearson Education.

References

1. Merriam J. L and Kraige L. G., Engineering Mechanics - Vols. 1 and 2, John Wiley.
2. Tayal A K, Engineering Mechanics – Statics and Dynamics, Umesh Publications
3. Bhavikkatti, S.S., Engineering Mechanics, New Age International Publishers
4. F.P.Beer and E.R.Johnston (2011), Vector Mechanics for Engineers, Vol.I-Statics, Vol.II-Dynamics, 9th Ed, Tata McGraw Hill
5. Rajasekaran S and Sankarasubramanian G, Engineering Mechanics - Statics and Dynamics, Vikas Publishing House Pvt Ltd.

Course Contents and Lecture Schedule:

Module	Topic	Course outcomes addressed	No. of Hours
1	Module 1		Total: 7
1.1	Introduction to engineering mechanics – introduction on statics and dynamics - Basic principles of statics – Parellogram law, equilibrium law – Superposition and transmissibility, law of action and reaction (review the topics)	CO1 and CO2	1
1.2	Free body diagrams. Degree of freedom-types of supports and nature of reactions - exercises for free body diagram preparation – composition and resolution of forces, resultant and equilibrium equations (review the topics) - numerical exercises for illustration.	CO1 and CO2	1
1.3	Concurrent coplanar forces - analysis of concurrent forces -methods of projections – illustrative numerical exercise – teacher assisted problem solving.	CO1 and CO2	1
1.4	Analysis of concurrent forces -methods of moment-Varignon's Theorem of Moments - illustrative numerical exercise– teacher assisted problem solving.	CO1 and CO2	1
1.5	Analysis of concurrent force systems – extended problem solving - Session I.	CO3,CO4 and CO5	1
1.6	Analysis of concurrent force systems – extended problem solving - Session II – learning review quiz.	CO3,CO4 and CO5	1
1.7	Analysis of concurrent force systems – extended problem solving - Session III.	CO3,CO4 and CO5	1
2	Module 2		Total: 7
2.1	Friction – sliding friction - Coulomb's laws of friction – analysis of single bodies –illustrative examples on wedges and ladder-teacher	CO1 and CO2	1

	assisted problem solving tutorials using problems from wedges and ladder.		
2.2	Problems on friction - analysis of connected bodies. illustrative numerical exercise– teacher assisted problem solving.	CO3, CO4 and CO5	1
2.3	Problems on friction-extended problem solving	CO3,CO4 and CO5	1
2.4	Parallel coplanar forces – couple - resultant of parallel forces – centre of parallel forces – equilibrium of parallel forces – Simple beam subject to concentrated vertical loads.	CO1 and CO2	1
2.5	General coplanar force system - resultant and equilibrium equations - illustrative examples- teacher assisted problem solving.	CO1 and CO2	1
2.6	General coplanar force system-resultant and equilibrium equations - illustrative examples	CO3, CO4 and CO5	1
2.7	General coplanar force system - Extended problem solving - Quiz to evaluate learning level.	CO3, CO4 and CO5	1
3	Module 3		Total: 7
3.1	Centroid of simple and regular geometrical shapes – centroid of figures in combination - composite areas- examples for illustration – problems for practice to be done by self.	CO1 and CO2	1
3.2	Moment of inertia- parallel axis theorem –examples for illustration - problems for practice to be done by self.	CO1 and CO2	1
3.3	Moment of inertia - perpendicular axis theorem - example for illustration to be given as hand out and discussion on the solved example.	CO1 and CO2	1
3.4	Solutions to practice problems – problems related to centroid and moment of inertia - problems for practice to be done by self.	CO3, CO4 and CO5	1
3.5	Polar moment of inertia, Radius of gyration. Mass moment of inertia of ring, cylinder and uniform disc. Theorem of Pappus Guldinus - Demonstration	CO1 and CO2	1
3.6	Introduction to forces in space – vectorial representation of forces, moments and couples – simple problems to illustrate vector representations of forces, moments and couples to be done in class.	CO1,and CO2	1
3.7	Solution to practice problems - resultant and equilibrium equations for concurrent forces in space – concurrent forces in space - 2 simple problems to illustrate the application of resultant and equilibrium equations for concurrent forces in space.	CO3,CO4 and CO5	1
4	Module 4		Total: 7

4.1	Introduction to dynamics – review of rectilinear translation - equations of kinematics – problems to review the concepts – additional problems involving extended application as exercises .	CO1 and CO2	1
4.2	Solutions to exercises with necessary explanation given as hand out – introduction to kinetics – equation of motion – D’Alembert’s principle – illustration of the concepts using one numerical exercise from motion on horizontal and inclined surfaces.	CO1 and CO2	1
4.3	Motion of connected bodies - example for illustration to be given as hand out and discussion on the solved example – problems for practice to be done by self.	CO3, CO4 and CO5	1
4.4	Motion of connected bodies-extended problem solving.	CO3, CO4 & CO5	1
4.5	Curvilinear translation - Review of kinematics –projectile motion – simple problems to review the concepts – introduction to kinetics – equation of motion – illustration of the concepts using numerical exercises.	CO3, CO4 & CO5	1
4.6	Extended problem solving – rectilinear and curvilinear translation.	CO3, CO4 & CO5	1
4.7	Concepts on Impulse momentum equation and work energy equation (rectilinear translation – discussions to bring out difference between elastic and inelastic collisions). Concepts on Moment of momentum and work energy equation (curvilinear translation).	CO1 and CO2	1
5	Module 5		Total: 7
5.1	Rotation – kinematics of rotation- equation of motion for a rigid body rotating about a fixed axis – simple problems for illustration.	CO1 and CO2	1
5.2	Rotation under a constant moment – teacher assisted problem solving.	CO3,CO4 and CO5	1
5.3	Rotation under a constant moment - extended problem solving.	CO3, CO4 and CO5	1
5.4	Plane motion of rigid body- instantaneous centre of rotation (concept only).	CO1 and CO2	1
5.5	Introduction to harmonic oscillation –free vibrations - simple harmonic motion – differential equation and solution. Degree of freedom – examples of single degree of freedom (SDOF) systems – Idealisation of mechanical systems as spring-mass systems (concept only).	CO1 and CO2	1

5.6	SDOF spring mass system –equation of motion – undamped free vibration response - concept of natural frequency. Free vibration response due to initial conditions. Simple problems on determination of natural frequency and free vibration response to test the understanding level.	CO1 and CO2	1
5.7	Free vibration analysis of SDOF spring-mass systems – Problem solving Effect of damping on free vibration response (concept only).	CO1and CO2	1



EST 110	ENGINEERING GRAPHICS	CATEGORY	L	T	P	CREDIT	Year of Introduction
		ESC	2	0	2	3	2019

Preamble: To enable the student to effectively perform technical communication through graphical representation as per global standards.

Prerequisite: NIL

Course Outcomes: After the completion of the course the student will be able to

CO 1	Draw the projection of points and lines located in different quadrants
CO 2	Prepare multiview orthographic projections of objects by visualizing them in different positions
CO 3	Draw sectional views and develop surfaces of a given object
CO 4	Prepare pictorial drawings using the principles of isometric and perspective projections to visualize objects in three dimensions.
CO 5	Convert 3D views to orthographic views
CO 6	Obtain multiview projections and solid models of objects using CAD tools

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3											
CO 2	3											
CO 3	3	1										
CO 4	3									1		
CO 5	3									2		
CO 6	3				3					3		

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination (100 Marks)
	Test 1 (15 Marks)	Test 2 (15 Marks)	
Remember			
Understand	5		20
Apply	10	10	80
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE (Marks)	ESE (Marks)	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks

CIA for section A carries 25 marks (15 marks for 1 test and Class work 10 marks)

CIA for section B carries 15 marks (10 marks for 1 test and Class work 5 marks)

End Semester Examination Pattern:

ESE will be of 3 hour duration on A4 size answer booklet and will be for 100 marks. The question paper shall contain two questions from each module of Section A only. Student has to answer any one question from each module. Each question carries 20 marks.

Course Level Assessment Questions

(Questions may be framed based on the outline given under each course outcome)

Course Outcome 1 (CO1):

1. Locate points in different quadrants as per given conditions.
2. Problems on lines inclined to both planes .
3. Find True length, Inclinations and Traces of lines.

Course Outcome 2 (CO2)

1. Draw orthographic views of solids and combination solids
2. Draw views of solids inclined to any one reference plane.
3. Draw views of solids inclined to both reference planes.

Course Outcome 3 (CO3):

1. Draw views of solids sectioned by a cutting plane
2. Find location and inclination of cutting plane given true shape of the section
3. Draw development of lateral surface of solids and also its sectioned views

Course Outcome 4 (CO4):

1. Draw Isometric views/projections of solids
2. Draw Isometric views/projections of combination of solids
3. Draw Perspective views of Solids

Course Outcome 5 (CO5):

1. Draw Orthographic views of solids from given three dimensional view

Course Outcome 6 (CO6):

1. Draw the given figure including dimensions using 2D software
2. Create 3D model using modelling software from the given orthographic views or 3D figure or from real 3D objects

Model Question paper

QP CODE:

PAGES:3

Reg No:_____

Name : _____

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY FIRST SEMESTER B.TECH DEGREE EXAMINATION,
MONTH & YEAR**

Course Code: EST 110

ENGINEERING GRAPHICS

Max.Marks:100

Duration: 3 Hours

PART A

Answer all Questions. Each question carries 3 Marks

Instructions: Retain necessary Construction lines

Show necessary dimensions

Answer any ONE question from each module

Each question carries 20 marks

MODULE I

1. The end point A of a line is 20mm above HP and 10mm in front of VP. The other end of the line is 50mm above HP and 15mm behind VP. The distance between the end projectors is 70mm. Draw the projections of the line. Find the true length and true inclinations of the line with the principal planes. Also locate the traces of the line.
2. One end of a line is 20mm from both the principal planes of projection. The other end of the line is 50mm above HP and 40mm in front of VP. The true length of the line is 70mm. Draw the projections of the line. Find its apparent inclinations, elevation length and plan length. Also locate its traces.

MODULE II

3. A pentagonal pyramid of base side 25mm and height 40mm, is resting on the ground on one of its triangular faces. The base edge of that face is inclined 30° to VP. Draw the projections of the solid.

4. A hexagonal prism has side 25mm and height 50mm has a corner of its base on the ground and the long edge containing that corner inclined at 30° to HP and 45° to VP. Draw the projections of the solid.

MODULE III

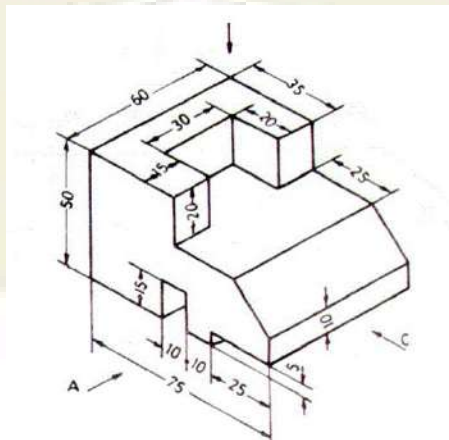
5. A triangular prism of base side 40mm and height 70mm is resting with its base on the ground and having an edge of the base perpendicular to VP. Section the solid such that the true shape of the section is a trapezium of parallel sides 30mm and 10mm. Draw the projections showing the true shape. Find the inclination of the cutting plane with the ground plane.
6. Draw the development of a pentagonal pyramid of base side 30mm and height 50mm. A string is wound from a corner of the base round the pyramid and back to the same point through the shortest distance. Show the position of the string in the elevation and plan.

MODULE IV

7. The frustum of a cone has base diameter 50mm and top diameter 40mm has a height of 60mm. It is placed centrally on top of a rectangular slab of size 80x60mm and of thickness 20mm. Draw the isometric view of the combination.
8. A hexagonal prism has base side 35mm and height 60mm. A sphere of diameter 40mm is placed centrally on top of it. Draw the isometric projection of the combination.

MODULE V

9. Draw the perspective view of a pentagonal prism, 20mm side and 45mm long lying on one of its rectangular faces on the ground and having its axis perpendicular to picture plane. One of its pentagonal faces touches the picture plane and the station point is 50mm in front of PP, 25mm above the ground plane and lies in a central plane, which is 70mm to the left of the center of the prism.
10. Draw three orthographic views with dimensions of the object shown in figure below.



(20X5=100)

SCHEME OF VALUATION

1. Locating the points and drawing the projections of the line – 4 marks
Finding true length by any one method – 6 marks
Finding true inclination with VP – 2 marks
Finding true inclination with HP – 2 marks
Locating horizontal trace – 2 marks
Locating vertical trace – 2 marks
Dimensioning and neatness – 2 marks

Total = 20 marks

2. Locating the points and drawing true length of the line – 4 marks
Finding projections by any method – 6 marks
Finding length of elevation and plan – 2 marks
Finding apparent inclinations – 2 marks
Locating horizontal trace – 2 marks
Locating vertical trace – 2 marks
Dimensioning and neatness – 2 marks

Total = 20 marks

3. Drawing initial position plan and elevation – 4 marks
First inclination views – 4 marks
Second inclination views -8 marks
Marking invisible edges – 2 marks
Dimensioning and neatness – 2 marks

Total = 20 marks

*(Any one method or combination of methods for solving can be used.**If initial position is wrong then maximum 50% marks may be allotted for the answer)*

4. Drawing initial position plan and elevation – 4 marks
First inclination views – 4 marks
Second inclination views -8 marks
Marking invisible edges – 2 marks
Dimensioning and neatness – 2 marks

Total = 20 marks

*(Any one method or combination of methods for solving can be used**If initial position is wrong then maximum 50% marks may be allotted for the answer)*

5. Drawing initial position plan and elevation – 4 marks
Locating section plane as per given condition – 5 marks
Drawing true shape -5 marks
Finding inclination of cutting plane – 2 marks
Dimensioning and neatness – 2 marks

Total = 20 marks

6. Drawing initial position plan and elevation – 4 marks
Development of the pyramid – 6 marks

Locating string in development -2 marks
Locating string in elevation – 3 marks
Locating string in plan – 3 marks
Dimensioning and neatness – 2 marks

Total = 20 marks

7. Drawing initial positions – 4 marks
Isometric View of Slab -6 marks
Isometric View of Frustum – 10 marks
Dimensioning and neatness – 2 marks

Total = 20 marks

*(Initial position is optional, hence redistribute if needed.
Reduce 4 marks if Isometric scale is taken)*

8. Drawing initial positions – 4 marks
Isometric scale – 4 marks
Isometric projection of prism -5 marks
Isometric projection of sphere – 5 marks
Dimensioning and neatness – 2 marks

Total = 20 marks

(Initial position is optional, hence redistribute if needed.

9. Drawing the planes and locating the station point – 4 marks
Locating elevation points – 2 marks
Locating plan points – 2 marks
Drawing the perspective view – 10 marks
Dimensioning and neatness – 2 marks

Total = 20 marks

10. Drawing the elevation – 8marks
Drawing the plan – 4 marks
Drawing the side view – 4 marks
Marking invisible edges – 2 marks
Dimensioning and neatness – 2 marks

Total = 20 marks

SYLLABUS

General Instructions:

- First angle projection to be followed
- Section A practice problems to be performed on A4 size sheets
- Section B classes to be conducted on CAD lab

SECTION A

Module 1

Introduction : Relevance of technical drawing in engineering field. Types of lines, Dimensioning, BIS code of practice for technical drawing.

Orthographic projection of Points and Lines: Projection of points in different quadrants, Projection of straight lines inclined to one plane and inclined to both planes. Trace of line. Inclination of lines with reference planes True length of line inclined to both the reference planes.

Module 2

Orthographic projection of Solids: Projection of Simple solids such as Triangular, Rectangle, Square, Pentagonal and Hexagonal Prisms, Pyramids, Cone and Cylinder. Projection of solids in simple position including profile view. Projection of solids with axis inclined to one of the reference planes and with axis inclined to both reference planes.

Module 3

Sections of Solids: Sections of Prisms, Pyramids, Cone, Cylinder with axis in vertical position and cut by different section planes. True shape of the sections. Also locating the section plane when the true shape of the section is given.

Development of Surfaces: Development of surfaces of the above solids and solids cut by different section planes. Also finding the shortest distance between two points on the surface.

Module 4

Isometric Projection: Isometric View and Projections of Prisms, Pyramids, Cone , Cylinder, Frustum of Pyramid, Frustum of Cone, Sphere, Hemisphere and their combinations.

Module 5

Perspective Projection: Perspective projection of Prisms and Pyramids with axis perpendicular to the ground plane, axis perpendicular to picture plane.

Conversion of Pictorial Views: Conversion of pictorial views into orthographic views.

SECTION B

(To be conducted in CAD Lab)

Introduction to Computer Aided Drawing: Role of CAD in design and development of new products, Advantages of CAD. Creating two dimensional drawing with dimensions using suitable software. (Minimum 2 exercises mandatory)

Introduction to Solid Modelling: Creating 3D models of various components using suitable modelling software. (Minimum 2 exercises mandatory)

Text Books

1. Bhatt, N.D., Engineering Drawing, Charotar Publishing House Pvt. Ltd.
2. John, K.C. Engineering Graphics, Prentice Hall India Publishers.

Reference Books

1. Anilkumar, K.N., Engineering Graphics, Adhyuth narayan Publishers
2. Agrawal, B. And Agrawal, C.M., Engineering Drawing, Tata McGraw Hill Publishers.
3. Benjamin, J., Engineering Graphics, Pentex Publishers- 3rd Edition, 2017
4. Duff, J.M. and Ross, W.A., Engineering Design and Visualisation, Cengage Learning.
5. Kulkarni, D.M., Rastogi, A.P. and Sarkar, A.K., Engineering Graphics with AutoCAD, PHI.
6. Luzaddff, W.J. and Duff, J.M., Fundamentals of Engineering Drawing, PHI.
7. Varghese, P.I., Engineering Graphics, V I P Publishers
8. Venugopal, K., Engineering Drawing and Graphics, New Age International Publishers.

Course Contents and Lecture Schedule

No	SECTION A	No. of Hours
1	MODULE I	
1.1	Introduction to graphics, types of lines, Dimensioning	1
1.2	Concept of principle planes of projection, different quadrants, locating points on different quadrants	2
1.3	Projection of lines, inclined to one plane. Lines inclined to both planes, trapezoid method of solving problems on lines.	2
1.4	Problems on lines using trapezoid method	2
1.5	Line rotation method of solving, problems on line rotation method	2
2	MODULE II	
2.1	Introduction of different solids, Simple position plan and elevation of solids	2
2.2	Problems on views of solids inclined to one plane	2
2.3	Problems on views of solids inclined to both planes	2
2.4	Practice problems on solids inclined to both planes	2

3	MODULE III	
3.1	Introduction to section planes. AIP and AVP. Principle of locating cutting points and finding true shape	2
3.2	Problems on sections of different solids	2
3.3	Problems when the true shape is given	2
3.4	Principle of development of solids, sectioned solids	2
4	MODULE IV	
4.1	Principle of Isometric View and Projection, Isometric Scale. Problems on simple solids	2
4.2	Isometric problems on Frustum of solids, Sphere and Hemisphere	2
4.3	Problems on combination of different solids	2
5	MODULE V	
5.1	Introduction to perspective projection, different planes, station point etc. Perspective problems on pyramids	2
5.2	Perspective problems on prisms	2
5.3	Practice on conversion of pictorial views into orthographic views	2
	SECTION B (To be conducted in CAD lab)	
1	Introduction to CAD and software. Familiarising features of 2D software. Practice on making 2D drawings	2
2	Practice session on 2D drafting	2
3	Introduction to solid modelling and software	2
4	Practice session on 3D modelling	2

EST 120	BASICS OF CIVIL & MECHANICAL ENGINEERING	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		ESC	4	0	0	4	2019

Preamble:

Objective of this course is to provide an insight and inculcate the essentials of Civil Engineering discipline to the students of all branches of Engineering and to provide the students an illustration of the significance of the Civil Engineering Profession in satisfying the societal needs.

To introduce the students to the basic principles of mechanical engineering

Prerequisite: NIL

Course Outcomes: After completion of the course, the student will be able to

CO 1	Recall the role of civil engineer in society and to relate the various disciplines of Civil Engineering.
CO 2	Explain different types of buildings, building components, building materials and building construction
CO 3	Describe the importance, objectives and principles of surveying.
CO 4	Summarise the basic infrastructure services MEP, HVAC, elevators, escalators and ramps
CO 5	Discuss the Materials, energy systems, water management and environment for green buildings.
CO 6	Analyse thermodynamic cycles and calculate its efficiency
CO 7	Illustrate the working and features of IC Engines
CO 8	Explain the basic principles of Refrigeration and Air Conditioning
CO 9	Describe the working of hydraulic machines
CO 10	Explain the working of power transmission elements
CO 11	Describe the basic manufacturing, metal joining and machining processes

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	-	-	-	-	3	2	2	-	-	-	-
CO2	3	2	-	1	3	-	-	3	-	-	-	-
CO3	3	2	-	-	3	-	-	-	2	-	-	-

CO4	3	2	-	-	3	-	-	-	2	-	-	-
CO5	3	2	-	-	3	2	3	-	2	-	-	-
CO6	3	2										
CO7	3	1										
CO8	3	1										
CO9	3	2										
CO10	3	1										
CO11	3											

Assessment Pattern

	Basic Civil Engineering			Basic Mechanical Engineering		
Bloom's Category	Continuous Assessment		End Semester Examination (marks)	Continuous Assessment		End Semester Examination (marks)
	Test 1 marks	Test 2 marks		Test 1 marks	Test 2 marks	
Remember	5	5	10	7.5	7.5	15
Understand	20	20	40	12.5	12.5	25
Apply				5	5	10
Analyse						
Evaluate						
Create						

Mark distribution

Total Marks	CIE (Marks)	ESE (Marks)	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25 marks
Assignment/Quiz/Course project	: 15 marks

End Semester Examination Pattern:

There will be two parts; Part I – Basic Civil Engineering and Part II – Basic Mechanical Engineering. Part I and PART II carries 50 marks each. For the end semester examination, part I contain 2 parts -

Part A and Part B. Part A contain 5 questions carrying 4 marks each (not exceeding 2 questions from each module). Part B contains 2 questions from each module out of which one to be answered. Each question carries 10 mark and can have maximum 2 sub-divisions. The pattern for end semester examination for part II is same as that of part I. **However, student should answer both part I and part 2 in separate answer booklets.**

Course Level Assessment Questions:

Course Outcome CO1: *To recall the role of civil engineer in society and to relate the various disciplines of Civil Engineering.*

1. Explain relevance of Civil engineering in the overall infrastructural development of the country.

Course outcome 2 (CO2) (One question from each module and not more than two)

Explain different types of buildings, building components, building materials and building construction

1. Discuss the difference between plinth area and carpet area.

Course outcome 3 (CO3) (One question from each module and not more than two)

Describe the importance, objectives and principles of surveying.

1. Explain the importance of surveying in Civil Engineering

Course outcome 4 (CO4) (One question from each module and not more than two)

Summarise the basic infrastructure services MEP, HVAC, elevators, escalators and ramps

1. Explain the civil engineering aspects of elevators, escalators and ramps in buildings

Course outcome 5 (CO5) (One question from each module and not more than two)

Discuss the Materials, energy systems, water management and environment for green buildings.

1. Discuss the relevance of Green building in society

Section II *Answer any 1 full question from each module. Each full question carries 10 marks*

Course Outcome 1 (CO1) (Two full question from each module and each question can have maximum 2 sub-divisions)

To recall the role of civil engineer in society and to relate the various disciplines of Civil Engineering

CO Questions

1. **a** List out the types of building as per occupancy. Explain any two, each in about five sentences.

b. Discuss the components of a building with a neat figure.

2. **a.** What are the major disciplines of civil engineering and explain their role in the infrastructural framework.

b. Explain the role of NBC, KBR & CRZ norms in building rules and regulations prevailing in our country.

Course Outcome 2 (CO2) & Course Outcome 3 (CO3) (Two full question from each module and each question can have maximum 2 sub-divisions)

Explain different types of buildings, building components, building materials and building construction & Describe the importance, objectives and principles of surveying.

CO Questions

1. a. What are the different kinds of cement available and what is their use.
b. List the properties of good building bricks. Explain any five.
2. a. List and explain any five modern construction materials used for construction.
b. Explain the objectives and principles of surveying

Course outcome 4 (CO4) & Course outcome 5 (CO5) (Two full question from each module and each question can have maximum 2 sub-divisions)

Summarise the basic infrastructure services MEP, HVAC, elevators, escalators and ramps & Discuss the Materials, energy systems, water management and environment for green buildings.

CO Questions

1. a. Draw the elevation and plan of one brick thick wall with English bond
b. Explain the energy systems and water management in Green buildings
2. a. Draw neat sketch of the following foundations: (i) Isolated stepped footing;
(ii) Cantilever footing; and (iii) Continuous footing.

b. Discuss the civil engineering aspect of MEP and HVAC in a commercial building

Course Outcome 6 (CO6):

1. In an air standard Otto cycle the compression ratio is 7 and compression begins at 35°C, 0.1 MPa. The maximum temperature of the cycle is 1100°C. Find
 - i) Heat supplied per kg of air,
 - ii) Work done per kg of air,
 - iii) Cycle efficiencyTake $C_p = 1.005 \text{ kJ/kgK}$ and $C_v = 0.718 \text{ kJ/kgK}$
2. A Carnot cycle works with adiabatic compression ratio of 5 and isothermal expansion ratio of 2. The volume of air at the beginning of isothermal expansion is 0.3 m^3 . If the maximum temperature and pressure is limited to 550K and 21 bar, determine the minimum temperature in the cycle and efficiency of the cycle.
3. In an ideal diesel cycle, the temperature at the beginning and end of compression is 65°C and 620°C respectively. The temperature at the beginning and end of the expansion is 1850°C and 850°C. Determine the ideal efficiency of the cycle.

4. Explain the concepts of CRDI and MPFI in IC Engines.

Course Outcome 7 (CO7)

1. With the help of a neat sketch explain the working of a 4 stroke SI engine
2. Compare the working of 2 stroke and 4 stroke IC engines
3. Explain the classification of IC Engines.

Course Outcome 8(CO8):

1. Explain the working of vapour compression refrigeration system.
2. With the help of suitable sketch explain the working of a split air conditioner.
3. Define: COP, specific humidity, relative humidity and dew point temperature.

Course Outcome 9 (CO9):

1. Explain the working of a single stage centrifugal pump with sketches.
2. With the help of a neat sketch, explain the working of a reciprocating pump.
3. A turbine is to operate under a head of 25 m at 200 rpm. The discharge is $9 \text{ m}^3/\text{s}$. If the overall efficiency of the turbine is 90%. Determine the power developed by the turbine.

Course Outcome 10 (CO10):

1. Explain the working of belt drive and gear drive with the help of neat sketches
2. Explain a single plate clutch.
3. Sketch different types of gear trains and explain.

Course Outcome 11 (CO11):

1. Describe the operations which can be performed using drilling machine.
2. Explain the functions of runners and risers used in casting.
3. With a neat sketch, explain the working and parts of a lathe.

Model Question Paper

QP CODE: EST120

page:3

Reg No: _____

Name: _____

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY FIRST SEMESTER B.TECH DEGREE EXAMINATION,
MONTH & YEAR**

Course Code: EST 120

Course Name: BASICS OF CIVIL AND MECHANICAL ENGINEERING

Max. Marks: 100

Duration: 3 hours

Answer both part I and part 2 in separate answer booklets

PART I: BASIC CIVIL ENGINEERING

PART A

(Answer all questions. Each question carries 4 marks)

1. Explain relevance of Civil engineering in the overall infrastructural development of the country.
2. Discuss the difference between plinth area and carpet area.
3. Explain different types of steel with their properties.
4. What are the different kinds of cement available and what is their use?
5. Define bearing capacity of soil.

(5 x 4 = 20)

Part B

Answer one full question from each module.

MODULE I

- 6a. List out the types of building as per occupancy. Explain any two, each in about five sentences. (5)
- b. Discuss the components of a building with a neat figure. (5)

OR

- 7a. What are the major disciplines of civil engineering and explain their role in the infrastructural framework. (5)
- b. Explain the role of NBC, KBR & CRZ norms in building rules and regulations prevailing in our country. (5)

MODULE II

- 8a. What are the different kinds of cement available and what is their use. (5)
- b. List the properties of good building bricks. Explain any five. (5)

OR

- 9a. List and explain any five modern construction materials used for construction. (5)
- b. Explain the objectives and principles of surveying (5)

MODULE III

- 10a. Draw the elevation and plan of one brick thick wall with English bond (5)
- b. Explain the energy systems and water management in Green buildings (5)

OR

- 11a. Draw neat sketch of the following foundations: (i) Isolated stepped footing; (ii) Cantilever footing; and (iii) Continuous footing. (5)
- b. Discuss the civil engineering aspect of MEP and HVAC in a commercial building (5)

[10 x 3 = 30]

PART II: BASIC MECHANICAL ENGINEERING

PART A

Answer all questions. Each question carries 4 marks

1. Sketch the P-v and T-s diagram of a Carnot cycle and List the processes.
2. Illustrate the working of an epicyclic gear train.
3. Explain cooling and dehumidification processes.
4. Differentiate between soldering and brazing.
5. Explain the principle of Additive manufacturing.

4 x 5 = 20 marks

Part B

Answer one full question from each module.

MODULE I

6. In an air standard Otto cycle the compression ratio is 7 and compression begins at 35°C, 0.1MPa. The maximum temperature of the cycle is 1100°C. Find
 - i) Heat supplied per kg of air,
 - ii) Work done per kg of air,
 - iii) Cycle efficiency

Take $C_p = 1.005 \text{ kJ/kgK}$ and $C_v = 0.718 \text{ kJ/kgK}$

10 marks

OR

7. a) Explain the working of a 4 stroke SI engine with neat sketches.
b) Explain the fuel system of a petrol engine.

7 marks

3 marks

MODULE II

8. a) Explain the working of a vapour compression system with help of a block diagram.
b) Define: Specific humidity, relative humidity and dew point temperature.

7 marks

3 marks

OR

9. With the help of a neat sketch, explain the working of a centrifugal pump.

10 marks

MODULE III

10. Explain the two high, three high, four high and cluster rolling mills with neat sketches.

10 marks

OR

11. a) Describe the arc welding process with a neat sketch.
b) Differentiate between up-milling and down-milling operations.

6 marks

4 marks

SYLLABUS

Module 1

General Introduction to Civil Engineering: Relevance of Civil Engineering in the overall infrastructural development of the country. Responsibility of an engineer in ensuring the safety of built environment. Brief introduction to major disciplines of Civil Engineering like Transportation Engineering, Structural Engineering, Geo-technical Engineering, Water Resources Engineering and Environmental Engineering.

Introduction to buildings: Types of buildings, selection of site for buildings, components of a residential building and their functions.

Building rules and regulations: Relevance of NBC, KBR & CRZ norms (brief discussion only).

Building area: Plinth area, built up area, floor area, carpet area and floor area ratio for a building as per KBR.

Module 2

Surveying: Importance, objectives and principles.

Construction materials, Conventional construction materials: types, properties and uses of building materials: bricks, stones, cement, sand and timber

Cement concrete: Constituent materials, properties and types.

Steel: Steel sections and steel reinforcements, types and uses.

Modern construction materials:- Architectural glass, ceramics, Plastics, composite materials, thermal and acoustic insulating materials, decorative panels, waterproofing materials. Modern uses of gypsum, pre-fabricated building components (brief discussion only).

Module 3

Building Construction: Foundations: Bearing capacity of soil (definition only), functions of foundations, types – shallow and deep (brief discussion only). Load bearing and framed structures (concept only).

Brick masonry: - Header and stretcher bond, English bond & Flemish bond random rubble masonry.

Roofs and floors: - Functions, types; flooring materials (brief discussion only).

Basic infrastructure services: MEP, HVAC, elevators, escalators and ramps (Civil Engineering aspects only), fire safety for buildings.

Green buildings:- Materials, energy systems, water management and environment for green buildings. (brief discussion only).

Module 4

Analysis of thermodynamic cycles: Carnot, Otto, Diesel cycles, Derivation of efficiency of these cycles, Problems to calculate heat added, heat rejected, net work and efficiency. IC Engines: CI, SI, 2-Stroke, 4-Stroke engines. Listing the parts of different types of IC Engines. Efficiencies of IC Engines(Definitions only), Air, Fuel, cooling and lubricating systems in SI and CI Engines, CRDI, MPFI. Concept of hybrid engines.

Module 5

Refrigeration: Unit of refrigeration, reversed Carnot cycle, COP, vapour compression cycle (only description and no problems); Definitions of dry, wet & dew point temperatures, specific humidity and relative humidity, Cooling and dehumidification, Layout of unit and central air conditioners.

Description about working with sketches of: Reciprocating pump, Centrifugal pump, Pelton turbine, Francis turbine and Kaplan turbine. Overall efficiency, Problems on calculation of input and output power of pumps and turbines (No velocity triangles)

Description about working with sketches of: Belt and Chain drives, Gear and Gear trains, Single plate clutches.

Module 6

Manufacturing Process: Basic description of the manufacturing processes – Sand Casting, Forging, Rolling, Extrusion and their applications.

Metal Joining Processes: List types of welding, Description with sketches of Arc Welding, Soldering and Brazing and their applications

Basic Machining operations: Turning, Drilling, Milling and Grinding.

Description about working with block diagram of: Lathe, Drilling machine, Milling machine, CNC Machine. Principle of CAD/CAM, Rapid and Additive manufacturing.

Text Books:

1. Rangwala, S. C., Essentials of Civil Engineering, Charotar Publishing House
2. McKay, W.B. and McKay, J. K., Building Construction, Volumes 1 to 4, Pearson India Education Services

References Books:

1. Chen W.F and Liew J Y R (Eds), The Civil Engineering Handbook. II Edition CRC Press (Taylor and Francis)
2. Chudley, R and Greeno R, Building construction handbook, Addison Wesley, Longman group, England
3. Chudley, R, Construction Technology, Vol. I to IV, Longman group, England Course Plan
4. Kandya A A, Elements of Civil Engineering, Charotar Publishing house
5. Mamlouk, M. S., and Zaniewski, J. P., Materials for Civil and Construction Engineering, Pearson Publishers
6. Rangwala S.C and Dalal K B Building Construction Charotar Publishing house
7. Clifford, M., Simmons, K. and Shipway, P., An Introduction to Mechanical Engineering Part I - CRC Press
8. Roy and Choudhary, Elements of Mechanical Engineering, Media Promoters & Publishers Pvt. Ltd., Mumbai.
9. Sawhney, G. S., Fundamentals of Mechanical Engineering, PHI
10. G Shanmugam, M S Palanichamy, Basic Civil and Mechanical Engineering, McGraw Hill Education; First edition, 2018
11. Benjamin, J., Basic Mechanical Engineering, Pentex Books, 9th Edition, 2018
12. Balachandran, P. Basic Mechanical Engineering, Owl Books

Course Contents and Lecture Schedule:

No	Topic	Course outcomes addressed	No. of Lectures
1	Module I		Total: 7
1.1	<i>General Introduction to Civil Engineering:</i> Relevance of Civil Engineering in the overall infrastructural development of the country. Responsibility of an engineer in ensuring the safety of built environment.	CO1	1
1.2	Brief introduction to major disciplines of Civil Engineering like Transportation Engineering, Structural Engineering, Geo-technical Engineering, Water Resources Engineering and Environmental Engineering.	CO1	2
1.3	<i>Introduction to buildings:</i> Types of buildings, selection of site for buildings, components of a residential building and their functions.	CO2	2
1.4	<i>Building rules and regulations:</i> Relevance of NBC, KBR & CRZ norms (brief discussion only)	CO2	1
1.5	<i>Building area:</i> Plinth area, built up area, floor area, carpet area and floor area ratio for a building as per KBR.	CO2	1
2	Module 2		Total: 7
2.1	<i>Surveying:</i> Importance, objectives and principles.	CO3	1
2.2	Bricks: - Classification, properties of good bricks, and tests on bricks	CO2	1
2.3	Stones: - <i>Qualities</i> of good stones, types of stones and their uses. Cement: - Good qualities of cement, types of cement and their uses.	CO2	1
2.4	Sand: - Classification, qualities of good sand and sieve analysis (basics only). Timber: - Characteristics, properties and uses.	CO2	1
2.5	Cement concrete: - Constituent materials, properties and types, Steel: - Steel sections and steel reinforcements, types and uses.	CO2	1

2.6	Modern construction materials: - Architectural glass, ceramics, plastics, composite materials, thermal and acoustic insulating materials, decorative panels, waterproofing materials, modern uses of gypsum, pre-fabricated building components (brief discussion only)	CO2	2
3	Module 3		Total: 7
3.1	Foundations: - Bearing capacity of soil (definition only), functions of foundations, types – shallow and deep (brief discussion only). Brick masonry: - Header and stretcher bond, English bond & Flemish bond– elevation and plan (one & one and a half brick wall only). Random rubble masonry.	CO2	2
3.2	Roofs: Functions, types; roofing materials (brief discussion only) Floors: Functions, types; flooring materials (brief discussion only)	CO2	2
3.3	<i>Basic infrastructure services:</i> MEP, HVAC, Elevators, escalators and ramps (Civil Engineering aspects only) fire safety for buildings	CO4	2
3.4	<i>Green buildings:-</i> Materials, energy systems, water management and environment for green buildings. (brief discussion only)	CO5	1
4	MODULE 4		
4.1	Analysis of thermodynamic cycles: Carnot, Otto, and Diesel cycle- Derivation of efficiency of these cycles, Problems to calculate heat added, heat rejected, net work and efficiency	4	
4.2	IC Engines: CI, SI, 2-Stroke, 4-Stroke engines. Listing the parts of different types of IC Engines, efficiencies of IC Engines(Description only)	2	
4.3	Air, Fuel, cooling and lubricating systems in SI and CI Engines, CRDI, MPFI. Concept of hybrid engines	2	
5	MODULE 5		
5.1	Refrigeration: Unit of refrigeration, reversed Carnot cycle, COP, vapour compression cycle (only description and no problems)	1	
5.2	Definitions of dry, wet & dew point temperatures, specific humidity and relative humidity, Cooling and dehumidification, Layout of unit and central air conditioners.	1	

5.3	Description about working with sketches : Reciprocating pump, Centrifugal pump, Pelton turbine, Francis turbine and Kaplan turbine. Overall efficiency, Problems on calculation of input and output power of pumps and turbines (No velocity triangles)	4
5.4	Description about working with sketches of: Belt and Chain drives, Gear and Gear trains, Single plate clutches	3
6	MODULE 6	
6.1	Manufacturing Process: Basic description of the manufacturing processes – Sand Casting, Forging, Rolling, Extrusion and their applications.	2
6.2	Metal Joining Processes :List types of welding, Description with sketches of Arc Welding, Soldering and Brazing, and their applications	1
6.3	Basic Machining operations: Turning, Drilling, Milling and Grinding Description about working with block diagrams of: Lathe, Drilling machine, Milling machine, CNC Machine	3
6.4	Principle of CAD/CAM, Rapid and Additive manufacturing	1

EST 130	BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		ESC	4	0	0	4	2019

Preamble:

This course aims to (1) equip the students with an understanding of the fundamental principles of electrical engineering (2) provide an overview of evolution of electronics, and introduce the working principle and examples of fundamental electronic devices and circuits (3) provide an overview of evolution of communication systems, and introduce the basic concepts in radio communication.

Prerequisite: Physics and Mathematics (Pre-university level)

Course Outcomes: After the completion of the course the student will be able to

CO 1	Apply fundamental concepts and circuit laws to solve simple DC electric circuits
CO 2	Develop and solve models of magnetic circuits
CO 3	Apply the fundamental laws of electrical engineering to solve simple ac circuits in steady state
CO 4	Describe working of a voltage amplifier
CO 5	Outline the principle of an electronic instrumentation system
CO 6	Explain the principle of radio and cellular communication

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	1	-	-	-	-	-	-	-	-	-	2
CO 2	3	1	-	-	-	-	-	-	-	-	-	2
CO 3	3	1	-	-	-	-	-	-	-	-	-	2
CO 4	2	-	-	-	-	-	-	-	-	-	-	-
CO 5	2	-	-	-	-	-	-	-	-	-	-	2
CO 6	2	-	-	-	-	-	-	-	-	-	-	2

Assessment Pattern

Bloom's Category	Basic Electrical Engineering			Basic Electronics Engineering		
	Continuous Assessment Tests		End Semester Examination (Marks)	Continuous Assessment Tests		End Semester Examination (Marks)
	Test 1 (Marks)	Test 2 (Marks)		Test 1 (Marks)	Test 2 (Marks)	
Remember	0	0	10	10	10	20
Understand	12.5	12.5	20	15	15	30
Apply	12.5	12.5	20			
Analyse						
Evaluate						
Create						

Mark distribution

Total Marks	CIE marks	ESE marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25 marks
Assignment/Quiz/Course project	: 15 marks

End Semester Examination Pattern: There will be two parts; Part I – Basic Electrical Engineering and Part II – Basic Electronics Engineering. Part I and PART II carries 50 marks each. For the end semester examination, part I contain 2 parts - Part A and Part B. Part A contain 5 questions carrying 4 marks each (not exceeding 2 questions from each module). Part B contains 2 questions from each module out of which one to be answered. Each question carries 10 mark and can have maximum 2 sub-divisions. The pattern for end semester examination for part II is same as that of part I. **However, student should answer both part I and part 2 in separate answer booklets.**

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Solve problems based on current division rule.
2. Solve problems with Mesh/node analysis.
3. Solve problems on Wye-Delta Transformation.

Course Outcome 2 (CO2):

1. Problems on series magnetic circuits
2. Problems on parallel magnetic circuits
3. Problems on composite magnetic circuits

4. Course Outcome 3 (CO3):

1. problems on self inductance, mutual inductance and coefficient of coupling
2. problems on rms and average values of periodic waveforms
3. problems on series ac circuits
4. Compare star and Delta connected 3 phase AC systems.

Course Outcome 4 (CO4): Describe working of a voltage amplifier

1. What is the need of voltage divider biasing in an RC coupled amplifier?

2. Define operating point in the context of a BJT amplifier.
3. Why is it required to have a voltage amplifier in a public address system?

Course Outcome 5 (CO5): Outline the principle of an electronic instrumentation system

1. Draw the block diagram of an electronic instrumentation system.
2. What is a transducer?
3. Explain the working principle of operation of digital multimeter.

Course Outcome 6 (CO6): Explain the principle of radio and cellular communication

1. What is the working principle of an antenna when used in a radio transmitter?
2. What is the need of two separate sections RF section and IF section in a super heterodyne receiver?
3. What is meant by a cell in a cellular communication?

Model Question Paper

QP CODE:

Pages: 3

Reg No.: _____

Name: _____

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY FIRST SEMESTER B.TECH DEGREE EXAMINATION,
MONTH & YEAR**

Course Code: EST 130

Course Name: BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING

Max. Marks: 100

Duration: 3 hours

Answer both part I and part 2 in separate answer booklets

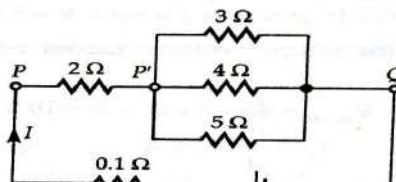
PART I

BASIC ELECTRICAL ENGINEERING

PART A

Answer all questions; each question carries 4 marks.

1. Calculate the current through the 4Ω resistor in the circuit shown, applying current division rule:



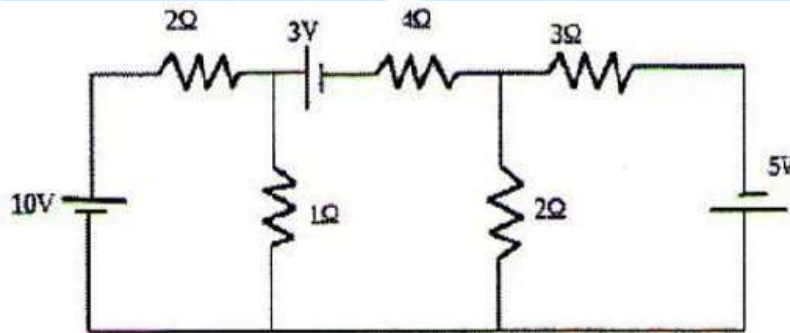
2. Calculate the RMS and average values of a purely sinusoidal current having peak value 15A.
3. An alternating voltage of $(80+j60)V$ is applied to an RX circuit and the current flowing through the circuit is $(-4+j10)A$. Calculate the impedance of the circuit in rectangular and polar forms. Also determine if X is inductive or capacitive.
4. Derive the relation between line and phase values of voltage in a three phase star connected system.
5. Compare electric and magnetic circuits. (5x4=20)

PART B

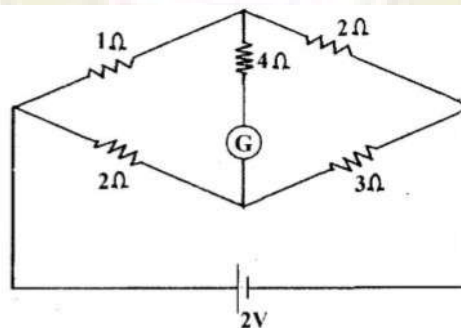
Answer one question from each module; each question carries 10 marks.

Module 1

6. . Calculate the node voltages in the circuit shown, applying node analysis:



7. (a) State and explain Kirchhoff's laws. (4 marks)
- (b) Calculate the current through the galvanometer (G) in the circuit shown:



(6 marks)

Module 2

8. (a) State and explain Faraday's laws of electromagnetic induction with examples. (4 marks)
- (b) Differentiate between statically and dynamically induced emf. A conductor of length 0.5m moves in a uniform magnetic field of flux density 1.1T at a velocity of 30m/s. Calculate the emf induced in the conductor if the direction of motion of the conductor is inclined at 60° to the direction of field. (6 marks)
9. (a) Derive the amplitude factor and form factor of a purely sinusoidal waveform. (5 marks)
- (b) A current wave is made up of two components-a 5A dc component and a 50Hz ac component, which is a sinusoidal wave with a peak value of 5A. Sketch the resultant waveform and determine its RMS and average values. (5 marks)

Module 3

10. Draw the power triangle and define active, reactive and apparent powers in ac circuits. Two coils A and B are connected in series across a 240V, 50Hz supply. The resistance of A is 5Ω and the inductance of B is 0.015H. If the input from the supply is 3kW and 2kVAR, find the inductance of A and the resistance of B. Also calculate the voltage across each coil.
11. A balanced three phase load consists of three coils each having resistance of 4Ω and inductance 0.02H. It is connected to a 415V, 50Hz, 3-phase ac supply. Determine the phase voltage, phase current, power factor and active power when the loads are connected in (i) star (ii) delta.

(3x10=30)

PART II

BASIC ELECTRONICS ENGINEERING

PART A

Answer all questions; each question carries 4 marks.

1. Give the specifications of a resistor. The colour bands marked on a resistor are Blue, Grey, Yellow and Gold. What are the minimum and maximum resistance values expected from that resistance?
2. What is meant by avalanche breakdown?
3. Explain the working of a full-wave bridge rectifier.
4. Discuss the role of coupling and bypass capacitors in a single stage RC coupled amplifier.
5. Differentiate AM and FM communication systems.

(5x4=20)

PART B

Answer one question from each module; each question carries 10 marks.

Module 4

6. a) Explain with diagram the principle of operation of an NPN transistor. (5)
b) Sketch and explain the typical input-output characteristics of a BJT when connected in common emitter configuration. (5)

OR

7. a) Explain the formation of a potential barrier in a P-N junction diode. (5)
b) What do you understand by Avalanche breakdown? Draw and explain the V-I characteristics of a P-N junction and Zener diode. (5)

Module 5

8. a) With a neat circuit diagram, explain the working of an RC coupled amplifier. (6)
b) Draw the frequency response characteristics of an RC coupled amplifier and state the reasons for the reduction of gain at lower and higher frequencies. (4)

OR

9. a) With the help of block diagram, explain how an electronic instrumentation system. (6)
b) Explain the principle of an antenna. (4)

Module 6

10. a) With the help of a block diagram, explain the working of Super hetrodyne receiver. (6)
b) Explain the importance of antenna in a communication system. (4)

OR

11. a) With neat sketches explain a cellular communication system. (5)
b) Explain GSM communication with the help of a block diagram. (5)

(3x10=30)

SYLLABUS

MODULE 1: Elementary Concepts of Electric Circuits

Elementary concepts of DC electric circuits: Basic Terminology including voltage, current, power, resistance, emf; Resistances in series and parallel; Current and Voltage Division Rules; Capacitors & Inductors: V-I relations and energy stored. Ohms Law and Kirchhoff's laws-Problems; Star-delta conversion (resistive networks only-derivation not required)-problems.

Analysis of DC electric circuits: Mesh current method - Matrix representation - Solution of network equations. Node voltage methods-matrix representation-solution of network equations by matrix methods. Numerical problems.

MODULE 2: Elementary Concepts of Magnetic circuits, Electromagnetic Induction and AC fundamentals

Magnetic Circuits: Basic Terminology: MMF, field strength, flux density, reluctance - comparison between electric and magnetic circuits- Series and parallel magnetic circuits with composite materials, numerical problems.

Electromagnetic Induction: Faraday's laws, problems, Lenz's law- statically induced and dynamically induced emfs - Self-inductance and mutual inductance, coefficient of coupling

Alternating Current fundamentals: Generation of alternating voltages-Representation of sinusoidal waveforms: frequency, period, Average, RMS values and form factor of waveforms-Numerical Problems.

MODULE 3: AC Circuits

AC Circuits: Phasor representation of sinusoidal quantities. Trigonometric, Rectangular, Polar and complex forms. Analysis of simple AC circuits: Purely resistive, inductive & capacitive circuits; Inductive and capacitive reactance, concept of impedance. Average Power Power factor. Analysis of RL, RC and RLC series circuits-active, reactive and apparent power. Simple numerical problems.

Three phase AC systems: Generation of three phase voltages; advantages of three phase systems, star and delta connections (balanced only), relation between line and phase voltages, line and phase currents- Numerical problems

MODULE 4

Introduction to Semiconductor devices: Evolution of electronics – Vacuum tubes to nano electronics. Resistors, Capacitors and Inductors (constructional features not required): types, specifications. Standard values, color coding. PN Junction diode: Principle of operation, V-I characteristics, principle of avalanche breakdown. Bipolar Junction Transistors: PNP and NPN structures, Principle of operation, relation between current gains in CE, CB and CC, input and output characteristics of common emitter configuration.

MODULE 5

Basic electronic circuits and instrumentation: Rectifiers and power supplies: Block diagram description of a dc power supply, Working of a full wave bridge rectifier, capacitor filter (no analysis), working of simple zener voltage regulator. Amplifiers: Block diagram of Public Address system, Circuit diagram and working of common emitter (RC coupled) amplifier with its frequency response, Concept of voltage divider biasing. Electronic Instrumentation: Block diagram of an electronic instrumentation system.

MODULE 6

Introduction to Communication Systems: Evolution of communication systems – Telegraphy to 5G. Radio communication: principle of AM & FM, frequency bands used for various communication systems, block diagram of super heterodyne receiver, Principle of antenna – radiation from accelerated charge. Mobile communication: basic principles of cellular communications, principle and block diagram of GSM.

Text Books

1. D P Kothari and I J Nagrath, "Basic Electrical Engineering", Tata McGraw Hill, 2010.
2. D C Kulshreshtha, "Basic Electrical Engineering", Tata McGraw Hill, 2010.
3. ChinmoySaha, Arindham Halder and Debarati Ganguly, Basic Electronics - Principles and Applications, Cambridge University Press, 2018.
4. M.S.Sukhija and T.K.Nagsarkar, Basic Electrical and Electronics Engineering, Oxford University Press, 2012.
5. Wayne Tomasi and Neil Storey, A Textbook On Basic Communication and Information Engineering, Pearson, 2010.

Reference Books

1. Del Toro V, "Electrical Engineering Fundamentals", Pearson Education.
2. T. K. Nagsarkar, M. S. Sukhija, "Basic Electrical Engineering", Oxford Higher Education.
3. Hayt W H, Kemmerly J E, and Durbin S M, "Engineering Circuit Analysis", Tata McGraw-Hill
4. Hughes, "Electrical and Electronic Technology", Pearson Education.
5. V. N. Mittle and Arvind Mittal, "Basic Electrical Engineering," Second Edition, McGraw Hill.
6. Parker and Smith, "Problems in Electrical Engineering", CBS Publishers and Distributors.
7. S. B. Lal Seksena and Kaustuv Dasgupta, "Fundamentals of Electrical Engineering", Cambridge University Press.
8. Anant Agarwal, Jeffrey Lang, Foundations of Analog and Digital Electronic Circuits, Morgan Kaufmann Publishers, 2005.
9. Bernard Grob, Basic Electronics, McGraw Hill.
10. A. Bruce Carlson, Paul B. Crilly, Communication Systems: An Introduction to Signals and Noise in Electrical Communication, Tata McGraw Hill, 5th Edition.

COURSE CONTENTS AND LECTURE SCHEDULE

No	Topic	No. of Lectures
1	<i>Elementary Concepts of Electric Circuits</i>	
1.1	Elementary concepts of DC electric circuits: Basic Terminology including voltage, current, power, resistance, emf; Resistances in series and parallel; Current and Voltage Division Rules; Capacitors & Inductors: V-I relations and energy stored. Ohms Law and Kirchhoff's laws-Problems; Star-delta conversion (resistive networks only-derivation not required)- problems.	1 2 1
1.2	Analysis of DC electric circuits: Mesh current method - Matrix representation - Solution of network equations. Node voltage methods-matrix representation-solution of network equations by matrix methods. Numerical problems.	1 1 2
2	Elementary Concepts of Magnetic circuits, Electromagnetic Induction and AC fundamentals	
2.1	Magnetic Circuits: Basic Terminology: MMF, field strength, flux density, reluctance - comparison between electric and magnetic circuits- Series and parallel magnetic circuits with composite materials, numerical problems.	1 2
2.2	Electromagnetic Induction: Faraday's laws, problems, Lenz's law- statically induced and dynamically induced emfs - Self-inductance and mutual inductance, coefficient of coupling	1 2
2.3	Alternating Current fundamentals: Generation of alternating voltages- Representation of sinusoidal waveforms: frequency, period, Average, RMS values and form factor of waveforms-Numerical Problems.	2
3	AC Circuits	

3.1	AC Circuits: Phasor representation of sinusoidal quantities. Trigonometric, Rectangular, Polar and complex forms. Analysis of simple AC circuits: Purely resistive, inductive & capacitive circuits; Inductive and capacitive reactance, concept of impedance. Average Power, Power factor. Analysis of RL, RC and RLC series circuits-active, reactive and apparent power. Simple numerical problems.	1 2 1 2
3.2	Three phase AC systems: Generation of three phase voltages; advantages of three phase systems, star and delta connections (balanced only), relation between line and phase voltages, line and phase currents- Numerical problems.	2
4	Introduction to Semiconductor devices	
4.1	Evolution of electronics – Vacuum tubes to nano electronics (In evolutionary perspective only)	1
4.2	Resistors, Capacitors and Inductors: types, specifications. Standard values, color coding (No constructional features)	2
4.3	PN Junction diode: Principle of operation, V-I characteristics, principle of avalanche breakdown	2
4.4	Bipolar Junction Transistors: PNP and NPN structures, Principle of operation, relation between current gains in CE, CB and CC, input and output characteristics of common emitter configuration	3
5	Basic electronic circuits and instrumentation	
5.1	Rectifiers and power supplies: Block diagram description of a dc power supply, Working of a full wave bridge rectifier, capacitor filter (no analysis), working of simple zener voltage regulator	3
5.2	Amplifiers: Block diagram of Public Address system, Circuit diagram and working of common emitter (RC coupled) amplifier with its frequency response, Concept of voltage divider biasing	4
5.3	Electronic Instrumentation: Block diagram of an electronic instrumentation system	2
6	Introduction to Communication Systems	
6.1	Evolution of communication systems – Telegraphy to 5G	1

6.2	Radio communication: principle of AM & FM, frequency bands used for various communication systems, block diagram of super heterodyne receiver, Principle of antenna – radiation from accelerated charge	4
6.3	Mobile communication: basic principles of cellular communications, principle and block diagram of GSM.	2

Suggested Simulation Assignments for Basic Electronics Engineering

1. Plot V-I characteristics of Si and Ge diodes on a simulator
2. Plot Input and Output characteristics of BJT on a simulator
3. Implementation of half wave and full wave rectifiers
4. Simulation of RC coupled amplifier with the design supplied
5. Generation of AM signal

Note: The simulations can be done on open tools such as QUCS, KiCad, GNURadio or similar software to augment the understanding.

HUN 101	LIFE SKILLS	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		MNC	2	0	2	---	2019

Preamble: Life skills are those competencies that provide the means for an individual to be resourceful and positive while taking on life's vicissitudes. Development of one's personality by being aware of the self, connecting with others, reflecting on the abstract and the concrete, leading and generating change, and staying rooted in time-tested values and principles is being aimed at. This course is designed to enhance the employability and maximize the potential of the students by introducing them to the principles that underly personal and professional success, and help them acquire the skills needed to apply these principles in their lives and careers.

Prerequisite: None

Course Outcomes: After the completion of the course the student will be able to

CO 1	Define and Identify different life skills required in personal and professional life
CO 2	Develop an awareness of the self and apply well-defined techniques to cope with emotions and stress.
CO 3	Explain the basic mechanics of effective communication and demonstrate these through presentations.
CO 4	Take part in group discussions
CO 5	Use appropriate thinking and problem solving techniques to solve new problems
CO 6	Understand the basics of teamwork and leadership

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1						2		1	2	2	1	3
CO 2									3			2
CO 3						1			1	3		
CO 4										3		1
CO 5		3	2	1								
CO 6						1			3			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
100	50	50	2 hours

Continuous Internal Evaluation

Total Marks: 50

Attendance	: 10 marks
Regular assessment	: 15 marks
Series test (one test only, should include first three modules)	: 25 marks

Regular assessment

➤ **Group Discussion (Marks: 9)**

Create groups of about 6 students each and engage them on a GD on a suitable topic for about 20 minutes. Parameters to be used for evaluation are as follows:

- Communication Skills : 3 marks
- Subject Clarity : 2 marks
- Group Dynamics : 2 marks
- Behaviours & Mannerisms : 2 marks

➤ **Presentation Skills (Marks: 6)**

Identify a suitable topic and ask the students to prepare a presentation (preferably a power point presentation) for about 10 minutes. Parameters to be used for evaluation are as follows:

- Communication Skills : 2 marks
- Platform Skills : 2 marks
- Subject Clarity/Knowledge : 2 marks

End Semester Examination

Total Marks: 50

Time: 2 hrs.

Part A: Short answer question (25 marks)

There will be one question from each MODULE (five questions in total, five marks each). Each question should be written in about maximum of 400 words. Parameters to be used for evaluation are as follows:

- (i) Content Clarity/Subject Knowledge
- (ii) Presentation style
- (iii) Organization of content

Part B: Case Study (25 marks)

The students will be given a case study with questions at the end. The students have to analyze the case and answer the question at the end. Parameters to be used for evaluation are as follows:

- (i) Analyze the case situation
- (ii) Key players/characters of the case
- (iii) Identification of the problem (both major & minor if exists)
- (iv) Bring out alternatives
- (v) Analyze each alternative against the problem
- (vi) Choose the best alternative
- (vii) Implement as solution
- (viii) Conclusion

(ix) Answer the question at the end of the case

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. List 'life skills' as identified by WHO
2. What do you mean by effective communication?
3. What are the essential life skills required by a professional?

Course Outcome 2 (CO2)

1. Identify an effective means to deal with workplace stress.
2. How can a student apply journaling to stress management?
3. What is the PATH method? Describe a situation where this method can be used effectively.

Course Outcome 3(CO3):

1. Identify the communication network structure that can be observed in the given situations. Describe them.
 - (a) A group discussion on development.
 - (b) An address from the Principal regarding punctuality.
 - (c) A reporter interviewing a movie star.
 - (d) Discussing the answers of a test with a group of friends.
2. Elucidate the importance of non-verbal communication in making a presentation
3. Differentiate between kinesics, proxemics, and chronemics with examples.

Course Outcome 4 (CO4):

1. How can a participant conclude a group discussion effectively?
2. 'Listening skills are essential for effectively participating in a group discussion.' Do you agree? Substantiate your answer.

Course Outcome 5 (CO5):

1. Illustrate the creative thinking process with the help of a suitable example
2. Translate the following problem from verbal to graphic form and find the solution : *In a quiz, Ananth has 50 points more than Bimal, Chinmay has 60 points less than Ananth, and Dharini is 20 points ahead of Chinmay. What is the difference in points between Bimal and Dharini?*

3. List at least five ways in which the problem "How to increase profit?" can be redefined

Course Outcome 6 (CO6):

1. A group of engineers decided to brainstorm a design issue on a new product. Since no one wanted to disagree with the senior members, new ideas were not flowing freely. What group dynamics technique would you suggest to avoid this 'groupthink'? Explain the procedure.
2. "A group focuses on individual contribution, while a team must focus on synergy." Explain.
3. Identify the type of group formed / constituted in each of the given situations
 - a) A Police Inspector with subordinates reporting to him
 - b) An enquiry committee constituted to investigate a specific incident
 - c) The Accounts Department of a company
 - d) A group of book lovers who meet to talk about reading

Syllabus

Module 1

Overview of Life Skills: Meaning and significance of life skills, Life skills identified by WHO: Self-awareness, Empathy, Critical thinking, Creative thinking, Decision making, problem solving, Effective communication, interpersonal relationship, coping with stress, coping with emotion.

Life skills for professionals: positive thinking, right attitude, attention to detail, having the big picture, learning skills, research skills, perseverance, setting goals and achieving them, helping others, leadership, motivation, self-motivation, and motivating others, personality development, IQ, EQ, and SQ

Module 2

Self-awareness: definition, need for self-awareness; Coping With Stress and Emotions, Human Values, tools and techniques of SA: questionnaires, journaling, reflective questions, meditation, mindfulness, psychometric tests, feedback.

Stress Management: Stress, reasons and effects, identifying stress, stress diaries, the four A's of stress management, techniques, Approaches: action-oriented, emotion-oriented, acceptance-oriented, resilience, Gratitude Training,

Coping with emotions: Identifying and managing emotions, harmful ways of dealing with emotions, PATH method and relaxation techniques.

Morals, Values and Ethics: Integrity, Civic Virtue, Respect for Others, Living Peacefully. Caring, Sharing, Honesty, Courage, Valuing Time, Time management, Co operation, Commitment, Empathy, Self-Confidence, Character, Spirituality, Avoiding Procrastination, Sense of Engineering Ethics.

Module 3

21st century skills: Creativity, Critical Thinking, Collaboration, Problem Solving, Decision Making, Need for Creativity in the 21st century, Imagination, Intuition, Experience, Sources of Creativity, Lateral Thinking, Myths of creativity, Critical thinking Vs Creative thinking, Functions of Left Brain & Right brain, Convergent & Divergent Thinking, Critical reading & Multiple Intelligence.

Steps in problem solving: Problem Solving Techniques, Six Thinking Hats, Mind Mapping, Forced Connections. Analytical Thinking, Numeric, symbolic, and graphic reasoning. Scientific temperament and Logical thinking.

Module 4

Group and Team Dynamics: Introduction to Groups: Composition, formation, Cycle, thinking, Clarifying expectations, Problem Solving, Consensus, Dynamics techniques, Group vs Team, Team Dynamics, Virtual Teams. Managing team performance and managing conflicts, Intrapreneurship.

Module 5

Leadership: Leadership framework, entrepreneurial and moral leadership, vision, cultural dimensions. Growing as a leader, turnaround leadership, managing diverse stakeholders, crisis management. Types of Leadership, Traits, Styles, VUCA Leadership, Levels of Leadership, Transactional vs Transformational Leaders, Leadership Grid, Effective Leaders.

Lab Activities

Verbal

Effective communication and Presentation skills.

Different kinds of communication; Flow of communication; Communication networks, Types of barriers; Miscommunication

Introduction to presentations and group discussions.

Learning styles: visual, aural, verbal, kinaesthetic, logical, social, solitary; Previewing, KWL table, active listening, REAP method

Note-taking skills: outlining, non-linear note-taking methods, Cornell notes, three column note taking.

Memory techniques: mnemonics, association, flashcards, keywords, outlines, spider diagrams and mind maps, spaced repetition.

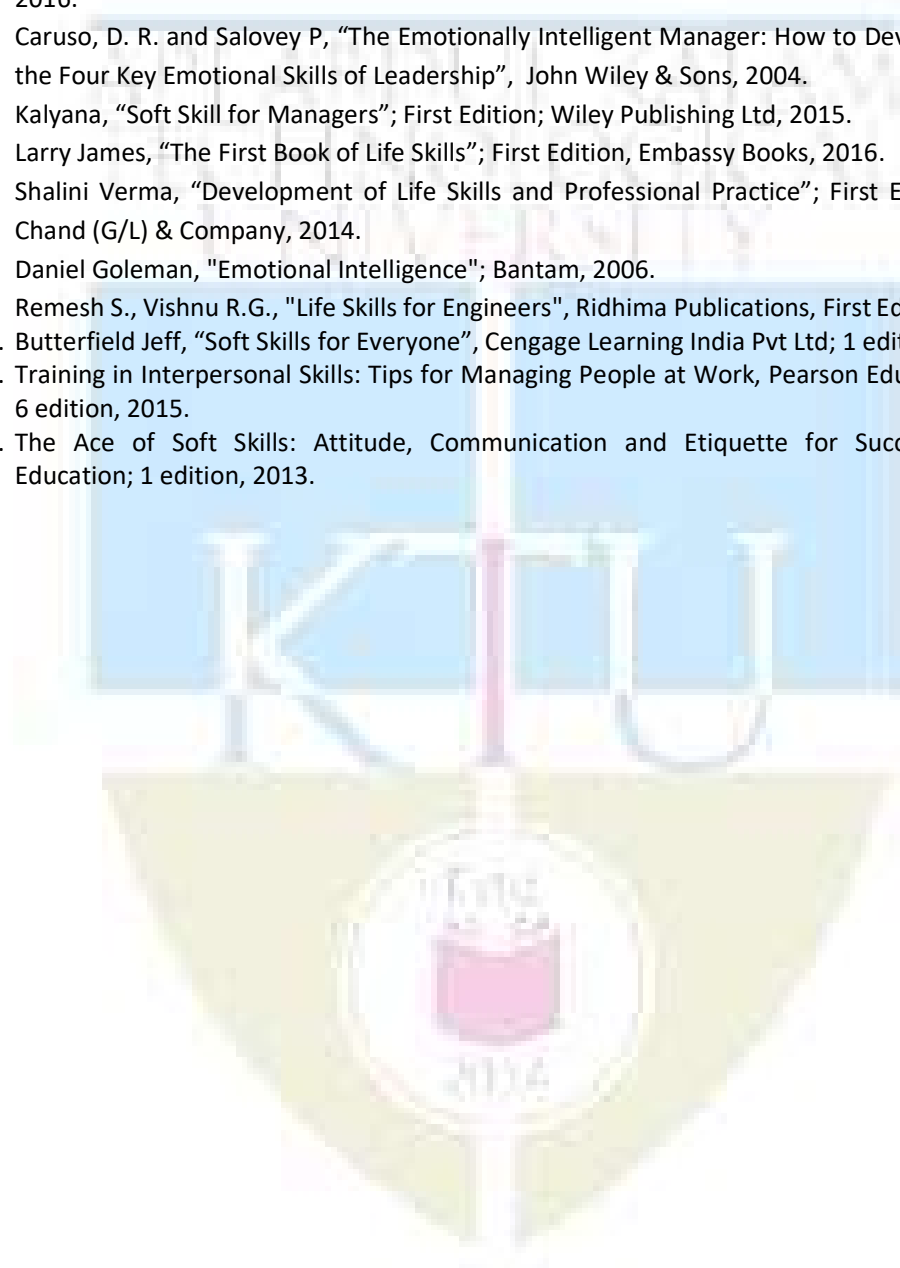
Time management: auditing, identifying time wasters, managing distractions, calendars and checklists; Prioritizing - Goal setting, SMART goals; Productivity tools and apps, Pomodoro technique.

Non Verbal:

Non-verbal Communication and Body Language: Forms of non-verbal communication; Interpreting body-language cues; Kinesics; Proxemics; Chronemics; Effective use of body language, Communication in a multi cultural environment.

Reference Books

1. Shiv Khera, You Can Win, Macmillan Books, New York, 2003.
2. Barun K. Mitra, "Personality Development & Soft Skills", Oxford Publishers, Third impression, 2017.
3. ICT Academy of Kerala, "Life Skills for Engineers", McGraw Hill Education (India) Private Ltd., 2016.
4. Caruso, D. R. and Salovey P, "The Emotionally Intelligent Manager: How to Develop and Use the Four Key Emotional Skills of Leadership", John Wiley & Sons, 2004.
5. Kalyana, "Soft Skill for Managers"; First Edition; Wiley Publishing Ltd, 2015.
6. Larry James, "The First Book of Life Skills"; First Edition, Embassy Books, 2016.
7. Shalini Verma, "Development of Life Skills and Professional Practice"; First Edition; Sultan Chand (G/L) & Company, 2014.
8. Daniel Goleman, "Emotional Intelligence"; Bantam, 2006.
9. Remesh S., Vishnu R.G., "Life Skills for Engineers", Ridhima Publications, First Edition, 2016.
10. Butterfield Jeff, "Soft Skills for Everyone", Cengage Learning India Pvt Ltd; 1 edition, 2011.
11. Training in Interpersonal Skills: Tips for Managing People at Work, Pearson Education, India; 6 edition, 2015.
12. The Ace of Soft Skills: Attitude, Communication and Etiquette for Success, Pearson Education; 1 edition, 2013.



PHL 120	ENGINEERING PHYSICS LAB	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		BSC	0	0	2	1	2019

Preamble: The aim of this course is to make the students gain practical knowledge to co-relate with the theoretical studies and to develop practical applications of engineering materials and use the principle in the right way to implement the modern technology.

Prerequisite: Higher secondary level Physics

Course Outcomes: After the completion of the course the student will be able to

CO 1	Develop analytical/experimental skills and impart prerequisite hands on experience for engineering laboratories
CO 2	Understand the need for precise measurement practices for data recording
CO 3	Understand the principle, concept, working and applications of relevant technologies and comparison of results with theoretical calculations
CO 4	Analyze the techniques and skills associated with modern scientific tools such as lasers and fiber optics
CO 5	Develop basic communication skills through working in groups in performing the laboratory experiments and by interpreting the results

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3				3			1	2			1
CO 2	3				3			1	2			1
CO 3	3				3			1	2			1
CO 4	3				3			1	2			1
CO 5	3				3			1	2			1

Mark distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration(Internal)
100	100	-	1 hour

Continuous Internal Evaluation Pattern:

Attendance	: 20 marks
Class work/ Assessment/Viva-voce	: 50 marks
End semester examination (Internally by college)	: 30 marks

End Semester Examination Pattern: Written Objective Examination of one hour

SYLLABUS**LIST OF EXPERIMENTS**

(Minimum 8 experiments should be completed)

1. CRO-Measurement of frequency and amplitude of wave forms
2. Measurement of strain using strain gauge and wheatstone bridge
3. LCR Circuit – Forced and damped harmonic oscillations
4. Melde's string apparatus- Measurement of frequency in the transverse and longitudinal mode
5. Wave length measurement of a monochromatic source of light using Newton's Rings method.
6. Determination of diameter of a thin wire or thickness of a thin strip of paper using air wedge method.
7. To measure the wavelength using a millimeter scale as a grating.
8. Measurement of wavelength of a source of light using grating.
9. Determination of dispersive power and resolving power of a plane transmission grating
10. Determination of the particle size of lycopodium powder
11. Determination of the wavelength of He-Ne laser or any standard laser using diffraction grating
12. Calculate the numerical aperture and study the losses that occur in optical fiber cable.
13. I-V characteristics of solar cell.
14. LED Characteristics.
15. Ultrasonic Diffractometer- Wavelength and velocity measurement of ultrasonic waves in a liquid
16. Deflection magnetometer-Moment of a magnet- Tan A position.

Reference books

1. S.L.Gupta and Dr.V.Kumar, "Practical physics with viva voice", Pragati Prakashan Publishers, Revised Edition, 2009
2. M.N.Abadhanulu, A.A.Dani and Pokely P.M, "Experiments in Engineering Physics", S.Chand & Co, 2008
3. S. K. Gupta, "Engineering physics practicals", Krishna Prakashan Pvt. Ltd., 2014
4. P. R. Sasikumar "Practical Physics", PHI Ltd., 2011.

CYL 120	ENGINEERING CHEMISTRY LAB	CATEGORY	L	T	P	CREDIT
		BSC	0	0	2	1

Preamble: To impart scientific approach and to familiarize with the experiments in chemistry relevant for research projects in higher semesters

Prerequisite: Experiments in chemistry introduced at the plus two levels in schools

Course outcomes: After the completion of the course the students will be able to

CO 1	Understand and practice different techniques of quantitative chemical analysis to generate experimental skills and apply these skills to various analyses
CO 2	Develop skills relevant to synthesize organic polymers and acquire the practical skill to use TLC for the identification of drugs
CO 3	Develop the ability to understand and explain the use of modern spectroscopic techniques for analysing and interpreting the IR spectra and NMR spectra of some organic compounds
CO 4	Acquire the ability to understand, explain and use instrumental techniques for chemical analysis
CO 5	Learn to design and carry out scientific experiments as well as accurately record and analyze the results of such experiments
CO 6	Function as a member of a team, communicate effectively and engage in further learning. Also understand how chemistry addresses social, economical and environmental problems and why it is an integral part of curriculum

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3				2							3
CO 2	3				3							3
CO 3	3				3							3
CO 4	3				3							3
CO 5	3				1							3
CO 6	3				1							3

Mark distribution

Total Marks	CIE marks	ESE marks	ESE Duration(Internal)
100	100	-	1 hour

Continuous Internal Evaluation Pattern:

Attendance	: 20 marks
Class work/ Assessment/Viva-voce	: 50 marks
End semester examination (Internally by college)	: 30 marks

End Semester Examination Pattern: Written Objective Examination of one hour

SYLLABUS**LIST OF EXPERIMENTS (MINIMUM 8 MANDATORY)**

1. Estimation of total hardness of water-EDTA method
2. Potentiometric titration
3. Determination of cell constant and conductance of solutions.
4. Calibration of pH meter and determination of pH of a solution
5. Estimation of chloride in water
6. Identification of drugs using TLC
7. Determination of wavelength of absorption maximum and colorimetric estimation of Fe^{3+} in solution
8. Determination of molar absorptivity of a compound (KMnO_4 or any water soluble food colorant)
9. Synthesis of polymers (a) Urea-formaldehyde resin (b) Phenol-formaldehyde resin
10. Estimation of iron in iron ore
11. Estimation of copper in brass
12. Estimation of dissolved oxygen by Winkler's method
13. (a) Analysis of IR spectra (minimum 3 spectra) (b) Analysis of ^1H NMR spectra (minimum 3 spectra)
14. Flame photometric estimation of Na^+ to find out the salinity in sand
15. Determination of acid value of a vegetable oil
16. Determination of saponification of a vegetable oil

Reference Books

1. G. Svehla, B. Sivasankar, "Vogel's Qualitative Inorganic Analysis", Pearson, 2012.
2. R. K. Mohapatra, "Engineering Chemistry with Laboratory Experiments", PHI Learning, 2017.
3. Muhammed Arif, "Engineering Chemistry Lab Manual", Owl publishers, 2019.
4. Ahad J., "Engineering Chemistry Lab manual", Jai Publications, 2019.
5. Roy K Varghese, "Engineering Chemistry Laboratory Manual", Crownplus Publishers, 2019.
6. Soney C George, Rino Laly Jose, "Lab Manual of Engineering Chemistry", S. Chand & Company Pvt Ltd, New Delhi, 2019.

CO 7	2											
CO 8	2											

Mark distribution

Total Marks	CIE	ESE	ESE Duration
100	70	30	1 hour

Assessment Procedure: Total marks allotted for the course is 100 marks. CIE shall be conducted for 70 marks and ESE for 30 marks. CIE should be done for the work done by the student and also viva voce based on the work done on each practical session. ESE shall be evaluated by written examination of one hour duration conducted internally by the institute.

Continuous Internal Evaluation Pattern:

Attendance	: 20 marks
Class work/ Assessment/Viva-voce	: 50 marks
End semester examination (Internally by college)	: 30 marks

End Semester Examination Pattern: Written Objective Examination of one hour

SYLLABUS

PART 1

CIVIL WORKSHOP

- Exercise 1. Calculate the area of a built-up space and a small parcel of land- Use standard measuring tape and digital distance measuring devices
- Exercise 2. (a) Use screw gauge and vernier calliper to measure the diameter of a steel rod and thickness of a flat bar
- (b) Transfer the level from one point to another using a water level
- (c) Set out a one room building with a given plan and measuring tape
- Exercise 3. Find the level difference between any two points using dumpy level
- Exercise 4. (a) Construct a $1\frac{1}{2}$ thick brick wall of 50 cm height and 60 cm length using English bond. Use spirit level to assess the tilt of walls.
- (b) Estimate the number of different types of building blocks to construct this wall.

- Exercise 5. (a) Introduce the students to plumbing tools, different types of pipes, type of connections, traps, valves, fixtures and sanitary fittings.
- (b) Install a small rainwater harvesting installation in the campus

Reference Books:

1. Khanna P.N, "Indian Practical Civil Engineering Handbook", Engineers Publishers.
2. Bhavikatti. S, "Surveying and Levelling (Volume 1)", I.K. International Publishing House
3. Arora S.P and Bindra S.P, " Building Construction", Dhanpat Rai Publications
4. S. C. Rangwala, "Engineering Materials," Charotar Publishing House.

PART II

MECHANICAL WORKSHOP

LIST OF EXERCISES

(Minimum EIGHT units mandatory and FIVE models from Units 2 to 8 mandatory)

UNIT 1:- General : Introduction to workshop practice, Safety precautions, Shop floor ethics, Basic First Aid knowledge.

Study of mechanical tools, components and their applications: (a) Tools: screw drivers, spanners, Allen keys, cutting pliers etc and accessories (b) bearings, seals, O-rings, circlips, keys etc.

UNIT 2:- Carpentry : Understanding of carpentry tools

Minimum any one model

1. T-Lap joint
2. Cross lap joint
3. Dovetail joint
4. Mortise joints

UNIT 3:- Foundry : Understanding of foundry tools

Minimum any one model

1. Bench Molding
2. Floor Molding
3. Core making
4. Pattern making

UNIT 4:- Sheet Metal : Understanding of sheet metal working tools

Minimum any one model

1. Cylindrical shape
2. Conical shape
3. Prismatic shaped job from sheet metal

UNIT 5:- Fitting : Understanding of tools used for fitting

Minimum any one model

1. Square Joint
2. V- Joint
3. Male and female fitting

UNIT 6:- Plumbing : Understanding of plumbing tools, pipe joints

Any one exercise on joining of pipes making use of minimum three types of pipe joints

UNIT 7:- Smithy: Understanding of tools used for smithy.

Demonstrating the forge-ability of different materials (MS, Al, alloy steel and cast steels) in cold and hot states.

Observing the qualitative difference in the hardness of these materials

Minimum any one exercise on smithy

1. Square prism
2. Hexagonal headed bolt
3. Hexagonal prism
4. Octagonal prism

UNIT 8: -Welding: Understanding of welding equipments

Minimum any one welding practice

Making Joints using electric arc welding. bead formation in horizontal, vertical and over head positions

UNIT 9: - Assembly: Demonstration only

Disassembling and assembling of

1. Cylinder and piston assembly
2. Tail stock assembly
3. Bicycle
4. Pump or any other machine

UNIT 10: - Machines: Demonstration and applications of the following machines

Shaping and slotting machine; Milling machine; Grinding Machine; Lathe; Drilling Machine.

UNIT 11: - Modern manufacturing methods: Power tools, CNC machine tools, 3D printing, Glass cutting.

Course Contents and Lecture Schedule:

No	Topic	No of Sessions
1	INTRODUCTION	
1.1	Workshop practice, shop floor precautions, ethics and First Aid knowledge. Studies of mechanical tools, components and their applications: (a) Tools: screw drivers, spanners, Allen keys, cutting pliers etc and accessories (b) bearings, seals, O-rings, circlips, keys etc	1
2	CARPENTRY	
2.1	Understanding of carpentry tools and making minimum one model	2

3	FOUNDRY	
3.1	Understanding of foundry tools and making minimum one model	2
4	SHEET METAL	
4.1	Understanding of sheet metal working tools and making minimum one model	2
5	FITTING	
5.1	Understanding of fitting tools and making minimum one model	2
6	PLUMBING	
6.1	Understanding of pipe joints and plumbing tools and making minimum one model	2
7	SMITHY	
7.1	Understanding of smithy tools and making minimum one model	2
8	WELDING	
8.1	Understanding of welding equipments and making minimum one model	2
9	ASSEMBLY	
9.1	Demonstration of assembly and dissembling of multiple parts components	1
10	MACHINES	
10.1	Demonstration of various machines	1
11	MODERN MANUFACTURING METHODS	
11.1	Demonstrations of: power tools, CNC Machine tools, 3D printing, Glass cutting	1

ESL 130	ELECTRICAL & ELECTRONICS WORKSHOP	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		ESC	0	0	2	1	2019

Preamble: Electrical Workshop is intended to impart skills to plan and carry out simple electrical wiring. It is essential for the practicing engineers to identify the basic practices and safety measures in electrical wiring.

Prerequisite: NIL

Course Outcomes: After the completion of the course the student will be able to

CO 1	Demonstrate safety measures against electric shocks.
CO 2	Identify the tools used for electrical wiring, electrical accessories, wires, cables, batteries and standard symbols
CO 3	Develop the connection diagram, identify the suitable accessories and materials necessary for wiring simple lighting circuits for domestic buildings
CO 4	Identify and test various electronic components
CO 5	Draw circuit schematics with EDA tools
CO 6	Assemble and test electronic circuits on boards
CO 7	Work in a team with good interpersonal skills

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	-	-	-	-	-	3	-	-	-	-	-	1
CO 2	2	-	-	-	-	-	-	-	-	1	-	-
CO 3	2	-	-	1	-	1	-	1	2	2	-	2
CO 4	3	-	-	-	-	-	-	-	-	-	-	2
CO 5	3	-	-	-	2	-	-	-	-	-	-	2
CO 6	3	-	-	-	2	-	-	-	-	-	-	1
CO 7	-	-	-	-	-	-	-	-	3	2	-	2

Mark distribution

Total Marks	CIE	ESE	ESE Duration(Internal)
100	100	-	1 hour

Continuous Internal Evaluation Pattern:

Attendance	: 20 marks
Class work/ Assessment/Viva-voce	: 50 marks
End semester examination (Internally by college)	: 30 marks

End Semester Examination Pattern: Written Objective Examination of one hour

Syllabus**PART 1****ELECTRICAL****List of Exercises / Experiments**

1. a) Demonstrate the precautionary steps adopted in case of Electrical shocks.
b) Identify different types of cables, wires, switches, fuses, fuse carriers, MCB, ELCB and MCCB with ratings.
2. Wiring of simple light circuit for controlling light/ fan point (PVC conduit wiring)
3. Wiring of light/fan circuit using Two way switches . (Staircase wiring)
4. Wiring of Fluorescent lamps and light sockets (6A) with a power circuit for controlling power device. (16A socket)
5. Wiring of power distribution arrangement using single phase MCB distribution board with ELCB, main switch and Energy meter.
6. a) Identify different types of batteries with their specifications.
b) Demonstrate the Pipe and Plate Earthing Schemes using Charts/Site Visit.

PART II**ELECTRONICS****List of Exercises / Experiments (Minimum of 7 mandatory)**

1. Familiarization/Identification of electronic components with specification (Functionality, type, size, colour coding, package, symbol, cost etc. [Active, Passive, Electrical, Electronic, Electro-mechanical, Wires, Cables, Connectors, Fuses, Switches, Relays, Crystals, Displays, Fasteners, Heat sink etc.]

2. Drawing of electronic circuit diagrams using BIS/IEEE symbols and introduction to EDA tools (such as Dia or Xcircuit), Interpret data sheets of discrete components and IC's, Estimation and costing.
3. Familiarization/Application of testing instruments and commonly used tools. [Multimeter, Function generator, Power supply, DSO etc.] [Soldering iron, De-soldering pump, Pliers, Cutters, Wire strippers, Screw drivers, Tweezers, Crimping tool, Hot air soldering and de-soldering station etc.]
4. Testing of electronic components [Resistor, Capacitor, Diode, Transistor and JFET using multimeter.]
5. Inter-connection methods and soldering practice. [Bread board, Wrapping, Crimping, Soldering - types - selection of materials and safety precautions, soldering practice in connectors and general purpose PCB, Crimping.]
6. Printed circuit boards (PCB) [Types, Single sided, Double sided, PTH, Processing methods, Design and fabrication of a single sided PCB for a simple circuit with manual etching (Ferric chloride) and drilling.]
7. Assembling of electronic circuits using SMT (Surface Mount Technology) stations.
8. Assembling of electronic circuit/system on general purpose PCB, test and show the functioning (**Any Two circuits**).
 1. Fixed voltage power supply with transformer, rectifier diode, capacitor filter, zener/IC regulator.
 2. Square wave generation using IC 555 timer in IC base.
 3. Sine wave generation using IC 741 OP-AMP in IC base.
 4. RC coupled amplifier with transistor BC107.

SEMESTER II

MAT 102	VECTOR CALCULUS, DIFFERENTIAL EQUATIONS AND TRANSFORMS	CATEGORY	L	T	P	CREDIT	Year of Introduction
		BSC	3	1	0	4	2019

Preamble: This course introduces the concepts and applications of differentiation and integration of vector valued functions, differential equations, Laplace and Fourier Transforms. The objective of this course is to familiarize the prospective engineers with some advanced concepts and methods in Mathematics which include the Calculus of vector valued functions, ordinary differential equations and basic transforms such as Laplace and Fourier Transforms which are invaluable for any engineer's mathematical tool box. The topics treated in this course have applications in all branches of engineering.

Prerequisite: Calculus of single and multi variable functions.

Course Outcomes: After the completion of the course the student will be able to

CO 1	Compute the derivatives and line integrals of vector functions and learn their applications
CO 2	Evaluate surface and volume integrals and learn their inter-relations and applications.
CO 3	Solve homogeneous and non-homogeneous linear differential equation with constant coefficients
CO 4	Compute Laplace transform and apply them to solve ODEs arising in engineering
CO 5	Determine the Fourier transforms of functions and apply them to solve problems arising in engineering

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	3	3	3	2	1			1	2		2
CO 2	3	3	3	3	2	1			1	2		2
CO 3	3	3	3	3	2	1			1	2		2
CO 4	3	3	3	3	2	1			1	2		2
CO 5	3	3	3	3	2	1			1	2		2

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination (Marks)
	Test 1 (Marks)	Test 2 (Marks)	
Remember	10	10	20
Understand	20	20	40
Apply	20	20	40
Analyse			
Evaluate			

Create			

Mark distribution

Total Marks	CIE (Marks)	ESE (Marks)	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks

Continuous Assessment Test (2 numbers) : 25 marks

Assignment/Quiz/Course project : 15 marks

Assignments: Assignment should include specific problems highlighting the applications of the methods introduced in this course in science and engineering.

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

Course Outcome 1 (CO1): Compute the derivatives and line integrals of vector functions and learn their applications

1. How would you calculate the speed, velocity and acceleration at any instant of a particle moving in space whose position vector at time t is $\mathbf{r}(t)$?
2. Find the work done by the force field $F = (e^x - y^3)\mathbf{i} + (\cos y + x^3)\mathbf{j}$ on a particle that travels once around the unit circle centred at origin having radius 1.
3. When do you say that a vector field is conservative? What are the implications if a vector field is conservative?

Course Outcome 2 (CO2): Evaluate surface and volume integrals and learn their inter-relations and applications

1. Write any one application each of line integral, double integral and surface integral.
2. Use the divergence theorem to find the outward flux of the vector field $F(x, y, z) = z\mathbf{k}$ across the

$$x^2 + y^2 + z^2 = a^2$$

3. State Greens theorem. Use Green's theorem to express the area of a plane region bounded by a curve as a line integral.

Course Outcome 3 (CO3): Solve homogeneous and non-homogeneous linear differential equation with constant coefficients

1. If $y_1(x)$ and $y_2(x)$ are solutions of $y'' + py' + qy = 0$, where p, q are constants, show that

$y_1(x) + y_2(x)$ is also a solution.

2. Solve the differential equation $y'' + y = 0.001x^2$ using method of undetermined coefficient.

3. Solve the differential equation of $y''' - 3y'' + 3y' - y = e^x - x - 1$.

Course Outcome 4 (CO4): Compute Laplace transform and apply them to solve ODEs arising in engineering

1. What is the inverse Laplace Transform of $(s) = \frac{3s-137}{s^2+2s+4}$?

2. Find Laplace Transform of Unit step function.

3. Solve the differential equation of $y'' + 9y = \delta\left(t - \frac{\pi}{2}\right)$? Given $y(0) = 2$, $y'(0) = 0$

Course Outcome 5 (CO5): Determine the Fourier transforms of functions and apply them to solve problems arising in engineering

1. Find the Fourier integral representation of function defined by

$$f(x) = e^{-x} \text{ for } x > 0 \text{ and } f(x) = 0 \text{ for } x < 0.$$

2. What are the conditions for the existence of Fourier Transform of a function $f(x)$?

3. Find the Fourier transform of $f(x) = 1$ for $|x| < 1$ and $f(x) = 0$ otherwise.

Model Question paper

QP CODE:

PAGES:3

Reg No: _____

Name : _____

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY FIRST SEMESTER B.TECH DEGREE EXAMINATION,
MONTH & YEAR**

Course Code: MAT 102

Max. Marks: 100

Duration: 3 Hours

VECTOR CALCULUS, DIFFERENTIAL EQUATIONS AND TRANSFORMS

(2019-Scheme)

(Common to all branches)

PART A

(Answer all questions. Each question carries 3 marks)

1. Is the vector $\mathbf{r}$ where $\mathbf{r} = x\mathbf{i} + y\mathbf{j} + z\mathbf{k}$ conservative. Justify your answer.
2. State Greens theorem including all the required hypotheses
3. What is the outward flux of $\mathbf{F}(x, y, z) = x\mathbf{i} + y\mathbf{j} + z\mathbf{k}$ across any unit cube.
4. What is the relationship between Green's theorem and Stokes theorem?
5. Solve $y'' + 4y' + 2.5y = 0$
6. Does the function $y = C_1 \cos x + C_2 \sin x$ form a solution of $y'' + y = 0$? Is it the general solution? Justify your answer.
7. Find the Laplace transform of $e^{-t} \sinh 4t$
8. Find the Laplace inverse transform of $\frac{1}{s(s^2 + \omega^2)}$.
9. Given the Fourier transform $\frac{1}{\sqrt{2}} e^{-\frac{\omega^2}{4}}$ of $f(x) = e^{-x^2}$, find the Fourier transform of xe^{-x^2}
10. State the convolution theorem for Fourier transform

PART B

(Answer one full question from each module. Each full question carries 14 marks)

MODULE 1

- 11a) Prove that the force field $\mathbf{F} = e^y \mathbf{i} + xe^y \mathbf{j}$ is conservative in the entire xy-plane
 - b) Use Greens theorem to find the area enclosed by the ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$
- 12 a) Find the divergence of the vector field $\mathbf{F} = \frac{c}{(x^2 + y^2 + z^2)^{3/2}} (x\mathbf{i} + y\mathbf{j} + z\mathbf{k})$
 - b) Find the work done by the force field $\mathbf{F}(x, y, z) = xy\mathbf{i} + yz\mathbf{j} + xz\mathbf{k}$ along C where C is the curve $\mathbf{r}(t) = t\mathbf{i} + t^2\mathbf{j} + t^3\mathbf{k}$

MODULE II

- 13 a) Use divergence theorem to find the outward flux of the vector field $\mathbf{F} = 2x\mathbf{i} + 3y\mathbf{j} + z^3\mathbf{k}$ across the unit cube bounded by $x = 0, y = 0, z = 0, x = 1, y = 1, z = 1$
 - b) Find the circulation of $\mathbf{F} = (x - z)\mathbf{i} + (y - x)\mathbf{j} + (z - xy)\mathbf{k}$ using Stokes theorem around the triangle with vertices $A(1,0,0), B(0,2,0)$ and $C(0,0,1)$
- 14 a) Use divergence theorem to find the volume of the cylindrical solid bounded by $x^2 + 4x + y^2 = 7, z = -1, z = 4$, given the vector field $\mathbf{F} = x\mathbf{i} + y\mathbf{j} + z\mathbf{k}$ across surface of the cylinder
 - b) Use Stokes theorem to evaluate $\int_C \mathbf{F} \cdot d\mathbf{r}$ where $\mathbf{F} = x^2\mathbf{i} + 3x\mathbf{j} - y^3\mathbf{k}$ where C is

the circle $x^2 + y^2 = 1$ in the xy - plane with counterclockwise orientation looking down the positive z -axis

MODULE III

- 15 a) Solve $y'' + 4y' + 4y = x^2 + e^{-x} \cos x$
b) Solve $y''' - 3y'' + 3y' - y = e^x - x - 1$
16 a) Solve $y''' + 3y'' + 3y' + y = 30e^{-x}$ given $y(0) = 3, y'(0) = -3, y''(0) = -47$
b) Using method of variation of parameters, solve $y'' + y = \sec x$

MODULE IV

- 17 a) Find the inverse Laplace transform of $F(s) = \frac{2(e^{-s} - e^{-3s})}{s^2 - 4}$
b) Solve the differential equation $y'' + 16y = 4\delta(t - 3\pi); y(0) = 2, y'(0) = 0$ using Laplace transform
18 a) Solve $y'' + 3y' + 2y = f(t)$ where $f(t) = 1$ for $0 < t < 1$ and $f(t) = 1$ for $t > 1$ using Laplace transform
b) Apply convolution theorem to find the Laplace inverse transform of $\frac{1}{s^2(s^2 + \omega^2)}$

MODULE V

- 19 a) Find the Fourier cosine integral representation for $f(x) = e^{-kx}$ for $x > 0$ and $k > 0$ and hence evaluate $\int_0^\infty \frac{\cos wx}{k^2 + w^2}$ the function
b) Does the Fourier sine transform $f(x) = x^{-1} \sin x$ for $0 < x < \infty$ exist? Justify your answer
20 a) Find the Fourier transform of $f(x) = |x|$ for $|x| < 1$ and $f(x) = 0$ otherwise
b) Find the Fourier cosine transform of $f(x) = e^{-ax}$ for $a > 0$

Syllabus

Module 1 (Calculus of vector functions)

(Text 1: Relevant topics from sections 12.1, 12.2, 12.6, 13.6, 15.1, 15.2, 15.3)

Vector valued function of single variable, derivative of vector function and geometrical interpretation, motion along a curve-velocity, speed and acceleration. Concept of scalar and vector fields, Gradient and its properties, directional derivative, divergence and curl, Line integrals of vector fields, work as line integral, Conservative vector fields, independence of path and potential function (results without proof).

Module 2 (Vector integral theorems)

(Text 1: Relevant topics from sections 15.4, 15.5, 15.6, 15.7, 15.8)

Green's theorem (for simply connected domains, without proof) and applications to evaluating line integrals and finding areas. Surface integrals over surfaces of the form $z = g(x, y)$, $y = g(x, z)$ or $x = g(y, z)$, Flux integrals over surfaces of the form $z = g(x, y)$, $y = g(x, z)$ or $x = g(y, z)$, divergence theorem (without proof) and its applications to finding flux integrals, Stokes' theorem (without proof) and its applications to finding line integrals of vector fields and work done.

Module- 3 (Ordinary differential equations)

(Text 2: Relevant topics from sections 2.1, 2.2, 2.5, 2.6, 2.7, 2.10, 3.1, 3.2, 3.3)

Homogenous linear differential equation of second order, superposition principle, general solution, homogenous linear ODEs with constant coefficients-general solution. Solution of Euler-Cauchy equations (second order only). Existence and uniqueness (without proof). Non homogenous linear ODEs-general solution, solution by the method of undetermined coefficients (for the right hand side of the form $x^n, e^{kx}, \sin ax, \cos ax, e^{kx} \sin ax, e^{kx} \cos ax$ and their linear combinations), methods of variation of parameters. Solution of higher order equations-homogeneous and non-homogeneous with constant coefficient using method of undetermined coefficient.

Module- 4 (Laplace transforms)

(Text 2: Relevant topics from sections 6.1, 6.2, 6.3, 6.4, 6.5)

Laplace Transform and its inverse, Existence theorem (without proof), linearity, Laplace transform of basic functions, first shifting theorem, Laplace transform of derivatives and integrals, solution of differential equations using Laplace transform, Unit step function, Second shifting theorems. Dirac delta function and its Laplace transform, Solution of ordinary differential equation involving unit step function and Dirac delta functions. Convolution theorem (without proof) and its application to finding inverse Laplace transform of products of functions.

Module-5 (Fourier Transforms)

(Text 2: Relevant topics from sections 11.7,11.8, 11.9)

Fourier integral representation, Fourier sine and cosine integrals. Fourier sine and cosine transforms, inverse sine and cosine transform. Fourier transform and inverse Fourier transform, basic properties. The Fourier transform of derivatives. Convolution theorem (without proof)

Text Books

1. H. Anton, I. Biven S.Davis, "Calculus", Wiley, 10th edition, 2015.
2. Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley, 10th edition, 2015.

Reference Books

1. J. Stewart, Essential Calculus, Cengage, 2nd edition, 2017
2. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.
3. Peter O Neil, Advanced Engineering Mathematics, 7th Edition, Thomson, 2007.
4. Louis C Barret, C Ray Wylie, "Advanced Engineering Mathematics", Tata McGraw Hill, 6th edition, 2003.
5. VeerarajanT."Engineering Mathematics for first year", Tata McGraw - Hill, 2008.
6. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th edition, 2010.
7. Srimanta Pal, Subodh C. Bhunia, "Engineering Mathematics", Oxford University Press, 2015.
8. Ronald N. Bracewell, "The Fourier Transform and its Applications", McGraw – Hill International Editions, 2000.

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	Calculus of vector functions (9 hours)	
1.1	Vector valued function of a scalar variable - derivative of vector valued function of scalar variable t-geometrical meaning	2
1.2	Motion along a curve-speed, velocity, acceleration	1
1.3	Gradient and its properties, directional derivative, divergent and curl	3
1.4	Line integrals with respect to arc length, line integrals of vector fields. Work done as line integral	2
1.5	Conservative vector field, independence of path, potential function	1

2	Vector integral theorems(9 hours)	
2.1	Green's theorem and it's applications	2
2.2	Surface integrals , flux integral and their evaluation	3
2.3	Divergence theorem and applications	2
2.4	Stokes theorem and applications	2
3	Ordinary Differential Equations (9 hours)	
3.1	Homogenous linear equation of second order, Superposition principle, general solution	1
3.2	Homogenous linear ODEs of second order with constant coefficients	2
3.3	Second order Euler-Cauchy equation	1
3.4	Non homogenous linear differential equations of second order with constant coefficient-solution by undetermined coefficients, variation of parameters.	3
3.5	Higher order equations with constant coefficients	2
4	Laplace Transform (10 hours)	
4.1	Laplace Transform , inverse Transform, Linearity, First shifting theorem, transform of basic functions	2
4.2	Transform of derivatives and integrals	1
4.3	Solution of Differential equations, Initial value problems by Laplace transform method.	2
4.4	Unit step function --- Second shifting theorem	2
4.5	Dirac Delta function and solution of ODE involving Dirac delta function	2
4.6	Convolution and related problems.	1
5	Fourier Transform (8 hours)	
5.1	Fourier integral representation	1
5.2	Fourier Cosine and Sine integrals and transforms	2
5.3	Complex Fourier integral representation, Fourier transform and its inverse transforms, basic properties	3
5.4	Fourier transform of derivatives, Convolution theorem	2

ABDUL KALAM
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PHT 100	ENGINEERING PHYSICS A (FOR CIRCUIT BRANCHES)	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		BSC	3	1	0	4	2019

Preamble: The aim of the Engineering Physics Program is to offer students a solid background in the fundamentals of Physics and to impart that knowledge in engineering disciplines. The program is designed to develop scientific attitudes and enable the students to correlate the concepts of Physics with the core programmes

Prerequisite: Higher secondary level Physics, Mathematical course on vector calculus, differential equations and linear algebra

Course Outcomes: After the completion of the course the student will be able to

CO 1	Compute the quantitative aspects of waves and oscillations in engineering systems.
CO 2	Apply the interaction of light with matter through interference, diffraction and identify these phenomena in different natural optical processes and optical instruments.
CO 3	Analyze the behaviour of matter in the atomic and subatomic level through the principles of quantum mechanics to perceive the microscopic processes in electronic devices.
CO 4	Classify the properties of magnetic materials and apply vector calculus to static magnetic fields and use Maxwell's equations to diverse engineering problems
CO 5	Analyze the principles behind various superconducting applications, explain the working of solid state lighting devices and fibre optic communication system

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	2						1	2			1
CO 2	3	2						1	2			1
CO 3	3	2						1	2			1
CO 4	3	1						1	2			1
CO 5	3	1						1	2			1

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination (Marks)
	Test 1 (Marks)	Test 2 (Marks)	
Remember	15	15	30
Understand	25	25	50
Apply	10	10	20

Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE marks	ESE marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25 marks
Assignment/Quiz/Course project	: 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Explain the effect of damping force on oscillators.
2. Distinguish between transverse and longitudinal waves.
3. (a) Derive an expression for the fundamental frequency of transverse vibration in a stretched string.
(b) Calculate the fundamental frequency of a string of length 2 m weighing 6 g kept stretched by a load of 600 kg.

Course Outcome 2 (CO2):

1. Explain colours in thin films.
2. Distinguish between Fresnel and Fraunhofer diffraction.
3. (a) Explain the formation of Newton's rings and obtain the expression for radii of bright and dark rings in reflected system. Also explain how it is used to determine the wavelength of a monochromatic source of light.
(b) A liquid of refractive index μ is introduced between the lens and glass plate.

What happens to the fringe system? Justify your answer.

Course Outcome 3 (CO3):

1. Give the physical significance of wave function ?
2. What are excitons ?
3. (a) Solve Schrodinger equation for a particle in a one dimensional box and obtain its energy eigen values and normalised wave functions.
(b) Calculate the first three energy values of an electron in a one dimensional box of width $1 \text{ \AA}$ in electron volt.

Course Outcome 4 (CO4):

1. Compare displacement current and conduction current.
2. Mention any four properties of ferro magnetic materials.
3. (a) Starting from Maxwell's equations, derive the free space electromagnetic wave equation and show that velocity of electromagnetic wave is $1/(\mu_0 \epsilon_0)^{1/2}$
(b) An electromagnetic wave is described by $E = 100 \exp 8\pi i [10^{14} t - (10^6 z / 3)] \text{ V/m}$. Find the direction of propagation of the wave, speed of the wave and magnetic flux density in the wave.

Course Outcome 5 (CO5):

1. Explain the working of a solar cell.
2. Distinguish between Type I and Type II super conductors.
3. (a) Define numerical aperture and derive an expression for it.
(b) Explain the working of intensity modulated fibre optic sensor.

Model Question paper

QP CODE:

PAGES:3

Reg No: _____

Name : _____

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY FIRST SEMESTER B.TECH DEGREE EXAMINATION,
MONTH & YEAR**

Course Code: PHT 100

Course Name: Engineering Physics A

Max. Marks: 100

Duration: 3 Hours

PART A

Answer all Questions. Each question carries 3 Marks

1. Compare electrical and mechanical oscillators
2. Distinguish between longitudinal and transverse waves
3. Write a short note on antireflection coating.
4. Diffraction of light is not as evident in daily experience as that of sound waves. Give reason.
5. State and explain Heisenberg's Uncertainty principle. With the help of it explain natural line broadening.
6. Explain surface to volume ratio of nanomaterials.
7. State Faraday's laws of electromagnetic induction.
8. Compare displacement current and conduction current
9. List four important applications of superconductors.
10. Give the working principle of LED. (10x3=30)

PART B

Answer any one full question from each module. Each question carries 14 Marks

Module 1

11. (a) Derive the differential equation of damped harmonic oscillator and deduce its solution. Discuss the cases of over damped, critically damped and under damped cases. (10)
- (b) The frequency of a tuning fork is 500 Hz and its Q factor is 7×10^4 . Find the relaxation time. Also calculate the time after which its energy becomes 1/10 of its initial undamped value. (4)
12. (a) Derive an expression for the velocity of propagation of a transverse wave in a stretched string. Deduce laws of transverse vibrations. (10)
- (b) The equation of transverse vibration of a stretched string is given by $y = 0.00327 \sin (72.1x - 2.72t)$ m, in which the numerical constants are in S.I units. Evaluate (i) Amplitude (ii) Wavelength (iii) Frequency and (iv) Velocity of the wave. (4)

Module 2

13. (a) Explain the formation of Newton's rings and show that the radius of dark ring is proportional to the square root of natural numbers. How can we use Newton's rings experiment to determine the refractive index of a liquid. (10)
- (b) Two pieces of plane glass are placed together with a piece of paper between two at one end. Find the angle of the wedge in seconds if the film is viewed with a monochromatic light of wavelength $4800 \text{ \AA}$. Given $\beta = 0.0555 \text{ cm}$. (4)
14. (a) Explain the diffraction due to a plane transmission grating. Obtain the grating equation. (10)
- (b) A grating has 6000 lines per cm. Find the angular separation of the two yellow lines of mercury of wavelengths 577 nm and 579 nm in the second order. (4)

Module 3

15. (a) Derive time dependent and independent Schrodinger equations. (10)
- (b) An electron is confined to one dimensional potential box of length $2 \text{ \AA}$. Calculate the energies corresponding to the first and second quantum states in eV. (4)
16. (a) Classify nanomaterials based on dimensionality of quantum confinement and explain the following nanostructures. (i) nano sheets (ii) nano wires (iii) quantum dots. (10)
- (b) Find the de Broglie wavelength of electron whose kinetic energy is 15 eV. (4)

Module 4

17. (a) State Poynting's Theorem. Calculate the value of Poynting vector at the surface of the sun if the power radiated by the sun is $3.8 \times 10^{26} \text{ W}$ and its radius is $7 \times 10^8 \text{ m}$. (5)

(b) Distinguish between paramagnetic, diamagnetic and ferromagnetic materials. (9)

18.(a) Starting from Maxwell's Equations, derive electromagnetic wave equations in free space. (10)

(b) If the magnitude of $\mathbf{H}$ in a plane wave is 1 A/m, find the magnitude of $\mathbf{E}$ in free space. (4)

Module 5

19.(a) Show that superconductors are perfect diamagnets. Distinguish between Type I and Type II superconductors with suitable examples. (10)

(b) Write a short note on high temperature superconductors. (4)

20.(a) Define numerical aperture of an optic fibre and derive an expression for the NA of a step index fibre with a neat diagram. (10)

(b) Calculate the numerical aperture and acceptance angle of a fibre with a core refractive index of 1.54 and a cladding refractive index of 1.50 when the fibre is inside water of refractive index 1.33. (4) (14x5=70)

Syllabus

ENGINEERING PHYSICS A (FOR CIRCUIT BRANCHES)

Module 1

Oscillations and Waves

Harmonic oscillations, Damped harmonic motion-Derivation of differential equation and its solution, Over damped, Critically damped and Under damped Cases, Quality factor-Expression, Forced oscillations-Differential Equation-Derivation of expressions for amplitude and phase of forced oscillations, Amplitude Resonance-Expression for Resonant frequency, Quality factor and Sharpness of Resonance, Electrical analogy of mechanical oscillators

Wave motion- Derivation of one dimensional wave equation and its solution, Three dimensional wave equation and its solution (no derivation), Distinction between transverse and longitudinal waves, Transverse vibration in a stretched string, Statement of laws of vibration

Module 2

Wave Optics

Interference of light-Principle of superposition of waves, Theory of thin films - Cosine law (Reflected system), Derivation of the conditions of constructive and destructive Interference, Interference due to wedge shaped films -Determination of thickness and test for optical planeness, Newton's rings - Measurement of wavelength and refractive index, Antireflection coatings

Diffraction of light, Fresnel and Fraunhofer classes of diffraction, Diffraction grating-Grating equation, Rayleigh criterion for limit of resolution, Resolving and Dispersive power of a grating with expression (no derivation)

Module 3

Quantum Mechanics & Nanotechnology

Introduction for the need of Quantum mechanics, Wave nature of Particles, Uncertainty principle, Applications-Absence of electrons inside a nucleus and Natural line broadening mechanism, Formulation of time dependent and independent Schrodinger wave equations-Physical meaning of wave function, Particle in a one dimensional box- Derivation for normalised wave function and energy eigen values, Quantum Mechanical Tunnelling (Qualitative)

Introduction to nanoscience and technology, Increase in surface to volume ratio for nanomaterials, Quantum confinement in one dimension, two dimension and three dimension-Nano sheets, Nano wires and Quantum dots, Properties of nanomaterials-mechanical, electrical and optical, Applications of nanotechnology (qualitative ideas)

Module 4

Magnetism & Electro Magnetic Theory

Magnetic field and Magnetic flux density, Gauss's law for Magnetic flux density, Ampere's Circuital law, Faraday's law in terms of EMF produced by changing magnetic flux, Magnetic permeability and susceptibility, Classification of magnetic materials-para, dia and ferromagnetic materials

Fundamentals of vector calculus, concept of divergence, gradient and curl along with physical significance, Line, Surface and Volume integrals, Gauss divergence theorem & Stokes' theorem, Equation of continuity, Derivation of Maxwell's equations in vacuum, Comparison of displacement current with conduction current. Electromagnetic waves, Velocity of Electromagnetic waves in free space, Flow of energy and Poynting's vector (no derivation)

Module 5

Superconductivity & Photonics

Superconducting phenomena, Meissner effect and perfect diamagnetism, Types of superconductors-Type I and Type II, BCS Theory (Qualitative), High temperature superconductors-Applications of super conductivity

Introduction to photonics-Photonic devices-Light Emitting Diode, Photo detectors -Junction and PIN photodiodes, Solar cells-I-V Characteristics, Optic fibre-Principle of propagation of light, Types of fibres-Step index and Graded index fibres, Numerical aperture –Derivation, Fibre optic communication system (block diagram), Industrial, Medical and Technological applications of optical fibre, Fibre optic sensors-Intensity Modulated and Phase modulated sensors.

Text Books

1. M.N.Abadhanulu, P.G.Kshirsagar,TVS Arun Murthy "A Text book of Engineering Physics", S.Chand &Co., Revised Edition 2019
2. H.K.Malik , A.K. Singh, "Engineering Physics" McGraw Hill Education, Second Edition 2017

Reference Books

1. Arthur Beiser, "Concepts of Modern Physics ", Tata McGraw Hill Publications, 6th Edition 2003
2. D.K. Bhattacharya, Poonam Tandon, "Engineering Physics", Oxford University Press, 2015
3. Md.N.Khan & S.Panigrahi "Principles of Engineering Physics 1&2", Cambridge University Press, 2016
4. Aruldas G., "Engineering Physics", PHI Pvt. Ltd., 2015
5. Ajoy Ghatak, "Optics", Mc Graw Hill Education, Sixth Edition, 2017
6. T. Pradeep, "Nano:The Essentials", McGraw Hill India Ltd, 2007
7. Halliday, Resnick, Walker, "Fundamentals of Physics", John Wiley & Sons.Inc, 2001
8. David J Griffiths, "Introduction to Electrodynamics", Addison-Wesley publishing, 3rd Edition, 1999
9. Premlet B., "Advanced Engineering Physics", Phasor Books,10th edition,2017
10. I. Dominic and. A. Nahari, "A Text Book of Engineering physics", Owl Books Publishers, Revised edition, 2016

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	Oscillations and Waves (9 hours)	
1.1	Harmonic oscillations, Damped harmonic motion-Derivation of differential equation and its solution, Over damped, Critically damped and Under damped Cases, Quality factor-Expression	2 hrs
1.2	Forced oscillations-Differential Equation-Derivation of expressions for amplitude and phase of forced oscillations, Amplitude Resonance-Expression for Resonant frequency, Quality factor and Sharpness of Resonance, Electrical analogy of mechanical oscillators	3hrs
1.3	Wave motion- Derivation of one dimensional wave equation and its solution, Three dimensional wave equation and its solution (no derivation)	2 hrs
1.4	Distinction between transverse and longitudinal waves. Transverse vibration in a stretched string, Statement of laws of vibration	2 hrs
2	Wave Optics (9 hours)	
2.1	Interference of light-Principle of superposition of waves, Theory of thin films - Cosine law (Reflected system), Derivation of the conditions of constructive and destructive Interference	2 hrs
2.2	Interference due to wedge shaped films -Determination of thickness and test for optical planeness, Newton's rings - Measurement of wavelength and refractive index, Antireflection coatings	4 hr
2.3	Diffraction of light, Fresnel and Fraunhofer classes of diffraction, Diffraction grating-Grating equation	2 hrs
2.4	Rayleigh criterion for limit of resolution, Resolving and Dispersive power of a grating with expression (no derivation)	1 hr
3	Quantum Mechanics & Nanotechnology (9hours)	
3.1	Introduction for the need of Quantum mechanics, Wave nature of Particles, Uncertainty principle, Applications-Absence of electrons inside a nucleus and Natural line broadening mechanism	2 hrs
3.2	Formulation of time dependent and independent Schrodinger wave equations-Physical Meaning of wave function, Particle in a one dimensional box- Derivation for normalised wave function and energy eigen values, Quantum Mechanical Tunnelling (Qualitative)	4 hrs
3.3	Introduction to nanoscience and technology, Increase in surface to volume ratio for nanomaterials, Quantum confinement in one dimension, two dimension and three dimension-Nano sheets, Nano wires and Quantum dots	2 hrs
3.4	Properties of nanomaterials-mechanical, electrical and optical Applications of nanotechnology (qualitative ideas)	1 hr
4	Magnetism & Electro Magnetic Theory (9 hours)	
4.1	Magnetic field and Magnetic flux density, Gauss's law for Magnetic flux	2 hrs

	density, Ampere's Circuital law, Faraday's law in terms of EMF produced by changing magnetic flux	
4.2	Explanation for Magnetic permeability and susceptibility Classification of magnetic materials- para, dia and ferromagnetic materials	1 hr
4.3	Fundamentals of vector calculus, concept of divergence, gradient and curl along with physical significance, Line, Surface and Volume integrals, Gauss divergence theorem & Stokes' theorem	2 hrs
4.4	Equation of continuity, Derivation of Maxwell's equations in vacuum, Comparison of displacement current with conduction current. Electromagnetic waves, Velocity of Electromagnetic waves in free space, Flow of energy and Poynting's vector (no derivation)	4 hrs
5	Superconductivity & Photonics (9hours)	
5.1	Super conducting Phenomena, Meissner effect and perfect diamagnetism, Types of superconductors-Type I and Type II	2 hrs
5.2	BCS Theory (Qualitative), High temperature superconductors, Applications of super conductivity	2 hrs
5.3	Introduction to photonics-Photonic devices-Light Emitting Diode, Photo detectors -Junction and PIN photodiodes, Solar cells-I-V Characteristics	2 hrs
5.4	Optic fibre-Principle of propagation of light, Types of fibres-Step index and Graded index fibres, Numerical aperture –Derivation, Fibre optic communication system (block diagram), Industrial, Medical and Technological applications of optical fibre, Fibre optic sensors-Intensity Modulated and Phase modulated sensors	3 hrs

PHT 110	ENGINEERING PHYSICS B (FOR NON-CIRCUIT BRANCHES)	Category	L	T	P	CREDIT	Year of Introduction
		BSC	3	1	0	4	2019

Preamble: The aim of the Engineering Physics program is to offer students a solid background in the fundamentals of Physics and to impart that knowledge in engineering disciplines. The program is designed to develop scientific attitudes and enable the students to correlate the concepts of Physics with the core programmes

Prerequisite: Higher secondary level Physics, Mathematical course on vector calculus, differential equations and linear algebra

Course Outcomes: After the completion of the course the student will be able to

CO 1	Compute the quantitative aspects of waves and oscillations in engineering systems.
CO 2	Apply the interaction of light with matter through interference, diffraction and identify these phenomena in different natural optical processes and optical instruments.
CO 3	Analyze the behaviour of matter in the atomic and subatomic level through the principles of quantum mechanics to perceive the microscopic processes in electronic devices.
CO 4	Apply the knowledge of ultrasonics in non-destructive testing and use the principles of acoustics to explain the nature and characterization of acoustic design and to provide a safe and healthy environment
CO 5	Apply the comprehended knowledge about laser and fibre optic communication systems in various engineering applications

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	2						1	2			1
CO 2	3	2						1	2			1
CO 3	3	2						1	2			1
CO 4	3							1	2			1
CO 5	3	2						1	2			1

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination (Marks)
	Test 1 (Marks)	Test 2 (Marks)	
Remember	15	15	30
Understand	25	25	50

Apply	10	10	20
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE MARKS	ESE MARKS	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25 marks
Assignment/Quiz/Course project	: 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Explain the effect of damping force on oscillators.
2. Distinguish between transverse and longitudinal waves.
3. (a) Derive an expression for the fundamental frequency of transverse vibration in a stretched string.
(b) Calculate the fundamental frequency of a string of length 2 m weighing 6 g kept stretched by a load of 600 kg.

Course Outcome 2 (CO2):

1. Explain colours in thin films.
2. Distinguish between Fresnel and Fraunhofer diffraction.
3. (a) Explain the formation of Newton's rings and obtain the expression for radii of bright and dark rings in reflected system. Also explain how it is used to determine the wavelength of a monochromatic source of light.
(b) A liquid of refractive index μ is introduced between the lens and glass plate. What happens to the fringe system? Justify your answer.

Course Outcome 3 (CO3):

1. Give the physical significance of wave function?

2. What are excitons ?
3. (a) Solve Schrodinger equation for a particle in a one dimensional box and obtain its energy eigen values and normalised wave functions.
(b) Calculate the first three energy values of an electron in a one dimensional box of width $1 \text{ \AA}$ in electron volt.

Course Outcome 4 (CO4):

1. Explain reverberation and reverberation time.
2. How ultrasonic waves are used in non-destructive testing.
3. (a) With a neat diagram explain how ultrasonic waves are produced by a piezoelectric oscillator.
(b) Calculate frequency of ultrasonic waves that can be produced by a nickel rod of length 4 cm. (Young's Modulus = 207 G Pa, Density = 8900 Kg /m^3)

Course Outcome 5 (CO 5):

1. Distinguish between spontaneous emission and stimulated emission.
2. Explain optical resonators.
3. (a) Explain the construction and working of Ruby Laser.
(b) Calculate the numerical aperture and acceptance angle of a fibre with a core refractive index of 1.54 and a cladding refractive index of 1.50 when the fibre is inside water of refractive index 1.33.

Model Question paper

QP CODE: _____

PAGES:3

Reg No: _____

Name : _____

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY FIRST SEMESTER B.TECH DEGREE EXAMINATION,
MONTH & YEAR**

Course Code: PHT 110

Course Name: Engineering Physics B

Max.Marks: 100

Duration: 3 Hours

PART A

Answer all Questions. Each question carries 3 Marks

1. Compare electrical and mechanical oscillators.
2. Distinguish between longitudinal and transverse waves.
3. Write a short note on antireflection coating.
4. Diffraction of light is not as evident in daily experience as that of sound waves. Give reason.
5. State and explain Heisenberg's Uncertainty principle. With the help of it explain natural line broadening.
6. Explain surface to volume ratio of nanomaterials.
7. Define sound intensity level. Give the values of threshold of hearing and threshold of pain.
8. Describe the method of non-destructive testing using ultra sonic waves
9. Explain the condition of population inversion
10. Distinguish between step index and graded index fibre. (10x3=30)

PART B

Answer any one full question from each module. Each question carries 14 Marks

Module 1

11. (a) Derive the differential equation of damped harmonic oscillator and deduce its solution. Discuss the cases of over damped, critically damped and under damped cases. (10)

- (b) The frequency of a tuning fork is 500 Hz and its Q factor is 7×10^4 . Find the relaxation time. Also calculate the time after which its energy becomes $1/10$ of its initial undamped value. (4)
12. (a) Derive an expression for the velocity of propagation of a transverse wave in a stretched string. Deduce laws of transverse vibrations. (10)
- (b) The equation of transverse vibration of a stretched string is given by $y = 0.00327 \sin(72.1x - 2.72t)$ m, in which the numerical constants are in S.I units. Evaluate (i) Amplitude (ii) Wavelength (iii) Frequency and (iv) Velocity of the wave. (4)

Module 2

13. (a) Explain the formation of Newton's rings and show that the radius of dark ring is proportional to the square root of natural numbers. How can we use Newton's rings experiment to determine the refractive index of a liquid? (10)
- (b) Two pieces of plane glass are placed together with a piece of paper between two at one end. Find the angle of the wedge in seconds if the film is viewed with a monochromatic light of wavelength $4800 \text{ \AA}$. Given $\beta = 0.0555 \text{ cm}$. (4)
14. (a) Explain the diffraction due to a plane transmission grating. Obtain the grating equation. (10)
- (b) A grating has 6000 lines per cm. Find the angular separation of the two yellow lines of mercury of wavelengths 577 nm and 579 nm in the second order. (4)

Module 3

15. (a) Derive time dependent and independent Schrodinger equations. (10)
- (b) An electron is confined to one dimensional potential box of length $2 \text{ \AA}$. Calculate the energies corresponding to the first and second quantum states in eV. (4)
16. (a) Classify nanomaterials based on dimensionality of quantum confinement and explain the following nanostructures. (i) nano sheets (ii) nano wires (iii) quantum dots. (10)
- (b) Find the de Broglie wavelength of electron whose kinetic energy is 15 eV. (4)

Module 4

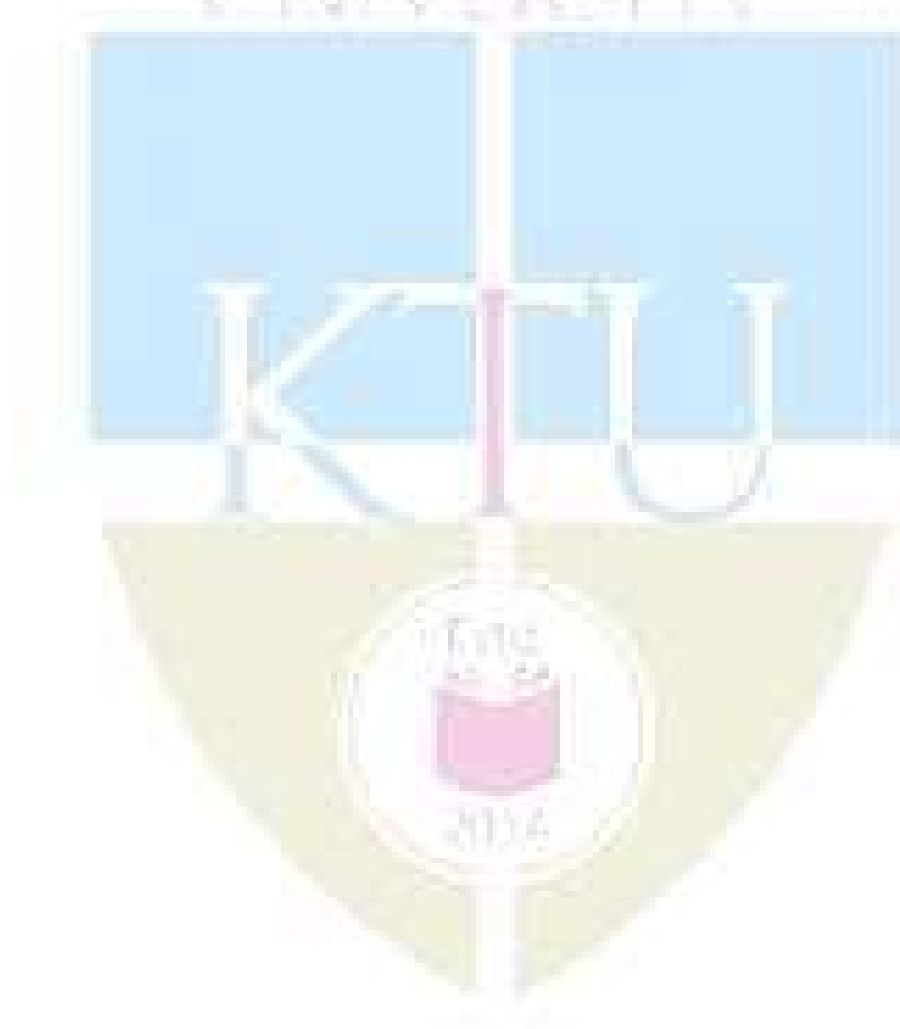
17. (a) Explain reverberation and reverberation time? What is the significance of Reverberation time. Explain the factors affecting the acoustics of a building and their corrective measures? (10)
- (b) The volume of a hall is 3000 m^3 . It has a total absorption of 100 m^2 sabine. If the hall is filled with audience who add another 80 m^2 sabine, then find the difference in reverberation time. (4)
18. (a) With a neat diagram explain how ultrasonic waves are produced by piezoelectric oscillator. Also discuss the piezoelectric method of detection of ultrasonic waves. (10)

- (b) An ultrasonic source of 0.09 MHz sends down a pulse towards the sea bed which returns after 0.55 sec. The velocity of sound in sea water is 1800 m/s. Calculate the depth of the sea and the wavelength of the pulse. (4)

Module 5

19. (a) Outline the construction and working of Ruby laser. (8)
- (b) What is the principle of holography? How is a hologram recorded? (6)
20. (a) Define numerical aperture of an optic fibre and derive an expression for the NA of a step index fibre with a neat diagram. (10)
- (b) An optical fibre made with core of refractive index 1.5 and cladding with a fractional index difference of 0.0006. Find refractive index of cladding and numerical aperture. (4)

(14x5=70)



SYLLABUS

ENGINEERING PHYSICS B (FOR NON-CIRCUIT BRANCHES)

Module 1

Oscillations and Waves

Harmonic oscillations, Damped harmonic motion-Derivation of differential equation and its solution, Over damped, Critically damped and Under damped Cases, Quality factor-Expression, Forced oscillations-Differential Equation-Derivation of expressions for amplitude and phase of forced oscillations, Amplitude Resonance-Expression for Resonant frequency, Quality factor and Sharpness of Resonance, Electrical analogy of mechanical oscillators

Wave motion- Derivation of one dimensional wave equation and its solution, Three dimensional wave equation and its solution (no derivation), Distinction between transverse and longitudinal waves, Transverse vibration in a stretched string, Statement of laws of vibration

Module 2

Wave Optics

Interference of light-Principle of superposition of waves, Theory of thin films - Cosine law (Reflected system), Derivation of the conditions of constructive and destructive Interference, Interference due to wedge shaped films -Determination of thickness and test for optical planeness, Newton's rings - Measurement of wavelength and refractive index, Antireflection coatings

Diffraction of light, Fresnel and Fraunhofer classes of diffraction, Diffraction grating-Grating equation, Rayleigh criterion for limit of resolution, Resolving and Dispersive power of a grating with expression (no derivation)

Module 3

Quantum Mechanics & Nanotechnology

Introduction for the need of Quantum mechanics, Wave nature of Particles, Uncertainty principle, Applications-Absence of electrons inside a nucleus and Natural line broadening Mechanism, Formulation of time dependent and independent Schrodinger wave equations-Physical Meaning of wave function, Particle in a one dimensional box- Derivation for normalised wave function and energy eigen values, Quantum Mechanical Tunnelling (Qualitative)

Introduction to nanoscience and technology, Increase in surface to volume ratio for nanomaterials, Quantum confinement in one dimension, two dimension and three dimension-Nano sheets, Nano wires and Quantum dots, Properties of nanomaterials-mechanical, electrical and optical, Applications of nanotechnology (qualitative ideas)

Module 4

Acoustics & Ultrasonics

Acoustics, Classification of sound-Musical sound-Noise, Characteristics of Musical Sounds-Pitch or frequency-Loudness or Intensity-Measurement of Intensity level-Decibel-Quality or timbre, Absorption coefficient, Reverberation-Reverberation time-Significance- Sabine's formula (no derivation), Factors affecting architectural acoustics and their remedies

Ultrasonics-Production- Magnetostriction effect and Piezoelectric effect, Magnetostriction oscillator and Piezoelectric oscillator -Working, Detection of ultrasonic waves - Thermal and Piezoelectric

methods, Ultrasonic diffractometer- Expression for the velocity of ultrasonic waves in a liquid , Applications of ultrasonic waves -SONAR,NDT and Medical

Module 5

Laser and Fibre optics

Properties of laser, Absorption and emission of radiation, Spontaneous and stimulated emission, Einstein's coefficients (no derivation), Population inversion, Metastable states, basic components of laser, Active medium, Pumping mechanism, Optical resonant cavity, working principle, Construction and working of Ruby laser and Helium neon laser ,Construction and working of semiconductor laser(Qualitative) ,Applications of laser, Holography, Difference between hologram and photograph, Recording of hologram and reconstruction of image, Applications

Optic fibre-Principle of propagation of light, Types of fibres-Step index and Graded index fibres, Numerical aperture –Derivation, Fibre optic communication system (block diagram), Industrial, Medical and Technological applications, Fibre optic sensors-Intensity Modulated and Phase modulated sensors

Text Books

1. M.N.Avadhanulu, P.G.Kshirsagar,TVS Arun Murthy "A Text book of Engineering Physics", S.Chand &Co., Revised Edition, 2019.
2. H.K.Malik , A.K. Singh, "Engineering Physics" McGraw Hill Education, Second Edition, 2017.

Reference Books

1. Arthur Beiser, "Concepts of Modern Physics ", Tata McGraw Hill Publications, 6th Edition 2003
2. D.K. Bhattacharya, Poonam Tandon, "Engineering Physics", Oxford University Press, 2015
3. Md.N.Khan & S.Panigrahi "Principles of Engineering Physics 1&2", Cambridge University Press, 2016
4. Aruldas G., "Engineering Physics", PHI Pvt. Ltd., 2015
5. Ajoy Ghatak, "Optics", Mc Graw Hill Education, Sixth Edition, 2017
6. T. Pradeep, "Nano:The Essentials", McGraw Hill India Ltd, 2007
7. B. B. Laud, "Lasers and Non linear optics", New age International Publishers, 2nd Edition ,2005
8. Premlet B., "Advanced Engineering Physics", Phasor Books,10th edition ,2017
9. I. Dominic and. A. Nahari, "A Text Book of Engineering physics", Owl Books Publishers, Revised edition, 2016

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	Oscillations and Waves (9 hours)	
1.1	Harmonic oscillations, Damped harmonic motion-Derivation of differential equation and its solution, Over damped, Critically damped and Under damped Cases, Quality factor-Expression	2 hrs
1.2	Forced oscillations-Differential Equation-Derivation of expressions for amplitude and phase of forced oscillations, Amplitude Resonance-Expression for Resonant frequency, Quality factor and Sharpness of Resonance, Electrical analogy of mechanical oscillators	3hrs
1.3	Wave motion- Derivation of one dimensional wave equation and its solution, Three dimensional wave equation and its solution (no derivation)	2 hrs
1.4	Distinction between transverse and longitudinal waves, Transverse vibration in a stretched string, Statement of laws of vibration	2 hrs
2	Wave Optics (9 hours)	
2.1	Interference of light-Principle of superposition of waves, Theory of thin films - Cosine law (Reflected system), Derivation of the conditions of constructive and destructive Interference	2 hrs
2.2	Interference due to wedge shaped films -Determination of thickness and test for optical planeness, Newton's rings - Measurement of wavelength and refractive index, Antireflection coatings	4 hrs
2.3	Diffraction of light, Fresnel and Fraunhofer classes of diffraction, Diffraction grating-Grating equation	2 hrs
2.4	Rayleigh criterion for limit of resolution, Resolving and Dispersive power of a grating with expression (no derivation)	1 hr
3	Quantum Mechanics & Nanotechnology (9hours)	
3.1	Introduction for the need of Quantum mechanics, Wave nature of Particles, Uncertainty principle, Applications-Absence of electrons inside a nucleus and Natural line broadening mechanism	2 hrs
3.2	Formulation of time dependent and independent Schrodinger wave equations-Physical Meaning of wave function, Particle in a one dimensional box- Derivation for normalised wave function and energy eigen values, Quantum Mechanical Tunnelling (Qualitative)	4 hrs
3.3	Introduction to nanoscience and technology, Increase in surface to volume ratio for nanomaterials, Quantum confinement in one dimension, two dimension and three dimension-Nano sheets, Nano wires and Quantum dots	2 hrs
3.4	Properties of nanomaterials-mechanical, electrical and optical Applications of nanotechnology (qualitative ideas)	1 hr
4	Acoustics & Ultrasonics (9hrs)	
4.1	Acoustics, Classification of sound-Musical sound-Noise, Characteristics	3 hrs

	of Musical Sounds-Pitch or frequency-Loudness or Intensity-Measurement of Intensity level-Decibel-Quality or timbre, Absorption coefficient, Reverberation-Reverberation time-Significance- Sabine's formula (no derivation)	
4.2	Factors affecting architectural acoustics and their remedies	1 hr
4.3	Ultrasonics-Production- Magnetostriction effect and Piezoelectric effect, Magnetostriction oscillator and Piezoelectric oscillator – Working, Detection of ultrasonic waves - Thermal and Piezoelectric methods	3hrs
4.4	Ultrasonic diffractometer- Expression for the velocity of ultrasonic waves in a liquid ,Applications of ultrasonic waves -SONAR,NDT and Medical.	2 hr
5	Laser and Fibre optics (9hours)	
5.1	Properties of laser, Absorption and emission of radiation, Spontaneous and stimulated emission, Einstein's coefficients (no derivation), Population inversion, Metastable states, basic components of laser, Active medium, Pumping mechanism, Optical resonant cavity, working principle	2 hrs
5.2	Construction and working of Ruby laser and Helium neon laser ,Construction and working of semiconductor laser(Qualitative) Applications of laser	3 hrs
5.3	Holography, Difference between hologram and photograph, Recording of hologram and reconstruction of image, Applications	1 hr
5.4	Optic fibre-Principle of propagation of light, Types of fibres-Step index and Graded index fibres, Numerical aperture –Derivation, Fibre optic communication system (block diagram), Industrial, Medical and Technological applications, Fibre optic sensors-Intensity Modulated and Phase modulated sensors	3 hrs

CYT 100	ENGINEERING CHEMISTRY	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		BSC	3	1	0	4	2019

Preamble: To enable the students to acquire knowledge in the concepts of chemistry for engineering applications and to familiarize the students with different application oriented topics like spectroscopy, electrochemistry, instrumental methods etc. Also familiarize the students with topics like mechanism of corrosion, corrosion prevention methods, SEM, stereochemistry, polymers, desalination etc., which enable them to develop abilities and skills that are relevant to the study and practice of chemistry.

Prerequisite: Concepts of chemistry introduced at the plus two levels in schools

Course outcomes: After the completion of the course the students will be able to

CO 1	Apply the basic concepts of electrochemistry and corrosion to explore its possible applications in various engineering fields.
CO 2	Understand various spectroscopic techniques like UV-Visible, IR, NMR and its applications.
CO 3	Apply the knowledge of analytical method for characterizing a chemical mixture or a compound. Understand the basic concept of SEM for surface characterisation of nanomaterials.
CO 4	Learn about the basics of stereochemistry and its application. Apply the knowledge of conducting polymers and advanced polymers in engineering.
CO 5	Study various types of water treatment methods to develop skills for treating wastewater.

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	1	2	1									
CO 2	1	1		1	2							
CO 3	1	1		1	2							
CO 4	2	1										
CO 5	1			1			3					

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	15	15	30
Understand	25	25	50
Apply	10	10	20
Analyse			
Evaluate			
Create			

End Semester Examination Pattern: There will be two parts- **Part A** and **Part B**. **Part A** contains **10** questions (**2** questions from each module), having **3** marks for each question. Students should answer **all** questions. **Part B** contains **2** questions from each module, of which student should answer any one. Each question can have maximum **2** subdivisions and carries **14** marks.

Course Level Assessment Questions

Course Outcome 1 (CO 1):

1. What is calomel electrode? Give the reduction reaction (3 Marks)
2. List three important advantages of potentiometric titration (3 Marks)
3. (a) Explain how electroless plating copper and nickel are carried out (10 Marks)
(b) Calculate the emf of the following cell at 30°C, $Zn / Zn^{2+} (0.1M) // Ag^+ (0.01M) // Ag$.
Given $E^0 Zn^{2+}/Zn = -0.76 V$, $E^0 Ag^+/Ag = 0.8 V$. (4 Marks)

Course Outcome 2 (CO 2)

1. State Beer Lambert's law (3 Marks)
2. List the important applications of IR spectroscopy (3 Marks)
3. (a) What is Chemical shift? What are factors affecting Chemical shift? How ^1H NMR spectrum of CH_3COCH_2Cl interpreted using the concept of chemical shift. (10 Marks)
(b) Calculate the force constant of HF molecule, if it shows IR absorption at 4138 cm^{-1} . Given that atomic masses of hydrogen and fluorine are 1u and 19u respectively. (4 Marks)

Course Outcome 3 (CO 3):

1. Distinguish between TGA and DTA (3 Marks)
2. Give two differences between GSC and GLC (3 Marks)

3. (a) Explain the principle, instrumentation and procedure of HPLC (10 Marks)

(b) Interpret TGA of $\text{CaC}_2\text{O}_4 \cdot \text{H}_2\text{O}$ (4 Marks)

Course Outcome 4 (CO 4):

1. Explain the geometrical isomerism in double bonds (3 Marks)

2. What are the rules of assigning R-S notation? (3 Marks)

3. (a) What are conducting polymers? How it is classified? Give the preparation of polyaniline (10 Marks)

(b) Draw the stereoisomers possible for $\text{CH}_3\text{-(CHOH)}_2\text{-COOH}$ (4 Marks)

Course Outcome 5 (CO 5):

1. What is degree of hardness? (3 Marks)

2. Define BOD and COD (3 Marks)

3. (a) Explain the EDTA estimation of hardness (10 Marks)

(b) Standard hard water contains 20 g of CaCO_3 per liter, 50 mL of this required 30 mL of EDTA solution, 50 mL of sample water required 20 mL of EDTA solution. 50 mL sample water after boiling required 14 mL EDTA solution. Calculate the temporary hardness of the given sample of water, in terms of ppm. (4 Marks)

MODEL QUESTION PAPER

Total Pages:

Reg No.: _____

Name: _____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
FIRST SEMESTER B.TECH DEGREE EXAMINATION

Course Code: CYT100,

Course Name: ENGINEERING CHEMISTRY

Max. Marks: 100

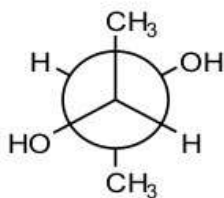
Duration: 3 Hours

PART A

Answer all questions, each carries 3 marks

		Marks
1	What is potentiometric titration? How the end point is determined graphically?	(3)
2	What is Galvanic series? How is it different from electrochemical series?	(3)
3	Which of the following molecules can give IR absorption? Give reason?	(3)
	(a) O_2 (b) H_2O (c) N_2 (d) HCl	
4	Which of the following molecules show UV-Visible absorption? Give reason.	(3)
	(a) Ethane (b) Butadiene (c) Benzene	

- 5 What are the visualization techniques used in TLC? (3)
- 6 Write the three important applications of nanomaterials. (3)
- 7 Draw the Fischer projection formula and find R-S notation of (3)



- 8 Write the structure of a) Polypyrrole b) Kevlar. (3)
- 9 What is break point chlorination? (3)
- 10 What is reverse osmosis? (3)

PART B

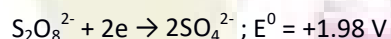
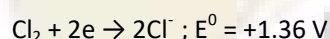
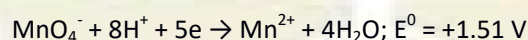
Answer any one full question from each module, each question carries 14 marks

Module 1

- 11 a) Give the construction of Li-ion cell. Give the reactions that take place at the electrodes during charging and discharging. What happens to anodic material when the cell is 100% charged. (10)
- b) Calculate the standard electrode potential of Cu, if its electrode potential at 25 °C is 0.296 V and the concentration of Cu^{2+} is 0.015 M. (4)

OR

- 12 a) Explain the mechanism of electrochemical corrosion of iron in oxygen rich and oxygen deficient acidic and basic environments. (10)
- b) Given below are reduction potentials of some species (4)



Use the above data to examine whether the acids, dil. HCl and dil. H_2SO_4 , can be used to provide acid medium in redox titrations involving KMnO_4 .

Module 2

- 13 a) What is spin-spin splitting? Draw the NMR spectrum of (i) $\text{CH}_3\text{CH}_2\text{CH}_2\text{Br}$ (ii) $\text{CH}_3\text{CH}(\text{Br})\text{CH}_3$. Explain how NMR spectrum can be used to identify the two isomers. (10)
- b) A dye solution of concentration 0.08M shows absorbance of 0.012 at 600 nm; while a test solution of same dye shows absorbance of 0.084 under same conditions. Find the concentration of the test solution. (4)

OR

- 14 a) Explain the basic principle of UV-Visible spectroscopy. What are the possible electronic transitions? Explain with examples. (10)
- b) Sketch the vibrational modes of CO_2 and H_2O . Which of them are IR active? (4)

Module 3

- 15 a) Explain the principle, instrumentation and procedure involved in gas chromatography. (10)
b) Explain the DTA of $\text{CaC}_2\text{O}_4 \cdot \text{H}_2\text{O}$ with a neat sketch. (4)

OR

- 16 a) Explain the various chemical methods used for the synthesis of nanomaterial (10)
b) How TGA is used to analyse the thermal stability of polymers? (4)

Module 4

- 17 a) What are conformers? Draw the *cis* and *trans* isomers of 1, 3-dimethylcyclohexane. (10)
Which conformer (chair form) is more stable in each case?
b) What is ABS? Give properties and applications. (4)

OR

- 18 a) Explain the various structural isomers with suitable example. (10)
b) What is OLED? Draw a labelled diagram. (4)

Module 5

- 19 a) What are ion exchange resins? Explain ion exchange process for removal of hardness of water? How exhausted resins are regenerated? (10)
b) 50 mL sewage water is diluted to 2000 mL with dilution water; the initial dissolved oxygen was 7.7 ppm. The dissolved oxygen level after 5 days of incubation was 2.4 ppm. Find the BOD of the sewage. (4)

OR

- 20 a) What are the different steps in sewage treatment? Give the flow diagram. Explain the working of trickling filter. (10)
b) Calculate the temporary and permanent hardness of a water sample which contains $[\text{Ca}^{2+}] = 160 \text{ mg/L}$, $[\text{Mg}^{2+}] = 192 \text{ mg/L}$ and $[\text{HCO}_3^-] = 122 \text{ mg/L}$. (4)

Syllabus

Module 1

Electrochemistry and Corrosion

Introduction - Differences between electrolytic and electrochemical cells - Daniel cell - redox reactions - cell representation. Different types of electrodes (brief) - Reference electrodes - SHE - Calomel electrode - Glass Electrode - Construction and Working. Single electrode potential - definition - Helmholtz electrical double layer - Determination of E^0 using calomel electrode. Determination of pH using glass electrode. Electrochemical series and its applications. Free energy and EMF - Nernst Equation - Derivation - single electrode and cell (Numericals) - Application - Variation of emf with temperature. Potentiometric titration - Introduction - Redox titration only. Lithium ion cell - construction and working. Conductivity- Measurement of conductivity of a solution (Numericals).

Corrosion-Electrochemical corrosion – mechanism. Galvanic series- cathodic protection - electroless plating –Copper and Nickel plating.

Module 2

Spectroscopic Techniques and Applications

Introduction- Types of spectrum - electromagnetic spectrum - molecular energy levels - Beer Lambert's law (Numericals). UV-Visible Spectroscopy – Principle - Types of electronic transitions - Energy level diagram of ethane, butadiene, benzene and hexatriene. Instrumentation of UV-Visible spectrometer and applications. IR-Spectroscopy – Principle - Number of vibrational modes - Vibrational energy states of a diatomic molecule and -Determination of force constant of diatomic molecule (Numericals) –Applications. ^1H NMR spectroscopy – Principle - Relation between field strength and frequency - chemical shift - spin-spin splitting (spectral problems) - coupling constant (definition) - applications of NMR- including MRI (brief).

Module 3

Instrumental Methods and Nanomaterials

Thermal analysis –TGA- Principle, instrumentation (block diagram) and applications – TGA of $\text{CaC}_2\text{O}_4 \cdot \text{H}_2\text{O}$ and polymers. DTA-Principle, instrumentation (block diagram) and applications - DTA of $\text{CaC}_2\text{O}_4 \cdot \text{H}_2\text{O}$. Chromatographic methods - Basic principles and applications of column and TLC- Retention factor. GC and HPLC-Principle, instrumentation (block diagram) - retention time and applications.

Nanomaterials - Definition - Classification - Chemical methods of preparation - Hydrolysis and Reduction - Applications of nanomaterials - Surface characterisation -SEM – Principle and instrumentation (block diagram).

Module 4

Stereochemistry and Polymer Chemistry

Isomerism-Structural, chain, position, functional, tautomerism and matamerism - Definition with examples - Representation of 3D structures-Newman, Sawhorse, Wedge and Fischer projection of substituted methane and ethane. Stereoisomerism - Geometrical isomerism in double bonds and cycloalkanes (cis-trans and E-Z notations). R-S Notation – Rules and examples - Optical isomerism, Chirality, Enantiomers and Diastereoisomers-Definition with examples. Conformational analysis of ethane, butane, cyclohexane, mono and di methyl substituted cyclohexane.

Copolymers - Definition - Types - Random, Alternating, Block and Graft copolymers - ABS - preparation, properties and applications. Kevlar-preparation, properties and applications. Conducting polymers - Doping - Polyaniline and Polypyrrole - preparation properties and applications. OLED - Principle, construction and advantages.

Module 5

Water Chemistry and Sewage Water Treatment

Water characteristics - Hardness - Types of hardness- Temporary and Permanent - Disadvantages of hard water -Units of hardness- ppm and mg/L -Degree of hardness (Numericals) - Estimation of

hardness-EDTA method (Numericals). Water softening methods-Ion exchange process-Principle, procedure and advantages. Reverse osmosis – principle, process and advantages. Municipal water treatment (brief) - Disinfection methods - chlorination, ozone and UV irradiation.

Dissolved oxygen (DO) -Estimation (only brief procedure-Winkler's method), BOD and COD- definition, estimation (only brief procedure) and significance (Numericals). Sewage water treatment - Primary, Secondary and Tertiary - Flow diagram -Trickling filter and UASB process.

Text Books

1. B. L. Tembe, Kamaluddin, M. S. Krishnan, "Engineering Chemistry (NPTEL Web-book)", 2018.
2. P. W. Atkins, "Physical Chemistry", Oxford University Press, 10th edn., 2014.

Reference Books

1. C. N. Banwell, "Fundamentals of Molecular Spectroscopy", McGraw-Hill, 4th edn., 1995.
2. Donald L. Pavia, "Introduction to Spectroscopy", Cengage Learning India Pvt. Ltd., 2015.
3. B. R. Puri, L. R. Sharma, M. S. Pathania, "Principles of Physical Chemistry", Vishal Publishing Co., 47th Edition, 2017.
4. H. H. Willard, L. L. Merritt, "Instrumental Methods of Analysis", CBS Publishers, 7th Edition, 2005.
5. Ernest L. Eliel, Samuel H. Wilen, "Stereo-chemistry of Organic Compounds", WILEY, 2008.
6. Raymond B. Seymour, Charles E. Carraher, "Polymer Chemistry: An Introduction", Marcel Dekker Inc; 4th Revised Edition, 1996.
7. MuhammedArif, Annette Fernandez, Kavitha P. Nair "Engineering Chemistry", Owl Books, 2019.
8. Ahad J., "Engineering Chemistry", Jai Publication, 2019.
9. Roy K. Varghese, "Engineering Chemistry", Crownplus Publishers, 2019.
10. Soney C. George, RinoLaly Jose, "Text Book of Engineering Chemistry", S. Chand & Company Pvt Ltd, 2019.

Course Contents and Lecture Schedule

No	Topic	No. of Lectures (hrs)
1	Electrochemistry and Corrosion	9
1.1	Introduction - Differences between electrolytic and electrochemical cells- Daniel cell - redox reactions - cell representation. Different types of electrodes (brief) - Reference electrodes- SHE - Calomel electrode - Glass Electrode - Construction and Working.	2
1.2	Single electrode potential – definition - Helmholtz electrical double layer - Determination of E^0 using calomel electrode. Determination of pH using glass electrode. Electrochemical series and its applications. Free energy and EMF - Nernst Equation – Derivation - single electrode and cell (Numericals) -Application -Variation of emf with temperature.	3
1.3	Potentiometric titration - Introduction -Redox titration only. Lithiumion cell - construction and working. Conductivity- Measurement of conductivity of a solution (Numericals).	2
1.4	Corrosion-Electrochemicalcorrosion – mechanism. Galvanic series- cathodic protection - electroless plating –Copper and Nickel plating.	2
2	Spectroscopic Techniques and Applications	9
2.1	Introduction- Types of spectrum - electromagnetic spectrum - molecular energy levels - Beer Lambert's law (Numericals).	2
2.2	UV-Visible Spectroscopy – Principle - Types of electronic transitions - Energy level diagram of ethane, butadiene, benzene and hexatriene. Instrumentation of UV-Visible spectrometer and applications.	2
2.3	IR-Spectroscopy – Principle - Number of vibrational modes -Vibrational energy states of a diatomic molecule and -Determination of force constant of diatomic molecule (Numericals) –Applications.	2
2.4	^1H NMR spectroscopy – Principle - Relation between field strength and frequency - chemical shift - spin-spin splitting (spectral problems) - coupling constant (definition) - applications of NMR- including MRI (brief).	3
3	Instrumental Methods and Nanomaterials	9
3.1	Thermal analysis –TGA- Principle, instrumentation (block diagram) and applications – TGA of $\text{CaC}_2\text{O}_4 \cdot \text{H}_2\text{O}$ and polymers. DTA-Principle, instrumentation (block diagram) and applications - DTA of $\text{CaC}_2\text{O}_4 \cdot \text{H}_2\text{O}$.	2

3.2	Chromatographic methods - Basic principles and applications of column and TLC-Retention factor.	2
3.3	GC and HPLC-Principle, instrumentation (block diagram) - retention time and applications.	2
3.4	Nanomaterials - Definition - Classification - Chemical methods of preparation - Hydrolysis and Reduction - Applications of nanomaterials - Surface characterisation -SEM – Principle and instrumentation (block diagram).	3
4	Stereochemistry and Polymer Chemistry	9
4.1	Isomerism-Structural, chain, position, functional, tautomerism and matamerism - Definition with examples - Representation of 3D structures-Newman, Sawhorse, Wedge and Fischer projection of substituted methane and ethane. Stereoisomerism - Geometrical isomerism in double bonds and cycloalkanes (cis-trans and E-Z notations).	2
4.2	R-S Notation – Rules and examples - Optical isomerism, Chirality, Enantiomers and Diastereoisomers-Definition with examples.	1
4.3	Conformational analysis of ethane, butane, cyclohexane, mono and di methyl substituted cyclohexane.	2
4.4	Copolymers - Definition - Types - Random, Alternating, Block and Graft copolymers - ABS - preparation, properties and applications. Kevlar-preparation, properties and applications. Conducting polymers - Doping -Polyaniline and Polypyrrole - preparation properties and applications. OLED - Principle, construction and advantages.	4
5	Water Chemistry and Sewage Water Treatment	9
5.1	Water characteristics - Hardness - Types of hardness- Temporary and Permanent - Disadvantages of hard water -Units of hardness- ppm and mg/L -Degree of hardness (Numericals) - Estimation of hardness-EDTA method (Numericals). Water softening methods-Ion exchange process-Principle, procedure and advantages. Reverse osmosis – principle, process and advantages.	3
5.2	Municipal water treatment (brief) - Disinfection methods - chlorination, ozone and UV irradiation.	2
5.3	Dissolved oxygen (DO) -Estimation (only brief procedure-Winkler's method), BOD and COD-definition, estimation (only brief procedure) and significance (Numericals).	2
5.4	Sewage water treatment - Primary, Secondary and Tertiary - Flow diagram - Trickling filter and UASB process.	2

EST 100	ENGINEERING MECHANICS	CATEGORY	L	T	P	CREDIT	Year of Introduction
		ESC	2	1	0	3	2019

Preamble: Goal of this course is to expose the students to the fundamental concepts of mechanics and enhance their problem-solving skills. It introduces students to the influence of applied force system and the geometrical properties of the rigid bodies while stationary or in motion. After this course students will be able to recognize similar problems in real-world situations and respond accordingly.

Prerequisite: Nil

Course Outcomes: After completion of the course the student will be able to:

CO 1	Recall principles and theorems related to rigid body mechanics
CO 2	Identify and describe the components of system of forces acting on the rigid body
CO 3	Apply the conditions of equilibrium to various practical problems involving different force system.
CO 4	Choose appropriate theorems, principles or formulae to solve problems of mechanics.
CO 5	Solve problems involving rigid bodies, applying the properties of distributed areas and masses

Mapping of course outcomes with program outcomes (Minimum requirement)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	2	2	-	-	-	-	-	-	-	-	-	-
CO 2	3	3	-	-	-	-	-	-	-	-	-	-
CO 3	3	3	-	-	-	-	-	-	-	-	-	-
CO 4	3	3	-	-	-	-	-	-	-	-	-	-
CO 5	3	3	-	-	-	-	-	-	-	-	-	-

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination (Marks)
	Test 1 (Marks)	Test 2 (Marks)	
Remember	10	10	15
Understand	10	10	15
Apply	30	30	70
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE marks	ESE marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25 marks
Assignment/Quiz/Course project	: 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions:

Part A

Course Outcome 1 (CO1): (One question from each module to meet the course objective 1: *To recall principles and theorems related to rigid body mechanics*)

1. Explain D'Alembert's principle
2. Distinguish static and dynamic friction
3. State and explain perpendicular axis theorem

Course Outcome 2 (CO2) (One question from each module to meet the course objective 2: *To identify and describe the components of system of forces acting on the rigid body*)

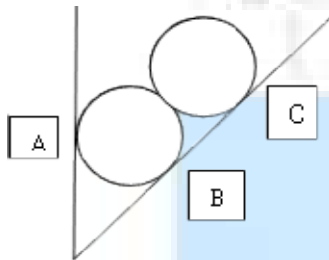
1. A simply supported beam AB of span 5 m is carrying point loads 5 kN, 3 kN and 2 kN at 1m, 3m and 4m respectively from support A. Calculate the support reaction at B.
2. A gymnast holding onto a bar, is suspended motionless in mid-air. The bar is supported by two ropes that attach to the ceiling. Diagram the forces acting on the combination of gymnast and bar
3. While you are riding your bike, you turn a corner following a circular arc. Illustrate the forces that act on your bike to keep you along the circular path ?

Part B

All the questions under this section shall assess the learning levels corresponding to the course outcomes listed below.

CO 3	To apply the conditions of equilibrium to various practical problems involving different force system.
CO 4	To choose appropriate theorems, principles or formulae to solve problems of mechanics.
CO 5	To solve problems involving rigid bodies, applying the properties of distributed areas and masses

1. Two rollers each of weight 100 N are supported by an inclined plane and a vertical wall. Find the reaction at the points of contact A, B, C. Assume all the surfaces to be smooth.

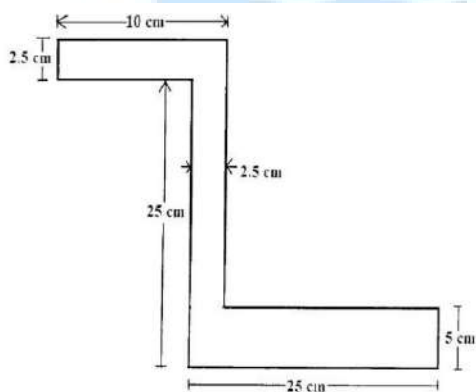


Course outcome identifier	Description of course outcome	Learning level assessed	Marks allocated
CO 3	To apply the conditions of equilibrium to various practical problems involving different force system.	Applying – (Sketch the free body diagram that represent equilibrium state of the body)	4
CO 4	To choose appropriate theorems, principles or formulae to solve problems of mechanics.	Applying (Choose the equations and formulae required for calculation)	4
CO 5	To solve problems involving rigid bodies, applying the properties of distributed areas and masses	Applying (Solve the problem based on the descriptions given in CO3 and CO4)	6
Total			14

2. A cylindrical disc, 50 cm diameter and cm thickness, is in contact with a horizontal conveyor belts running at uniform speeds of 5 m/s. Assuming there is no slip at points of contact determine (i) angular velocity of disc (ii) Angular acceleration of disc if velocity of conveyor changes to 8 m/s. Also compute the moment acting about the axis of the disc in both cases.

Course outcome identifier	Description of course outcome	Learning level assessed	Marks allocated
CO 3	To apply the conditions of equilibrium to various practical problems involving different force system.	Applying – (Sketch the free body diagram that represent state of the body)	4
CO 4	To choose appropriate theorems, principles or formulae to solve problems of mechanics.	Applying (Choose the equations and formulae required for calculation)	4
CO 5	To solve problems involving rigid bodies, applying the properties of distributed areas and masses	Applying (Solve the problem based on the descriptions given in CO3 and CO4)	6
Total			14

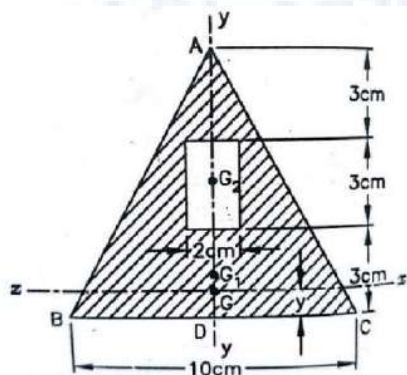
3. Determine the centroid of the given section



Course outcome identifier	Description of course outcome	Learning level assessed	Marks allocated
CO 3	To apply the conditions of equilibrium to various practical problems involving different force system.	Applying – (Illustrate the computation of centroid for the given geometrical shape)	4
CO 4	To choose appropriate theorems, principles or formulae to solve problems of mechanics.	Applying (Choose the equations and formulae required for calculation)	4
CO 5	To solve problems involving rigid bodies, applying the properties of distributed	Applying (Solve the problem based on the descriptions	6

	areas and masses	given in CO3 and CO4)	
Total			14

4. A rectangular hole is made in a triangular section as shown. Find moment of inertia about the section x-x passing through the CG of the section and parallel to BC.



Course outcome identifier	Description of course outcome	Learning level assessed	Marks allocated
CO 3	To apply the conditions of equilibrium to various practical problems involving different force system.	Applying – (Illustrate the computation of moment of inertia for the given geometrical shape)	4
CO 4	To choose appropriate theorems, principles or formulae to solve problems of mechanics.	Applying (Choose the equations and formulae required for calculation)	4
CO 5	To solve problems involving rigid bodies, applying the properties of distributed areas and masses	Applying (Solve the problem based on the descriptions given in CO3 and CO4)	6
Total			14

Model Question Paper

QP CODE:

Reg No.: _____

Name: _____

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY FIRST SEMESTER B.TECH DEGREE EXAMINATION,
MONTH & YEAR**

Course Code: EST 100

ENGINEERING MECHANICS

Max. Marks: 100

Duration: 3 hours

Part A

(Answer all questions; each question carries 3 marks)

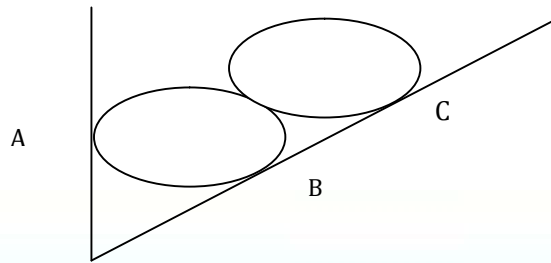
1. Explain D'Alembert's principle
2. Distinguish static and dynamic friction.
3. State and explain perpendicular axis theorem.
4. A simply supported beam AB of span 5 m is carrying point loads 5 kN, 3 kN and 2 kN at 1m, 3m and 4m respectively from support A. Calculate the support reaction at B.
5. A gymnast holding onto a bar, is suspended motionless in mid-air. The bar is supported by two ropes that attach to the ceiling. Diagram the forces acting on the combination of gymnast and bar
6. While you are riding your bike, you turn a corner following a circular arc. Illustrate the forces that act on your bike to keep you along the circular path ?
7. Compare damped and undamped free vibrations.
8. State the equation of motion of a rotating rigid body, rotating about its fixed axis.
9. Illustrate the significance of instantaneous centre in the analysis of rigid body undergoing rotational motion.
10. Highlight the principles of mechanics applied in the evaluation of elastic collision of rigid bodies.

PART B

(Answer **one full** question from each module, each question carries **14** marks)

Module -I

11. Two identical rollers each of weight 100 N are supported by an inclined plane, making an angle of 30° with the vertical, and a vertical wall. Find the reaction at the points of contact A, B, C. Assume all the surfaces to be smooth. (14 marks)

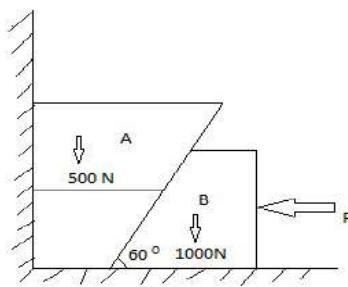


12. A string tied to a wall is made to pass over a pulley placed 2m away from it. A weight P is attached to the string such that the string stretches by 2m from the support on the wall to the location of attachment of weight. Determine the force P required to maintain 200 kg body in position for $\theta = 30^\circ$. The diameter of pulley B is negligible. (14 marks)

Module – 2

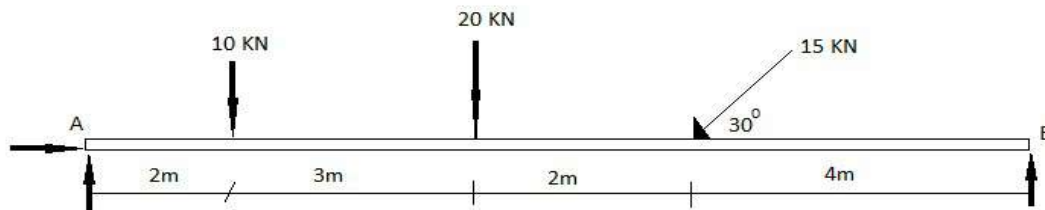
13. Two blocks A & B are resting against a wall and the floor as shown in figure below. Find the value of horizontal force P applied to the lower block that will hold the system in equilibrium. Coefficient of friction are : 0.25 at the floor, 0.3 at the wall and 0.2 between the blocks.

(14 marks)



14. A beam is hinged at A and roller supported at B. It is acted upon by loads as shown below. Find the reactions at A & B.

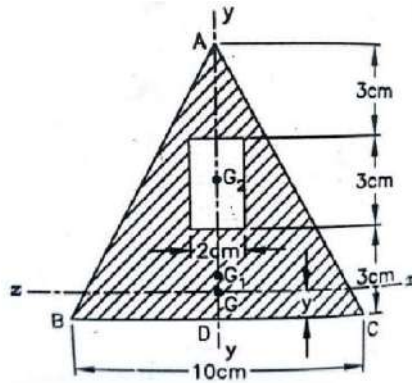
(14 marks)



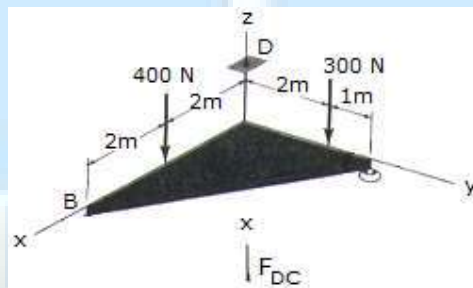
Module – 3

15. A rectangular hole is made in a triangular section as shown. Find moment of inertia about the section x-x passing through the CG of the section and parallel to BC.

(14 marks)



16. Support A has ball and socket connection. Roller support at B prevents motion in the $-z$ direction. Corner C is tied to D by a rope. The triangle is weightless. Determine the unknown force components acting at A, B, and C. (14 marks)



Module - 4

17. A cricket ball is thrown by a fielder from a height of 2m at an angle of 30° to the horizontal with an initial velocity of 20 m/s, hits the wickets at a height of 0.5 m from the ground. How far was the fielder from the wicket? (14 marks)

18. An engine of weight 500 kN pull a train weighing 1500 kN up an incline of 1 in 100. The train starts from rest and moves with constant acceleration against a resistance of 5 N/kN. It attains a maximum speed of 36 kmph in 1 km distance. Determine the tension in the coupling between train and engine and the traction force developed by the engine. (14marks)

Module – 5

19. A cylindrical disc, 50 cm diameter and 10 cm thickness having mass of 10 kg, is in contact with a horizontal conveyor belt running at uniform speeds of 5 m/s. Assuming there is no slip at points of contact determine (i) angular velocity of disc (ii) Angular acceleration of disc if velocity of conveyor changes to 8 m/s in 10 seconds. Also compute the moment acting about the axis of the disc in both cases. (14 marks)
20. A wheel rotating about fixed axis at 20 rpm is uniformly accelerated for 70 seconds during which time it makes 50 revolutions. Find the (i) angular velocity at the end of this interval and (ii) time required for the velocity to reach 100 revolutions per minute. (14 marks)

SYLLABUS

Module 1

Introduction to Engineering Mechanics-statics-basic principles of statics-Parallelogram law, equilibrium law, principles of superposition and transmissibility, law of action and reaction(review) free body diagrams.

Concurrent coplanar forces-composition and resolution of forces-resultant and equilibrium equations – methods of projections – methods of moments – Varignon's Theorem of moments.

Module 2

Friction – sliding friction - Coulomb's laws of friction – analysis of single bodies –wedges, ladder-analysis of connected bodies .

Parallel coplanar forces – couple - resultant of parallel forces – centre of parallel forces – equilibrium of parallel forces – Simple beam subject to concentrated vertical loads. General coplanar force system - resultant and equilibrium equations.

Module 3

Centroid of composite areas- – moment of inertia-parallel axis and perpendicular axis theorems. Polar moment of inertia, radius of gyration, mass moment of inertia-ring, cylinder and disc.

Theorem of Pappus Guldinus(demonstration only)

Forces in space - vectorial representation of forces, moments and couples –resultant and equilibrium equations – concurrent forces in space (simple problems only)

Module 4

Dynamics – rectilinear translation - equations of kinematics(review)

kinetics – equation of motion – D'Alembert's principle. – motion on horizontal and inclined surfaces, motion of connected bodies. Impulse momentum equation and work energy equation (concepts only).

Curvilinear translation - equations of kinematics –projectile motion(review), kinetics – equation of motion. Moment of momentum and work energy equation (concepts only).

Module 5

Rotation – kinematics of rotation- equation of motion for a rigid body rotating about a fixed axis – rotation under a constant moment.

Plane motion of rigid body – instantaneous centre of rotation (concept only).

Simple harmonic motion – free vibration –degree of freedom- undamped free vibration of spring mass system-effect of damping(concept only)

Text Books

1. Timoshenko and Young, Engineering Mechanics, McGraw Hill Publishers
2. Shames, I. H., Engineering Mechanics - Statics and Dynamics, Prentice Hall of India.
3. R. C. Hibbeler and Ashok Gupta, Engineering Mechanics, Vol. I statics, Vol II Dynamics, Pearson Education.

References

1. Merriam J. L and Kraige L. G., Engineering Mechanics - Vols. 1 and 2, John Wiley.
2. Tayal A K, Engineering Mechanics – Statics and Dynamics, Umesh Publications
3. Bhavikkatti, S.S., Engineering Mechanics, New Age International Publishers
4. F.P.Beer and E.R.Johnston (2011), Vector Mechanics for Engineers, Vol.I-Statics, Vol.II-Dynamics, 9th Ed, Tata McGraw Hill
5. Rajasekaran S and Sankarasubramanian G, Engineering Mechanics - Statics and Dynamics, Vikas Publishing House Pvt Ltd.

Course Contents and Lecture Schedule:

Module	Topic	Course outcomes addressed	No. of Hours
1	Module 1		Total: 7
1.1	Introduction to engineering mechanics – introduction on statics and dynamics - Basic principles of statics – Parellogram law, equilibrium law – Superposition and transmissibility, law of action and reaction (review the topics)	CO1 and CO2	1
1.2	Free body diagrams. Degree of freedom-types of supports and nature of reactions - exercises for free body diagram preparation – composition and resolution of forces, resultant and equilibrium equations (review the topics) - numerical exercises for illustration.	CO1 and CO2	1
1.3	Concurrent coplanar forces - analysis of concurrent forces -methods of projections – illustrative numerical exercise – teacher assisted problem solving.	CO1 and CO2	1
1.4	Analysis of concurrent forces -methods of moment-Varignon's Theorem of Moments - illustrative numerical exercise– teacher assisted problem solving.	CO1 and CO2	1
1.5	Analysis of concurrent force systems – extended problem solving - Session I.	CO3,CO4 and CO5	1
1.6	Analysis of concurrent force systems – extended problem solving - Session II – learning review quiz.	CO3,CO4 and CO5	1
1.7	Analysis of concurrent force systems – extended problem solving - Session III.	CO3,CO4 and CO5	1
2	Module 2		Total: 7
2.1	Friction – sliding friction - Coulomb's laws of friction – analysis of single bodies –illustrative examples on wedges and ladder-teacher	CO1 and CO2	1

	assisted problem solving tutorials using problems from wedges and ladder.		
2.2	Problems on friction - analysis of connected bodies. illustrative numerical exercise– teacher assisted problem solving.	CO3, CO4 and CO5	1
2.3	Problems on friction-extended problem solving	CO3,CO4 and CO5	1
2.4	Parallel coplanar forces – couple - resultant of parallel forces – centre of parallel forces – equilibrium of parallel forces – Simple beam subject to concentrated vertical loads.	CO1 and CO2	1
2.5	General coplanar force system - resultant and equilibrium equations - illustrative examples- teacher assisted problem solving.	CO1 and CO2	1
2.6	General coplanar force system-resultant and equilibrium equations - illustrative examples	CO3, CO4 and CO5	1
2.7	General coplanar force system - Extended problem solving - Quiz to evaluate learning level.	CO3, CO4 and CO5	1
3	Module 3		Total: 7
3.1	Centroid of simple and regular geometrical shapes – centroid of figures in combination - composite areas- examples for illustration – problems for practice to be done by self.	CO1 and CO2	1
3.2	Moment of inertia- parallel axis theorem –examples for illustration - problems for practice to be done by self.	CO1 and CO2	1
3.3	Moment of inertia - perpendicular axis theorem - example for illustration to be given as hand out and discussion on the solved example.	CO1 and CO2	1
3.4	Solutions to practice problems – problems related to centroid and moment of inertia - problems for practice to be done by self.	CO3, CO4 and CO5	1
3.5	Polar moment of inertia, Radius of gyration. Mass moment of inertia of ring, cylinder and uniform disc. Theorem of Pappus Guldinus - Demonstration	CO1 and CO2	1
3.6	Introduction to forces in space – vectorial representation of forces, moments and couples – simple problems to illustrate vector representations of forces, moments and couples to be done in class.	CO1,and CO2	1
3.7	Solution to practice problems - resultant and equilibrium equations for concurrent forces in space – concurrent forces in space - 2 simple problems to illustrate the application of resultant and equilibrium equations for concurrent forces in space.	CO3,CO4 and CO5	1
4	Module 4		Total: 7

4.1	Introduction to dynamics – review of rectilinear translation - equations of kinematics – problems to review the concepts – additional problems involving extended application as exercises .	CO1 and CO2	1
4.2	Solutions to exercises with necessary explanation given as hand out – introduction to kinetics – equation of motion – D’Alembert’s principle – illustration of the concepts using one numerical exercise from motion on horizontal and inclined surfaces.	CO1 and CO2	1
4.3	Motion of connected bodies - example for illustration to be given as hand out and discussion on the solved example – problems for practice to be done by self.	CO3, CO4 and CO5	1
4.4	Motion of connected bodies-extended problem solving.	CO3, CO4 & CO5	1
4.5	Curvilinear translation - Review of kinematics –projectile motion – simple problems to review the concepts – introduction to kinetics – equation of motion – illustration of the concepts using numerical exercises.	CO3, CO4 & CO5	1
4.6	Extended problem solving – rectilinear and curvilinear translation.	CO3, CO4 & CO5	1
4.7	Concepts on Impulse momentum equation and work energy equation (rectilinear translation – discussions to bring out difference between elastic and inelastic collisions). Concepts on Moment of momentum and work energy equation (curvilinear translation).	CO1 and CO2	1
5	Module 5		Total: 7
5.1	Rotation – kinematics of rotation- equation of motion for a rigid body rotating about a fixed axis – simple problems for illustration.	CO1 and CO2	1
5.2	Rotation under a constant moment – teacher assisted problem solving.	CO3,CO4 and CO5	1
5.3	Rotation under a constant moment - extended problem solving.	CO3, CO4 and CO5	1
5.4	Plane motion of rigid body- instantaneous centre of rotation (concept only).	CO1 and CO2	1
5.5	Introduction to harmonic oscillation –free vibrations - simple harmonic motion – differential equation and solution. Degree of freedom – examples of single degree of freedom (SDOF) systems – Idealisation of mechanical systems as spring-mass systems (concept only).	CO1 and CO2	1

5.6	SDOF spring mass system –equation of motion – undamped free vibration response - concept of natural frequency. Free vibration response due to initial conditions. Simple problems on determination of natural frequency and free vibration response to test the understanding level.	CO1 and CO2	1
5.7	Free vibration analysis of SDOF spring-mass systems – Problem solving Effect of damping on free vibration response (concept only).	CO1and CO2	1



EST 110	ENGINEERING GRAPHICS	CATEGORY	L	T	P	CREDIT	Year of Introduction
		ESC	2	0	2	3	2019

Preamble: To enable the student to effectively perform technical communication through graphical representation as per global standards.

Prerequisite: NIL

Course Outcomes: After the completion of the course the student will be able to

CO 1	Draw the projection of points and lines located in different quadrants
CO 2	Prepare multiview orthographic projections of objects by visualizing them in different positions
CO 3	Draw sectional views and develop surfaces of a given object
CO 4	Prepare pictorial drawings using the principles of isometric and perspective projections to visualize objects in three dimensions.
CO 5	Convert 3D views to orthographic views
CO 6	Obtain multiview projections and solid models of objects using CAD tools

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3											
CO 2	3											
CO 3	3	1										
CO 4	3									1		
CO 5	3									2		
CO 6	3				3					3		

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination (100 Marks)
	Test 1 (15 Marks)	Test 2 (15 Marks)	
Remember			
Understand	5		20
Apply	10	10	80
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE (Marks)	ESE (Marks)	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks

CIA for section A carries 25 marks (15 marks for 1 test and Class work 10 marks)

CIA for section B carries 15 marks (10 marks for 1 test and Class work 5 marks)

End Semester Examination Pattern:

ESE will be of 3 hour duration on A4 size answer booklet and will be for 100 marks. The question paper shall contain two questions from each module of Section A only. Student has to answer any one question from each module. Each question carries 20 marks.

Course Level Assessment Questions

(Questions may be framed based on the outline given under each course outcome)

Course Outcome 1 (CO1):

1. Locate points in different quadrants as per given conditions.
2. Problems on lines inclined to both planes .
3. Find True length, Inclinations and Traces of lines.

Course Outcome 2 (CO2)

1. Draw orthographic views of solids and combination solids
2. Draw views of solids inclined to any one reference plane.
3. Draw views of solids inclined to both reference planes.

Course Outcome 3 (CO3):

1. Draw views of solids sectioned by a cutting plane
2. Find location and inclination of cutting plane given true shape of the section
3. Draw development of lateral surface of solids and also its sectioned views

Course Outcome 4 (CO4):

1. Draw Isometric views/projections of solids
2. Draw Isometric views/projections of combination of solids
3. Draw Perspective views of Solids

Course Outcome 5 (CO5):

1. Draw Orthographic views of solids from given three dimensional view

Course Outcome 6 (CO6):

1. Draw the given figure including dimensions using 2D software
2. Create 3D model using modelling software from the given orthographic views or 3D figure or from real 3D objects

Model Question paper

QP CODE:

PAGES:3

Reg No: _____

Name : _____

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY FIRST SEMESTER B.TECH DEGREE EXAMINATION,
MONTH & YEAR**

Course Code: EST 110

ENGINEERING GRAPHICS

Max.Marks:100

Duration: 3 Hours

PART A

Answer all Questions. Each question carries 3 Marks

Instructions: Retain necessary Construction lines

Show necessary dimensions

Answer any ONE question from each module

Each question carries 20 marks

MODULE I

1. The end point A of a line is 20mm above HP and 10mm in front of VP. The other end of the line is 50mm above HP and 15mm behind VP. The distance between the end projectors is 70mm. Draw the projections of the line. Find the true length and true inclinations of the line with the principal planes. Also locate the traces of the line.
2. One end of a line is 20mm from both the principal planes of projection. The other end of the line is 50mm above HP and 40mm in front of VP. The true length of the line is 70mm. Draw the projections of the line. Find its apparent inclinations, elevation length and plan length. Also locate its traces.

MODULE II

3. A pentagonal pyramid of base side 25mm and height 40mm, is resting on the ground on one of its triangular faces. The base edge of that face is inclined 30° to VP. Draw the projections of the solid.

4. A hexagonal prism has side 25mm and height 50mm has a corner of its base on the ground and the long edge containing that corner inclined at 30° to HP and 45° to VP. Draw the projections of the solid.

MODULE III

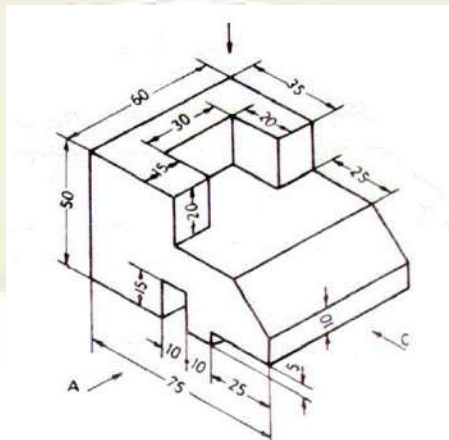
5. A triangular prism of base side 40mm and height 70mm is resting with its base on the ground and having an edge of the base perpendicular to VP. Section the solid such that the true shape of the section is a trapezium of parallel sides 30mm and 10mm. Draw the projections showing the true shape. Find the inclination of the cutting plane with the ground plane.
6. Draw the development of a pentagonal pyramid of base side 30mm and height 50mm. A string is wound from a corner of the base round the pyramid and back to the same point through the shortest distance. Show the position of the string in the elevation and plan.

MODULE IV

7. The frustum of a cone has base diameter 50mm and top diameter 40mm has a height of 60mm. It is placed centrally on top of a rectangular slab of size 80x60mm and of thickness 20mm. Draw the isometric view of the combination.
8. A hexagonal prism has base side 35mm and height 60mm. A sphere of diameter 40mm is placed centrally on top of it. Draw the isometric projection of the combination.

MODULE V

9. Draw the perspective view of a pentagonal prism, 20mm side and 45mm long lying on one of its rectangular faces on the ground and having its axis perpendicular to picture plane. One of its pentagonal faces touches the picture plane and the station point is 50mm in front of PP, 25mm above the ground plane and lies in a central plane, which is 70mm to the left of the center of the prism.
10. Draw three orthographic views with dimensions of the object shown in figure below.



(20X5=100)

SCHEME OF VALUATION

1. Locating the points and drawing the projections of the line – 4 marks
Finding true length by any one method – 6 marks
Finding true inclination with VP – 2 marks
Finding true inclination with HP – 2 marks
Locating horizontal trace – 2 marks
Locating vertical trace – 2 marks
Dimensioning and neatness – 2 marks

Total = 20 marks

2. Locating the points and drawing true length of the line – 4 marks
Finding projections by any method – 6 marks
Finding length of elevation and plan – 2 marks
Finding apparent inclinations – 2 marks
Locating horizontal trace – 2 marks
Locating vertical trace – 2 marks
Dimensioning and neatness – 2 marks

Total = 20 marks

3. Drawing initial position plan and elevation – 4 marks
First inclination views – 4 marks
Second inclination views -8 marks
Marking invisible edges – 2 marks
Dimensioning and neatness – 2 marks

Total = 20 marks

*(Any one method or combination of methods for solving can be used.**If initial position is wrong then maximum 50% marks may be allotted for the answer)*

4. Drawing initial position plan and elevation – 4 marks
First inclination views – 4 marks
Second inclination views -8 marks
Marking invisible edges – 2 marks
Dimensioning and neatness – 2 marks

Total = 20 marks

*(Any one method or combination of methods for solving can be used**If initial position is wrong then maximum 50% marks may be allotted for the answer)*

5. Drawing initial position plan and elevation – 4 marks
Locating section plane as per given condition – 5 marks
Drawing true shape -5 marks
Finding inclination of cutting plane – 2 marks
Dimensioning and neatness – 2 marks

Total = 20 marks

6. Drawing initial position plan and elevation – 4 marks
Development of the pyramid – 6 marks

Locating string in development -2 marks
Locating string in elevation – 3 marks
Locating string in plan – 3 marks
Dimensioning and neatness – 2 marks

Total = 20 marks

7. Drawing initial positions – 4 marks
Isometric View of Slab -6 marks
Isometric View of Frustum – 10 marks
Dimensioning and neatness – 2 marks

Total = 20 marks

*(Initial position is optional, hence redistribute if needed.
Reduce 4 marks if Isometric scale is taken)*

8. Drawing initial positions – 4 marks
Isometric scale – 4 marks
Isometric projection of prism -5 marks
Isometric projection of sphere – 5 marks
Dimensioning and neatness – 2 marks

Total = 20 marks

(Initial position is optional, hence redistribute if needed.

9. Drawing the planes and locating the station point – 4 marks
Locating elevation points – 2 marks
Locating plan points – 2 marks
Drawing the perspective view – 10 marks
Dimensioning and neatness – 2 marks

Total = 20 marks

10. Drawing the elevation – 8marks
Drawing the plan – 4 marks
Drawing the side view – 4 marks
Marking invisible edges – 2 marks
Dimensioning and neatness – 2 marks

Total = 20 marks

SYLLABUS

General Instructions:

- First angle projection to be followed
- Section A practice problems to be performed on A4 size sheets
- Section B classes to be conducted on CAD lab

SECTION A

Module 1

Introduction : Relevance of technical drawing in engineering field. Types of lines, Dimensioning, BIS code of practice for technical drawing.

Orthographic projection of Points and Lines: Projection of points in different quadrants, Projection of straight lines inclined to one plane and inclined to both planes. Trace of line. Inclination of lines with reference planes True length of line inclined to both the reference planes.

Module 2

Orthographic projection of Solids: Projection of Simple solids such as Triangular, Rectangle, Square, Pentagonal and Hexagonal Prisms, Pyramids, Cone and Cylinder. Projection of solids in simple position including profile view. Projection of solids with axis inclined to one of the reference planes and with axis inclined to both reference planes.

Module 3

Sections of Solids: Sections of Prisms, Pyramids, Cone, Cylinder with axis in vertical position and cut by different section planes. True shape of the sections. Also locating the section plane when the true shape of the section is given.

Development of Surfaces: Development of surfaces of the above solids and solids cut by different section planes. Also finding the shortest distance between two points on the surface.

Module 4

Isometric Projection: Isometric View and Projections of Prisms, Pyramids, Cone , Cylinder, Frustum of Pyramid, Frustum of Cone, Sphere, Hemisphere and their combinations.

Module 5

Perspective Projection: Perspective projection of Prisms and Pyramids with axis perpendicular to the ground plane, axis perpendicular to picture plane.

Conversion of Pictorial Views: Conversion of pictorial views into orthographic views.

SECTION B

(To be conducted in CAD Lab)

Introduction to Computer Aided Drawing: Role of CAD in design and development of new products, Advantages of CAD. Creating two dimensional drawing with dimensions using suitable software. (Minimum 2 exercises mandatory)

Introduction to Solid Modelling: Creating 3D models of various components using suitable modelling software. (Minimum 2 exercises mandatory)

Text Books

1. Bhatt, N.D., Engineering Drawing, Charotar Publishing House Pvt. Ltd.
2. John, K.C. Engineering Graphics, Prentice Hall India Publishers.

Reference Books

1. Anilkumar, K.N., Engineering Graphics, Adhyuth narayan Publishers
2. Agrawal, B. And Agrawal, C.M., Engineering Drawing, Tata McGraw Hill Publishers.
3. Benjamin, J., Engineering Graphics, Pentex Publishers- 3rd Edition, 2017
4. Duff, J.M. and Ross, W.A., Engineering Design and Visualisation, Cengage Learning.
5. Kulkarni, D.M., Rastogi, A.P. and Sarkar, A.K., Engineering Graphics with AutoCAD, PHI.
6. Luzaddff, W.J. and Duff, J.M., Fundamentals of Engineering Drawing, PHI.
7. Varghese, P.I., Engineering Graphics, V I P Publishers
8. Venugopal, K., Engineering Drawing and Graphics, New Age International Publishers.

Course Contents and Lecture Schedule

No	SECTION A	No. of Hours
1	MODULE I	
1.1	Introduction to graphics, types of lines, Dimensioning	1
1.2	Concept of principle planes of projection, different quadrants, locating points on different quadrants	2
1.3	Projection of lines, inclined to one plane. Lines inclined to both planes, trapezoid method of solving problems on lines.	2
1.4	Problems on lines using trapezoid method	2
1.5	Line rotation method of solving, problems on line rotation method	2
2	MODULE II	
2.1	Introduction of different solids, Simple position plan and elevation of solids	2
2.2	Problems on views of solids inclined to one plane	2
2.3	Problems on views of solids inclined to both planes	2
2.4	Practice problems on solids inclined to both planes	2

3	MODULE III	
3.1	Introduction to section planes. AIP and AVP. Principle of locating cutting points and finding true shape	2
3.2	Problems on sections of different solids	2
3.3	Problems when the true shape is given	2
3.4	Principle of development of solids, sectioned solids	2
4	MODULE IV	
4.1	Principle of Isometric View and Projection, Isometric Scale. Problems on simple solids	2
4.2	Isometric problems on Frustum of solids, Sphere and Hemisphere	2
4.3	Problems on combination of different solids	2
5	MODULE V	
5.1	Introduction to perspective projection, different planes, station point etc. Perspective problems on pyramids	2
5.2	Perspective problems on prisms	2
5.3	Practice on conversion of pictorial views into orthographic views	2
	SECTION B <i>(To be conducted in CAD lab)</i>	
1	Introduction to CAD and software. Familiarising features of 2D software. Practice on making 2D drawings	2
2	Practice session on 2D drafting	2
3	Introduction to solid modelling and software	2
4	Practice session on 3D modelling	2

EST 120	BASICS OF CIVIL & MECHANICAL ENGINEERING	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		ESC	4	0	0	4	2019

Preamble:

Objective of this course is to provide an insight and inculcate the essentials of Civil Engineering discipline to the students of all branches of Engineering and to provide the students an illustration of the significance of the Civil Engineering Profession in satisfying the societal needs.

To introduce the students to the basic principles of mechanical engineering

Prerequisite: NIL

Course Outcomes: After completion of the course, the student will be able to

CO 1	Recall the role of civil engineer in society and to relate the various disciplines of Civil Engineering.
CO 2	Explain different types of buildings, building components, building materials and building construction
CO 3	Describe the importance, objectives and principles of surveying.
CO 4	Summarise the basic infrastructure services MEP, HVAC, elevators, escalators and ramps
CO 5	Discuss the Materials, energy systems, water management and environment for green buildings.
CO 6	Analyse thermodynamic cycles and calculate its efficiency
CO 7	Illustrate the working and features of IC Engines
CO 8	Explain the basic principles of Refrigeration and Air Conditioning
CO 9	Describe the working of hydraulic machines
CO 10	Explain the working of power transmission elements
CO 11	Describe the basic manufacturing, metal joining and machining processes

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	-	-	-	-	3	2	2	-	-	-	-
CO2	3	2	-	1	3	-	-	3	-	-	-	-
CO3	3	2	-	-	3	-	-	-	2	-	-	-

CO4	3	2	-	-	3	-	-	-	2	-	-	-
CO5	3	2	-	-	3	2	3	-	2	-	-	-
CO6	3	2										
CO7	3	1										
CO8	3	1										
CO9	3	2										
CO10	3	1										
CO11	3											

Assessment Pattern

	Basic Civil Engineering			Basic Mechanical Engineering		
Bloom's Category	Continuous Assessment		End Semester Examination (marks)	Continuous Assessment		End Semester Examination (marks)
	Test 1 marks	Test 2 marks		Test 1 marks	Test 2 marks	
Remember	5	5	10	7.5	7.5	15
Understand	20	20	40	12.5	12.5	25
Apply				5	5	10
Analyse						
Evaluate						
Create						

Mark distribution

Total Marks	CIE (Marks)	ESE (Marks)	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25 marks
Assignment/Quiz/Course project	: 15 marks

End Semester Examination Pattern:

There will be two parts; Part I – Basic Civil Engineering and Part II – Basic Mechanical Engineering. Part I and PART II carries 50 marks each. For the end semester examination, part I contain 2 parts -

Part A and Part B. Part A contain 5 questions carrying 4 marks each (not exceeding 2 questions from each module). Part B contains 2 questions from each module out of which one to be answered. Each question carries 10 mark and can have maximum 2 sub-divisions. The pattern for end semester examination for part II is same as that of part I. **However, student should answer both part I and part 2 in separate answer booklets.**

Course Level Assessment Questions:

Course Outcome CO1: *To recall the role of civil engineer in society and to relate the various disciplines of Civil Engineering.*

1. Explain relevance of Civil engineering in the overall infrastructural development of the country.

Course outcome 2 (CO2) (One question from each module and not more than two)

Explain different types of buildings, building components, building materials and building construction

1. Discuss the difference between plinth area and carpet area.

Course outcome 3 (CO3) (One question from each module and not more than two)

Describe the importance, objectives and principles of surveying.

1. Explain the importance of surveying in Civil Engineering

Course outcome 4 (CO4) (One question from each module and not more than two)

Summarise the basic infrastructure services MEP, HVAC, elevators, escalators and ramps

1. Explain the civil engineering aspects of elevators, escalators and ramps in buildings

Course outcome 5 (CO5) (One question from each module and not more than two)

Discuss the Materials, energy systems, water management and environment for green buildings.

1. Discuss the relevance of Green building in society

Section II *Answer any 1 full question from each module. Each full question carries 10 marks*

Course Outcome 1 (CO1) (Two full question from each module and each question can have maximum 2 sub-divisions)

To recall the role of civil engineer in society and to relate the various disciplines of Civil Engineering

CO Questions

1. **a** List out the types of building as per occupancy. Explain any two, each in about five sentences.

b. Discuss the components of a building with a neat figure.

2. **a.** What are the major disciplines of civil engineering and explain their role in the infrastructural framework.

b. Explain the role of NBC, KBR & CRZ norms in building rules and regulations prevailing in our country.

Course Outcome 2 (CO2) & Course Outcome 3 (CO3) (Two full question from each module and each question can have maximum 2 sub-divisions)

Explain different types of buildings, building components, building materials and building construction & Describe the importance, objectives and principles of surveying.

CO Questions

1. a. What are the different kinds of cement available and what is their use.
b. List the properties of good building bricks. Explain any five.
2. a. List and explain any five modern construction materials used for construction.
b. Explain the objectives and principles of surveying

Course outcome 4 (CO4) & Course outcome 5 (CO5) (Two full question from each module and each question can have maximum 2 sub-divisions)

Summarise the basic infrastructure services MEP, HVAC, elevators, escalators and ramps & Discuss the Materials, energy systems, water management and environment for green buildings.

CO Questions

1. a. Draw the elevation and plan of one brick thick wall with English bond
b. Explain the energy systems and water management in Green buildings
2. a. Draw neat sketch of the following foundations: (i) Isolated stepped footing;
(ii) Cantilever footing; and (iii) Continuous footing.

b. Discuss the civil engineering aspect of MEP and HVAC in a commercial building

Course Outcome 6 (CO6):

1. In an air standard Otto cycle the compression ratio is 7 and compression begins at 35°C, 0.1 MPa. The maximum temperature of the cycle is 1100°C. Find
 - i) Heat supplied per kg of air,
 - ii) Work done per kg of air,
 - iii) Cycle efficiencyTake $C_p = 1.005 \text{ kJ/kgK}$ and $C_v = 0.718 \text{ kJ/kgK}$
2. A Carnot cycle works with adiabatic compression ratio of 5 and isothermal expansion ratio of 2. The volume of air at the beginning of isothermal expansion is 0.3 m^3 . If the maximum temperature and pressure is limited to 550K and 21 bar, determine the minimum temperature in the cycle and efficiency of the cycle.
3. In an ideal diesel cycle, the temperature at the beginning and end of compression is 65°C and 620°C respectively. The temperature at the beginning and end of the expansion is 1850°C and 850°C. Determine the ideal efficiency of the cycle.

4. Explain the concepts of CRDI and MPFI in IC Engines.

Course Outcome 7 (CO7)

1. With the help of a neat sketch explain the working of a 4 stroke SI engine
2. Compare the working of 2 stroke and 4 stroke IC engines
3. Explain the classification of IC Engines.

Course Outcome 8(CO8):

1. Explain the working of vapour compression refrigeration system.
2. With the help of suitable sketch explain the working of a split air conditioner.
3. Define: COP, specific humidity, relative humidity and dew point temperature.

Course Outcome 9 (CO9):

1. Explain the working of a single stage centrifugal pump with sketches.
2. With the help of a neat sketch, explain the working of a reciprocating pump.
3. A turbine is to operate under a head of 25 m at 200 rpm. The discharge is $9 \text{ m}^3/\text{s}$. If the overall efficiency of the turbine is 90%. Determine the power developed by the turbine.

Course Outcome 10 (CO10):

1. Explain the working of belt drive and gear drive with the help of neat sketches
2. Explain a single plate clutch.
3. Sketch different types of gear trains and explain.

Course Outcome 11 (CO11):

1. Describe the operations which can be performed using drilling machine.
2. Explain the functions of runners and risers used in casting.
3. With a neat sketch, explain the working and parts of a lathe.

Model Question Paper

QP CODE: EST120

page:3

Reg No: _____

Name: _____

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY FIRST SEMESTER B.TECH DEGREE EXAMINATION,
MONTH & YEAR**

Course Code: EST 120

Course Name: BASICS OF CIVIL AND MECHANICAL ENGINEERING

Max. Marks: 100

Duration: 3 hours

Answer both part I and part 2 in separate answer booklets

PART I: BASIC CIVIL ENGINEERING

PART A

(Answer all questions. Each question carries 4 marks)

1. Explain relevance of Civil engineering in the overall infrastructural development of the country.
2. Discuss the difference between plinth area and carpet area.
3. Explain different types of steel with their properties.
4. What are the different kinds of cement available and what is their use?
5. Define bearing capacity of soil.

(5 x 4 = 20)

Part B

Answer one full question from each module.

MODULE I

- 6a. List out the types of building as per occupancy. Explain any two, each in about five sentences. (5)
- b. Discuss the components of a building with a neat figure. (5)

OR

- 7a. What are the major disciplines of civil engineering and explain their role in the infrastructural framework. (5)
- b. Explain the role of NBC, KBR & CRZ norms in building rules and regulations prevailing in our country. (5)

MODULE II

- 8a. What are the different kinds of cement available and what is their use. (5)
- b. List the properties of good building bricks. Explain any five. (5)

OR

- 9a. List and explain any five modern construction materials used for construction. (5)
- b. Explain the objectives and principles of surveying (5)

MODULE III

- 10a. Draw the elevation and plan of one brick thick wall with English bond (5)
- b. Explain the energy systems and water management in Green buildings (5)

OR

- 11a. Draw neat sketch of the following foundations: (i) Isolated stepped footing; (ii) Cantilever footing; and (iii) Continuous footing. (5)
- b. Discuss the civil engineering aspect of MEP and HVAC in a commercial building (5)

[10 x 3 = 30]

PART II: BASIC MECHANICAL ENGINEERING

PART A

Answer all questions. Each question carries 4 marks

1. Sketch the P-v and T-s diagram of a Carnot cycle and List the processes.
2. Illustrate the working of an epicyclic gear train.
3. Explain cooling and dehumidification processes.
4. Differentiate between soldering and brazing.
5. Explain the principle of Additive manufacturing.

4 x 5 = 20 marks

Part B

Answer one full question from each module.

MODULE I

6. In an air standard Otto cycle the compression ratio is 7 and compression begins at 35°C, 0.1MPa. The maximum temperature of the cycle is 1100°C. Find
 - i) Heat supplied per kg of air,
 - ii) Work done per kg of air,
 - iii) Cycle efficiency

Take $C_p = 1.005 \text{ kJ/kgK}$ and $C_v = 0.718 \text{ kJ/kgK}$

10 marks

OR

7. a) Explain the working of a 4 stroke SI engine with neat sketches.
b) Explain the fuel system of a petrol engine.

7 marks

3 marks

MODULE II

8. a) Explain the working of a vapour compression system with help of a block diagram.
b) Define: Specific humidity, relative humidity and dew point temperature.

7 marks

3 marks

OR

9. With the help of a neat sketch, explain the working of a centrifugal pump.

10 marks

MODULE III

10. Explain the two high, three high, four high and cluster rolling mills with neat sketches.

10 marks

OR

11. a) Describe the arc welding process with a neat sketch.
b) Differentiate between up-milling and down-milling operations.

6 marks

4 marks

SYLLABUS

Module 1

General Introduction to Civil Engineering: Relevance of Civil Engineering in the overall infrastructural development of the country. Responsibility of an engineer in ensuring the safety of built environment. Brief introduction to major disciplines of Civil Engineering like Transportation Engineering, Structural Engineering, Geo-technical Engineering, Water Resources Engineering and Environmental Engineering.

Introduction to buildings: Types of buildings, selection of site for buildings, components of a residential building and their functions.

Building rules and regulations: Relevance of NBC, KBR & CRZ norms (brief discussion only).

Building area: Plinth area, built up area, floor area, carpet area and floor area ratio for a building as per KBR.

Module 2

Surveying: Importance, objectives and principles.

Construction materials, Conventional construction materials: types, properties and uses of building materials: bricks, stones, cement, sand and timber

Cement concrete: Constituent materials, properties and types.

Steel: Steel sections and steel reinforcements, types and uses.

Modern construction materials:- Architectural glass, ceramics, Plastics, composite materials, thermal and acoustic insulating materials, decorative panels, waterproofing materials. Modern uses of gypsum, pre-fabricated building components (brief discussion only).

Module 3

Building Construction: Foundations: Bearing capacity of soil (definition only), functions of foundations, types – shallow and deep (brief discussion only). Load bearing and framed structures (concept only).

Brick masonry: - Header and stretcher bond, English bond & Flemish bond random rubble masonry.

Roofs and floors: - Functions, types; flooring materials (brief discussion only).

Basic infrastructure services: MEP, HVAC, elevators, escalators and ramps (Civil Engineering aspects only), fire safety for buildings.

Green buildings:- Materials, energy systems, water management and environment for green buildings. (brief discussion only).

Module 4

Analysis of thermodynamic cycles: Carnot, Otto, Diesel cycles, Derivation of efficiency of these cycles, Problems to calculate heat added, heat rejected, net work and efficiency. IC Engines: CI, SI, 2-Stroke, 4-Stroke engines. Listing the parts of different types of IC Engines. Efficiencies of IC Engines(Definitions only), Air, Fuel, cooling and lubricating systems in SI and CI Engines, CRDI, MPFI. Concept of hybrid engines.

Module 5

Refrigeration: Unit of refrigeration, reversed Carnot cycle, COP, vapour compression cycle (only description and no problems); Definitions of dry, wet & dew point temperatures, specific humidity and relative humidity, Cooling and dehumidification, Layout of unit and central air conditioners.

Description about working with sketches of: Reciprocating pump, Centrifugal pump, Pelton turbine, Francis turbine and Kaplan turbine. Overall efficiency, Problems on calculation of input and output power of pumps and turbines (No velocity triangles)

Description about working with sketches of: Belt and Chain drives, Gear and Gear trains, Single plate clutches.

Module 6

Manufacturing Process: Basic description of the manufacturing processes – Sand Casting, Forging, Rolling, Extrusion and their applications.

Metal Joining Processes: List types of welding, Description with sketches of Arc Welding, Soldering and Brazing and their applications

Basic Machining operations: Turning, Drilling, Milling and Grinding.

Description about working with block diagram of: Lathe, Drilling machine, Milling machine, CNC Machine. Principle of CAD/CAM, Rapid and Additive manufacturing.

Text Books:

1. Rangwala, S. C., Essentials of Civil Engineering, Charotar Publishing House
2. McKay, W.B. and McKay, J. K., Building Construction, Volumes 1 to 4, Pearson India Education Services

References Books:

1. Chen W.F and Liew J Y R (Eds), The Civil Engineering Handbook. II Edition CRC Press (Taylor and Francis)
2. Chudley, R and Greeno R, Building construction handbook, Addison Wesley, Longman group, England
3. Chudley, R, Construction Technology, Vol. I to IV, Longman group, England Course Plan
4. Kandya A A, Elements of Civil Engineering, Charotar Publishing house
5. Mamlouk, M. S., and Zaniewski, J. P., Materials for Civil and Construction Engineering, Pearson Publishers
6. Rangwala S.C and Dalal K B Building Construction Charotar Publishing house
7. Clifford, M., Simmons, K. and Shipway, P., An Introduction to Mechanical Engineering Part I - CRC Press
8. Roy and Choudhary, Elements of Mechanical Engineering, Media Promoters & Publishers Pvt. Ltd., Mumbai.
9. Sawhney, G. S., Fundamentals of Mechanical Engineering, PHI
10. G Shanmugam, M S Palanichamy, Basic Civil and Mechanical Engineering, McGraw Hill Education; First edition, 2018
11. Benjamin, J., Basic Mechanical Engineering, Pentex Books, 9th Edition, 2018
12. Balachandran, P. Basic Mechanical Engineering, Owl Books

Course Contents and Lecture Schedule:

No	Topic	Course outcomes addressed	No. of Lectures
1	Module I		Total: 7
1.1	<i>General Introduction to Civil Engineering:</i> Relevance of Civil Engineering in the overall infrastructural development of the country. Responsibility of an engineer in ensuring the safety of built environment.	CO1	1
1.2	Brief introduction to major disciplines of Civil Engineering like Transportation Engineering, Structural Engineering, Geo-technical Engineering, Water Resources Engineering and Environmental Engineering.	CO1	2
1.3	<i>Introduction to buildings:</i> Types of buildings, selection of site for buildings, components of a residential building and their functions.	CO2	2
1.4	<i>Building rules and regulations:</i> Relevance of NBC, KBR & CRZ norms (brief discussion only)	CO2	1
1.5	<i>Building area:</i> Plinth area, built up area, floor area, carpet area and floor area ratio for a building as per KBR.	CO2	1
2	Module 2		Total: 7
2.1	<i>Surveying:</i> Importance, objectives and principles.	CO3	1
2.2	Bricks: - Classification, properties of good bricks, and tests on bricks	CO2	1
2.3	Stones: - <i>Qualities</i> of good stones, types of stones and their uses. Cement: - Good qualities of cement, types of cement and their uses.	CO2	1
2.4	Sand: - Classification, qualities of good sand and sieve analysis (basics only). Timber: - Characteristics, properties and uses.	CO2	1
2.5	Cement concrete: - Constituent materials, properties and types, Steel: - Steel sections and steel reinforcements, types and uses.	CO2	1

2.6	Modern construction materials: - Architectural glass, ceramics, plastics, composite materials, thermal and acoustic insulating materials, decorative panels, waterproofing materials, modern uses of gypsum, pre-fabricated building components (brief discussion only)	CO2	2
3	Module 3		Total: 7
3.1	Foundations: - Bearing capacity of soil (definition only), functions of foundations, types – shallow and deep (brief discussion only). Brick masonry: - Header and stretcher bond, English bond & Flemish bond– elevation and plan (one & one and a half brick wall only). Random rubble masonry.	CO2	2
3.2	Roofs: Functions, types; roofing materials (brief discussion only) Floors: Functions, types; flooring materials (brief discussion only)	CO2	2
3.3	<i>Basic infrastructure services:</i> MEP, HVAC, Elevators, escalators and ramps (Civil Engineering aspects only) fire safety for buildings	CO4	2
3.4	<i>Green buildings:-</i> Materials, energy systems, water management and environment for green buildings. (brief discussion only)	CO5	1
4	MODULE 4		
4.1	Analysis of thermodynamic cycles: Carnot, Otto, and Diesel cycle- Derivation of efficiency of these cycles, Problems to calculate heat added, heat rejected, net work and efficiency	4	
4.2	IC Engines: CI, SI, 2-Stroke, 4-Stroke engines. Listing the parts of different types of IC Engines, efficiencies of IC Engines(Description only)	2	
4.3	Air, Fuel, cooling and lubricating systems in SI and CI Engines, CRDI, MPFI. Concept of hybrid engines	2	
5	MODULE 5		
5.1	Refrigeration: Unit of refrigeration, reversed Carnot cycle, COP, vapour compression cycle (only description and no problems)	1	
5.2	Definitions of dry, wet & dew point temperatures, specific humidity and relative humidity, Cooling and dehumidification, Layout of unit and central air conditioners.	1	

5.3	Description about working with sketches : Reciprocating pump, Centrifugal pump, Pelton turbine, Francis turbine and Kaplan turbine. Overall efficiency, Problems on calculation of input and output power of pumps and turbines (No velocity triangles)	4
5.4	Description about working with sketches of: Belt and Chain drives, Gear and Gear trains, Single plate clutches	3
6	MODULE 6	
6.1	Manufacturing Process: Basic description of the manufacturing processes – Sand Casting, Forging, Rolling, Extrusion and their applications.	2
6.2	Metal Joining Processes :List types of welding, Description with sketches of Arc Welding, Soldering and Brazing, and their applications	1
6.3	Basic Machining operations: Turning, Drilling, Milling and Grinding Description about working with block diagrams of: Lathe, Drilling machine, Milling machine, CNC Machine	3
6.4	Principle of CAD/CAM, Rapid and Additive manufacturing	1

EST 130	BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		ESC	4	0	0	4	2019

Preamble:

This course aims to (1) equip the students with an understanding of the fundamental principles of electrical engineering (2) provide an overview of evolution of electronics, and introduce the working principle and examples of fundamental electronic devices and circuits (3) provide an overview of evolution of communication systems, and introduce the basic concepts in radio communication.

Prerequisite: Physics and Mathematics (Pre-university level)

Course Outcomes: After the completion of the course the student will be able to

CO 1	Apply fundamental concepts and circuit laws to solve simple DC electric circuits
CO 2	Develop and solve models of magnetic circuits
CO 3	Apply the fundamental laws of electrical engineering to solve simple ac circuits in steady state
CO 4	Describe working of a voltage amplifier
CO 5	Outline the principle of an electronic instrumentation system
CO 6	Explain the principle of radio and cellular communication

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	1	-	-	-	-	-	-	-	-	-	2
CO 2	3	1	-	-	-	-	-	-	-	-	-	2
CO 3	3	1	-	-	-	-	-	-	-	-	-	2
CO 4	2	-	-	-	-	-	-	-	-	-	-	-
CO 5	2	-	-	-	-	-	-	-	-	-	-	2
CO 6	2	-	-	-	-	-	-	-	-	-	-	2

Assessment Pattern

Bloom's Category	Basic Electrical Engineering			Basic Electronics Engineering		
	Continuous Assessment Tests		End Semester Examination (Marks)	Continuous Assessment Tests		End Semester Examination (Marks)
	Test 1 (Marks)	Test 2 (Marks)		Test 1 (Marks)	Test 2 (Marks)	
Remember	0	0	10	10	10	20
Understand	12.5	12.5	20	15	15	30
Apply	12.5	12.5	20			
Analyse						
Evaluate						
Create						

Mark distribution

Total Marks	CIE marks	ESE marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25 marks
Assignment/Quiz/Course project	: 15 marks

End Semester Examination Pattern: There will be two parts; Part I – Basic Electrical Engineering and Part II – Basic Electronics Engineering. Part I and PART II carries 50 marks each. For the end semester examination, part I contain 2 parts - Part A and Part B. Part A contain 5 questions carrying 4 marks each (not exceeding 2 questions from each module). Part B contains 2 questions from each module out of which one to be answered. Each question carries 10 mark and can have maximum 2 sub-divisions. The pattern for end semester examination for part II is same as that of part I. **However, student should answer both part I and part 2 in separate answer booklets.**

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Solve problems based on current division rule.
2. Solve problems with Mesh/node analysis.
3. Solve problems on Wye-Delta Transformation.

Course Outcome 2 (CO2):

1. Problems on series magnetic circuits
2. Problems on parallel magnetic circuits
3. Problems on composite magnetic circuits

4. Course Outcome 3 (CO3):

1. problems on self inductance, mutual inductance and coefficient of coupling
2. problems on rms and average values of periodic waveforms
3. problems on series ac circuits
4. Compare star and Delta connected 3 phase AC systems.

Course Outcome 4 (CO4): Describe working of a voltage amplifier

1. What is the need of voltage divider biasing in an RC coupled amplifier?

2. Define operating point in the context of a BJT amplifier.
3. Why is it required to have a voltage amplifier in a public address system?

Course Outcome 5 (CO5): Outline the principle of an electronic instrumentation system

1. Draw the block diagram of an electronic instrumentation system.
2. What is a transducer?
3. Explain the working principle of operation of digital multimeter.

Course Outcome 6 (CO6): Explain the principle of radio and cellular communication

1. What is the working principle of an antenna when used in a radio transmitter?
2. What is the need of two separate sections RF section and IF section in a super heterodyne receiver?
3. What is meant by a cell in a cellular communication?

Model Question Paper

QP CODE:

Pages: 3

Reg No.: _____

Name: _____

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY FIRST SEMESTER B.TECH DEGREE EXAMINATION,
MONTH & YEAR**

Course Code: EST 130

Course Name: BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING

Max. Marks: 100

Duration: 3 hours

Answer both part I and part 2 in separate answer booklets

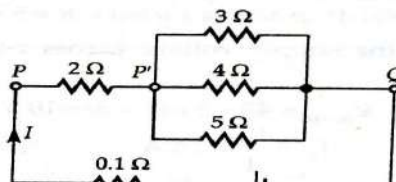
PART I

BASIC ELECTRICAL ENGINEERING

PART A

Answer all questions; each question carries 4 marks.

1. Calculate the current through the 4Ω resistor in the circuit shown, applying current division rule:



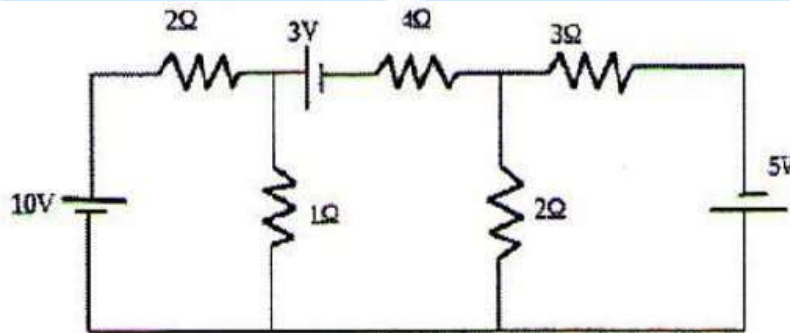
2. Calculate the RMS and average values of a purely sinusoidal current having peak value 15A.
3. An alternating voltage of $(80+j60)V$ is applied to an RX circuit and the current flowing through the circuit is $(-4+j10)A$. Calculate the impedance of the circuit in rectangular and polar forms. Also determine if X is inductive or capacitive.
4. Derive the relation between line and phase values of voltage in a three phase star connected system.
5. Compare electric and magnetic circuits. (5x4=20)

PART B

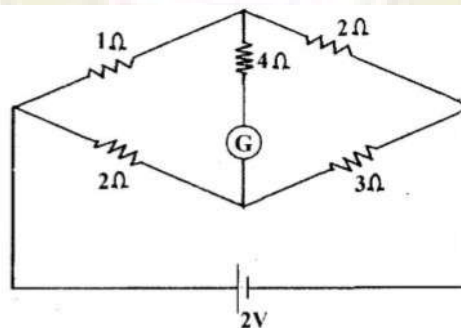
Answer one question from each module; each question carries 10 marks.

Module 1

6. . Calculate the node voltages in the circuit shown, applying node analysis:



7. (a) State and explain Kirchhoff's laws. (4 marks)
- (b) Calculate the current through the galvanometer (G) in the circuit shown:



(6 marks)

Module 2

8. (a) State and explain Faraday's laws of electromagnetic induction with examples. (4 marks)
- (b) Differentiate between statically and dynamically induced emf. A conductor of length 0.5m moves in a uniform magnetic field of flux density 1.1T at a velocity of 30m/s. Calculate the emf induced in the conductor if the direction of motion of the conductor is inclined at 60° to the direction of field. (6 marks)
9. (a) Derive the amplitude factor and form factor of a purely sinusoidal waveform. (5 marks)
- (b) A current wave is made up of two components-a 5A dc component and a 50Hz ac component, which is a sinusoidal wave with a peak value of 5A. Sketch the resultant waveform and determine its RMS and average values. (5 marks)

Module 3

10. Draw the power triangle and define active, reactive and apparent powers in ac circuits. Two coils A and B are connected in series across a 240V, 50Hz supply. The resistance of A is 5Ω and the inductance of B is 0.015H. If the input from the supply is 3kW and 2kVAR, find the inductance of A and the resistance of B. Also calculate the voltage across each coil.
11. A balanced three phase load consists of three coils each having resistance of 4Ω and inductance 0.02H. It is connected to a 415V, 50Hz, 3-phase ac supply. Determine the phase voltage, phase current, power factor and active power when the loads are connected in (i) star (ii) delta.

(3x10=30)

PART II

BASIC ELECTRONICS ENGINEERING

PART A

Answer all questions; each question carries 4 marks.

1. Give the specifications of a resistor. The colour bands marked on a resistor are Blue, Grey, Yellow and Gold. What are the minimum and maximum resistance values expected from that resistance?
2. What is meant by avalanche breakdown?
3. Explain the working of a full-wave bridge rectifier.
4. Discuss the role of coupling and bypass capacitors in a single stage RC coupled amplifier.
5. Differentiate AM and FM communication systems.

(5x4=20)

PART B

Answer one question from each module; each question carries 10 marks.

Module 4

6. a) Explain with diagram the principle of operation of an NPN transistor. (5)
b) Sketch and explain the typical input-output characteristics of a BJT when connected in common emitter configuration. (5)

OR

7. a) Explain the formation of a potential barrier in a P-N junction diode. (5)
b) What do you understand by Avalanche breakdown? Draw and explain the V-I characteristics of a P-N junction and Zener diode. (5)

Module 5

8. a) With a neat circuit diagram, explain the working of an RC coupled amplifier. (6)
b) Draw the frequency response characteristics of an RC coupled amplifier and state the reasons for the reduction of gain at lower and higher frequencies. (4)

OR

9. a) With the help of block diagram, explain how an electronic instrumentation system. (6)
b) Explain the principle of an antenna. (4)

Module 6

10. a) With the help of a block diagram, explain the working of Super hetrodyne receiver. (6)
b) Explain the importance of antenna in a communication system. (4)

OR

11. a) With neat sketches explain a cellular communication system. (5)
b) Explain GSM communication with the help of a block diagram. (5)

(3x10=30)

SYLLABUS

MODULE 1: Elementary Concepts of Electric Circuits

Elementary concepts of DC electric circuits: Basic Terminology including voltage, current, power, resistance, emf; Resistances in series and parallel; Current and Voltage Division Rules; Capacitors & Inductors: V-I relations and energy stored. Ohms Law and Kirchhoff's laws-Problems; Star-delta conversion (resistive networks only-derivation not required)-problems.

Analysis of DC electric circuits: Mesh current method - Matrix representation - Solution of network equations. Node voltage methods-matrix representation-solution of network equations by matrix methods. Numerical problems.

MODULE 2: Elementary Concepts of Magnetic circuits, Electromagnetic Induction and AC fundamentals

Magnetic Circuits: Basic Terminology: MMF, field strength, flux density, reluctance - comparison between electric and magnetic circuits- Series and parallel magnetic circuits with composite materials, numerical problems.

Electromagnetic Induction: Faraday's laws, problems, Lenz's law- statically induced and dynamically induced emfs - Self-inductance and mutual inductance, coefficient of coupling

Alternating Current fundamentals: Generation of alternating voltages-Representation of sinusoidal waveforms: frequency, period, Average, RMS values and form factor of waveforms-Numerical Problems.

MODULE 3: AC Circuits

AC Circuits: Phasor representation of sinusoidal quantities. Trigonometric, Rectangular, Polar and complex forms. Analysis of simple AC circuits: Purely resistive, inductive & capacitive circuits; Inductive and capacitive reactance, concept of impedance. Average Power Power factor. Analysis of RL, RC and RLC series circuits-active, reactive and apparent power. Simple numerical problems.

Three phase AC systems: Generation of three phase voltages; advantages of three phase systems, star and delta connections (balanced only), relation between line and phase voltages, line and phase currents- Numerical problems

MODULE 4

Introduction to Semiconductor devices: Evolution of electronics – Vacuum tubes to nano electronics. Resistors, Capacitors and Inductors (constructional features not required): types, specifications. Standard values, color coding. PN Junction diode: Principle of operation, V-I characteristics, principle of avalanche breakdown. Bipolar Junction Transistors: PNP and NPN structures, Principle of operation, relation between current gains in CE, CB and CC, input and output characteristics of common emitter configuration.

MODULE 5

Basic electronic circuits and instrumentation: Rectifiers and power supplies: Block diagram description of a dc power supply, Working of a full wave bridge rectifier, capacitor filter (no analysis), working of simple zener voltage regulator. Amplifiers: Block diagram of Public Address system, Circuit diagram and working of common emitter (RC coupled) amplifier with its frequency response, Concept of voltage divider biasing. Electronic Instrumentation: Block diagram of an electronic instrumentation system.

MODULE 6

Introduction to Communication Systems: Evolution of communication systems – Telegraphy to 5G. Radio communication: principle of AM & FM, frequency bands used for various communication systems, block diagram of super heterodyne receiver, Principle of antenna – radiation from accelerated charge. Mobile communication: basic principles of cellular communications, principle and block diagram of GSM.

Text Books

1. D P Kothari and I J Nagrath, "Basic Electrical Engineering", Tata McGraw Hill, 2010.
2. D C Kulshreshtha, "Basic Electrical Engineering", Tata McGraw Hill, 2010.
3. ChinmoySaha, Arindham Halder and Debarati Ganguly, Basic Electronics - Principles and Applications, Cambridge University Press, 2018.
4. M.S.Sukhija and T.K.Nagsarkar, Basic Electrical and Electronics Engineering, Oxford University Press, 2012.
5. Wayne Tomasi and Neil Storey, A Textbook On Basic Communication and Information Engineering, Pearson, 2010.

Reference Books

1. Del Toro V, "Electrical Engineering Fundamentals", Pearson Education.
2. T. K. Nagsarkar, M. S. Sukhija, "Basic Electrical Engineering", Oxford Higher Education.
3. Hayt W H, Kemmerly J E, and Durbin S M, "Engineering Circuit Analysis", Tata McGraw-Hill
4. Hughes, "Electrical and Electronic Technology", Pearson Education.
5. V. N. Mittle and Arvind Mittal, "Basic Electrical Engineering," Second Edition, McGraw Hill.
6. Parker and Smith, "Problems in Electrical Engineering", CBS Publishers and Distributors.
7. S. B. Lal Seksena and Kaustuv Dasgupta, "Fundamentals of Electrical Engineering", Cambridge University Press.
8. Anant Agarwal, Jeffrey Lang, Foundations of Analog and Digital Electronic Circuits, Morgan Kaufmann Publishers, 2005.
9. Bernard Grob, Basic Electronics, McGraw Hill.
10. A. Bruce Carlson, Paul B. Crilly, Communication Systems: An Introduction to Signals and Noise in Electrical Communication, Tata McGraw Hill, 5th Edition.

COURSE CONTENTS AND LECTURE SCHEDULE

No	Topic	No. of Lectures
1	<i>Elementary Concepts of Electric Circuits</i>	
1.1	Elementary concepts of DC electric circuits: Basic Terminology including voltage, current, power, resistance, emf; Resistances in series and parallel; Current and Voltage Division Rules; Capacitors & Inductors: V-I relations and energy stored. Ohms Law and Kirchhoff's laws-Problems; Star-delta conversion (resistive networks only-derivation not required)- problems.	1 2 1
1.2	Analysis of DC electric circuits: Mesh current method - Matrix representation - Solution of network equations. Node voltage methods-matrix representation-solution of network equations by matrix methods. Numerical problems.	1 1 2
2	Elementary Concepts of Magnetic circuits, Electromagnetic Induction and AC fundamentals	
2.1	Magnetic Circuits: Basic Terminology: MMF, field strength, flux density, reluctance - comparison between electric and magnetic circuits- Series and parallel magnetic circuits with composite materials, numerical problems.	1 2
2.2	Electromagnetic Induction: Faraday's laws, problems, Lenz's law- statically induced and dynamically induced emfs - Self-inductance and mutual inductance, coefficient of coupling	1 2
2.3	Alternating Current fundamentals: Generation of alternating voltages- Representation of sinusoidal waveforms: frequency, period, Average, RMS values and form factor of waveforms-Numerical Problems.	2
3	AC Circuits	

3.1	AC Circuits: Phasor representation of sinusoidal quantities. Trigonometric, Rectangular, Polar and complex forms. Analysis of simple AC circuits: Purely resistive, inductive & capacitive circuits; Inductive and capacitive reactance, concept of impedance. Average Power, Power factor. Analysis of RL, RC and RLC series circuits-active, reactive and apparent power. Simple numerical problems.	1 2 1 2
3.2	Three phase AC systems: Generation of three phase voltages; advantages of three phase systems, star and delta connections (balanced only), relation between line and phase voltages, line and phase currents- Numerical problems.	2
4	Introduction to Semiconductor devices	
4.1	Evolution of electronics – Vacuum tubes to nano electronics (In evolutionary perspective only)	1
4.2	Resistors, Capacitors and Inductors: types, specifications. Standard values, color coding (No constructional features)	2
4.3	PN Junction diode: Principle of operation, V-I characteristics, principle of avalanche breakdown	2
4.4	Bipolar Junction Transistors: PNP and NPN structures, Principle of operation, relation between current gains in CE, CB and CC, input and output characteristics of common emitter configuration	3
5	Basic electronic circuits and instrumentation	
5.1	Rectifiers and power supplies: Block diagram description of a dc power supply, Working of a full wave bridge rectifier, capacitor filter (no analysis), working of simple zener voltage regulator	3
5.2	Amplifiers: Block diagram of Public Address system, Circuit diagram and working of common emitter (RC coupled) amplifier with its frequency response, Concept of voltage divider biasing	4
5.3	Electronic Instrumentation: Block diagram of an electronic instrumentation system	2
6	Introduction to Communication Systems	
6.1	Evolution of communication systems – Telegraphy to 5G	1

6.2	Radio communication: principle of AM & FM, frequency bands used for various communication systems, block diagram of super heterodyne receiver, Principle of antenna – radiation from accelerated charge	4
6.3	Mobile communication: basic principles of cellular communications, principle and block diagram of GSM.	2

Suggested Simulation Assignments for Basic Electronics Engineering

1. Plot V-I characteristics of Si and Ge diodes on a simulator
2. Plot Input and Output characteristics of BJT on a simulator
3. Implementation of half wave and full wave rectifiers
4. Simulation of RC coupled amplifier with the design supplied
5. Generation of AM signal

Note: The simulations can be done on open tools such as QUCS, KiCad, GNURadio or similar software to augment the understanding.

HUN 102	PROFESSIONAL COMMUNICATION	CATEGORY	L	T	P	CREDIT
		MNC	2	0	2	--

Preamble: Clear, precise, and effective communication has become a *sine qua non* in today's information-driven world given its interdependencies and seamless connectivity. Any aspiring professional cannot but master the key elements of such communication. The objective of this course is to equip students with the necessary skills to listen, read, write, and speak so as to comprehend and successfully convey any idea, technical or otherwise, as well as give them the necessary polish to become persuasive communicators.

Prerequisite: None

Course Outcomes: After the completion of the course the student will be able to

CO 1	Develop vocabulary and language skills relevant to engineering as a profession
CO 2	Analyze, interpret and effectively summarize a variety of textual content
CO 3	Create effective technical presentations
CO 4	Discuss a given technical/non-technical topic in a group setting and arrive at generalizations/consensus
CO 5	Identify drawbacks in listening patterns and apply listening techniques for specific needs
CO 6	Create professional and technical documents that are clear and adhering to all the necessary conventions

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1										3		2
CO 2										1		3
CO 3						1			1	3		
CO 4										3		1
CO 5		1							2	3		
CO 6	1					1			1	3		

Mark distribution

Total Marks	CIE	ESE	ESE Duration
100	50	50	2 hours

Continuous Internal Evaluation

Total Marks: 50

Attendance	: 10 marks
Regular assessment	: 25 marks
Series test (one test only, should include verbal aptitude for placement and higher studies, this test will be conducted for 50 marks and reduced to 15)	: 15 marks

Regular assessment

Project report presentation and Technical presentation through PPT	: 7.5 marks
Listening Test	: 5 marks
Group discussion/mock job interview	: 7.5 marks
Resume submission	: 5 marks

End Semester Examination

Total Marks: 50, Time: 2 hrs.

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. List down the ways in which gestures affect verbal communication.
2. Match the words and meanings
Ambiguous promotion
Bona fide referring to whole
Holistic not clear
Exaltation genuine
3. Expand the following Compound Nouns - a. Water supply. b. Object recognition. c. Steam turbine

Course Outcome 2 (CO2)

1. Read the passage below and prepare notes:

Mathematics, rightly viewed, possesses not only truth, but supreme beauty—a beauty cold and austere, like that of sculpture, without appeal to any part of our weaker nature, without the gorgeous trappings of painting or music, yet sublimely pure, and capable of a stern perfection such as only the greatest art can show. The true spirit of delight, the exaltation, the sense of being more than man, which is the touchstone of the highest excellence, is to be found in mathematics as surely as in poetry. What is best in mathematics deserves not merely to be learnt as a task, but to be assimilated as a part of daily thought, and brought again and again before the mind with ever-renewed encouragement. Real life is, to most men, a long second-best, a perpetual compromise between the ideal and the possible; but the world of pure reason knows no compromise, no practical limitations, no barrier to the creative activity embodying in splendid edifices the passionate aspiration after the perfect from which all great work springs. Remote from human passions, remote even from the pitiful facts of nature, the generations have gradually created an ordered cosmos, where pure thought can dwell as in its natural home, and where one, at least, of our nobler impulses can escape from the dreary exile of the actual world.

So little, however, have mathematicians aimed at beauty, that hardly anything in their work has had this conscious purpose. Much, owing to irrepressible instincts, which were better than avowed

beliefs, has been moulded by an unconscious taste; but much also has been spoilt by false notions of what was fitting. The characteristic excellence of mathematics is only to be found where the reasoning is rigidly logical: the rules of logic are to mathematics what those of structure are to architecture. In the most beautiful work, a chain of argument is presented in which every link is important on its own account, in which there is an air of ease and lucidity throughout, and the premises achieve more than would have been thought possible, by means which appear natural and inevitable. Literature embodies what is general in particular circumstances whose universal significance shines through their individual dress; but mathematics endeavours to present whatever is most general in its purity, without any irrelevant trappings.

How should the teaching of mathematics be conducted so as to communicate to the learner as much as possible of this high ideal? Here experience must, in a great measure, be our guide; but some maxims may result from our consideration of the ultimate purpose to be achieved.

- From "On the teaching of mathematics" – Bertrand Russell

2. Enumerate the advantages and disadvantages of speed reading. Discuss how it can impact comprehension.

Course Outcome 3(CO3):

1. What are the key elements of a successful presentation?
2. Elucidate the importance of non-verbal communication in making a presentation
3. List out the key components in a technical presentation.

Course Outcome 4 (CO4):

1. Discuss: 'In today's world, being a good listener is more important than being a good Speaker.'
2. Listen to a video/live group discussion on a particular topic, and prepare a brief summary of the proceedings.
3. List the do's and don'ts in a group discussion.

Course Outcome 5 (CO5):

1. Watch a movie clip and write the subtitles for the dialogue.
2. What do you mean by barriers to effective listening? List ways to overcome each of these.
3. What are the different types of interviews? How are listening skills particularly important in Skype/telephonic interviews?

Course Outcome 6 (CO6):

1. Explain the basic structure of a technical report.
2. You have been offered an internship in a much sought-after aerospace company and are very excited about it. However, the dates clash with your series tests. Write a letter to the Manager – University Relations of the company asking them if they can change the dates to coincide with your vacation.
3. You work in a well-reputed aerospace company as Manager – University Relations. You are in charge of offering internships. A student has sent you a letter requesting you to change the dates allotted to him since he has series exams at that time. But there are no vacancies available during the period he has requested for. Compose an e-mail informing him of this and suggest that he try to arrange the matter with his college.

Syllabus

Module 1

Use of language in communication: Significance of technical communication Vocabulary Development: technical vocabulary, vocabulary used in formal letters/emails and reports, sequence words, misspelled words, compound words, finding suitable synonyms, paraphrasing, verbal analogies. Language Development: subject-verb agreement, personal passive voice, numerical adjectives, embedded sentences, clauses, conditionals, reported speech, active/passive voice.

Technology-based communication: Effective email messages, slide presentations, editing skills using software. Modern day research and study skills: search engines, repositories, forums such as Git Hub, Stack Exchange, OSS communities (MOOC, SWAYAM, NPTEL), and Quora; Plagiarism

Module 2

Reading, Comprehension, and Summarizing: Reading styles, speed, valuation, critical reading, reading and comprehending shorter and longer technical articles from journals, newspapers, identifying the various transitions in a text, SQ3R method, PQRS method, speed reading. Comprehension: techniques, understanding textbooks, marking and underlining, Note-taking: recognizing non-verbal cues.

Module 3

Oral Presentation: Voice modulation, tone, describing a process, Presentation Skills: Oral presentation and public speaking skills, business presentations, Preparation: organizing the material, self-Introduction, introducing the topic, answering questions, individual presentation practice, presenting visuals effectively.

Debate and Group Discussions: introduction to Group Discussion (GD), differences between GD and debate; participating GD, understanding GD, brainstorming the topic, questioning and clarifying, GD strategies, activities to improve GD skills

Module 4

Listening and Interview Skills Listening: Active and Passive listening, listening: for general content, to fill up information, intensive listening, for specific information, to answer, and to understand. Developing effective listening skills, barriers to effective listening, listening to longer technical talks, listening to classroom lectures, talks on engineering /technology, listening to documentaries and making notes, TED talks.

Interview Skills: types of interviews, successful interviews, interview etiquette, dress code, body language, telephone/online (skype) interviews, one-to-one interview & panel interview, FAQs related to job interviews

Module 5

Formal writing: Technical Writing: differences between technical and literary style. Letter Writing (formal, informal and semi formal), Job applications, Minute preparation, CV preparation (differences between Bio-Data, CV and Resume), and Reports. Elements of style, Common Errors in Writing: describing a process, use of sequence words, Statements of Purpose, Instructions, Checklists.

Analytical and issue-based Essays and Report Writing: basics of report writing; Referencing Style (IEEE Format), structure of a report; types of reports, references, bibliography.

Lab Activities

Written: Letter writing, CV writing, Attending a meeting and Minute Preparation, Vocabulary Building

Spoken: Phonetics, MMFS (Multimedia Feedback System), Mirroring, Elevator Pitch, telephone etiquette, qualities of a good presentation with emphasis on body language and use of visual aids.

Listening: Exercises based on audio materials like radio and podcasts. Listening to Song. practice and exercises.

Reading: Speed Reading, Reading with the help of Audio Visual Aids, Reading Comprehension Skills

Mock interview and Debate/Group Discussion: concepts, types, Do's and don'ts- intensive practice

Reference Books

1. English for Engineers and Technologists (Combined edition, Vol. 1 and 2), Orient Blackswan 2010.
2. Meenakshi Raman and Sangeetha Sharma, "Technical Communication: Principles and Practice", 2nd Edition, Oxford University Press, 2011
3. Stephen E. Lucas, "The Art of Public Speaking", 10th Edition; McGraw Hill Education, 2012.
4. Ashraf Rizvi, "Effective Technical Communication", 2nd Edition, McGraw Hill Education, 2017.
5. William Strunk Jr. & E.B. White, "The Elements of Style", 4th Edition, Pearson, 1999.
6. David F. Beer and David McMurrey, Guide to writing as an Engineer, John Wiley. New York, 2004.
7. Goodheart-Willcox, "Professional Communication", First Edition, 2017.
8. Training in Interpersonal Skills: Tips for Managing People at Work, Pearson Education, India, 6 edition, 2015.
9. The Ace of Soft Skills: Attitude, Communication and Etiquette for Success, Pearson Education; 1 edition, 2013.
10. Anand Ganguly, "Success in Interview", RPH, 5th Edition, 2016.
11. Raman Sharma, "Technical Communications", Oxford Publication, London, 2004.

EST 102	PROGRAMING IN C	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		ESC	2	1	2	4	2019

Preamble: The syllabus is prepared with the view of preparing the Engineering Graduates capable of writing readable C programs to solve computational problems that they may have to solve in their professional life. The course content is decided to cover the essential programming fundamentals which can be taught within the given slots in the curriculum. This course has got 2 Hours per week for practicing programming in C. A list showing 24 mandatory programming problems are given at the end. The instructor is supposed to give homework/assignments to write the listed programs in the rough record as and when the required theory part is covered in the class. The students are expected to come prepared with the required program written in the rough record for the lab classes.

Prerequisite: NIL

Course Outcomes: After the completion of the course the student will be able to

CO 1	Analyze a computational problem and develop an algorithm/flowchart to find its solution
CO 2	Develop readable* C programs with branching and looping statements, which uses Arithmetic, Logical, Relational or Bitwise operators.
CO 3	Write readable C programs with arrays, structure or union for storing the data to be processed
CO 4	Divide a given computational problem into a number of modules and develop a readable multi-function C program by using recursion if required, to find the solution to the computational problem
CO 5	Write readable C programs which use pointers for array processing and parameter passing
CO 6	Develop readable C programs with files for reading input and storing output
readable* - readability of a program means the following: 1. Logic used is easy to follow 2. Standards to be followed for indentation and formatting 3. Meaningful names are given to variables 4. Concise comments are provided wherever needed	

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓		✓				✓	✓	✓
CO2	✓	✓	✓	✓	✓					✓		✓
CO3	✓	✓	✓	✓	✓					✓		✓
CO4	✓	✓	✓	✓	✓					✓	✓	✓
CO5	✓	✓			✓					✓		✓
CO6	✓	✓			✓					✓		✓

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination Marks
	Test 1 (Marks)	Test 2 (Marks)	
Remember	15	10	25
Understand	10	15	25
Apply	20	20	40
Analyse	5	5	10
Evaluate			
Create			

Mark distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks

Continuous Assessment Test 1 (for theory, for 2 hrs) : 20 marks

Continuous Assessment Test 2 (for lab, internal examination, for 2 hrs) : 20 marks

Internal Examination Pattern: There will be two parts; Part A and Part B. Part A contains 5 questions with 2 questions from each module ($2.5 \text{ modules} \times 2 = 5$), having 3 marks for each question. Students should answer all questions. Part B also contains 5 questions with 2 questions from each module ($2.5 \text{ modules} \times 2 = 5$), of which a student should answer any one. The questions should not have sub-divisions and each one carries 7 marks.

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which a student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Sample Course Level Assessment Questions

Course Outcome 1 (CO1): Write an algorithm to check whether largest of 3 natural numbers is prime or not. Also, draw a flowchart for solving the same problem.

Course Outcome 2 (CO2): Write an easy to read C program to process a set of n natural numbers and to find the largest even number and smallest odd number from the given set of numbers. The program should not use division and modulus operators.

Course Outcome 3 (CO3): Write an easy to read C program to process the marks obtained by n students of a class and prepare their rank list based on the sum of the marks obtained. There are 3 subjects for which examinations are conducted and the third subject is an elective where a student is allowed to take any one of the two courses offered.

Course Outcome 4 (CO4): Write an easy to read C program to find the value of a mathematical function f which is defined as follows. $f(n) = n! / (\text{sum of factors of } n)$, if n is not prime and $f(n) = n! / (\text{sum of digits of } n)$, if n is prime.

Course Outcome 5 (CO5): Write an easy to read C program to sort a set of n integers and to find the number of unique numbers and the number of repeated numbers in the given set of numbers. Use a function which takes an integer array of n elements, sorts the array using the Bubble Sorting Technique and returns the number of unique numbers and the number of repeated numbers in the given array.

Course Outcome 6 (CO6): Write an easy to read C program to process a text file and to print the Palindrome words into an output file.

Model Question paper

QP CODE:

PAGES:3

Reg No: _____

Name : _____

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY FIRST SEMESTER B.TECH DEGREE EXAMINATION,
MONTH & YEAR**

Course Code: EST 102

Course Name: Programming in C (Common to all programs)

Max.Marks:100

Duration: 3 Hours

PART A

Answer all Questions. Each question carries 3 Marks

1. Write short note on processor and memory in a computer.
2. What are the differences between compiled and interpreted languages? Give example for each.
3. Write a C program to read a Natural Number through keyboard and to display the reverse of the given number. For example, if "3214567" is given as input, the output to be shown is "7654123".
4. Is it advisable to use *goto* statements in a C program? Justify your answer.
5. Explain the different ways in which you can *declare & initialize* a single dimensional array.
6. Write a C program to read a sentence through keyboard and to display the count of white spaces in the given sentence.
7. What are the advantages of using functions in a program?
8. With a simple example program, explain *scope* and *life time* of variables in C.
9. Write a function in C which takes the address of a single dimensional array (containing a finite sequence of numbers) and the number of numbers stored in the array as arguments and stores the numbers in the same array in reverse order. Use pointers to access the elements of the array.
10. With an example, explain the different modes of opening a file. (10x3=30)

Part B

Answer any one Question from each module. Each question carries 14 Marks

11. (a) Draw a flow chart to find the position of an element in a given sequence, using linear searching technique. With an example explain how the flowchart finds the position of a given element. (10)
(b) Write a pseudo code representing the flowchart for linear searching. (4)

OR

12. (a) With the help of a flow chart, explain the bubble sort operation. Illustrate with an example. (10)
(b) Write an algorithm representing the flowchart for bubble sort. (4)

13. (a) Write a C program to read an English Alphabet through keyboard and display whether the given Alphabet is in upper case or lower case. (6)
(b) Explain how one can use the builtin function in C, *scanf* to read values of different data types. Also explain using examples how one can use the builtin function in C, *printf* for text formatting. (8)

OR

14. (a) With suitable examples, explain various operators in C. (10)
(b) Explain how characters are stored and processed in C. (4)

15. (a) Write a function in C which takes a 2-Dimensional array storing a matrix of numbers and the order of the matrix (number of rows and columns) as arguments and displays the sum of the elements stored in each row. (6)
(b) Write a C program to check whether a given matrix is a diagonal matrix. (8)

OR

16. (a) Without using any builtin string processing function like *strlen*, *strcat* etc., write a program to concatenate two strings. (8)
(b) Write a C program to perform bubble sort. (6)

17. (a) Write a function namely *myFact* in C to find the factorial of a given number. Also, write another function in C namely *nCr* which accepts two positive integer parameters *n* and *r* and returns the value of the mathematical function $C(n,r) = \frac{n!}{r! \times (n-r)!}$. The function *nCr* is expected to make use of the factorial function *myFact*. (10)
(b) What is recursion? Give an example. (4)

OR

18. (a) With a suitable example, explain the differences between a structure and a union in C. (6)
(b) Declare a structure namely *Student* to store the details (*roll number*, *name*, *mark_for_C*) of a student. Then, write a program in C to find the average mark obtained by the students in a class for the subject *Programming in C* (using the field *mark_for_C*). Use array of structures to store the required data (8)

19. (a) With a suitable example, explain the concept of pass by reference. (6)
(b) With a suitable example, explain how pointers can help in changing the content of a single dimensionally array passed as an argument to a function in C. (8)

OR

20. (a) Differentiate between sequential files and random access files? (4)

(b) Using the prototypes explain the functionality provided by the following functions. (10)

rewind()

i. *fseek()*

ii. *ftell()*

iii. *fread()*

iv. *fwrite()*

(14X5=70)

SYLLABUS

Programming in C (Common to all disciplines)

Module 1

Basics of Computer Hardware and Software

Basics of Computer Architecture: processor, Memory, Input& Output devices

Application Software & System software: Compilers, interpreters, High level and low level languages

Introduction to structured approach to programming, Flow chart Algorithms, Pseudo code (*bubble sort, linear search - algorithms and pseudocode*)

Module 2

Program Basics

Basic structure of C program: Character set, Tokens, Identifiers in C, Variables and Data Types , Constants, Console IO Operations, printf and scanf

Operators and Expressions: Expressions and Arithmetic Operators, Relational and Logical Operators, Conditional operator, size of operator, Assignment operators and Bitwise Operators. Operators Precedence

Control Flow Statements: If Statement, Switch Statement, Unconditional Branching using goto statement, While Loop, Do While Loop, For Loop, Break and Continue statements.(Simple programs covering control flow)

Module 3

Arrays and strings

Arrays Declaration and Initialization, 1-Dimensional Array, 2-Dimensional Array

String processing: In built String handling functions (strlen, strcpy, strcat and strcmp, puts, gets)

Linear search program, bubble sort program, simple programs covering arrays and strings

Module 4

Working with functions

Introduction to modular programming, writing functions, formal parameters, actual parameters Pass by Value, Recursion, Arrays as Function Parameters structure, union, Storage Classes, Scope and life time of variables, *simple programs using functions*

Module 5

Pointers and Files

Basics of Pointer: declaring pointers, accessing data through pointers, NULL pointer, array access using pointers, pass by reference effect

File Operations: open, close, read, write, append

Sequential access and random access to files: In built file handling functions (*rewind()*, *fseek()*, *ftell()*, *feof()*, *fread()*, *fwrite()*), simple programs covering pointers and files.

Text Books

1. Schaum Series, Gottfried B.S., Tata McGraw Hill, Programming with C
2. E. Balagurusamy, McGraw Hill, Programming in ANSI C
3. Asok N Kamthane, Pearson, Programming in C
4. Anita Goel, Pearson, Computer Fundamentals

Reference Books

1. Anita Goel and Ajay Mittal, Pearson, Computer fundamentals and Programming in C
2. Brian W. Kernighan and Dennis M. Ritchie, Pearson, C Programming Language
3. Rajaraman V, PHI, Computer Basics and Programming in C
4. Yashavant P, Kanetkar, BPB Publications, Let us C

Course Contents and Lecture Schedule

Module 1: Basics of Computer Hardware and Software		(7 hours)
1.1	Basics of Computer Architecture: Processor, Memory, Input & Output devices	2 hours
1.2	Application Software & System software: Compilers, interpreters, High level and low level languages	2 hours
1.3	Introduction to structured approach to programming, Flow chart	1 hours
1.4	Algorithms, Pseudo code (<i>bubble sort, linear search - algorithms and pseudocode</i>)	2 hours
Module 2: Program Basics		(8 hours)
2.1	Basic structure of C program: Character set, Tokens, Identifiers in C, Variables and Data Types, Constants, Console IO Operations, printf and scanf	2 hours
2.2	Operators and Expressions: Expressions and Arithmetic Operators, Relational and Logical Operators, Conditional operator, sizeof operator, Assignment operators and Bitwise Operators. Operators Precedence	2 hours

2.3	Control Flow Statements: If Statement, Switch Statement, Unconditional Branching using goto statement, While Loop, Do While Loop, For Loop, Break and Continue statements.(<i>Simple programs covering control flow</i>)	4 hours
Module 3: Arrays and strings:		(6 hours)
3.1	Arrays Declaration and Initialization, 1-Dimensional Array, 2-Dimensional Array	2 hours
3.2	String processing: In built String handling functions(<i>strlen, strcpy, strcat and strcmp, puts, gets</i>)	2 hours
3.3	Linear search program, bubble sort program, <i>simple programs covering arrays and strings</i>	3 hours
Module 4: Working with functions		(7 hours)
4.1	Introduction to modular programming, writing functions, formal parameters, actual parameters	2 hours
4.2	Pass by Value, Recursion, Arrays as Function Parameters	2 hours
4.3	structure, union, Storage Classes, Scope and life time of variables, <i>simple programs using functions</i>	3 hours
Module 5: Pointers and Files		(7 hours)
5.1	Basics of Pointer: declaring pointers, accessing data through pointers, NULL pointer, array access using pointers, pass by reference effect	3 hours
5.2	File Operations: open, close, read, write, append	1 hours
5.3	Sequential access and random access to files: In built file handling functions (<i>rewind(), fseek(), ftell(), feof(), fread(), fwrite()</i>), <i>simple programs covering pointers and files.</i>	2 hours

C PROGRAMMING LAB (Practical part of EST 102, Programming in C)

Assessment Method: The Academic Assessment for the Programming lab should be done internally by the College. The assessment shall be made on 50 marks and the mark is divided as follows: Practical Records/Outputs - 20 marks (internal by the College), Regular Lab Viva - 5 marks (internal by the College), Final Practical Exam – 25 marks (internal by the College).

The mark obtained out of 50 will be converted into equivalent proportion out of 20 for CIE computation.

LIST OF LAB EXPERIMENTS

1. Familiarization of Hardware Components of a Computer
2. Familiarization of Linux environment – How to do Programming in C with Linux
3. Familiarization of console I/O and operators in C
 - i) Display “Hello World”
 - ii) Read two numbers, add them and display their sum
 - iii) Read the radius of a circle, calculate its area and display it
 - iv) Evaluate the arithmetic expression $((a - b / c * d + e) * (f + g))$ and display its solution. Read the values of the variables from the user through console.
4. Read 3 integer values and find the largest among them.
5. Read a Natural Number and check whether the number is prime or not
6. Read a Natural Number and check whether the number is Armstrong or not
7. Read n integers, store them in an array and find their sum and average
8. Read n integers, store them in an array and search for an element in the array using an algorithm for Linear Search
9. Read n integers, store them in an array and sort the elements in the array using Bubble Sort algorithm
10. Read a string (word), store it in an array and check whether it is a palindrome word or not.
11. Read two strings (each one ending with a \$ symbol), store them in arrays and concatenate them without using library functions.
12. Read a string (ending with a \$ symbol), store it in an array and count the number of vowels, consonants and spaces in it.
13. Read two input each representing the distances between two points in the Euclidean space, store these in structure variables and add the two distance values.
14. Using structure, read and print data of n employees (*Name, Employee Id and Salary*)
15. Declare a union containing 5 string variables (*Name, House Name, City Name, State and Pin code*) each with a length of C_SIZE (user defined constant). Then, read and display the address of a person using a variable of the union.
16. Find the factorial of a given Natural Number n using recursive and non recursive functions
17. Read a string (word), store it in an array and obtain its reverse by using a user defined function.
18. Write a menu driven program for performing matrix addition, multiplication and finding the transpose. Use functions to (i) read a matrix, (ii) find the sum of two matrices, (iii) find the product of two matrices, (iv) find the transpose of a matrix and (v) display a matrix.
19. Do the following using pointers
 - i) add two numbers
 - ii) swap two numbers using a user defined function
20. Input and Print the elements of an array using pointers
21. Compute sum of the elements stored in an array using pointers and user defined function.
22. Create a file and perform the following
 - iii) Write data to the file
 - iv) Read the data in a given file & display the file content on console
 - v) append new data and display on console
23. Open a text input file and count number of characters, words and lines in it; and store the results in an output file.

PHL 120	ENGINEERING PHYSICS LAB	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		BSC	0	0	2	1	2019

Preamble: The aim of this course is to make the students gain practical knowledge to co-relate with the theoretical studies and to develop practical applications of engineering materials and use the principle in the right way to implement the modern technology.

Prerequisite: Higher secondary level Physics

Course Outcomes: After the completion of the course the student will be able to

CO 1	Develop analytical/experimental skills and impart prerequisite hands on experience for engineering laboratories
CO 2	Understand the need for precise measurement practices for data recording
CO 3	Understand the principle, concept, working and applications of relevant technologies and comparison of results with theoretical calculations
CO 4	Analyze the techniques and skills associated with modern scientific tools such as lasers and fiber optics
CO 5	Develop basic communication skills through working in groups in performing the laboratory experiments and by interpreting the results

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3				3			1	2			1
CO 2	3				3			1	2			1
CO 3	3				3			1	2			1
CO 4	3				3			1	2			1
CO 5	3				3			1	2			1

Mark distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration(Internal)
100	100	-	1 hour

Continuous Internal Evaluation Pattern:

Attendance	: 20 marks
Class work/ Assessment/Viva-voce	: 50 marks
End semester examination (Internally by college)	: 30 marks

End Semester Examination Pattern: Written Objective Examination of one hour**SYLLABUS****LIST OF EXPERIMENTS**

(Minimum 8 experiments should be completed)

1. CRO-Measurement of frequency and amplitude of wave forms
2. Measurement of strain using strain gauge and wheatstone bridge
3. LCR Circuit – Forced and damped harmonic oscillations
4. Melde's string apparatus- Measurement of frequency in the transverse and longitudinal mode
5. Wave length measurement of a monochromatic source of light using Newton's Rings method.
6. Determination of diameter of a thin wire or thickness of a thin strip of paper using air wedge method.
7. To measure the wavelength using a millimeter scale as a grating.
8. Measurement of wavelength of a source of light using grating.
9. Determination of dispersive power and resolving power of a plane transmission grating
10. Determination of the particle size of lycopodium powder
11. Determination of the wavelength of He-Ne laser or any standard laser using diffraction grating
12. Calculate the numerical aperture and study the losses that occur in optical fiber cable.
13. I-V characteristics of solar cell.
14. LED Characteristics.
15. Ultrasonic Diffractometer- Wavelength and velocity measurement of ultrasonic waves in a liquid
16. Deflection magnetometer-Moment of a magnet- Tan A position.

Reference books

1. S.L.Gupta and Dr.V.Kumar, "Practical physics with viva voice", Pragati Prakashan Publishers, Revised Edition, 2009
2. M.N.Abadhanulu, A.A.Dani and Pokely P.M, "Experiments in Engineering Physics", S.Chand & Co, 2008
3. S. K. Gupta, "Engineering physics practicals", Krishna Prakashan Pvt. Ltd., 2014
4. P. R. Sasikumar "Practical Physics", PHI Ltd., 2011.

CYL 120	ENGINEERING CHEMISTRY LAB	CATEGORY	L	T	P	CREDIT
		BSC	0	0	2	1

Preamble: To impart scientific approach and to familiarize with the experiments in chemistry relevant for research projects in higher semesters

Prerequisite: Experiments in chemistry introduced at the plus two levels in schools

Course outcomes: After the completion of the course the students will be able to

CO 1	Understand and practice different techniques of quantitative chemical analysis to generate experimental skills and apply these skills to various analyses
CO 2	Develop skills relevant to synthesize organic polymers and acquire the practical skill to use TLC for the identification of drugs
CO 3	Develop the ability to understand and explain the use of modern spectroscopic techniques for analysing and interpreting the IR spectra and NMR spectra of some organic compounds
CO 4	Acquire the ability to understand, explain and use instrumental techniques for chemical analysis
CO 5	Learn to design and carry out scientific experiments as well as accurately record and analyze the results of such experiments
CO 6	Function as a member of a team, communicate effectively and engage in further learning. Also understand how chemistry addresses social, economical and environmental problems and why it is an integral part of curriculum

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3				2							3
CO 2	3				3							3
CO 3	3				3							3
CO 4	3				3							3
CO 5	3				1							3
CO 6	3				1							3

Mark distribution

Total Marks	CIE marks	ESE marks	ESE Duration(Internal)
100	100	-	1 hour

Continuous Internal Evaluation Pattern:

Attendance	: 20 marks
Class work/ Assessment/Viva-voce	: 50 marks
End semester examination (Internally by college)	: 30 marks

End Semester Examination Pattern: Written Objective Examination of one hour

SYLLABUS**LIST OF EXPERIMENTS (MINIMUM 8 MANDATORY)**

1. Estimation of total hardness of water-EDTA method
2. Potentiometric titration
3. Determination of cell constant and conductance of solutions.
4. Calibration of pH meter and determination of pH of a solution
5. Estimation of chloride in water
6. Identification of drugs using TLC
7. Determination of wavelength of absorption maximum and colorimetric estimation of Fe^{3+} in solution
8. Determination of molar absorptivity of a compound (KMnO_4 or any water soluble food colorant)
9. Synthesis of polymers (a) Urea-formaldehyde resin (b) Phenol-formaldehyde resin
10. Estimation of iron in iron ore
11. Estimation of copper in brass
12. Estimation of dissolved oxygen by Winkler's method
13. (a) Analysis of IR spectra (minimum 3 spectra) (b) Analysis of ^1H NMR spectra (minimum 3 spectra)
14. Flame photometric estimation of Na^+ to find out the salinity in sand
15. Determination of acid value of a vegetable oil
16. Determination of saponification of a vegetable oil

Reference Books

1. G. Svehla, B. Sivasankar, "Vogel's Qualitative Inorganic Analysis", Pearson, 2012.
2. R. K. Mohapatra, "Engineering Chemistry with Laboratory Experiments", PHI Learning, 2017.
3. Muhammed Arif, "Engineering Chemistry Lab Manual", Owl publishers, 2019.
4. Ahad J., "Engineering Chemistry Lab manual", Jai Publications, 2019.
5. Roy K Varghese, "Engineering Chemistry Laboratory Manual", Crownplus Publishers, 2019.
6. Soney C George, Rino Laly Jose, "Lab Manual of Engineering Chemistry", S. Chand & Company Pvt Ltd, New Delhi, 2019.

CO 7	2											
CO 8	2											

Mark distribution

Total Marks	CIE	ESE	ESE Duration
100	70	30	1 hour

Assessment Procedure: Total marks allotted for the course is 100 marks. CIE shall be conducted for 70 marks and ESE for 30 marks. CIE should be done for the work done by the student and also viva voce based on the work done on each practical session. ESE shall be evaluated by written examination of one hour duration conducted internally by the institute.

Continuous Internal Evaluation Pattern:

Attendance	: 20 marks
Class work/ Assessment/Viva-voce	: 50 marks
End semester examination (Internally by college)	: 30 marks

End Semester Examination Pattern: Written Objective Examination of one hour

SYLLABUS

PART 1

CIVIL WORKSHOP

- Exercise 1. Calculate the area of a built-up space and a small parcel of land- Use standard measuring tape and digital distance measuring devices
- Exercise 2. (a) Use screw gauge and vernier calliper to measure the diameter of a steel rod and thickness of a flat bar
- (b) Transfer the level from one point to another using a water level
- (c) Set out a one room building with a given plan and measuring tape
- Exercise 3. Find the level difference between any two points using dumpy level
- Exercise 4. (a) Construct a $1\frac{1}{2}$ thick brick wall of 50 cm height and 60 cm length using English bond. Use spirit level to assess the tilt of walls.
- (b) Estimate the number of different types of building blocks to construct this wall.

- Exercise 5. (a) Introduce the students to plumbing tools, different types of pipes, type of connections, traps, valves, fixtures and sanitary fittings.
- (b) Install a small rainwater harvesting installation in the campus

Reference Books:

1. Khanna P.N, "Indian Practical Civil Engineering Handbook", Engineers Publishers.
2. Bhavikatti. S, "Surveying and Levelling (Volume 1)", I.K. International Publishing House
3. Arora S.P and Bindra S.P, " Building Construction", Dhanpat Rai Publications
4. S. C. Rangwala, "Engineering Materials," Charotar Publishing House.

PART II

MECHANICAL WORKSHOP

LIST OF EXERCISES

(Minimum EIGHT units mandatory and FIVE models from Units 2 to 8 mandatory)

UNIT 1:- General : Introduction to workshop practice, Safety precautions, Shop floor ethics, Basic First Aid knowledge.

Study of mechanical tools, components and their applications: (a) Tools: screw drivers, spanners, Allen keys, cutting pliers etc and accessories (b) bearings, seals, O-rings, circlips, keys etc.

UNIT 2:- Carpentry : Understanding of carpentry tools

Minimum any one model

1. T-Lap joint
2. Cross lap joint
3. Dovetail joint
4. Mortise joints

UNIT 3:- Foundry : Understanding of foundry tools

Minimum any one model

1. Bench Molding
2. Floor Molding
3. Core making
4. Pattern making

UNIT 4: - Sheet Metal : Understanding of sheet metal working tools

Minimum any one model

1. Cylindrical shape
2. Conical shape
3. Prismatic shaped job from sheet metal

UNIT 5: - Fitting : Understanding of tools used for fitting

Minimum any one model

1. Square Joint
2. V- Joint
3. Male and female fitting

UNIT 6: - Plumbing : Understanding of plumbing tools, pipe joints

Any one exercise on joining of pipes making use of minimum three types of pipe joints

UNIT 7: - Smithy: Understanding of tools used for smithy.

Demonstrating the forge-ability of different materials (MS, Al, alloy steel and cast steels) in cold and hot states.

Observing the qualitative difference in the hardness of these materials

Minimum any one exercise on smithy

1. Square prism
2. Hexagonal headed bolt
3. Hexagonal prism
4. Octagonal prism

UNIT 8: -Welding: Understanding of welding equipments

Minimum any one welding practice

Making Joints using electric arc welding. bead formation in horizontal, vertical and over head positions

UNIT 9: - Assembly: Demonstration only

Disassembling and assembling of

1. Cylinder and piston assembly
2. Tail stock assembly
3. Bicycle
4. Pump or any other machine

UNIT 10: - Machines: Demonstration and applications of the following machines

Shaping and slotting machine; Milling machine; Grinding Machine; Lathe; Drilling Machine.

UNIT 11: - Modern manufacturing methods: Power tools, CNC machine tools, 3D printing, Glass cutting.

Course Contents and Lecture Schedule:

No	Topic	No of Sessions
1	INTRODUCTION	
1.1	Workshop practice, shop floor precautions, ethics and First Aid knowledge. Studies of mechanical tools, components and their applications: (a) Tools: screw drivers, spanners, Allen keys, cutting pliers etc and accessories (b) bearings, seals, O-rings, circlips, keys etc	1
2	CARPENTRY	
2.1	Understanding of carpentry tools and making minimum one model	2

3	FOUNDRY	
3.1	Understanding of foundry tools and making minimum one model	2
4	SHEET METAL	
4.1	Understanding of sheet metal working tools and making minimum one model	2
5	FITTING	
5.1	Understanding of fitting tools and making minimum one model	2
6	PLUMBING	
6.1	Understanding of pipe joints and plumbing tools and making minimum one model	2
7	SMITHY	
7.1	Understanding of smithy tools and making minimum one model	2
8	WELDING	
8.1	Understanding of welding equipments and making minimum one model	2
9	ASSEMBLY	
9.1	Demonstration of assembly and dissembling of multiple parts components	1
10	MACHINES	
10.1	Demonstration of various machines	1
11	MODERN MANUFACTURING METHODS	
11.1	Demonstrations of: power tools, CNC Machine tools, 3D printing, Glass cutting	1

ESL 130	ELECTRICAL & ELECTRONICS WORKSHOP	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		ESC	0	0	2	1	2019

Preamble: Electrical Workshop is intended to impart skills to plan and carry out simple electrical wiring. It is essential for the practicing engineers to identify the basic practices and safety measures in electrical wiring.

Prerequisite: NIL

Course Outcomes: After the completion of the course the student will be able to

CO 1	Demonstrate safety measures against electric shocks.
CO 2	Identify the tools used for electrical wiring, electrical accessories, wires, cables, batteries and standard symbols
CO 3	Develop the connection diagram, identify the suitable accessories and materials necessary for wiring simple lighting circuits for domestic buildings
CO 4	Identify and test various electronic components
CO 5	Draw circuit schematics with EDA tools
CO 6	Assemble and test electronic circuits on boards
CO 7	Work in a team with good interpersonal skills

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	-	-	-	-	-	3	-	-	-	-	-	1
CO 2	2	-	-	-	-	-	-	-	-	1	-	-
CO 3	2	-	-	1	-	1	-	1	2	2	-	2
CO 4	3	-	-	-	-	-	-	-	-	-	-	2
CO 5	3	-	-	-	2	-	-	-	-	-	-	2
CO 6	3	-	-	-	2	-	-	-	-	-	-	1
CO 7	-	-	-	-	-	-	-	-	3	2	-	2

Mark distribution

Total Marks	CIE	ESE	ESE Duration(Internal)
100	100	-	1 hour

Continuous Internal Evaluation Pattern:

Attendance	: 20 marks
Class work/ Assessment/Viva-voce	: 50 marks
End semester examination (Internally by college)	: 30 marks

End Semester Examination Pattern: Written Objective Examination of one hour

Syllabus**PART 1****ELECTRICAL****List of Exercises / Experiments**

1. a) Demonstrate the precautionary steps adopted in case of Electrical shocks.
b) Identify different types of cables, wires, switches, fuses, fuse carriers, MCB, ELCB and MCCB with ratings.
2. Wiring of simple light circuit for controlling light/ fan point (PVC conduit wiring)
3. Wiring of light/fan circuit using Two way switches . (Staircase wiring)
4. Wiring of Fluorescent lamps and light sockets (6A) with a power circuit for controlling power device. (16A socket)
5. Wiring of power distribution arrangement using single phase MCB distribution board with ELCB, main switch and Energy meter.
6. a) Identify different types of batteries with their specifications.
b) Demonstrate the Pipe and Plate Earthing Schemes using Charts/Site Visit.

PART II**ELECTRONICS****List of Exercises / Experiments (Minimum of 7 mandatory)**

1. Familiarization/Identification of electronic components with specification (Functionality, type, size, colour coding, package, symbol, cost etc. [Active, Passive, Electrical, Electronic, Electro-mechanical, Wires, Cables, Connectors, Fuses, Switches, Relays, Crystals, Displays, Fasteners, Heat sink etc.]

2. Drawing of electronic circuit diagrams using BIS/IEEE symbols and introduction to EDA tools (such as Dia or Xcircuit), Interpret data sheets of discrete components and IC's, Estimation and costing.
3. Familiarization/Application of testing instruments and commonly used tools. [Multimeter, Function generator, Power supply, DSO etc.] [Soldering iron, De-soldering pump, Pliers, Cutters, Wire strippers, Screw drivers, Tweezers, Crimping tool, Hot air soldering and de-soldering station etc.]
4. Testing of electronic components [Resistor, Capacitor, Diode, Transistor and JFET using multimeter.]
5. Inter-connection methods and soldering practice. [Bread board, Wrapping, Crimping, Soldering - types - selection of materials and safety precautions, soldering practice in connectors and general purpose PCB, Crimping.]
6. Printed circuit boards (PCB) [Types, Single sided, Double sided, PTH, Processing methods, Design and fabrication of a single sided PCB for a simple circuit with manual etching (Ferric chloride) and drilling.]
7. Assembling of electronic circuits using SMT (Surface Mount Technology) stations.
8. Assembling of electronic circuit/system on general purpose PCB, test and show the functioning (**Any Two circuits**).
 1. Fixed voltage power supply with transformer, rectifier diode, capacitor filter, zener/IC regulator.
 2. Square wave generation using IC 555 timer in IC base.
 3. Sine wave generation using IC 741 OP-AMP in IC base.
 4. RC coupled amplifier with transistor BC107.

APJ ABDUL KALAM
TECHNOLOGICAL
UNIVERSITY

SEMESTER III

KTU

Estd.



2014

MAT 203	DISCRETE MATHEMATICAL STRUCTURES	CATEGORY	L	T	P	CREDITS
		BSC	3	1	0	4

Preamble:

The purpose of this course is to create awareness in students about the basic terminologies used in advanced courses in Computer Science and develop rigorous logical thinking for solving different kinds of problems in Computer Science. This course helps the learner to apply the theory and applications of elementary Counting Principles, Propositional Logic, Predicate Logic, Lattices, Generating Functions, Recurrence Relations and Algebraic Structures eventually in practical applications.

Prerequisite: A sound background in higher secondary school Mathematics

Course Outcomes: After the completion of the course the student will be able to

CO#	CO
CO1	Check the validity of predicates in Propositional and Quantified Propositional Logic using truth tables, deductive reasoning and inference theory on Propositional Logic (Cognitive Knowledge Level: Apply)
CO2	Solve counting problems by applying the elementary counting techniques - Rule of Sum, Rule of Product, Permutation, Combination, Binomial Theorem, Pigeonhole Principle and Principle of Inclusion and Exclusion (Cognitive Knowledge Level: Apply)
CO3	Classify binary relations into various types and illustrate an application for each type of binary relation, in Computer Science (Cognitive Knowledge Level: Understand)
CO4	Illustrate an application for Partially Ordered Sets and Complete Lattices, in Computer Science (Cognitive Knowledge Level: Apply)
CO5	Explain Generating Functions and solve First Order and Second Order Linear Recurrence Relations with Constant Coefficients (Cognitive Knowledge Level: Apply)
CO6	Illustrate the abstract algebraic systems - Semigroups, Monoids, Groups, Homomorphism and Isomorphism of Monoids and Groups (Cognitive Knowledge Level: Understand)

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓								✓
CO2	✓	✓	✓	✓								✓
CO3	✓	✓	✓	✓		✓						✓
CO4	✓	✓	✓	✓		✓						✓
CO5	✓	✓	✓	✓								✓
CO6	✓	✓	✓	✓								✓

Abstract POs defined by National Board of Accreditation

PO#	Broad PO	PO#	Broad PO
PO1	Engineering Knowledge	PO7	Environment and Sustainability
PO2	Problem Analysis	PO8	Ethics
PO3	Design/Development of solutions	PO9	Individual and team work
PO4	Conduct investigations of complex problems	PO10	Communication
PO5	Modern tool usage	PO11	Project Management and Finance
PO6	The Engineer and Society	PO12	Life long learning

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination Marks (%)
	Test 1 (%)	Test 2 (%)	
Remember	30	30	30
Understand	30	30	30
Apply	40	40	40
Analyze			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3

Continuous Internal Evaluation Pattern:

Attendance	10 marks
Continuous Assessment Tests (Average of Series Tests 1 & 2)	25 marks
Continuous Assessment Assignment	15 marks

Internal Examination Pattern:

Each of the two internal examinations has to be conducted out of 50 marks. First series test shall be preferably conducted after completing the first half of the syllabus and the second series test shall be preferably conducted after completing remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly completed module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly completed module), each with 7 marks. Out of the 7 questions, a student should answer any 5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 full questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carries 14 marks.

Syllabus**Module – 1 (Fundamentals of Logic)**

Mathematical logic - Basic connectives and truth table, Statements, Logical Connectives, Tautology, Contradiction. Logical Equivalence - The Laws of Logic, The Principle of duality, Substitution Rules . The implication - The Contrapositive, The Converse, The Inverse.

Logical Implication - Rules of Inference. The use of Quantifiers - Open Statement, Quantifier. Logically Equivalent – Contrapositive, Converse , Inverse , Logical equivalences and implications for quantified statement, Implications , Negation .

Module - 2 (Fundamentals of Counting Theory)

The Rule of Sum – Extension of Sum Rule . The Rule of Product - Extension of Product Rule . Permutations. Combinations. The Binomial Theorem (without proof). Combination with Repetition. The Pigeon hole Principle. The Principle of Inclusion and Exclusion Theorem (Without Proof) - Generalization of the Principle. Derangements.

Module - 3 (Relations and Functions)

Cartesian Product - Binary Relation. Function – domain , range-one to one function, Image-restriction. Properties of Relations- Reachability Relations, Reflexive Relations, Symmetric Relations, Transitive relations, Anti-symmetric Relations, Partial Order relations, Equivalence Relations, Irreflexive relations.

Partially ordered Set – Hasse Diagram, Maximal-Minimal Element, Least upper bound (lub), Greatest Lower bound(glb) (Topological sorting Algorithm- excluded). Equivalence Relations and Partitions - Equivalence Class.

Lattice - Dual Lattice , Sub lattice , Properties of glb and lub , Properties of Lattice , Special Lattice , Complete Lattice, Bounded Lattice, Completed Lattice , Distributive Lattice.

Module - 4 (Generating Functions and Recurrence Relations)

Generating Function - Definition and Examples , Calculation techniques, Exponential generating function. First order linear recurrence relations with constant coefficients – homogeneous, non-homogeneous Solution. Second order linear recurrence relations with constant coefficients, homogeneous, non-homogeneous Solution.

Module - 5 (Algebraic Structures)

Algebraic system-properties- Homomorphism and Isomorphism. Semi group and monoid – cyclic monoid , sub semi group and sub monoid, Homomorphism and Isomorphism of Semi group and monoids. Group- Elementary properties, subgroup, symmetric group on three symbols ,The direct product of two groups, Group Homomorphism, Isomorphism of groups, Cyclic group. Rightcosets - Leftcosets. Lagrange's Theorem

Text Book

1. Discrete and Combinatorial Mathematics (An Applied Introduction), Ralph P Grimaldi, B V Ramana , 5th Edition, Pearson

Reference Books

- 1) Kenneth H. Rosen, Discrete Mathematics and Its Applications with Combinatorics and Graph Theory, Seventh Edition, MGH, 2011
- 2) Trembly J.P and Manohar R, "Discrete Mathematical Structures with Applications to Computer Science", Tata Mc Graw Hill Pub. Co. Ltd., New Delhi, 2003.
- 3) Bernard Kolman, Robert C. Busby, Sharan Cutler Ross, "Discrete Mathematical Structures", Pearson Education Pvt Ltd., New Delhi, 2003
- 4) Kenneth H .Rosen, "Discrete Mathematics and its Applications", 5/e, Tata Mc Graw Hill Pub. Co. Ltd, New Delhi 2003
- 5) Richard Johnsonbaugh, "Discrete Mathematics", 5/e, Pearson Education Asia, NewDelhi, 2002.
- 6) Joe L Mott, Abraham Kandel, Theodore P Baker, "Discrete Mathematics for Computer Scientists and Mathematicians", 2/e, Prentice-Hall India, 2009.

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Show that $R \vee M$, $\neg R \vee S$, $\neg M$, $\neg S$ cannot exist simultaneously (without using truth table)
2. Represent the following statement in symbolic form "Not every city in Canada is clean".

Course Outcome 2 (CO2):

1. How many possible arrangements are there for the letters in MASSASAUGA in which 4 A's are together?
2. Find the number of integers between 1 and 1000 inclusive, which are not divisible by 5, 6 or 8

Course Outcome 3 (CO3):

1. If $A = \{1, 2, 3, 4\}$, give an example of a relation R that is reflexive and symmetric but not transitive.
2. Let Z be the set of integers. R is a relation called "Congruence Modulo 3 " defined by $R = \{ (x,y) / x \in Z, y \in Z, x - y \text{ is divisible by } 3 \}$. Show that R is an equivalence relation.

Course Outcome 4 (CO4):

1. Assume $A = \{ a, b, c \}$. Let $P(A)$ be its power set and ' $\leq$ ' be the subset relation on the power set. Draw the Hasse diagram of $(P(A), \leq)$.
2. What is meant by Bounded Lattice ? Give an example.

Course Outcome 5 (CO5):

1. Solve $a_r - 3a_{r-1} - 4a_{r-2} = 3^r$ using Generating function method; Given $a_0 = 1$, $a_1 = 2$.
2. Find the generating function for the sequence 1, 3, 3^2 , 3^3

Course Outcome 6 (CO6):

1. Prove that the group $\{ 1, -1, i, -i \}$ is cyclic with generators i and $-i$.
2. State and prove Lagrange's Theorem.

Model Question Paper

QP CODE:

Reg No: _____

Name : _____

PAGES : 3

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

THIRD SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: MAT 203

Course Name: Discrete Mathematical Structures

Max.Marks :100

Duration: 3 Hrs

PART A

Answer all Questions. Each question carries 3 Marks

1. Show the following implication without constructing the truth table: $(P \wedge Q) \Rightarrow P \rightarrow Q$
2. Write the negation of the following statement. "If I drive, then I will not walk"
3. What is pigeon hole principle? Explain. If you select any five numbers from 1 to 8 then prove that at least two of them will add up to 9 .
4. In how many ways can the letters of the word ALLAHABAD be arranged ?
5. Show that the divisibility relation ' / ' is a partial ordering on the set Z^+ .
6. Consider the functions given by $f(x) = 2x+3$ and $g(x) = x^2$. Find $(g \circ f)$ and $(f \circ g)$.
7. What is meant by exponential generating function? Explain.
8. Provide one example of linear homogeneous recurrence relation. Mention the degree also.
9. What is a monoid ? Explain.
10. Let $(A, .)$ be a group. Show that $(ab)^{-1} = b^{-1}a^{-1}$

(10 x 3 = 30 Marks)

PART B

(Answer any one Question from each Module. Each question carries 14 Marks)

11.

- (a) Show that $S \vee R$ is tautologically implied by $(P \vee Q) \wedge (P \rightarrow R) \wedge (Q \rightarrow S)$

(6 marks)

(b) Show that from

(ii) $(\exists x)(F(x) \wedge S(x)) \rightarrow (y)(M(y) \rightarrow W(y))$.

(iii) $(\exists y)(M(y) \wedge \neg W(y))$ the conclusion $(x)(F(x) \rightarrow \neg S(x))$ follows.

(8 marks)

OR

12.

(a) Show that $(x)(P(x) \vee Q(x)) \Rightarrow ((x)P(x) \vee (\exists x)Q(x))$ using indirect method of proof.

(6 marks)

(b) Discuss indirect method of proof. Show that the following premises are inconsistent

(i) If Jack misses many classes through illness, then he fails high school.

(ii) If Jack fails high school, then he is uneducated.

(iii) If Jack reads a lot of books, then he is not uneducated.

(iv) Jack misses many classes through illness and reads a lot of books.

(8 marks)

13.

(a) Explain binomial theorem. Determine the coefficient of x^9y^3 in the expansion of $(x+y)^{12}$, $(x+2y)^{12}$ and $(2x-3y)^{12}$ using binomial theorem.

(6 marks)

(b) How many 5 digit numbers can be formed from the digits 1,2,3,4,5 using the digits without repetition?

(i) How many of them are even?

(ii) How many are even and greater than 30,000?

(8 marks)

OR

14.

(a) There are 8 guests in a party. Each guest brings a gift and receives another gift in return. No one is allowed to receive the gift they bought. How many ways are there to distribute the gifts?

(6 marks)

(b) Six papers are set in an examination of which two are mathematical. Only one examination will be conducted in a day. In how many different orders can the papers be arranged so that

(i) Two mathematical papers are consecutive?

(ii) Two mathematical papers are not consecutive?

(8 marks)

15.

- (a) Let $A = \{1, 2, 3, 4, \dots, 11, 12\}$ and let R be the equivalence relation on $A \times A$ defined by $(a, b) R (c, d)$ iff $a+d = b+c$. Prove that R is an equivalence relation and find the equivalence class of $(2, 5)$

(8 marks)

- (b) What is a chain lattice ? Explain. Also show that every chain is a distributive lattice.

(6 marks)

OR

16.

- (a) Suppose $f(x) = x+2$, $g(x) = x-2$, and $h(x) = 3x$ for $x \in \mathbb{R}$, where $\mathbb{R}$ is the set of real numbers. Find $(g \circ f)$, $(f \circ g)$, $(f \circ f)$ and $(g \circ g)$

(8 marks)

- (b) Let R and S be two relations on a set A . If R and S are symmetric, Prove that $(R \cap S)$ is also symmetric.

(6 marks)

17.

- (a) Solve the recurrence relation $a_r - 7a_{r-1} + 10a_{r-2} = 0$ for $r \geq 2$; Given $a_0 = 0$; $a_1 = 41$ using generating functions

(8 marks)

- (b) Solve the recurrence relation $a_r - 4a_{r-1} + 4a_{r-2} = (r+1)^2$ using generating function.

(6 marks)

OR

18.

- (a) Solve $a_n - 3a_{n-1} + 2 = 0$; $a_0 = 1$ $n \geq 1$, using generating functions.

(8 marks)

- (b) Use generating function to solve the following recurrence relation $a_n = 2a_{n-1} + 2^n$; with $a_0 = 2$.

(6 marks)

19.

- (a) Prove that the set ' $\mathbb{Q}$ ' of rational numbers other than 1 forms an abelian group with respect to the operation ' $*$ ' defined by $a * b = a+b-ab$.

(8 Marks)

- (b) Show that the direct product of two group is a group.

(6 Marks)

OR

20.

- (a) Show that the subgroup of a cyclic group is cyclic.

(8 Marks)

- (b) Let $(A, *)$ be a group. Show that $(A, *)$ is an abelian group if and only if $a^2 * b^2 = (a * b)^2$ for all ' a ' and ' b ' in A

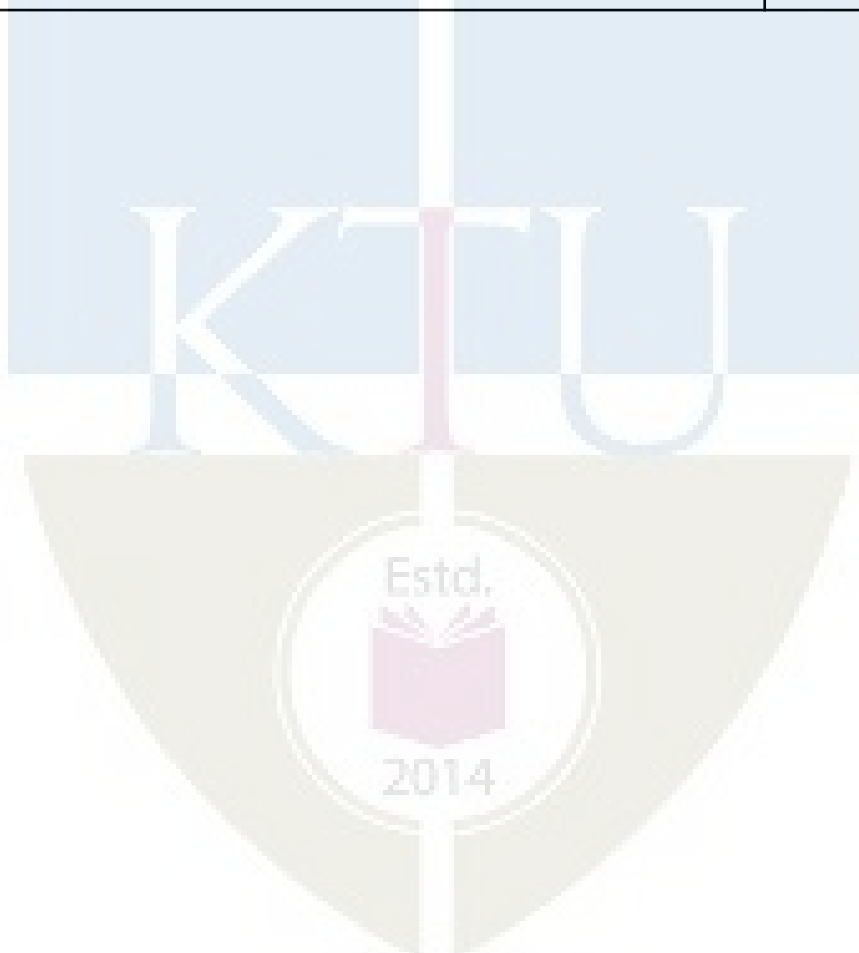
(6 Marks)

TEACHING PLAN

No	Contents	No of Lecture Hrs
Module – 1 (Fundamentals of Logic) (9 hrs)		
1.1	Mathematical logic, Basic Connectives and Truth Table	1
1.2	Statements, Logical Connectives, Tautology, Contradiction	1
1.3	Logical Equivalence, The Laws of Logic	1
1.4	The Principle of duality, Substitution Rules	1
1.5	The implication, The Contrapositive, the Converse , the Inverse	1
1.6	Logical Implication, Rules of Inference, Logical Implication	1
1.7	The use of Quantifiers, Open Statement, Quantifier, Negation	1
1.8	Logically Equivalent, Contrapositive, The Converse, The Inverse	1
1.9	Logical Implications	1
Module - 2 (Fundamentals of Counting Theory) (9 hrs)		
2.1	The Pigeon-hole Principle	1
2.2	The Rule of Sum	1
2.3	Extension of Sum Rule	1
2.4	The Rule of Product	1
2.5	Extension of Product Rule , Permutations	1
2.6	Combinations, Combination with repetition	1
2.7	The Binomial Theorem	1
2.8	The Principle of Inclusion and Exclusion Theorem (Without Proof) Generalization of the Principle	1
2.9	Derangements	1
Module - 3 (Relations and Functions) (9 hrs)		
3.1	Cartesian Product, Binary Relation, Function, Domain, Range , One to One Function Image - Restriction	1
3.2	Properties, Reachability Relations, Reflexive Relations, Symmetric Relations, Transitive relations, Antisymmetric Relations.	1

3.3	Partial Order relations	1
3.4	Equivalence Relation, Irreflexive Relations.	1
3.5	Partially ordered Set, Hasse Diagram.	1
3.6	Maximal-Minimal Element, Least Upper bound, Greatest Lower Bound	1
3.7	Equivalence Relations and Partitions, Equivalence Class	1
3.8	Lattice- Dual Lattice, sub lattice, Properties of glb and lub	1
3.9	Properties of Lattice, Special Lattice, Complete Lattice, Bounded Lattice, Completed Lattice, Distributive Lattice	1
Module - 4 (Generating Functions and Recurrence Relations) (9 hrs)		
4.1	Generating Function, Definition and Examples	1
4.2	Exponential Generating Function.	1
4.3	First Order Linear Recurrence Relations with Constant Coefficients (Lecture I)	1
4.4	First Order Linear Recurrence Relations with Constant Coefficients (Lecture II)	1
4.5	Homogeneous Solution	1
4.6	Non homogeneous Solution	1
4.7	Second order linear recurrence relations with constant coefficients	1
4.8	Homogeneous Solution	1
4.9	Non homogeneous Solution	1
Module - 5 (Algebraic Structures) (9 hrs)		
5.1	Algebraic System-Properties, Homomorphism and Isomorphism	1
5.2	Semi group, Monoid, Cyclic monoid	1

5.3	Sub semigroup and sub monoid	1
5.4	Homomorphism and Isomorphism of Semigroup, Monoids and Groups	1
5.5	Elementary Properties, Subgroup, Symmetric group on three symbols	1
5.6	The direct Product of two Groups	1
5.7	Group Homomorphism, Isomorphism, Cyclic group	1
5.8	Right coset, Left coset	1
5.9	Lagrange's Theorem	1



CST201	DATA STRUCTURES	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		PCC	3	1	0		

Preamble: This course aims at moulding the learner to understand the various data structures, their organization and operations. The course helps the learners to assess the applicability of different data structures and associated algorithms for solving real world problem which requires to compare and select appropriate data structures to solve the problem efficiently. This course introduces abstract concepts for data organization and manipulation using data structures such as stacks, queues, linked lists, binary trees, heaps and graphs for designing their own data structures to solve practical application problems in various fields of Computer Science.

Prerequisite: Topics covered under the course Programming in C (EST 102)

CO1	Design an algorithm for a computational task and calculate the time/space complexities of that algorithm (Cognitive Knowledge Level: Apply)
CO2	Identify the suitable data structure (array or linked list) to represent a data item required to be processed to solve a given computational problem and write an algorithm to find the solution of the computational problem (Cognitive Knowledge Level: Apply)
CO3	Write an algorithm to find the solution of a computational problem by selecting an appropriate data structure (binary tree/graph) to represent a data item to be processed (Cognitive Knowledge Level: Apply)
CO4	Store a given dataset using an appropriate Hash Function to enable efficient access of data in the given set (Cognitive Knowledge Level: Apply)
CO5	Select appropriate sorting algorithms to be used in specific circumstances (Cognitive Knowledge Level: Analyze)
CO6	Design and implement Data Structures for solving real world problems efficiently (Cognitive Knowledge Level: Apply)

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												
CO6												

Abstract POs defined by National Board of Accreditation			
PO#	Broad PO	PO#	Broad PO
PO1	Engineering Knowledge	PO7	Environment and Sustainability
PO2	Problem Analysis	PO8	Ethics
PO3	Design/Development of solutions	PO9	Individual and team work
PO4	Conduct investigations of complex problems	PO10	Communication
PO5	Modern tool usage	PO11	Project Management and Finance
PO6	The Engineer and Society	PO12	Life long learning

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination Marks
	Test1 (Percentage)	Test2 (Percentage)	
Remember	30	30	30
Understand	30	30	30
Apply	40	40	40

Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks

Continuous Assessment Tests : 25 marks

Continuous Assessment Assignment : 15 marks

Internal Examination Pattern:

Each of the two internal examinations has to be conducted out of 50 marks

First Internal Examination shall be preferably conducted after completing the first half of the syllabus and the Second Internal Examination shall be preferably conducted after completing remaining part of the syllabus.

There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly covered module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly covered module), each with 7 marks. Out of the 7 questions in Part B, a student should answer any 5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which a student should answer any one. Each question can have maximum 2 sub-divisions and carries 14 marks.

SYLLABUS

Module 1

Basic Concepts of Data Structures

System Life Cycle, Algorithms, Performance Analysis, Space Complexity, Time Complexity, Asymptotic Notation, Complexity Calculation of Simple Algorithms

Module 2

Arrays and Searching

Polynomial representation using Arrays, Sparse matrix, Stacks, Queues-Circular Queues, Priority Queues, Double Ended Queues, Evaluation of Expressions
Linear Search and Binary Search

Module 3

Linked List and Memory Management

Self Referential Structures, Dynamic Memory Allocation, Singly Linked List-Operations on Linked List. Doubly Linked List, Circular Linked List, Stacks and Queues using Linked List, Polynomial representation using Linked List
Memory allocation and de-allocation-First-fit, Best-fit and Worst-fit allocation schemes

Module 4

Trees and Graphs

Trees, Binary Trees-Tree Operations, Binary Tree Representation, Tree Traversals, Binary Search Trees- Binary Search Tree Operations
Graphs, Representation of Graphs, Depth First Search and Breadth First Search on Graphs, Applications of Graphs

Module 5

Sorting and Hashing

Sorting Techniques – Selection Sort, Insertion Sort, Quick Sort, Merge Sort and Heap Sort
Hashing- Hashing Techniques, Collision Resolution, Overflow handling, Hashing functions – Mid square, Division, Folding, Digit Analysis

Text Book

1. Ellis Horowitz, Sartaj Sahni and Susan Anderson-Freed, Universities Press, Fundamentals of Data Structures in C

Reference Books

1. Samanta D., Classic Data Structures, Prentice Hall India.
2. Richard F. Gilberg, Behrouz A. Forouzan, Data Structures: A Pseudocode Approach with C, 2/e, Cengage Learning.
3. Aho A. V., J. E. Hopcroft and J. D. Ullman, Data Structures and Algorithms, Pearson Publication.
4. Tremblay J. P. and P. G. Sorenson, Introduction to Data Structures with Applications, Tata McGraw Hill.
5. Peter Brass, Advanced Data Structures, Cambridge University Press.
6. Lipschuts S., Theory and Problems of Data Structures, Schaum's Series.
7. Wirth N., Algorithms + Data Structures = Programs, Prentice Hall.
8. Hugges J. K. and J. I. Michtm, A Structured Approach to Programming, PHI.
9. Martin Barrett, Clifford Wagner, C And Unix: Tools For Software Design, John Wiley.

Sample Course Level Assessment Questions

Course Outcome1(CO1): Write an algorithm for matrix multiplication and calculate its time complexity.

Course Outcome 2(CO2): How a linked list can be used to represent the polynomial $5x^4y^6+24x^3y^4-17x^2y^3+15xy^2+45$. Write an algorithm to add two Bivariate polynomials represented using linked list.

Course Outcome 3(CO3): Create a Binary search Tree with node representing the following sequence 14, 15, 4, 18, 9, 16, 20, 17, 3, 7, 5, 2 and perform inorder, preorder and postorder traversals on the above tree and print the output.

Course Outcome 4(CO4): The size of a hash table is 7. The index of the hash table varies from 0 to 6. Consider the keys 89, 18, 49, 58, 25 in the order. Show how the keys are stored in the hash table using Linear probing.

Course Outcome 5(CO5): In what circumstances does Quick Sort perform over Merge sort.

Course Outcome 6(CO6): Design a reservation system for railways that include waiting list. If the reservation is full “Display reservation full” and put the passenger in in waiting list and give a waiting list number. If a passenger cancels the ticket, then the seat should be automatically allocated to the first passenger in the waiting list.

Model Question Paper

QP CODE: _____

PAGES:3

Reg No: _____

Name: _____

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY THIRD SEMESTER B.TECH
DEGREE EXAMINATION, MONTH & YEAR**

Course Code: CST201

Course Name: DATA STRUCTURES

Max.Marks:100

Duration: 3 Hours

PART A

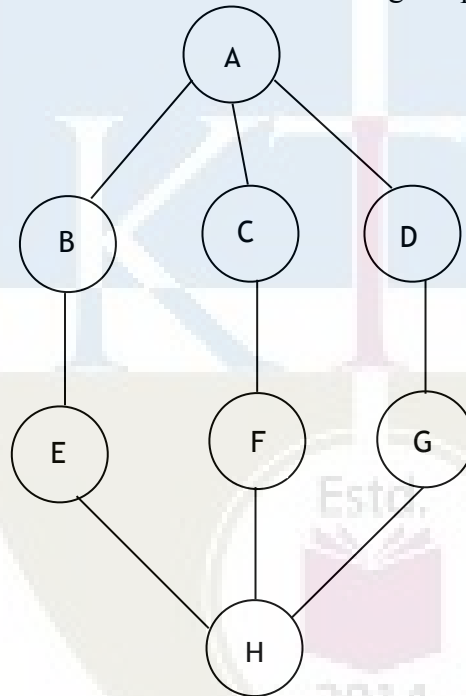
Answer all Questions. Each question carries 3 Marks

1. Calculate the frequency count of the statement $x = x+1$; in the following code segment
for ($i = 0$; $i < n$; $i++$)
for ($j = 0$; $j < n$; $j*=2$)
 $x = x + 1$;
2. What is the relevance of verification in System Life Cycle?
3. Write an algorithm to insert a new element in a particular position of an array.

4. Convert the expression $((A/(B-D+E))*(F-G)*H)$ to postfix form. Show each step in the conversion including the stack contents
5. Write an algorithm to count the number of occurrences of a character in a linked list (each node contains only one character)
6. Write an algorithm for best-fit method of memory allocation
7. Draw the binary tree whose sequential representation is given below

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
A	B	C	-	D	E	-	-	-	-	F	G	-	-	-

8. Find the Depth First Search of the following Graph



9. Write an algorithm to arrange n numbers in nonincreasing order.
10. Let the size of a hash table is 10. The index of the hash table varies from 0 to 9. Assume the keys 73, 54, 15, 48, 89, 66, 37, 18, 41, 22, 62 are mapped using modulo operator. Show how the keys are distributed using chaining method.

Part B

Answer any one Question from each module. Each question carries 14 Marks

11. a) Explain the System Life Cycle in detail (10)
b) How the performance of an algorithm is evaluated? (4)

OR

12. a) Write algorithms for Linear Search and Binary Search and Compare their time complexities (10)
b) Between $O(n \log n)$ and $O(\log n)$ which one is better and why? (4)

13. a) Write algorithms to insert and delete elements from a double ended queue. Demonstrate with examples (10)
b) Compare and contrast Circular Queue with a Normal Queue (4)

OR

14. a) Write an algorithm to insert and delete elements from a Priority Queue (8)
b) Discuss an algorithm to convert an infix expression to a prefix expression (6)

15. a) Write an algorithm to multiply two polynomials represented using linked list (10)
b) How doubly linked list can be used to find palindromes ? (4)

OR

16. a) How is memory compaction (de-allocation) done in memory management ? (8)
b) Discuss the advantages and disadvantages of First-fit, Best-fit and Worst-fit allocation schemes (6)

17. a) List the properties of Binary Search Tree. Write an algorithm to search an element

from a Binary Search Tree (10)

b) Write an iterative algorithm for in-order traversal of a Binary Tree (4)

OR

18. a) Give algorithms for DFS and BFS of a graph and explain with examples (8)

b) How graphs can be represented in a Computer? (6)

19. a) Write algorithms for Merge sort and Quick Sort. (10)

b) Illustrate the working of Quick sort on the following input 38, 8, 0, 28, 45, -12, 89, 66, 42 (4)

OR

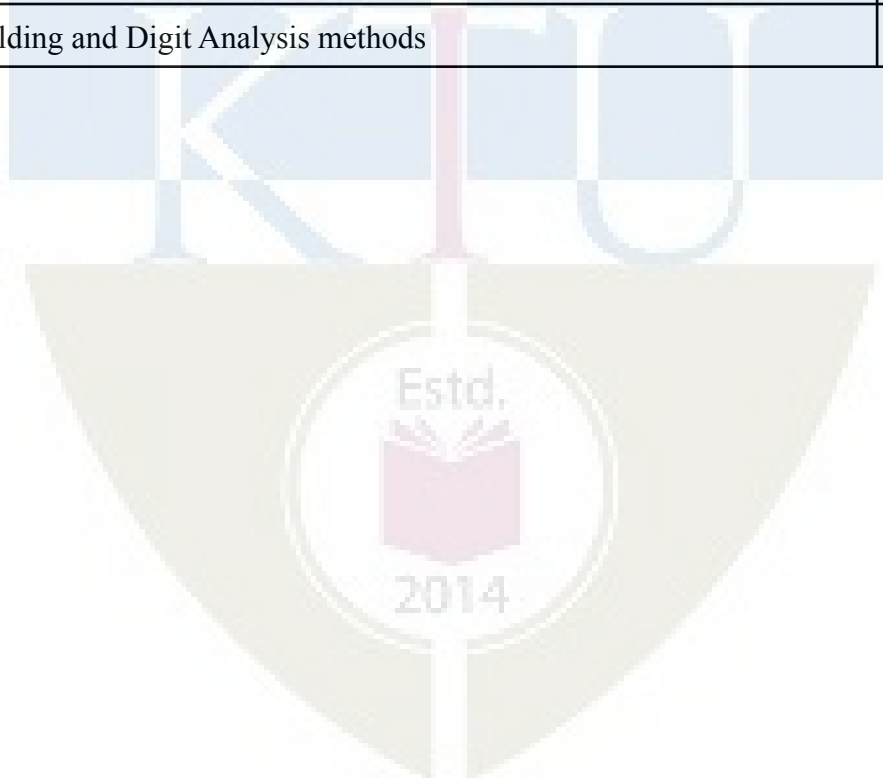
20. a) With examples discuss the different hash functions used for hashing (10)

b) Apply the hash function $h(x) = x \bmod 7$ for linear probing on the data 2341, 4234, 2839, 430, 22, 397, 3920 and show the resulting hash table (4)

Teaching Plan		
Module 1 :Basic Concepts of Data Structures		(5 hours)
1.1	System Life Cycle,	1 hour
1.2	Algorithms , Performance Analysis	1 hour
1.3	Space Complexity, Time Complexity	1 hour
1.4	Asymptotic Notation (Big O Notation)	1 hour
1.5	Complexity Calculation of Simple Algorithms	1hour
Module 2 :Arrays and Searching		(10 hours)
2.1	Polynomial representation using Arrays	1 hour
2.2	Sparse matrix (Lecture 1)	1 hour
2.3	Sparse matrix (Lecture 2)	1 hour

2.4	Stacks	1 hour
2.5	Queues, Circular Queues	1 hour
2.6	Priority Queues,	1 hour
2.7	Double Ended Queues,	1 hour
2.8	Conversion and Evaluation of Expressions (Lecture 1)	1 hour
2.9	Conversion and Evaluation of Expressions (Lecture 2)	1 hour
2.10	Linear Search and Binary Search	1 hour
Module 3 : Linked List and Memory Management		(12 hours)
3.1	Self Referential Structures	1 hour
3.2	Dynamic Memory Allocation	1 hour
3.3	Singly Linked List-Operations on Linked List,	1 hour
3.4	Doubly Linked List	1 hour
3.5	Circular Linked List	1 hour
3.6	Stacks using Linked List	1 hour
3.7	Queues using Linked List	1 hour
3.8	Polynomial representation using Linked List (Lecture 1)	1 hour
3.9	Polynomial representation using Linked List (Lecture2)	1 hour
3.10	Memory de-allocation	1 hour
3.11	Memory allocation-First-fit	1 hour
3.12	Best-fit and Worst-fit allocation schemes	1hour
Module 4 :Trees and Graphs		(8 hours)
4.1	Trees, Binary Trees	1hour
4.2	Tree Operations, Binary Tree Representation,	1hour
4.3	Tree Traversals	1hour
4.4	Binary Search Trees	1hour
4.5	Binary Search Tree Operations	1hour
4.6	Graphs, Representation of Graphs	1hour

4.7	Depth First Search and Breadth First Search on Graphs	1hour
4.8	Applications of Graphs	1hour
Module 5 : Sorting and Hashing		(10 hours)
5.1	Sorting Techniques – Selection Sort	1hour
5.2	Insertion Sort	1hour
5.3	Quick Sort	1hour
5.4	Merge Sort	1hour
5.5	Heap Sort	1hour
5.6	Hashing- Hashing Techniques	1hour
5.7	Collision Resolution	1hour
5.8	Overflow handling	1hour
5.9	Hashing functions – Mid square and Division methods	1hour
5.10	Folding and Digit Analysis methods	1hour



CST 203	LOGIC SYSTEM DESIGN	Category	L	T	P	Credit	Year of Introduction
		PCC	3	1	0		

Preamble: The objective of the course is to familiarize learners with the basic concepts of Boolean algebra and digital systems. This course covers the design of simple combinational and sequential logic circuits, representation and arithmetic algorithms for Binary, BCD (Binary Coded Decimal) and Floating point numbers which in turn are helpful in understanding organization & design of a computer system and understanding how patterns of ones and zeros can be used to store information on computers, including multimedia data.

Prerequisite: Nil

Course Outcomes: After the completion of the course the student will be able to

CO#	CO
CO1	Illustrate decimal, binary, octal, hexadecimal and BCD number systems, perform conversions among them and do the operations - complementation, addition, subtraction, multiplication and division on binary numbers (Cognitive Knowledge level: Understand)
CO2	Simplify a given Boolean Function and design a combinational circuit to implement the simplified function using Digital Logic Gates (Cognitive Knowledge level: Apply)
CO3	Design combinational circuits - Adders, Code Convertors, Decoders, Magnitude Comparators, Parity Generator/Checker and design the Programmable Logic Devices - ROM and PLA. (Cognitive Knowledge level: Apply)
CO4	Design sequential circuits - Registers, Counters and Shift Registers. (Cognitive Knowledge level: Apply)
CO5	Use algorithms to perform addition and subtraction on binary, BCD and floating point numbers (Cognitive Knowledge level: Understand)

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓										✓
CO2	✓	✓	✓	✓		✓						✓
CO3	✓	✓	✓	✓		✓						✓
CO4	✓	✓	✓	✓		✓						✓
CO5	✓	✓	✓									✓

Abstract POs defined by National Board of Accreditation			
PO#	Broad PO	PO#	Broad PO
PO1	Engineering Knowledge	PO7	Environment and Sustainability
PO2	Problem Analysis	PO8	Ethics
PO3	Design/Development of solutions	PO9	Individual and team work
PO4	Conduct investigations of complex problems	PO10	Communication
PO5	Modern tool usage	PO11	Project Management and Finance
PO6	The Engineer and Society	PO12	Life long learning

Assessment Pattern:

Bloom's Category	Test 1 (%)	Test 2 (%)	End Semester Examination Marks (%)
Remember	20	20	20
Understand	35	35	35
Apply	45	45	45
Analyse			
Evaluate			
Create			

Mark Distribution:

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3

Continuous Internal Evaluation Pattern:

Attendance : 10 marks

Continuous Assessment Test : 25 marks

Continuous Assessment Assignment : 15 marks

Internal Examination Pattern:

Each of the two internal examinations has to be conducted out of 50 marks. First series test shall be preferably conducted after completing the first half of the syllabus and the second series test shall be preferably conducted after completing remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly completed module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly completed module), each with 7 marks. Out of the 7 questions, a student should answer any 5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which a student should answer any one. Each question can have maximum 2 sub-divisions and carries 14 marks.

SYLLABUS**Module I****Number systems, Operations & Codes**

Decimal, Binary, Octal and Hexadecimal Number Systems- Number Base Conversions. Addition, Subtraction, Multiplication and Division of binary numbers. Representation of negative numbers- Complements, Subtraction with complements. Addition and subtraction of BCD, Octal and Hexadecimal numbers. Binary codes- Decimal codes, Error detection codes, Reflected code, Character coding schemes – ASCII, EBCDIC.

Module II**Boolean Algebra**

Postulates of Boolean Algebra. Basic theorems and Properties of Boolean Algebra. Boolean Functions - Canonical and Standard forms. Simplification of Boolean Functions- Using Karnaugh- Map Method (upto five variables), Don't care conditions, Product of sums

simplification, Tabulation Method. Digital Logic Gates- Implementation of Boolean functions using basic and universal gates.

Module III

Combinational Logic Circuits

Design Procedure & Implementation of combinational logic circuits- Binary adders and subtractors, Binary Parallel adder, Carry look ahead adder, BCD adder, Code converter, Magnitude comparator, Decoder, Demultiplexer, Encoder, Multiplexer, Parity generator/Checker.

Module IV

Sequential logic circuits:

Flip-flops- SR, JK, T and D. Triggering of flip-flops- Master slave flip-flops, Edge-triggered flip-flops. Excitation table and characteristic equation. Registers- register with parallel load. Counter design: Asynchronous counters- Binary and BCD counters, timing sequences and state diagrams. Synchronous counters- Binary Up-down counter, BCD counter.

Module V

Shift registers

Shift registers – Serial In Serial Out, Serial In Parallel Out, Bidirectional Shift Register with Parallel load. Ring counter. Johnson counter- timing sequences and state diagrams.

Arithmetic algorithms

Algorithms for addition and subtraction of binary numbers in signed magnitude and 2's complement representations. Algorithm for addition and subtraction of BCD numbers. Representation of floating point numbers, Algorithm for addition and subtraction of floating point numbers.

Programmable Logic devices

ROM. Programmable Logic Array(PLA)- Implementation of simple circuits using PLA.

Text Books:

1. M. Morris Mano, Digital Logic & Computer Design, 4/e, Pearson Education, 2013
2. Thomas L Floyd, Digital Fundamentals, 10/e, Pearson Education, 2009.
3. M. Morris Mano, Computer System Architecture, 3/e, Pearson Education, 2007.

Reference Books:

1. M. Morris Mano, Michael D Ciletti, Digital Design With An Introduction to the Verilog HDL, 5/e, Pearson Education, 2013.
2. Donald D Givone, Digital Principles and Design, Tata McGraw Hill, 2003

Sample Course Level Assessment Questions

Course Outcome1(CO1): Perform the following number base conversions:

a) $(250.55)_{10}$ to Hexadecimal

b) $(357)_8$ to Decimal

Course Outcome 2(CO2): Given a Boolean function F and don't care conditions D, using Karnaugh map obtain the simplified expression in (i) SOP and (ii) POS:

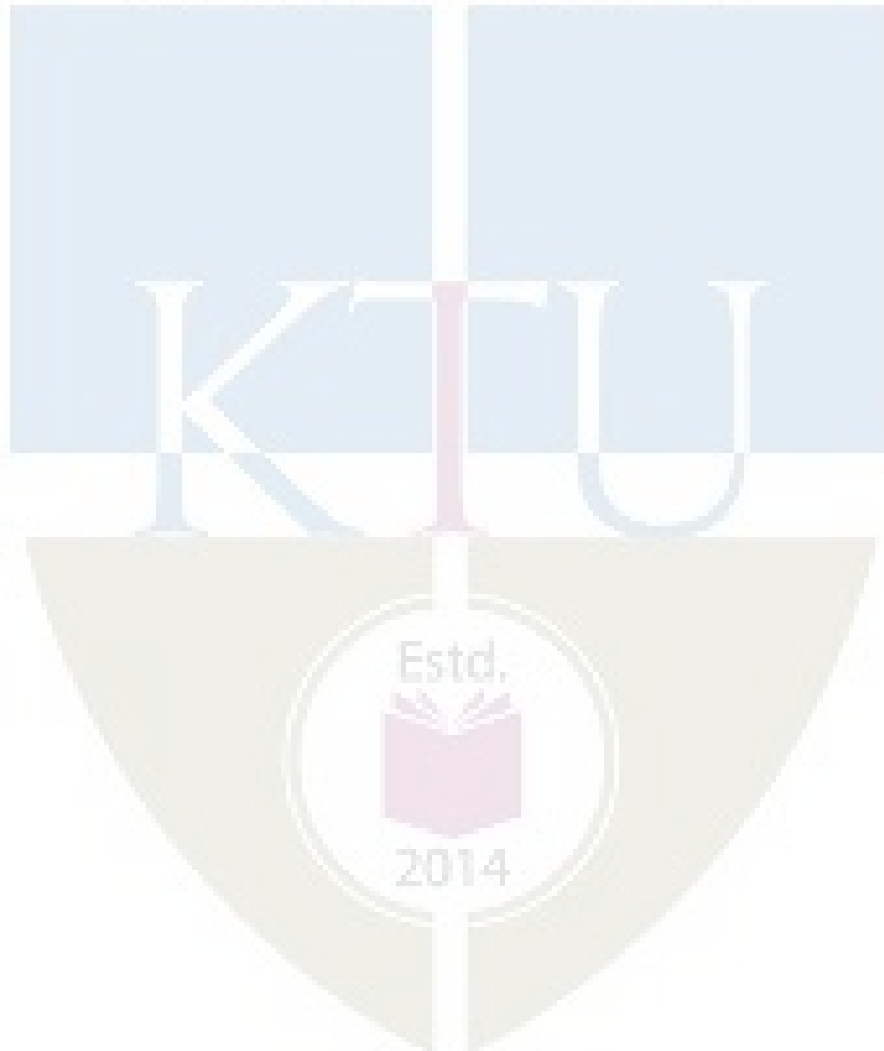
$$F(A, B, C, D) = A'B'D' + A'CD + A'BC$$

$$D(A, B, C, D) = A'BC'D + ACD + AB'D$$

Course Outcome 3(CO3): Design a BCD to Excess-3 Code Converter.

Course Outcome 4(CO4): Design a 4- bit binary ripple counter.

Course Outcome 5(CO5): Demonstrate floating-point addition algorithm.



Model Question Paper

QP CODE:

PAGES: 2

Reg No: _____

Name: _____

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY THIRD SEMESTER B.TECH
DEGREE EXAMINATION, MONTH & YEAR****Course Code: CST 203****Course name : LOGIC SYSTEM DESIGN****Max Marks: 100****Duration: 3 Hours****PART-A****(Answer All Questions. Each question carries 3 marks)**

1. Represent the decimal numbers $(459)_{10}$ and $(859)_{10}$ in hexadecimal and perform addition of these hexadecimal numbers.
2. Subtract $(1101)_2$ from $(11010)_2$ using: i) 2's complement and ii) 1's complement arithmetic.
3. Find the dual and complement of the boolean function $F = AB' + B(A + B')$.
4. Using K-map, reduce the expression: $AB + ABC + ABC + BC$.
5. Design a half subtractor with NAND gates only.
6. Design a combinational circuit that multiplies an input decimal digit by 5 represented in BCD. The output is also in BCD. Show that the outputs can be obtained from the input lines without using any logic gates.
7. Differentiate between ripple counter and synchronous counter.
8. Construct D flip-flop using NAND gates. Also give its truth table.
9. Explain how a shift register is used for serial data transfer?
10. Write short notes on ROM.

PART-B**(Answer any one full question from each module)****(14X5=70)**

11. (a) Perform the following operations using 2's complement arithmetic: (8)

(i) $88_{10} + (-37)_{10}$ (ii) $(-20)_{10} + (-12)_{10}$

- (b) Perform the following base conversions: (i) $(101011.11)_2$ to octal (6)
 (ii) $(3F9B)_{16}$ to binary (iii) $(121)_{10}$ to binary (iv) $(3077)_8$ to binary

OR

12. (a) Find the 12 bit 2's complement representation of the following decimal numbers. (6)

(i) -97 (ii) -224 (iii) -197.5

- (b) Perform the following operations (8)

(i) $(520)_8 + (488)_8$ (ii) $(520)_{16} - (488)_{16}$

13. (a) Prove that (i) $AB + A(B + C) + B(B + C) = B + AC$ (4)

(ii) $AB + A(B + C) + B(B + D) = A$

- (b) Using K-map, simplify the Boolean function F in sum of products form, using the don't care conditions d: (10)

$$F(w, x, y, z) = w'(x'y + x'y' + xyz) + x'z'(y + w)$$

$$d(w, x, y, z) = w'x(y'z + yz') + w yz$$

OR

14. (a) Simplify the following expressions using Karnaugh- map method. (8)

(i) $F = \Sigma(0,2,4,6,9,11,13,15,17,21,25,27,29,31)$

(ii) $F = \Pi(0,2,5,7)$

- (b) Convert the following to the other canonical form: (6)

(i) $F(x, y, z, a) = \sum (1,3,7)$

(ii) $F(x, y, z) = \Pi(0,3,6,7)$

(iii) $F(A, B, C, D) = \Pi(0,1,2,3,4,6,12)$

15. (a) Implement Full adder circuit using NAND gate only. (4)

- (b) Design a code converter for converting BCD to Excess 3 code (10)

OR

16. (a) With a neat diagram explain 4-bit carry look-ahead adder. (6)

- (b) Design a Gray to binary code converter using a 4x1 MUX. Draw the circuit diagram and explain. (8)

17. (a) Design a counter that count the states 0,3,5,6,0... using T flip-flops. (10)

- (b) Write the characteristics equation, excitation table of JK, T and D flipflop. (4)

OR

18. (a) Explain race around condition and how it can be avoided. (6)

- (b) Design a synchronous Binary Up-Down Counter. (8)

19. (a) With a neat diagram explain universal shift register. (8)

- (b) Explain Johnson Counter with timing diagram. (6)

OR

20. (a) Write algorithm for floating point addition and subtraction. (8)

- (b) Implement the functions $Y_1 = AB'C' + AB'C + ABC$ and $Y_2 = BC + AC$ using minimum gates Programmable Logic Array. (6)

Teaching Plan

Module 1: Number systems, Operations & Codes (No algorithms)		(7 hours)
1.1	Number Systems: Decimal, Binary, Octal and Hexadecimal number systems, Number Base Conversions.	1 hour
1.2	Binary Arithmetic: Addition, Subtraction, Multiplication & Division of Binary Numbers. (Lecture 1)	1 hour
1.3	Addition, Subtraction, Multiplication & Division of Binary Numbers. (Lecture 2)	1 hour
1.4	Representation of Negative Numbers- Complements, subtraction with complements.	1 hour
1.5	BCD Arithmetic: Addition and Subtraction of BCD Numbers	1 hour
1.6	Octal and Hexadecimal Arithmetic: Addition & Subtraction of Octal and Hexadecimal Numbers.	1 hour

1.7	Binary Codes: Decimal Codes, Error detection codes, Reflected code, Character Coding Schemes-ASCII, EBCDIC	1 hour
Module 2: Boolean Algebra		(9 hours)
2.1	Introduction to Boolean Algebra: Postulates of Boolean Algebra	1 hour
2.2	Basic theorems and Properties of Boolean Algebra	1 hour
2.3	Boolean Functions: Canonical and Standard Forms	1 hour
2.4	Simplification of Boolean Functions: Karnaugh -Map Method (upto five variables), Don't care conditions (Lecture 1)	1 hour
2.5	Simplification of Boolean Functions: Karnaugh -Map Method (upto five variables), Don't care conditions (Lecture 2)	1 hour
2.6	Product of sums simplification	1 hour
2.7	Tabulation method	1 hour
2.8	Digital Logic Gates: AND, OR, NOT, NAND, NOR, XOR, XNOR, Implementation of Boolean functions using basic and universal gates. (Lecture 1)	1 hour
2.9	Digital Logic Gates: AND, OR, NOT, NAND, NOR, XOR, XNOR, Implementation of Boolean functions using basic and universal gates. (Lecture 2)	1 hour
Module 3: Combinational Logic Circuits		(9 hours)
3.1	Design Procedure & Implementation of Combinational Circuits	1 hour
3.2	Binary Adders: Implementation of Half Adder, Full Adder	1 hour
3.3	Binary Subtractors: Implementation of Half Subtractor, Full Subtractor	1 hour
3.4	Implementation of Binary Parallel Adder ,Carry look ahead Adder, BCD Adder (Lecture 1)	1 hour
3.5	Implementation of Binary Parallel Adder ,Carry look ahead Adder, BCD Adder (Lecture 2)	1 hour

3.6	Implementation of Various Combinational Circuits: Code Converters, Magnitude Comparator	1 hour
3.7	Implementation of Decoder, Demultiplexer	1 hour
3.8	Implementation of Encoder, Multiplexer	1 hour
3.9	Implementation of Parity Generator/Checker	1 hour
Module 4: Sequential logic circuits:		(9 hours)
4.1	Flip flops: SR, JK, T and D flip- flops (Lecture 1)	1 hour
4.2	SR, JK, T and D flip- flops (Lecture 2)	1 hour
4.3	Triggering of flip-flops- Master slave flip- flop, Edge- triggered flip-flops (Lecture 1)	1 hour
4.4	Triggering of flip-flops- Master slave flip- flop, Edge- triggered flip-flops (Lecture 2)	1 hour
4.5	Excitation table and characteristic equations of flip- flops	1 hour
4.6	Registers- Register with parallel load	1 hour
4.7	Counter Design: Asynchronous counters- Binary and BCD counters- timing sequences and state diagrams. (Lecture 1)	1 hour
4.8	Asynchronous counters- Binary and BCD counters- timing sequences and state diagrams. (Lecture 2)	1 hour
4.9	Synchronous counters- Binary Up- down counter, BCD counter	1 hour
Module 5: Shift registers, Arithmetic algorithms & PLD's		(11 hours)
5.1	Shift Registers - Serial In Serial Out, Serial In Parallel Out.	1 hour
5.2	Bidirectional Shift Register with Parallel load	1 hour

5.3	Shift register counters - Ring Counter, Johnson Counter- timing sequences and state diagrams	1 hour
5.4	Arithmetic Algorithms: Algorithm for addition and subtraction of binary numbers in Signed magnitude and 2's complement representations (Lecture 1)	1 hour
5.5	Algorithm for addition and subtraction of binary numbers in Signed magnitude and 2's complement representations (Lecture 2)	1 hour
5.6	Algorithm for addition and subtraction of BCD numbers	1 hour
5.7	Representation of floating point numbers (IEEE Standard representations).	1 hour
5.8	Algorithms for floating point addition and subtraction	1 hour
5.9	Programmable Logic devices - ROM	1 hour
5.10	PLA, Implementation of simple circuits using PLA(Lecture 1)	1 hour
5.11	PLA, Implementation of simple circuits using PLA(Lecture 2)	1 hour



CST 205	OBJECT ORIENTED PROGRAMMING USING JAVA	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		PCC	3	1	0	4	2019

Preamble: The purpose of this course is to enable learners to solve problems by breaking it down to object level while designing software and to implement it using Java. This course covers Object Oriented Principles, Object Oriented Programming in Java, Inheritance, Exception handling, Event handling, multithreaded programming and working with window-based graphics. This course helps the learners to develop Desktop GUI Applications, Mobile applications, Enterprise Applications, Scientific Applications and Web based Applications.

Prerequisite: Topics covered under the course PROGRAMMING IN C (EST 102)

Course Outcomes: After the completion of the course the student will be able to

CO1	Write Java programs using the object oriented concepts - classes, objects, constructors, data hiding, inheritance and polymorphism (Cognitive Knowledge Level: Apply)
CO2	Utilise datatypes, operators, control statements, built in packages & interfaces, Input/ Output Streams and Files in Java to develop programs (Cognitive Knowledge Level: Apply)
CO3	Illustrate how robust programs can be written in Java using exception handling mechanism (Cognitive Knowledge Level: Understand)
CO4	Write application programs in Java using multithreading and database connectivity (Cognitive Knowledge Level: Apply)
CO5	Write Graphical User Interface based application programs by utilising event handling features and Swing in Java (Cognitive Knowledge Level: Apply)

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓								✓
CO2	✓	✓	✓	✓								✓
CO3	✓	✓	✓	✓						✓		✓
CO4	✓	✓	✓	✓								✓
CO5	✓	✓	✓	✓								✓

Abstract POs defined by National Board of Accreditation			
PO#	Broad PO	PO#	Broad PO
PO1	Engineering Knowledge	PO7	Environment and Sustainability
PO2	Problem Analysis	PO8	Ethics
PO3	Design/Development of solutions	PO9	Individual and team work
PO4	Conduct investigations of complex problems	PO10	Communication
PO5	Modern tool usage	PO11	Project Management and Finance
PO6	The Engineer and Society	PO12	Life long learning

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination Marks (%)
	Test1 (Marks %)	Test2 (Marks %)	
Remember	30	30	30
Understand	30	30	30
Apply	40	40	40
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks

Continuous Assessment Tests : 25 marks

Continuous Assessment Assignment : 15 marks

Internal Examination Pattern:

Each of the two internal examinations has to be conducted out of 50 marks

First series test shall be preferably conducted after completing the first half of the syllabus and the second series test shall be preferably conducted after completing remaining part of the syllabus.

There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly covered module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly covered module), each with 7 marks. Out of the 7 questions in Part B, a student should answer any 5.

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which a student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

SYLLABUS

Object Oriented Programming Using Java

Module 1

Introduction:

Approaches to Software Design - Functional Oriented Design, Object Oriented Design, Case Study of Automated Fire Alarm System.

Object Modeling Using Unified Modeling Language (UML) – Basic Object Oriented concepts, UML diagrams, Use case model, Class diagram, Interaction diagram, Activity diagram, State chart diagram.

Introduction to Java - Java programming Environment and Runtime Environment, Development Platforms -Standard, Enterprise. Java Virtual Machine (JVM), Java compiler, Bytecode, Java applet, Java Buzzwords, Java program structure, Comments, Garbage Collection, Lexical Issues.

Module 2

Core Java Fundamentals:

Primitive Data types - Integers, Floating Point Types, Characters, Boolean. Literals, Type Conversion and Casting, Variables, Arrays, Strings, Vector class.

Operators - Arithmetic Operators, Bitwise Operators, Relational Operators, Boolean Logical Operators, Assignment Operator, Conditional (Ternary) Operator, Operator Precedence.

Control Statements - Selection Statements, Iteration Statements and Jump Statements.

Object Oriented Programming in Java - Class Fundamentals, Declaring Objects, Object Reference, Introduction to Methods, Constructors, **this** Keyword, Method Overloading, Using Objects as Parameters, Returning Objects, Recursion, Access Control, Static Members, Final Variables, Inner Classes, Command Line Arguments, Variable Length Arguments.

Inheritance - Super Class, Sub Class, The Keyword **super**, protected Members, Calling Order of Constructors, Method Overriding, the Object class, Abstract Classes and Methods, using **final** with Inheritance.

Module 3

More features of Java:

Packages and Interfaces - Defining Package, CLASSPATH, Access Protection, Importing Packages, Interfaces.

Exception Handling - Checked Exceptions, Unchecked Exceptions, **try** Block and **catch** Clause, Multiple **catch** Clauses, Nested **try** Statements, **throw**, **throws** and **finally**.

Input/Output - I/O Basics, Reading Console Input, Writing Console Output, PrintWriter Class, Object Streams and Serialization, Working with Files.

Module 4

Advanced features of Java:

Java Library - String Handling – String Constructors, String Length, Special String Operations - Character Extraction, String Comparison, Searching Strings, Modifying Strings, using valueOf(), Comparison of StringBuffer and String.

Collections framework - Collections overview, Collections Interfaces- Collection Interface, List Interface.

Collections Class – ArrayList class. Accessing a Collection via an Iterator.

Event handling - Event Handling Mechanisms, Delegation Event Model, Event Classes, Sources of Events, Event Listener Interfaces, Using the Delegation Model.

Multithreaded Programming - The Java Thread Model, The Main Thread, Creating Thread, Creating Multiple Threads, Synchronization, Suspending, Resuming and Stopping Threads.

Module 5

Graphical User Interface and Database support of Java:

Swings fundamentals - Swing Key Features, Model View Controller (MVC), Swing Controls, Components and Containers, Swing Packages, Event Handling in Swings, Swing Layout Managers, Exploring Swings –JFrame, JLabel, The Swing Buttons, JTextField.

Java DataBase Connectivity (JDBC) - JDBC overview, Creating and Executing Queries – create table, delete, insert, select.

Text Books:

1. Herbert Schildt, Java: The Complete Reference, 8/e, Tata McGraw Hill, 2011.
2. Rajib Mall, Fundamentals of Software Engineering, 4th edition, PHI, 2014.
3. Paul Deitel, Harvey Deitel, Java How to Program, Early Objects 11th Edition, Pearson, 2018.

Reference Books:

1. Y. Daniel Liang, Introduction to Java Programming, 7/e, Pearson, 2013.
2. Nageswararao R., Core Java: An Integrated Approach, Dreamtech Press, 2008.
3. Flanagan D., Java in A Nutshell, 5/e, O'Reilly, 2005.
4. Barclay K., J. Savage, Object Oriented Design with UML and Java, Elsevier, 2004.
5. Sierra K., Head First Java, 2/e, O'Reilly, 2005.
6. Balagurusamy E., Programming JAVA a Primer, 5/e, McGraw Hill, 2014.

Sample Course Level Assessment Questions

Course Outcome1(CO1): For the following passage develop UML diagrams and then implement it as a Java program in accordance with your UML design.

Passage: College Office collects semester fee and college bus fee for each student. A clerk at the college office collects the fees from each student. The bus fee is calculated depending on the distance of the corresponding bus stop from the college. The semester fee varies depending upon the semester as well as branch of each student. Students are supposed to pay the fees in full. Economically backward students are eligible for 50% discount in semester fee. The consolidated fees receipt is issued to each student by the clerk, which contains the student name, admission number, semester and branch of student along with details of fees collected. Students can log in and view the details of fees remitted and dues if any. The system allows students and clerk level login to the system. Clerk is able to view reports of each class showing status of fees payment of each student.

Course Outcome 2(CO2): Write a Java program to evaluate a post fix expression containing two operands and a single operator using stack. Stack should be implemented as a separate entity so as to reflect OOP concepts.

Course Outcome 3(CO3): Write a program to demonstrate the start, run, sleep and join methods in Thread class.

Course Outcome 4(CO4): Write a GUI based program with separate buttons to add, delete and display student details i.e. name, student ID, current semester and branch of study based on student ID.

Course Outcome 5(CO5): Using Swing create a JFrame with a JLabel and two JButtons. Set the texts of JButtons as “Yes” and “No” respectively. Set the JLabel’s text to the text of the button currently being pressed. Initially the JLabel’s text is blank.

Model Question Paper

QP CODE:

PAGES:3

Reg No: _____

Name: _____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

THIRD SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: CST 205

Course Name: Object Oriented Programming using Java

Max.Marks:100

Duration: 3 Hours

PART A

Answer all Questions. Each question carries 3 Marks

1. Briefly explain the portable, secure and robust features of Java.
2. Describe the concepts of object and class with a suitable Java program.
3. Explain the concept of method overriding with an example.
4. What is the use of the keyword *final* in Java?
5. Explain the concept of streams.
6. Explain any two applications of Serialization.
7. Distinguish the usage of “==” and *equals()* method when comparing String type?
8. What are Collections in Java? Explain any one Collection interface in Java.
9. Explain any two properties of Swing components in Java.
10. Explain JLabel component. With suitable examples explain any two of its constructors.

Part B

Answer any one question completely from each module

11.

- (a) Describe in detail any three Object Oriented Programming principles. Illustrate with suitable examples.

- (b) What is Java Runtime Environment? What is the role of Java Virtual Machine in it? (5)

OR

12.

- (a) Compare and contrast Java standard edition and Java enterprise edition. (5)
- (b) Why is Java considered to be platform independent? What is the role of Bytecode in making Java platform independent? (9)

13.

- (a) Explain in detail the primitive data types in Java. (8)
- (b) Explain automatic type conversion in Java with an example. What are the two conditions required for it? (6)

OR

14.

- (a) Using a suitable Java program explain the difference between *private* and *public* members in the context of inheritance. (8)
- (b) Is it possible to use the keyword *super* within a static method? Give justification for your answer. (6)

15.

- (a) Explain in detail about byte streams and character streams with suitable code samples. (6)
- (b) Describe in detail about exception handling, *try* block and *catch* clause with the help of a suitable Java program. (8)

OR

16.

- (a) Explain object streams in Java. Explain the role of Serializable interface with a suitable code sample. (8)
- (b) Explain *throw*, *throws* and *finally* constructs with the help of a Java program. (6)

17.

(a) Describe in detail the creation of a thread using the Runnable interface and the Thread class with suitable examples. (10)

(b) Explain List Interface. Mention any two exceptions thrown by its methods. (4)

OR

18.

(a) Explain in detail the Delegation Event model for event handling in Java. (7)

(b) Write a simple program by extending appropriate class to demonstrate the working of threads in java. (7)

19.

(a) Write a Java program to demonstrate the use of JLabel and JButton by adding them to JFrame. (7)

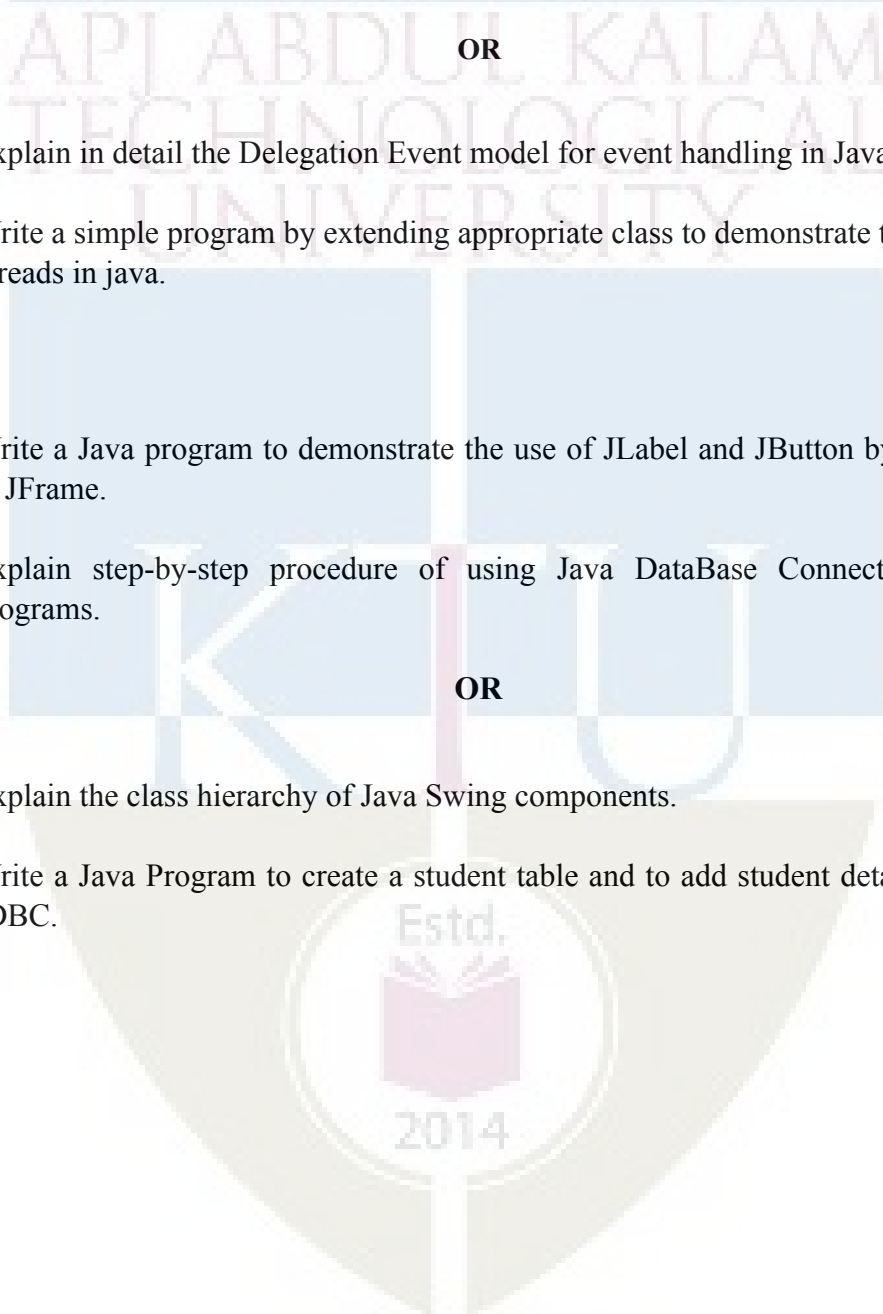
(b) Explain step-by-step procedure of using Java DataBase Connectivity in Java programs. (7)

OR

20.

(a) Explain the class hierarchy of Java Swing components. (7)

(b) Write a Java Program to create a student table and to add student details to it using JDBC. (7)



Teaching Plan		
Module 1 : Introduction		(8 hours)
1.1	Approaches to Software Design- Functional Oriented Design, Object-Oriented Design, Case Study of Automated Fire Alarm System.	1 hour
1.2	Object Modeling Using UML – Basic object oriented concepts	1 hour
1.3	Basic object oriented concepts	1 hour
1.4	UML diagrams, Use case model	1hour
1.5	Class diagram, Interaction diagram	1hour
1.6	Activity diagram, State chart diagram	1hour
1.7	Java programming Environment and Runtime Environment, Development Platforms -Standard, Enterprise. JVM, Java compiler, Bytecode	1hour
1.8	Java applet, Java Buzzwords, Java program structure, Comments, Garbage Collection, Lexical Issues	1hour
Module 2: Core Java Fundamentals		(11 hours)
2.1	Core Java Fundamentals: Primitive Data types, Integers, Floating Point Types, Characters, Boolean	1 hour
2.2	Literals, Type Conversion and Casting, Variables, Arrays, Strings, Vector class.	1 hour
2.3	Operators: Arithmetic Operators, Bitwise Operators, Relational Operators, Boolean Logical Operators, Assignment Operator, Conditional (Ternary) Operator, Operator Precedence.	1 hour
2.4	Control Statements: Selection Statements, Iteration Statements and Jump Statements.	1 hour
2.5	Object Oriented Programming in Java: Class Fundamentals, Declaring Objects, Object Reference, Introduction to Methods	1 hour
2.6	Constructors, <i>this</i> Keyword, Method Overloading, Using Objects as Parameters	1 hour
2.7	Returning Objects, Recursion, Access Control, static Members	1 hour

2.8	Final Variables, Inner Classes, Command-Line Arguments, Variable Length Arguments	1 hour
2.9	Inheritance : Super class, Sub class, the keywords <i>super</i> , <i>protected</i> Members,	1 hour
2.10	Calling Order of Constructors, Method Overriding, the Object class,	1 hour
2.11	Abstract Classes and Methods, Using <i>final</i> with Inheritance	1 hour
Module 3: More features of Java		(8 hours)
3.1	Packages and Interfaces: Defining Package, CLASSPATH, Access Protection, Importing Packages	1 hour
3.2	Interfaces	1 hour
3.3	Input / Output: I/O Basics, Reading Console Input, Writing Console Output, PrintWriter Class	1 hour
3.4	Object Streams and Serialization	1 hour
3.5	Working with Files	1 hour
3.6	Exception Handling: Checked Exceptions, Unchecked Exceptions, <i>try</i> Block and <i>catch</i> Clause	1 hour
3.7	Multiple <i>catch</i> Clauses, Nested <i>try</i> Statements	1 hour
3.8	<i>throw</i> , <i>throws</i> and <i>finally</i>	1 hour
Module 4: Advanced features of Java		(10 hours)
4.1	Java Library: String Handling – String Constructors, String Length, Special String Operations	1hour
4.2	Character Extraction, String Comparison, Searching Strings, Modifying Strings Using <code>valueOf()</code> , Comparison of String Buffer and String.	1hour
4.3	Collections framework – Collections overview, Collections Interfaces- Collection Interface	1hour
4.4	List Interface, Collections Class – ArrayList Class	1hour
4.5	Accessing Collections via an Iterator.	1hour
4.6	Event handling: Event Handling Mechanisms, Delegation Event Model	1hour
4.7	Delegation Event Model, Event Classes	1hour

4.8	Sources of Events, Event Listener Interfaces, Using the Delegation Model	1hour
4.9	Multithreaded Programming: The Java Thread Model, The Main Thread, Creating Thread	1hour
4.10	Creating Multiple Threads, Synchronization, Suspending, Resuming and Stopping Threads.	1hour
Module 5: Graphical User Interface and Database support of Java		(8 hours)
5.1	Swings fundamentals, Swing Key Features	1hour
5.2	MVC, Swing Controls, Components and Containers	1hour
5.3	Swing Packages, Event Handling in Swings.	1 hour
5.4	Swing Layout Managers	1hour
5.5	Exploring Swings –JFrame, JLabel, The Swing Buttons, JTextField.	1 hour
5.6	JDBC overview, Creating and Executing Queries – create table, delete, insert, select (Basics only, DBMS course is not a prerequisite).	1hour
5.7	Creating and Executing Queries – create table, delete, insert, select.	1 hour
5.8	Creating and Executing Queries – create table, delete, insert, select.	1 hour



CSL201	DATA STRUCTURES LAB	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		PCC	0	0	3	2	2019

Preamble: The aim of the Course is to give hands-on experience for Learners on creating and using different Data Structures. Data Structures are used to process data and arrange data in different formats for many applications. The most commonly performed operations on data structures are traversing, searching, inserting, deleting and few special operations like merging and sorting.

Prerequisite: Topics covered under the course Programming in C (EST 102)

CO1	Write a time/space efficient program using arrays/linked lists/trees/graphs to provide necessary functionalities meeting a given set of user requirements (Cognitive Knowledge Level: Analyse)
CO2	Write a time/space efficient program to sort a list of records based on a given key in the record (Cognitive Knowledge Level: Apply)
CO3	Examine a given Data Structure to determine its space complexity and time complexities of operations on it (Cognitive Knowledge Level: Apply)
CO4	Design and implement an efficient data structure to represent given data (Cognitive Knowledge Level: Apply)
CO5	Write a time/space efficient program to convert an arithmetic expression from one notation to another (Cognitive Knowledge Level: Apply)
CO6	Write a program using linked lists to simulate Memory Allocation and Garbage Collection (Cognitive Knowledge Level: Apply)

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												
CO6												

Abstract POs defined by National Board of Accreditation			
PO#	Broad PO	PO#	Broad PO
PO1	Engineering Knowledge	PO7	Environment and Sustainability
PO2	Problem Analysis	PO8	Ethics
PO3	Design/Development of solutions	PO9	Individual and team work
PO4	Conduct investigations of complex problems	PO10	Communication
PO5	Modern tool usage	PO11	Project Management and Finance
PO6	The Engineer and Society	PO12	Life long learning

Assessment Pattern

Bloom's Category	Continuous Assessment Test (Internal Exam)Percentage	End Semester Examination Percentage
Remember	20	20
Understand	20	20
Apply	60	60
Analyse		
Evaluate		
Create		

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	75	75	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 15 marks

Continuous Evaluation in Lab : 30 marks

Continuous Assessment Test : 15 marks

Viva-voce : 15 marks

Internal Examination Pattern: The marks will be distributed as Algorithm 30 marks, Program 20 marks, Output 20 marks and Viva 30 marks. Total 100 marks which will be converted out of 15 while calculating Internal Evaluation marks.

End Semester Examination Pattern: The marks will be distributed as Algorithm 30 marks, Program 20 marks, Output 20 marks and Viva 30 marks. Total 100 marks will be converted out of 75 for End Semester Examination.

Operating System to Use in Lab : Linux

Compiler/Software to Use in Lab : gcc

Programming Language to Use in Lab : Ansi C

Fair Lab Record:

All Students attending the Data Structures Lab should have a Fair Record. The fair record should be produced in the University Lab Examination. Every experiment conducted in the lab should be noted in the fair record. For every experiment in the fair record the right hand page should contain Experiment Heading, Experiment Number, Date of Experiment, Aim of Experiment, Data Structure used and the operations performed on them, Details of Experiment including algorithm and Result of Experiment. The left hand page should contain a print out of the code used for the experiment and sample output obtained for a set of input.

SYLLABUS

1. Implementation of Polynomials and Sparse matrices using arrays**
2. Implementation of Stack , Queues, Priority Queues, DEQUEUE and Circular Queues using arrays**
3. Application problems using stacks: Conversion of expression from one notation to another notation . **
4. Implementation of various linked list operations. **
5. Implementation of stack, queue and their applications using linked list.pression
6. Implementation of trees using linked list
7. Representation of polynomials using linked list, addition and multiplication of polynomials. **
8. Implementation of binary trees using linked lists and arrays- creations, insertion, deletion and traversal. **
9. Implementation of binary search trees – creation, insertion, deletion, search
10. Any application programs using trees
11. Implementation of sorting algorithms – bubble, insertion, selection, quick, merge sort

and heap sort.**

12. Implementation of searching algorithms – linear search, binary search.**

13. Representation of graphs and computing various parameters (in degree, out degree etc.) - adjacency list, adjacency matrix.

14. Implementation of BFS and DFS for each graph representations.**

15. Implementation of hash table using your own mapping functions and observe collisions and overflow resolving schemes.**

16. Simulation of first-fit, best-fit and worst-fit allocations.

17. Simulation of a basic memory allocator and garbage collector using doubly linked list.
** mandatory.

DATA STRUCTURES LAB - PRACTICE QUESTIONS

1. Write a program to read two polynomials and store them in an array. Calculate the sum of the two polynomials and display the first polynomial, second polynomial and the resultant polynomial.
2. C Write a program to enter two matrices in normal form . Write a function to convert two matrices to tuple form and display it. Also find the transpose of the two matrices represented in tuple form and display it. Find the sum of the two matrices in tuple form and display the sum in tuple form.
3. Write a program to enter two matrices in normal form . Write a function to convert two matrices to tuple form and display it. Also find the transpose of the two matrices represented in tuple form and display it. Find the sum of the two matrices in tuple form and display the sum in tuple form.
4. Implement a circular queue using arrays with the operations:
 - 4.1. Insert an element to the queue.
 - 4.2. Delete an elements from the queue.
 - 4.3. Display the contents of the queue after each operation.
5. Implement a Queue using arrays with the operations:

- 5.1. Insert elements to the Queue.
- 5.2. Delete elements from the Queue.
- 5.3. Display the contents of the Queue after each operation.
6. Implement a Stack using arrays with the operations:
 - 6.1. Pushing elements to the Stack.
 - 6.2. Popping elements from the Stack
 - 6.3. Display the contents of the Stack after each operation.
7. Implement a Priority Queue using arrays with the operations:
 - 7.1. Insert elements to the Priority Queue.
 - 7.2. Delete elements from the Priority Queue.
 - 7.3. Display the contents of the Priority Queue after each operation.
8. Implement a Double-Ended Queue (DEQUEUE) with the operations:
 - 8.1. Insert elements to the Front of the queue.
 - 8.2. Insert elements to the Rear of the queue
 - 8.3. Delete elements from the Front of the queue.
 - 8.4. Delete elements from the Rear of the queue.
 - 8.5. Display the queue after each operation.
9. Using stack convert an infix expression to a postfix expression and evaluate the postfix expression.
10. Write a program to convert an infix expression to a prefix expression using stacks.
11. Convert an infix expression to a postfix expression without using a stack
12. Write a menu driven program for performing the following operations on a Linked List:
 - 12.1. Display
 - 12.2. Insert at Beginning
 - 12.3. Insert at End
 - 12.4. Insert at a specified Position
 - 12.5. Delete from Beginning
 - 12.6. Delete from End
 - 12.7. Delete from a specified Position
13. Implement a stack using linked list with the operations:
 - 13.1. Push elements to the queue.
 - 13.2. Pop elements from the queue.
 - 13.3. Display the queue after each operation.
14. Implement a Queue using linked list with the operations:

- 14.1. Insert an element to the queue.
 - 14.2. Delete an element from the queue.
 - 14.3. Display the queue after each operation.
15. Write a program to reverse the content of queue using stack
 16. Write a program to read two polynomials and store them using linked list. Calculate the sum of the two polynomials and display the first polynomial, second polynomial and the resultant polynomial.
 17. Write a program to read two polynomials and store them using linked list. Find the product of two polynomials and store the result using linked list. Display the resultant polynomial.
 18. Write a program for addition of polynomials containing two variables using linked list.
 19. The details of students (number, name, total-mark) are to be stored in a linked list. Write functions for the following operations:
 - 19.1. Insert
 - 19.2. Delete
 - 19.3. Search
 - 19.4. Sort on the basis of number
 - 19.5. Display the resultant list after every operation
 20. Create a Doubly Linked List from a string taking each character from the string. Check if the given string is palindrome in an efficient method.
 21. Create a binary tree with the following operations
 - 21.1. Insert a new node
 - 21.2. Inorder traversal.
 - 21.3. Preorder traversal.
 - 21.4. Postorder traversal.
 - 21.5. Delete a node.
 22. Write a program to create a binary search tree and find the number of leaf nodes
 23. Create a binary search tree with the following operations:
 - 23.1. Insert a new node .
 - 23.2. Inorder traversal.
 - 23.3. Preorder traversal.
 - 23.4. Postorder traversal.
 - 23.5. Delete a node.

24. Write a program to sort a set of numbers using a binary tree.

25. Represent any given graph and

25.1. Perform a depth first search .

25.2. Perform a breadth first search

26. Create a text file containing the name, height, weight of the students in a class. Perform Quick sort and Merge sort on this data and store the resultant data in two separate files. Also write the time taken by the two sorting methods into the respective files.

Eg.	Sony Mathew	5.5	60
	Arun Sajeev	5.7	58
	Rajesh Kumar	6.1	70

27. Write a program to sort a set of numbers using Heap sort and find a particular number from the sorted set using Binary Search.

28. Implement a Hash table using Chaining method. Let the size of hash table be 10 so that the index varies from 0 to 9.

29. Implement a Hash table that uses Linear Probing for collision resolution



CSL 203	OBJECT ORIENTED PROGRAMMING LAB (IN JAVA)	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		PCC	0	0	3	2	2019

Preamble: The aim of the course is to provide hands-on experience to the learners on various object oriented concepts in Java Programming. This course helps the learners to enhance the capability to design and implement various Java applications for real world problems.

Prerequisite: Topics covered under the course Programming in C (EST 102)

Course Outcomes:

At the end of the course, the student should be able to

CO1	Implement the Object Oriented concepts - constructors, inheritance, method overloading & overriding and polymorphism in Java (Cognitive Knowledge Level: Apply)
CO2	Implement programs in Java which use datatypes, operators, control statements, built in packages & interfaces, Input/Output streams and Files (Cognitive Knowledge Level: Apply)
CO3	Implement robust application programs in Java using exception handling (Cognitive Knowledge Level: Apply)
CO4	Implement application programs in Java using multithreading and database connectivity (Cognitive Knowledge Level: Apply)
CO5	Implement Graphical User Interface based application programs by utilizing event handling features and Swing in Java (Cognitive Knowledge Level: Apply)

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	☑	☑	☑	☑	☑			☑		☑		☑
CO2	☑	☑	☑	☑	☑			☑		☑		☑
CO3	☑	☑	☑	☑	☑			☑		☑		☑
CO4	☑	☑	☑	☑	☑			☑		☑		☑
CO5	☑	☑	☑	☑	☑			☑		☑		☑

Abstract POs defined by National Board of Accreditation			
PO#	Broad PO	PO#	Broad PO
PO1	Engineering Knowledge	PO7	Environment and Sustainability
PO2	Problem Analysis	PO8	Ethics
PO3	Design/Development of solutions	PO9	Individual and team work
PO4	Conduct investigations of complex problems	PO10	Communication
PO5	Modern tool usage	PO11	Project Management and Finance
PO6	The Engineer and Society	PO12	Life long learning

Assessment Pattern

Bloom's Category	Continuous Assessment Test - Internal Exam (Percentage)	End Semester Examination (Percentage)
Remember	20	20
Understand	20	20
Apply	60	60
Analyse		
Evaluate		
Create		

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	75	75	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 15 marks

Continuous Evaluation in Lab : 30 marks

Continuous Assessment Test : 15 marks

Viva-voce : 15 marks

Internal Examination Pattern: The marks will be distributed as Algorithm 30 marks, Program 20 marks, Output 20 marks and Viva 30 marks. Total 100 marks which will be converted out of 15 while calculating Internal Evaluation marks.

End Semester Examination Pattern: The marks will be distributed as Algorithm 30 marks, Program 20 marks, Output 20 marks and Viva 30 marks. Total 100 marks will be converted out of 75 for End Semester Examination.

Operating System to Use in Lab : Linux

Compiler/Software to Use in Lab : gcc, javac, jdk, jre, Eclipse, NetBeans,
MySQL / PostgreSQL.

Programming Language to Use in Lab : Java

Fair Lab Record:

All Students attending the Object Oriented Programming Lab (in Java) should have a Fair Record. The fair record should be produced in the University Lab Examination. Every experiment conducted in the lab should be noted in the fair record. For every experiment in the fair record the right hand page should contain Experiment Heading, Experiment Number, Date of Experiment, Aim of Experiment, Operations Performed, Details of Experiment including algorithm and Result of Experiment. The left hand page should contain a print out of the code used for the experiment and sample output obtained for a set of input.

SYLLABUS

The syllabus contains six sessions (A, B, C, D, E, F). Each session consists of three concrete Java exercises, out of which at least two questions are mandatory.

(A) Basic programs using datatypes, operators, and control statements in Java.

- 1) Write a Java program that checks whether a given string is a palindrome or not.
Ex: MALAYALAM is palindrome.
- 2) Write a Java Program to find the frequency of a given character in a string. **
- 3) Write a Java program to multiply two given matrices. **

(B) Object Oriented Programming Concepts: Problem on the use of constructors, inheritance, method overloading & overriding, polymorphism and garbage collection:

- 4) Write a Java program which creates a class named 'Employee' having the following members: Name, Age, Phone number, Address, Salary. It also has a method named 'printSalary()' which prints the salary of the Employee. Two classes 'Officer' and 'Manager' inherits the 'Employee' class. The 'Officer' and 'Manager' classes have data members 'specialization' and 'department' respectively. Now, assign name, age, phone number, address and salary to an officer and a manager by making an object of both of these classes and print the same. (Exercise to understand inheritance). **
- 5) Write a java program to create an abstract class named Shape that contains an empty method named numberOfSides(). Provide three classes named Rectangle, Triangle and Hexagon such that each one of the classes extends the class Shape. Each one of the classes contains only the method numberOfSides() that shows the number of sides in the given geometrical structures. (Exercise to understand polymorphism). **
- 6) Write a Java program to demonstrate the use of garbage collector.

(C) Handling different types of files as well as input and output management methods:

- 7) Write a file handling program in Java with reader/writer.
- 8) Write a Java program that read from a file and write to file by handling all file related exceptions. **
- 9) Write a Java program that reads a line of integers, and then displays each integer, and the sum of all the integers (Use String Tokenizer class of java.util). **

(D) Exception handling and multi-threading applications:

- 10) Write a Java program that shows the usage of try, catch, throws and finally. **
- 11) Write a Java program that implements a multi-threaded program which has three threads. First thread generates a random integer every 1 second. If the value is even, second thread computes the square of the number and prints. If the value is odd the third thread will print the value of cube of the number.
- 12) Write a Java program that shows thread synchronization. **

(E) Graphics Programming:

- 13) Write a Java program that works as a simple calculator. Arrange Buttons for digits and the + - * % operations properly. Add a text field to display the result. Handle any possible exceptions like divide by zero. Use Java Swing. **
- 14) Write a Java program that simulates a traffic light. The program lets the user select one of three lights: red, yellow, or green. When a radio button is selected, the light is turned on, and only one light can be on at a time. No light is on when the program starts. **
- 15) Write a Java program to display all records from a table using Java Database Connectivity (JDBC).

(F) Standard Searching and Sorting Algorithms using data structures and algorithms learned from course Data Structures (CST 201):

- 16) Write a Java program for the following: **
 - 1) Create a doubly linked list of elements.
 - 2) Delete a given element from the above list.
 - 3) Display the contents of the list after deletion.
- 17) Write a Java program that implements Quick sort algorithm for sorting a list of names in ascending order. **
- 18) Write a Java program that implements the binary search algorithm.

**** Mandatory**

PRACTICE QUESTIONS

- 1) Write a Java program to reverse an given string.
- 2) Write a Java program to display the transpose of a given matrix.
- 3) Write a Java program to find the second smallest element in an array.
- 4) Write a Java program to check whether a given number is prime or not.
- 5) Write a Java program to calculate the area of different shapes namely circle, rectangle, and triangle using the concept of method overloading.
- 6) Write two Java classes Employee and Engineer. Engineer should inherit from Employee class. Employee class to have two methods display() and calcSalary(). Write a program to display the engineer salary and to display from Employee class using a single object instantiation (i.e., only one object creation is allowed).
 - display() only prints the name of the class and does not return any value. Ex. “ Name of class is Employee.”
 - calcSalary() in Employee displays “Salary of employee is 10000” and calcSalary() in Engineer displays “Salary of employee is 20000.”
- 7) Write a Java program to illustrate Interface inheritance.
- 8) Write a Java program that shows how to create a user-defined exception.
- 9) Write a Java program to create two threads: One for displaying all odd number between 1 and 100 and second thread for displaying all even numbers between 1 and 100.
- 10) Write a Java program that shows thread priorities.
- 11) Write a Java program that reads a file and displays the file on the screen, with a line number before each line.
- 12) Write a Java program that displays the number of characters, lines and words in a text file.
- 13) Write a Java program for handling mouse events.
- 14) Write a Java program for handling key events using Adapter classes (general).
- 15) Write a Java program that allows the user to draw lines, rectangles and ovals.
- 16) Write a Java Swing program to print a wave form on the output screen.
- 17) Write a program to accept rollno, name, CGPA of “n” students and store the data to a database using JDBC connectivity. Display the list of students having CGPA greater than 7. (Use MySQL /PostgreSQL).
- 18) Write a Java program to implement Heap sort algorithm using array.

APJ ABDUL KALAM
TECHNOLOGICAL
UNIVERSITY

SEMESTER IV

KTU

Estd.



2014

MAT 266	MATHEMATICAL FOUNDATIONS FOR SECURITY SYSTEMS	Category	L	T	P	Credit	Year of Introduction
		BSC	3	1	0	4	2021

Preamble: This course helps the learners to understand the concepts of algebraic structures, number theory and random variables. The topics covered include rings, finite field, properties of numbers, primality test, factorization, vector space and discrete random variables. These concepts will help them to develop security model and analyse them before being used in many commercial, industrial as well as web application.

Prerequisite: A sound knowledge in elementary algebraic and probability concepts.

Course Outcomes: After the completion of the course the student will be able to

CO1	Illustrate the basic concepts of various algebraic structures like rings, finite fields and construction of Galois fields.(Cognitive Knowledge Level: Apply)
CO2	Make use of concepts of vector space and its operations.(Cognitive Knowledge Level: Apply)
CO3	Identify and apply the properties of integers including divisibility, congruence, primality testing, prime factorization, modulo operations.(Cognitive Knowledge Level: Apply)
CO4	Recognize the concepts and properties of discrete random variables and use them to model and analyse random phenomena.(Cognitive Knowledge Level: Apply)

Mapping of course outcomes with program outcomes

	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												

Abstract POs defined by National Board of Accreditation			
PO#	Broad PO	PO#	Broad PO
PO1	Engineering Knowledge	PO7	Environment and Sustainability
PO2	Problem Analysis	PO8	Ethics
PO3	Design/Development of solutions	PO9	Individual and team work
PO4	Conduct investigations of complex problems	PO10	Communication
PO5	Modern tool usage	PO11	Project Management and Finance
PO6	The Engineer and Society	PO12	Lifelong learning

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination Marks (%)
	Test 1 (%)	Test 2 (%)	
Remember	20	20	20
Understand	40	40	40
Apply	40	40	40
Analyze			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3

Continuous Internal Evaluation Pattern:

Attendance	10 marks
Continuous Assessment Tests(Average of Internal Tests1& 2)	25 marks
Continuous Assessment Assignment	15 marks

Internal Examination Pattern

Each of the two internal examinations has to be conducted out of 50 marks. First series test shall be preferably conducted after completing the first half of the syllabus and the second series test shall be preferably conducted after completing remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly completed module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly completed module), each with 7 marks. Out of the 7 questions, a student should answer any 5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 full questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carries 14 marks.

Syllabus**Module – 1 (Algebraic Structures)**

Rings – Definition, Rings of Polynomial. Quotient Rings. Fields – Finite field, Galois Field Construction – Illustration. Applications in LFSR, Properties of Galois fields. Subfields of Galois Fields. (All theorems without proofs.).

Module– 2(Linear Algebra)

Irreducible and Primitive Polynomials. Conjugate Elements and Minimal Polynomials. Vector space – Linear combination of the vectors, Spanning set for vector space, Row space, column space, linearly dependent and independent vectors, Basis, Vector subspace, Inner product, Orthogonality, dual space. (All theorems without proofs.)

Module - 3 (Number Theory I)

Divisibility, Greatest Common Divisor, Euclidean Algorithm, The Extended Euclidean Algorithm. Congruence, Residue Classes. Primes, Cardinality of Primes, Checking for Primeness, Euler's phi function, Fermat's Little Theorem, Euler's Theorem, Generating Primes.

Module - 4 (Number Theory II)

Primality Testing – Fermat’s Test, Divisibility Test, Miller – Rabin Test, Combination of Divisibility Test and Miller – Rabin Test. Factorization – Fundamental Theorem of Arithmetic, Fermat method, Pollard p-1 method, Pollard rho method. The Chinese Remainder Theorem. Quadratic Congruence - Quadratic Congruence Modulo a Prime, Quadratic Congruence Modulo a Composite. Order of an element, Primitive Roots.

Module - 5 (Probability Theory)

Discrete random variable, Probability distributions, Expected value, Variance, Sum and Product of Random Variable, Independent Random variables. Binomial distribution, Mean and Variance. Markov’s inequality, Chebysheff’s inequality. Law of Large Numbers. Entropy – Entropy of a sample space, Joint entropy and conditional entropy.

Text Books

1. Todd K. Moon, ‘Error Correction Coding, Mathematical Methods and Algorithms’, Second Edition, John Wiley & Sons, 2021.
2. Behrouz A. Forouzan, ‘Cryptography and Network Security’, McGraw-Hill.
3. Paul Garrett, ‘The Mathematics of Coding Theory’, Prentice-Hall. Inc., 2004.

ReferenceBooks

1. Thomas Koshy, ‘Elementary Number Theory with Applications’, Second Edition, Elsevier Inc., 2007.
2. David c. Lay, Linear Algebra and its Applications, 3rd edition.
3. Stephen Andrilli and David Hecker, ‘Elementary Linear Algebra’, Fifth edition, Elsevier Inc, 2016.
4. Fraleigh J. B., ‘A first course in abstract algebra’, Narosa, 1990.
5. Sheldon M. Ross, “Introduction to Probability Models”, Academic Press, 2003
6. Niven, H. S. Zuckerman and H. L. Montgomery, An introduction to the theory of numbers, John Wiley and Sons, 2004.
7. Jay L. Devore, Probability and Statistics for Engineering and the Sciences, 8th edition, Cengage, 2012.

Course Level Assessment Questions**Course Outcome1 (CO1):**

1. Check whether the set of 2×2 matrices under usual definitions of addition and multiplication form a ring?
2. Is every field a ring? Does the converse hold? Justify your answer.
3. Check whether 242 a Galois field.
4. Illustrate the subfields of $GF(2^{24})$.

Course Outcome 2(CO2):

1. Does $(x^3 + x + 1)$ divides $(x^7 + 1)$ in $GF(2)$?
2. If $f(x) \in GF(q)[x]$ is irreducible, then is it possible for all the roots of $f(x)$ to have the same order?
3. Determine the minimal polynomial for each conjugacy class in $GF(8)$ with respect to $GF(2)$.
4. Is it true that if x, y and z are linearly independent vectors over $GF(q)$ then so also are $x + y, y + z$ and $z + x$?

Course Outcome 3(CO3):

1. Using the Euclidean algorithm, find the greatest common divisor of 88 and 220.
2. Find the result of $6^{10} \bmod 11$.
3. Specify the formula for a Fermat number? Is F_5 a prime?
4. The number 4033 is a composite (33×109). Does it pass the Miller – Rabin test?
5. Use The Pollard $p - 1$ method to find a factor of 57247159 with the bound $B = 8$.
6. Find an integer that has a remainder of 3 when divided by 7 and 13, but is divisible by 12.
7. For the group $G = \langle Z_{19}^*, \times \rangle$: find the order of each element in the group. Also find the primitive roots in the group.
8. Implement primality test (Programming Assignment)

Course Outcome 4 (CO4):

1. Let X denote the number that show up when an unfair die is tossed. Faces 1 to 5 of the die are equally likely, while face 6 is twice as likely as any other. Find the probability distribution, mean and variance of X .
2. An equipment consists of 5 components each of which may fail independently with probability 0.15. If the equipment is able to function properly when at least three of the components are operational, what is the probability that it functions properly?
3. Compute the expected value and variance of the random variable which tells the sum of the result of the roll of two fair dice.
4. Determine the entropy of the random variable which counts the sum of three dice.

Model Question Paper

QP CODE:

Reg No: _____

Name: _____

PAGES: 4

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FOURTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: MAT266

Course Name: MATHEMATICAL FOUNDATIONS FOR SECURITY SYSTEMS

Max.Marks:100

Duration: 3 Hours

PART A

Answer All Questions. Each Question Carries 3 Marks

1. Define a ring with a suitable example.
2. Is $GF(12)$ a Galois field? Justify.
3. Show that $x^5 + x^3 + 1$ is irreducible over $GF(2)$.
4. Using an example show that the intersection of two subspaces is also a subspace of a vector space.
5. Find the greatest common divisor of 25 and 60.
6. Define Mersenne primes. Are all Mersenne primes primes? Justify.
7. Find the order of all elements in $G = \langle \mathbb{Z}_{10}^*, \times \rangle$.
8. Test whether the number 561 pass the Miller – Rabin Test?
9. Let X and Y be two independent random variables with $Var(2X - Y) = 6$ and $Var(X + 2Y) = 9$. Find $Var(X)$ and $Var(Y)$.

10. Find the probability of exactly 3 heads out of 10 flips of a fair coin?

(10x3=30)

Part B

(Answer any one question from each module. Each question carries 14 Marks)

11. (a) Construct the ring $R_4 = GF(2)[x]/(x^3 + 1)$. Is R_4 a field? (7)

(b) In $GF(2^4)$, find the product of the Galois field numbers $1 + \alpha + \alpha^3$ and $\alpha + \alpha^2$. (7)

OR

12. (a) Prove that the characteristic of a field must be either 0 or a prime number. (7)

(b) The field $GF(4)$ is a subfield of $GF(256)$. Let α be primitive in $GF(256)$. Find an element in $GF(4) \subset GF(256)$. (7)

13. (a) Determine whether each of the following polynomials in $GF(2)[x]$ is irreducible. If irreducible, determine if it is also primitive. (7)

(i) $x^2 + 1$ (ii) $x^3 + x + 1$.

(b) Find all conjugacy classes in $GF(2^4)$ with respect to $GF(4)$. (7)

OR

14. (a) Check that $V = \left\{ \begin{pmatrix} x \\ y \end{pmatrix} : x, y \in \mathbb{R} \right\}$ with the usual addition and scalar multiplication is a vector space. (7)

(b) Find a basis for the dual space to the vector space spanned by $\{(1,1,1,0,0), (0,1,1,1,0), (0,0,1,1,1)\}$. (7)

15. (a) Given $a = 161$ and $b = 28$, find $\gcd(a, b)$ using Extended Euclidean Algorithm and also find the integers s and t such that $sa + tb = \gcd(a, b)$. (7)

(b) Find the results of the following using Fermat's little theorem: (7)

(i) $5^{-1} \bmod 13$ (ii) $5^{15} \bmod 13$.

OR

16. (a) Define Euler's totient function. What are the values of $\phi(13)$, $\phi(240)$.
Determine the number of elements in Z_{14}^* ? (7)
- (b) Find the results of the following using Euler's theorem: (7)
- (i) $20^{62} \bmod 77$ (ii) $71^{-1} \bmod 100$.
17. (a) Use any primality test to determine whether any of the following integers are primes: 271, 3149, 9673. (7)
- (b) Assume that there is a computer that can perform 2^{30} (almost 1 billion) bit operations per second. What is the approximation time required to factor an integer of size (i) 60 decimal digits? (ii) 100 decimal digits? (using Pollard rho method). (7)

OR

18. (a) State Chinese Remainder Theorem. Find the solution to the simultaneous equations: (7)
- $$\begin{aligned}x &\equiv 2 \bmod 3 \\x &\equiv 3 \bmod 5 \\x &\equiv 2 \bmod 7.\end{aligned}$$
- (b) Solve the following quadratic equations: (7)
- (i) $x^2 \equiv 3 \bmod 23$ (ii) $x^2 \equiv 2 \bmod 11$ (iii) $x^2 \equiv 7 \bmod 19$.
19. (a) The probability mass function of a discrete random variable is $p(x) = kx$, $x = 1, 2, 3$, where 'k' is a positive constant. Find (7)
- (i) the value of 'k' (ii) $P(X \leq 2)$ (iii) $E[X]$ and (iv) $\text{Var}(1 - X)$.
- (b) Find the mean and variance of a binomial distribution. (7)

OR

20. (a) With a coin that has probability only $\frac{1}{10}$ of coming up heads, show that the probability is less than $\frac{1}{900}$ that in 10,000 flips the number of heads will be (7)

less than 2000.

- (b) Determine the entropy of the random variable which counts the number of heads in flipping three fair coins. (7)

Teaching Plan

No	Contents	No. of Lecture Hours (45 hrs)
Module-1(Algebraic Structures) (9 hours) (Text 1: Relevant topics from sections 4.3, 4.4, 5.4, 5.5, 5.7) (Section 5.4.1 is excluded)		
1.1	Rings – Definition.	1 hour
1.2	Rings of Polynomial	1 hour
1.3	Quotient Rings.	1 hour
1.4	Fields – Finite field	1 hour
1.5	Galois Field Construction	1 hour
1.6	Galois Field Construction – Illustration	1 hour
1.7	Applications in LFSR.	1 hour
1.8	Properties of Galois Fields.	1 hour
1.9	Subfields of Galois Fields.	1 hour
Module-2(Linear Algebra)(11 hours) (Text 1: Relevant topics from sections 5.8, 5.9, 2.4)		
2.1	Irreducible Polynomials.	1 hour
2.2	Primitive Polynomials.	1 hour
2.3	Conjugate Elements.	1 hour
2.4	Minimal Polynomials.	1 hour
2.5	Vector space.	1 hour

2.6	Linear combination of the vectors, Spanning set for vector space.	1 hour
2.7	Row space, Column space.	1 hour
2.8	Linearly dependent and independent vectors, Basis.	1 hour
2.9	Vector subspace.	1 hour
2.10	Inner product.	1 hour
2.11	Orthogonality, dual space	1 hour
Module-3(Number Theory I) (9 hours) (Text 2: Relevant topics from sections 2.1, 2.2, 9.1)		
3.1	Divisibility, Greatest Common Divisor.	1 hour
3.2	Euclidean Algorithm.	1 hour
3.3	The Extended Euclidean Algorithm.	1 hour
3.4	Congruence, Residue Classes.	1 hour
3.5	Primes, Cardinality of Primes, Checking for Primeness.	1 hour
3.6	Euler's phi function	1 hour
3.7	Fermat's Little Theorem.	1 hour
3.8	Euler's Theorem.	1 hour
3.9	Generating Primes.	1 hour
Module-4 (Number Theory II) (8 hours) (Text 2: Relevant topics from sections 9.2, 9.3, 9.4, 9.5, 9.6)		
4.1	Fundamental Theorem of Arithmetic, Primality Testing – Fermat's Test, Divisibility Test.	1 hour
4.2	Miller – Rabin Test.	1 hour
4.3	Combination of Divisibility Test and Miller – RabinTest.	1 hour
4.4	Fermat method.	1 hour
4.5	Pollard p-1 method, Pollard rho method.	1 hour
4.6	The Chinese Remainder Theorem.	1 hour
4.7	Quadratic Congruence Modulo a Prime, Quadratic Congruence Modulo a	1 hour

	Composite.	
4.8	Order of an element, Primitive Roots.	1 hour
Module-5(Probability Theory)(8 hours) (Text 3: Relevant topics from sections 1.5, 1.6, 1.7, 2.2)		
5.1	Discrete random variable, Probability distributions, Expectation, Variance.	1 hour
5.2	Independent Random variables, Sum and Product of random Variables.	1 hour
5.3	Binomial distribution, Mean and Variance.	1 hour
5.4	Binomial distribution – Problems.	1 hour
5.5	Markov’s inequality, Chebysheff’s inequality.	1 hour
5.6	Law of Large Numbers.	1 hour
5.7	Entropy of a sample space, Joint entropy and conditional entropy.	1 hour
5.8	Entropy of a sample space – Problems.	1 hour



CST202	COMPUTER ORGANISATION AND ARCHITECTURE	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		PCC	3	1	0	4	2019

Preamble:

The course is prepared with the view of enabling the learners capable of understanding the fundamental architecture of a digital computer. Study of Computer Organization and Architecture is essential to understand the hardware behind the code and its execution at physical level by interacting with existing memory and I/O structure. It helps the learners to understand the fundamentals about computer system design so that they can extend the features of computer organization to detect and solve problems occurring in computer architecture.

Prerequisite : Topics covered under the course Logic System Design (CST 203)

Course Outcomes: After the completion of the course the student will be able to

CO#	CO
CO1	Recognize and express the relevance of basic components, I/O organization and pipelining schemes in a digital computer (Cognitive knowledge: Understand)
CO2	Explain the types of memory systems and mapping functions used in memory systems (Cognitive Knowledge Level: Understand)
CO3	Demonstrate the control signals required for the execution of a given instruction (Cognitive Knowledge Level: Apply))
CO4	Illustrate the design of Arithmetic Logic Unit and explain the usage of registers in it (Cognitive Knowledge Level: Apply)
CO5	Explain the implementation aspects of arithmetic algorithms in a digital computer (Cognitive Knowledge Level: Apply)
CO6	Develop the control logic for a given arithmetic problem (Cognitive Knowledge Level: Apply)

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓								✓
CO2	✓	✓	✓	✓						✓		✓
CO3	✓	✓	✓	✓						✓		✓
CO4	✓	✓	✓	✓						✓		✓
CO5	✓	✓	✓							✓		✓
CO6	✓	✓	✓	✓								✓

Abstract POs defined by National Board of Accreditation			
PO#	Broad PO	PO#	Broad PO
PO1	Engineering Knowledge	PO7	Environment and Sustainability
PO2	Problem Analysis	PO8	Ethics
PO3	Design/Development of solutions	PO9	Individual and team work
PO4	Conduct investigations of complex problems	PO10	Communication
PO5	Modern tool usage	PO11	Project Management and Finance
PO6	The Engineer and Society	PO12	Life long learning

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination Marks (%)
	Test1 (%)	Test2 (%)	
Remember	20	20	30
Understand	40	40	30
Apply	40	40	40
Analyze			

Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks

Continuous Assessment Tests : 25 marks

Continuous Assessment Assignment : 15 marks

Internal Examination Pattern:

Each of the two internal examinations has to be conducted out of 50 marks

First Internal Examination shall be preferably conducted after completing the first half of the syllabus and the Second Internal Examination shall be preferably conducted after completing remaining part of the syllabus.

There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly covered module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly covered module), each with 7 marks. Out of the 7 questions in Part B, a student should answer any 5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which a student should answer any one. Each question can have maximum 2 sub-divisions and carries 14 marks.

Syllabus

Module 1

Basic Structure of computers – functional units - basic operational concepts - bus structures. Memory locations and addresses - memory operations, Instructions and instruction sequencing , addressing modes.

Basic processing unit – fundamental concepts – instruction cycle – execution of a complete instruction - single bus and multiple bus organization

Module 2

Register transfer logic: inter register transfer – arithmetic, logic and shift micro operations.

Processor logic design: - processor organization – Arithmetic logic unit - design of arithmetic circuit - design of logic circuit - Design of arithmetic logic unit - status register – design of shifter - processor unit – design of accumulator.

Module 3

Arithmetic algorithms: Algorithms for multiplication and division (restoring method) of binary numbers. Array multiplier , Booth's multiplication algorithm.

Pipelining: Basic principles, classification of pipeline processors, instruction and arithmetic pipelines (Design examples not required), hazard detection and resolution.

Module 4

Control Logic Design: Control organization – Hard_wired control-microprogram control – control of processor unit - Microprogram sequencer,micro programmed CPU organization - horizontal and vertical micro instructions.

Module 5

I/O organization: accessing of I/O devices – interrupts, interrupt hardware -Direct memory access.

Memory system: basic concepts – semiconductor RAMs. memory system considerations – ROMs, Content addressable memory, cache memories - mapping functions.

Text Books

1. Hamacher C., Z. Vranesic and S. Zaky, Computer Organization ,5/e, McGraw Hill, 2011
2. Mano M. M., Digital Logic & Computer Design, PHI, 2004
3. KaiHwang, Faye Alye Briggs, Computer architecture and parallel processing McGraw-Hill, 1984

Reference Books

1. Mano M. M., Digital Logic & Computer Design, 3/e, Pearson Education, 2013.
2. Patterson D.A. and J. L. Hennessy, Computer Organization and Design, 5/e, Morgan Kaufmann Publishers, 2013.
3. William Stallings, Computer Organization and Architecture: Designing for Performance, Pearson, 9/e, 2013.
4. Chaudhuri P., Computer Organization and Design, 2/e, Prentice Hall, 2008.
5. Rajaraman V. and T. Radhakrishnan, Computer Organization and Architecture, Prentice Hall, 2011

Sample Course Level Assessment Questions

Course Outcome1(CO1): Which are the registers involved in a memory access operation and how are they involved in it?

Course Outcome 2(CO2): Explain the steps taken by the system to handle a write miss condition inside the cache memory.

Course Outcome 3(CO3): Generate the sequence of control signals required for the execution of the instruction MOV [R1],R2 in a threebus organization.

Course Outcome 4(CO4): Design a 4-bit combinational logic shifter with 2 control signals H0 and H1 that perform the following operations :

H1	H0	Operation
0	0	Transfer 1's to all output line
0	1	No shift operation
1	0	Shift left
1	1	Shift right

Course Outcome 5(CO5): Explain the restoring algorithm for binary division. Also trace the algorithm to divide $(1001)_2$ by $(11)_2$

Course Outcome 6(CO6): Design a software control logic based on microprogramed control to perform the addition of 2 signed numbers represented in sign magnitude form.



Model Question Paper

QP CODE:

PAGES:2

Reg No: _____

Name: _____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

THIRD SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: CST 202

Course Name: Computer organisation and architecture

Max.Marks:100

Duration: 3 Hours

PART A

Answer all Questions. Each question carries 3 Marks

1. Give the significance of instruction cycle.
2. Distinguish between big endian and little endian notations. Also give the significance of these notations.
3. Compare I/O mapped I/O and memory mapped I/O.
4. Give the importance of interrupts in I/O interconnection.
5. Justify the significance of status register.
6. How does the arithmetic circuitry perform logical operations in an ALU.
7. Illustrate divide overflow with an example.
8. Write notes on arithmetic pipeline.
9. Briefly explain the role of micro program sequence.
10. Differentiate between horizontal and vertical micro instructions.

Part B

Answer any one Question from each module. Each question carries 14 Marks

11.

11.(a) What is the significance of addressing modes in computer architecture.

(4)

11.(b) Write the control sequence for the instruction `DIV R1,[R2]` in a three bus structure.

(10)

OR

12. Explain the concept of a single bus organization with help of a diagram. Write the control sequence for the instruction `ADD [R1],[R2]`.

(14)

13. Explain various register transfer logics.

(14)

OR

14.

14.(a) Design a 4 bit combinational logic shifter with 2 control signals H1 and H2 that perform the following operations (bit values given in parenthesis are the values of control variable H1 and H2 respectively.) : Transfer of 0's to S (00), shift right (01), shift left (10), no shift (11).

(5)

14.(b) Design an ALU unit which will perform arithmetic and logic operation with a given binary adder.

(9)

15.

15.(a) Give the logic used behind Booth's multiplication algorithm.

(4)

15.(b) Identify the appropriate algorithm available inside the system to perform the multiplication between -14 and -9. Also trace the algorithm for the above input.

(10)

OR

16.

16.(a) List and explain the different pipeline hazards and their possible solutions

(10)

16.(b) Design a combinational circuit for 3×2 multiplication.

(4)

17. Design a hardware control unit used to perform addition/subtraction of 2 numbers represented in sign magnitude form.

(14)

OR

18. Give the structure of the micro program sequencer and its role in sequencing the micro instructions.

(14)

19.

19.(a) Explain the different ways in which interrupt priority schemes can be implemented

(10)

19.(b) Give the structure of SRAM cell.

(4)

OR

20.

20.(a) Explain the various mapping functions available in cache memory.

(9)

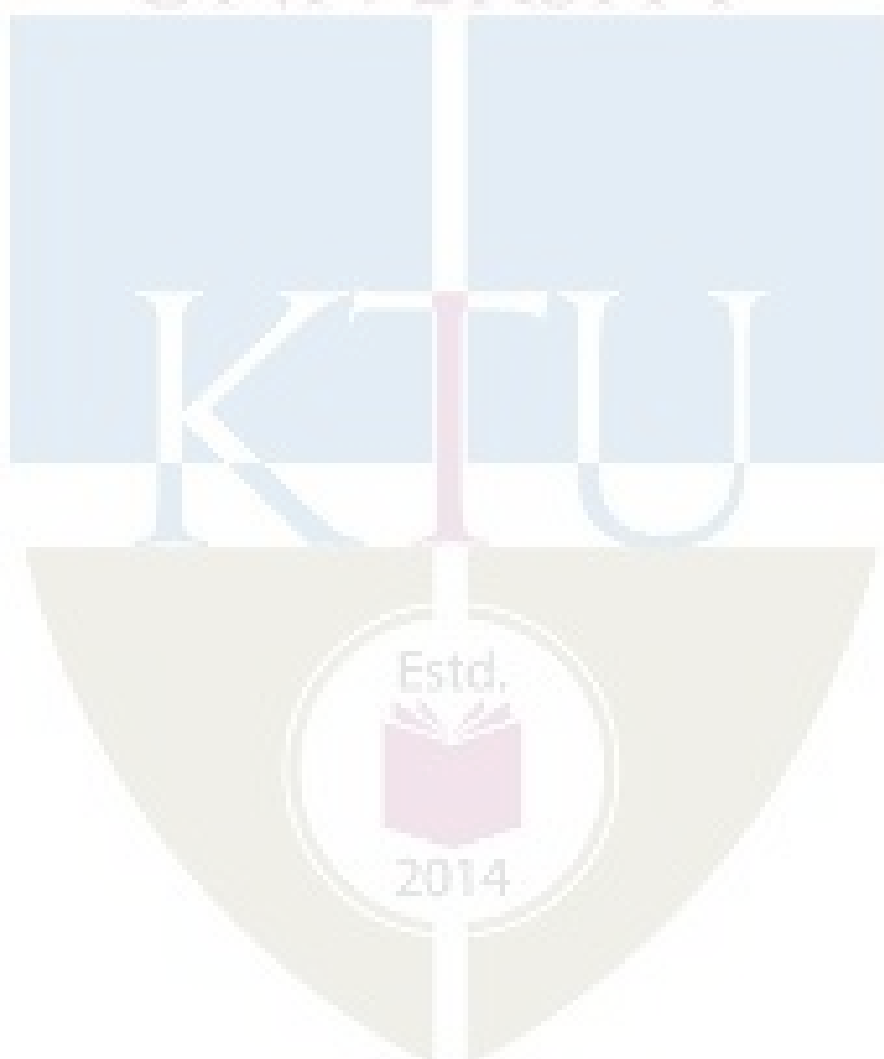
20.(b) Briefly explain content addressable memory.

(5)

TEACHING PLAN		
No	Contents	No of Lecture Hrs
Module 1 : (Basic Structure of computers) (9 hours)		
1.1	Functional units, basic operational concepts, bus structures (introduction)	1
1.2	Memory locations and addresses , memory operations	1
1.3	Instructions and instruction sequencing	1
1.4	Addressing modes	1
1.5	Fundamental concepts of instruction execution, instruction cycle	1
1.6	Execution of a complete instruction - single bus organization (Lecture 1)	1
1.7	Execution of a complete instruction - single bus organization (Lecture 2)	1
1.8	Execution of a complete instruction - multiple bus organization (Lecture 1)	1
1.9	Execution of a complete instruction - multiple bus organization (Lecture 2)	1
Module 2 :(Register transfer logic and Processor logic design) (10 hours)		
2.1	Inter register transfer – arithmetic micro operations	1
2.2	Inter register transfer – logic and shift micro operations	1
2.3	Processor organization	1
2.4	Design of arithmetic circuit	1
2.5	Design of logic circuit	1
2.6	Design of arithmetic logic unit	1
2.7	Design of status register	1
2.8	Design of shifter - processor unit	1

2.9	Design of accumulator (Lecture 1)	1
2.10	Design of accumulator (Lecture 2)	1
Module 3 : (Arithmetic algorithms and Pipelining) (9 hours)		
3.1	Algorithm for multiplication of binary numbers	1
3.2	Algorithm for division (restoring method) of binary numbers	1
3.3	Array multiplier	1
3.4	Booth's multiplication algorithm	1
3.5	Pipelining: Basic principles	1
3.6	Classification of pipeline processors (Lecture 1)	1
3.7	Classification of pipeline processors (Lecture 2)	1
3.8	Instruction and arithmetic pipelines (Design examples not required)	1
3.9	Hazard detection and resolution	1
Module 4 :(Control Logic Design) (9 hours)		
4.1	Control organization –design of hardwired control logic (Lecture 1)	1
4.2	Control organization –design of hardwired control logic (Lecture 2)	1
4.3	Control organization –design of hardwired control logic (Lecture 3)	1
4.4	Design of microprogram control logic–control of processor unit (Lecture1)	1
4.5	Design of microprogram control logic–control of processor unit (Lecture2)	1
4.6	Design of microprogram control logic–control of processor unit (Lecture3)	1
4.7	Microprogram sequencer	1
4.8	Micro programmed CPU organization	1
4.9	Microinstructions –horizontal and vertical micro instructions	1
Module 5 : (Basic processing units, I/O and memory) (8 hours)		
5.1	Accessing of I/O devices –interrupts	1
5.2	Interrupt hardware	1

5.3	Direct memory access	1
5.4	Memory system: basic concepts –semiconductor RAMs	1
5.5	Memory system considerations – ROMs	1
5.6	Content addressable memory	1
5.7	Cache memories -mapping functions (Lecture 1)	1
5.8	Cache memories -mapping functions (Lecture 2)	1



CST 204	DATABASE MANAGEMENT SYSTEMS	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		PCC	3	1	0	4	2019

Preamble: This course provides a clear understanding of fundamental principles of Database Management Systems (DBMS) with special focus on relational databases to the learners. The topics covered in this course are basic concepts of DBMS, Entity Relationship (ER) model, Relational Database principles, Relational Algebra, Structured Query Language (SQL), Physical Data Organization, Normalization and Transaction Processing Concepts. The course also gives a glimpse of the alternative data management model, NoSQL. This course helps the learners to manage data efficiently by identifying suitable structures to maintain data assets of organizations and to develop applications that utilize database technologies.

Prerequisite: Topics covered under the course Data Structures (CST 201), Exposure to a High Level Language like C/python.

Course Outcomes: After the completion of the course the student will be able to

CO1	Summarize and exemplify fundamental nature and characteristics of database systems (Cognitive Knowledge Level: Understand)
CO2	Model real word scenarios given as informal descriptions, using Entity Relationship diagrams. (Cognitive Knowledge Level: Apply)
CO3	Model and design solutions for efficiently representing and querying data using relational model (Cognitive Knowledge Level: Analyze)
CO4	Demonstrate the features of indexing and hashing in database applications (Cognitive Knowledge Level: Apply)
CO5	Discuss and compare the aspects of Concurrency Control and Recovery in Database systems (Cognitive Knowledge Level: Apply)
CO6	Explain various types of NoSQL databases (Cognitive Knowledge Level: Understand)

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓									✓
CO2	✓	✓	✓	✓								✓
CO3	✓	✓	✓	✓								✓
CO4	✓	✓	✓							✓		✓
CO5	✓	✓	✓							✓		✓
CO6	✓	✓	✓		✓					✓		✓

Abstract POs defined by National Board of Accreditation			
PO#	Broad PO	PO#	Broad PO
PO1	Engineering Knowledge	PO7	Environment and Sustainability
PO2	Problem Analysis	PO8	Ethics
PO3	Design/Development of solutions	PO9	Individual and team work
PO4	Conduct investigations of complex problems	PO10	Communication
PO5	Modern tool usage	PO11	Project Management and Finance
PO6	The Engineer and Society	PO12	Life long learning

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination Marks (%)
	Test1 (%)	Test2 (%)	
Remember	30	30	30
Understand	40	40	40
Apply	30	30	30

Analyze			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks

Continuous Assessment Tests : 25 marks

Continuous Assessment Assignment : 15 marks

Internal Examination Pattern:

Each of the two internal examinations has to be conducted out of 50 marks

First Internal Examination shall be preferably conducted after completing the first half of the syllabus and the Second Internal Examination shall be preferably conducted after completing remaining part of the syllabus.

There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly covered module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly covered module), each with 7 marks. Out of the 7 questions in Part B, a student should answer any 5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which a student should answer any one. Each question can have maximum 2 sub-divisions and carries 14 marks.

Syllabus

Module 1: Introduction & Entity Relationship (ER) Model

Concept & Overview of Database Management Systems (DBMS) - Characteristics of Database system, Database Users, structured, semi-structured and unstructured data. Data Models and Schema - Three Schema architecture. Database Languages, Database architectures and classification.

ER model - Basic concepts, entity set & attributes, notations, Relationships and constraints, cardinality, participation, notations, weak entities, relationships of degree 3.

Module 2: Relational Model

Structure of Relational Databases - Integrity Constraints, Synthesizing ER diagram to relational schema

Introduction to Relational Algebra - select, project, cartesian product operations, join - Equi-join, natural join. query examples, introduction to Structured Query Language (SQL), Data Definition Language (DDL), Table definitions and operations – CREATE, DROP, ALTER, INSERT, DELETE, UPDATE.

Module 3: SQL DML (Data Manipulation Language), Physical Data Organization

SQL DML (Data Manipulation Language) - SQL queries on single and multiple tables, Nested queries (correlated and non-correlated), Aggregation and grouping, Views, assertions, Triggers, SQL data types.

Physical Data Organization - Review of terms: physical and logical records, blocking factor, pinned and unpinned organization. Heap files, Indexing, Single level indices, numerical examples, Multi-level-indices, numerical examples, B-Trees & B+-Trees (structure only, algorithms not required), Extendible Hashing, Indexing on multiple keys – grid files.

Module 4: Normalization

Different anomalies in designing a database, The idea of normalization, Functional dependency, Armstrong's Axioms (proofs not required), Closures and their computation, Equivalence of Functional Dependencies (FD), Minimal Cover (proofs not required). First Normal Form (1NF), Second Normal Form (2NF), Third Normal Form (3NF), Boyce Codd Normal Form (BCNF), Lossless join and dependency preserving decomposition, Algorithms for checking Lossless Join (LJ) and Dependency Preserving (DP) properties.

Module 5: Transactions, Concurrency and Recovery, Recent Topics

Transaction Processing Concepts - overview of concurrency control, Transaction Model, Significance of concurrency Control & Recovery, Transaction States, System Log, Desirable Properties of transactions.

Serial schedules, Concurrent and Serializable Schedules, Conflict equivalence and conflict serializability, Recoverable and cascade-less schedules, Locking, Two-phase locking and its variations. Log-based recovery, Deferred database modification, check-pointing.

Introduction to NoSQL Databases, Main characteristics of Key-value DB (examples from: Redis), Document DB (examples from: MongoDB)

Main characteristics of Column - Family DB (examples from: Cassandra) and Graph DB (examples from : ArangoDB)

Text Books

1. Elmasri R. and S. Navathe, Database Systems: Models, Languages, Design and Application Programming, Pearson Education, 2013.
2. Sliberschatz A., H. F. Korth and S. Sudarshan, Database System Concepts, 6/e, McGraw Hill, 2011.

Reference Books:

1. Adam Fowler, NoSQL for Dummies, John Wiley & Sons, 2015
2. NoSQL Data Models: Trends and Challenges (Computer Engineering: Databases and Big Data), Wiley, 2018
3. Web Resource: <https://www.w3resource.com/redis/>
4. web Resource: <https://www.w3schools.in/category/mongodb/>
5. Web Resource: https://www.tutorialspoint.com/cassandra/cassandra_introduction.htm
6. Web Resource : <https://www.tutorialspoint.com/arangodb/index.htm>

Sample Course Level Assessment Questions

Course Outcome1 (CO1):

1. List out any three salient features of database systems, which distinguish it from a file system.
2. Give one example each for logical and physical data independence.

Course Outcome 2(CO2):

1. What facts about the relationships between entities EMPLOYEE and PROJECT are conveyed by the following ER diagram?



1. Design an ER diagram for the following scenario:
There is a set of teams, each team has an ID (unique identifier), name, main stadium, and to which city this team belongs. Each team has many players, and each player belongs to one team. Each player has a number (unique identifier), name, DoB, start year, and shirt number that he uses. Teams play matches, in each match there is a host team and a guest team.

Course Outcome 3(CO3):

1. For the SQL query, `SELECT A, B FROM R WHERE B = 'apple' AND C = 'orange'` on the table `R(A, B, C, D)`, where `A` is a key, write any three equivalent relational algebra expressions.
2. Given the FDs $P \rightarrow Q$, $P \rightarrow R$, $QR \rightarrow S$, $Q \rightarrow T$, $QR \rightarrow U$, $PR \rightarrow U$, write the sequence of *Armstrong's Axioms* needed to arrive at the following FDs: (a) $P \rightarrow T$ (b) $PR \rightarrow S$ (c) $QR \rightarrow SU$
3. Consider a relation `PLAYER` (`PLAYER-NO`, `PLAYER-NAME`, `PLAYER-POSN`, `TEAM`, `TEAM-COLOR`, `COACH-NO`, `COACH-NAME`, `TEAM-CAPTAIN`). Assume that `PLAYER-NO` is the *only* key of the relation and that the following dependencies hold:

$TEAM \rightarrow \{TEAM-COLOR, COACH-NO, TEAM-CAPTAIN\}$
 $COACH-NO \rightarrow COACH-NAME$

 - i. Is the relation in 2NF? If not, decompose to 2NF.
 - ii. Is the relation in 3NF? If not, decompose to 3NF.

4. In the following tables foreign keys have the same name as primary keys except DIRECTED-BY, which refers to the primary key ARTIST-ID. Consider only *single-director* movies.

MOVIES(MOVIE-ID, MNAME, GENRE, LENGTH, DIRECTED-BY)

ARTIST(ARTIST-ID, ANAME)

ACTING(ARTIST-ID, MOVIE-ID)

Write SQL expressions for the following queries:

- (a) Name(s) and director name(s) of movie(s) acted by 'Jenny'.
- (b) Names of actors who have never acted with 'Rony'
- (c) Count of movies genre-wise.
- (d) Name(s) of movies with maximum length.

Course Outcome 4(CO4):

1. Consider an EMPLOYEE file with 10000 records where each record is of size 80 bytes. The file is sorted on employee number (15 bytes long), which is the primary key. Assuming un-spanned organization, block size of 512 bytes and block pointer size of 5 bytes. Compute the number of block accesses needed for retrieving an employee record based on employee number if (i) No index is used (ii) Multi-level primary index is used.

Course Outcome 5(CO5):

1. Determine if the following schedule is *recoverable*. Is the schedule *cascade-less*? Justify your answer. $r1(X)$, $r2(Z)$, $r1(Z)$, $r3(X)$, $r3(Y)$, $w1(X)$, $c1$, $w3(Y)$, $c3$, $r2(Y)$, $w2(Z)$, $w2(Y)$, $c2$. (Note: $ri(X)/wi(X)$ means transaction T_i issues read/write on item X ; ci means transaction T_i commits.)
2. Two-phase locking protocol ensures serializability. Justify.

Course Outcome 6(CO6):

1. List out any three salient features of NoSQL databases. Give example of a document in MongoDB.

Model Question paper

QPCODE

Reg No: _____

Name: _____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FOURTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: CST 204

Course Name: Database Management Systems

Max.Marks:100

Duration: 3 Hours

PART A

Answer all Questions. Each question carries 3 Marks

- 1 List out any three salient features of a database systems.
- 2 When is multi-valued composite attribute used in ER modelling?
- 3 For the SQL query, *SELECT A, B FROM R WHERE B='apple' AND C = 'orange'* on the table *R(A, B, C, D)*, where A is a key, write any two equivalent relational algebra expressions.
- 4 Outline the concept of *theta*-join.
- 5 How is the purpose of *where* clause is different from that of having clause?
- 6 What is the use of a trigger?
- 7 When do you say that a relation is not in 1NF?
- 8 Given the FDs $P \rightarrow Q$, $P \rightarrow R$, $QR \rightarrow S$, $Q \rightarrow T$, $QR \rightarrow U$, $PR \rightarrow U$, write the sequence of Armstrong's Axioms needed to arrive at a. $P \rightarrow T$ b. $PR \rightarrow S$
- 9 What is meant by the lost update problem?
- 10 What is meant by check pointing?

- 13 **EMPLOYEE**(ENO, NAME, ADDRESS, DOB, AGE, GENDER, SALARY, DNUM, SUPERENO) (14)
DEPARTMENT(DNO, DNAME, DLOCATION, DPHONE, MGRENO)
PROJECT(PNO, PNAME, PLOCATION, PCOST, CDNO)

DNUM is a foreign key that identifies the department to which an employee belongs. MGRENO is a foreign key identifying the employee who manages the department. CDNO is a foreign key identifying the department that controls the project. SUPERENO is a foreign key identifying the supervisor of each employee.

Write relational algebra expressions for the following queries:-

- Names of female employees whose salary is more than 20000.
- Salaries of employee from 'Accounts' department
- Names of employees along with his/her supervisor's name
- For each employee return name of the employee along with his department name and the names of projects in which he/she works
- Names of employees working in all the departments

OR

- 14 a. Write SQL DDL statements for the the following (Assume suitable domain types): (10)
- Create the tables **STUDENT**(ROLLNO, NAME, CLASS, SEM, ADVISER), **FACULTY**(FID, NAME, SALARY, DEPT). Assume that ADVISER is a foreign key referring FACUTY table.
 - Delete department with name 'CS' and all employees of the department.
 - Increment salary of every faculty by 10%.
- b. Illustrate foreign key constraint with a typical example. (4)

- 15 For the relation schema below, give an expression in SQL for each of the queries (14) that follows:

employee(employee-name, street, city)
works(employee-name, company-name, salary)
company(company-name, city)
manages(employee-name, manager-name)

- Find the names, street address, and cities of residence for all employees who work for the Company 'RIL Inc.' and earn more than \$10,000.
- Find the names of all employees who live in the same cities as the companies for which they work.
- Find the names of all employees who do not work for 'KYS Inc.'. Assume that all people work for exactly one company.
- Find the names of all employees who earn more than every employee of 'SB Corporation'. Assume that all people work for at most one company.
- List out number of employees company-wise in the decreasing order of number of employees.

OR

- 16 a. Consider an EMPLOYEE file with 10000 records where each record is of size 80 bytes. The file is sorted on employee number (15 bytes long), which is the primary key. Assuming un-spanned organization and block size of 512 bytes compute the number of block accesses needed for selecting records based on employee number if, (9)
- No index is used
 - Single level primary index is used
 - Multi-level primary index is used
- Assume a block pointer size of 6 bytes.

- b. Illustrate correlated and non-correlated nested queries with real examples. (5)

- 17 a. Illustrate 3NF and BCNF with suitable real examples. (6)
- b. Given a relation $R(A_1, A_2, A_3, A_4, A_5)$ with functional dependencies $A_1 \rightarrow A_2, A_4 \rightarrow A_5$, check if the decomposition $R_1(A_1, A_2, A_3), R_2(A_1, A_4), R_3(A_2, A_4, A_5)$ is lossless. (8)

OR

- 18 a. Consider the un-normalized relation $R(A, B, C, D, E, F, G)$ with the FDs $A \rightarrow B, AC \rightarrow G, AD \rightarrow EF, EF \rightarrow G, CDE \rightarrow AB$. Trace the normalization process to reach 3NF relations. (7)

- b. Illustrate Lossless Join Decomposition and Dependency Preserving Decomposition with typical examples. (7)

19 a. Discuss the four ACID properties and their importance. (7)

- b. Determine if the following schedule is conflict serializable. Is the schedule recoverable? Is the schedule cascade-less? Justify your answers. (7)

$r_1(X), r_2(Z), r_1(Z), r_3(X), r_3(Y), w_1(X), c_1, w_3(Y), c_3, r_2(Y), w_2(Z), w_2(Y), c_2$

(Note: $r_i(X)/w_i(X)$ means transaction T_i issues read/write on item X ; c_i means transaction T_i commits.)

OR

20 a. Discuss the main characteristics of Key-value DB and Graph DB. (7)

- b. Illustrate two-phase locking with a schedule containing three transactions. Argue that 2PL ensures serializability. Also argue that 2PL can lead to deadlock. (7)

Teaching Plan

	Course Name	Hours (48)
	Module 1: Introduction & ER Model	8
1.1	Concept & Overview of DBMS, Characteristics of DB system, Database Users.	1
1.2	Structured, semi-structured and unstructured data. Data Models and Schema	1
1.3	Three-Schema-architecture. Database Languages	1
1.4	Database architectures and classification	1
1.5	ER model: basic concepts, entity set & attributes, notations	1
1.6	Relationships and constraints – cardinality, participation, notations	1
1.7	Weak entities, relationships of degree 3	1
1.8	ER diagram – exercises	1
	Module 2: Relational Model	7
2.1	Structure of relational Databases, Integrity Constraints	1
2.2	Synthesizing ER diagram to relational schema, Introduction to relational algebra.	1
2.3	Relational algebra: select, project, Cartesian product operations	1
2.4	Relational Algebra: join - Equi-join, Natural join	1
2.5	Query examples	1
2.6	Introduction to SQL, important data types	1
2.7	DDL, Table definitions and operations – CREATE, DROP, ALTER, INSERT, DELETE, UPDATE	1
	Module 3: SQL DML, Physical Data Organization	11
3.1	SQL DML, SQL queries on single and multiple tables	1
3.2	Nested queries (correlated and non-correlated)	1
3.3	Aggregation and grouping	1

	Course Name	Hours (48)
3.4	Views, assertions (with examples)	1
3.5	Triggers (with examples), SQL data types	1
3.6	Review of terms: physical and logical records, blocking factor, pinned and unpinned organization. Heap files, Indexing	1
3.7	Singe level indices, numerical examples	1
3.8	Multi-level-indices, numerical examples	1
3.9	B-Trees and B+Trees (structure only, algorithms not required)	1
3.10	Extendible Hashing	1
3.11	Indexing on multiple keys – grid files	1
	Module 4: Normalization	8
4.1	Different anomalies in designing a database, The idea of normalization	1
4.2	Functional dependency, Armstrong's Axioms (proofs not required)	1
4.3	Closures and their computation, Equivalence of FDs, minimal Cover (proofs not required).	1
4.4	1NF, 2NF	1
4.5	3NF, BCNF	1
4.6	Lossless join and dependency preserving decomposition	1
4.7	Algorithms for checking Lossless Join and Dependency preserving properties (Lecture 1)	1
4.8	Algorithms for checking Lossless Join and Dependency preserving properties (Lecture 2)	1
	Module 5: Transactions, Concurrency and Recovery, Recent Topics	14
5.1	Transaction Processing Concepts: Transaction Model	1
5.2	Overview of concurrency control, Significance of concurrency Control & Recovery	1
5.3	Transaction States, System Log	1

	Course Name	Hours (48)
5.4	Desirable Properties of transactions, Serial schedules	1
5.5	Concurrent and Serializable Schedules	1
5.6	Conflict equivalence and conflict serializability	1
5.7	Recoverable and cascade-less schedules	1
5.8	Locking, Two-phase locking, strict 2PL.	1
5.9	Log-based recovery	1
5.10	Deferred database modification (serial schedule), example	1
5.11	Deferred database modification (concurrent schedule) example, check-pointing	1
5.12	Introduction to NoSQL Databases	1
5.13	Main characteristics of Key-value DB (examples from: Redis), Document DB (examples from: MongoDB) [detailed study not expected]	1
5.14	Main characteristics of Column-Family DB (examples from: Cassandra) and Graph DB (examples from : ArangoDB) [detailed study not expected]	1

Estd.



2014

CST 206	OPERATING SYSTEMS	Category	L	T	P	Credit	Year of Introduction
		PCC	3	1	0	4	2019

Preamble: Study of operating system is an essential to understand the overall working of computer system, tradeoffs between performance and functionality and the division of jobs between hardware and software. This course introduces the concepts of memory management, device management, process management, file management and security & protection mechanisms available in an operating system. The course helps the learner to understand the fundamentals about any operating system design so that they can extend the features of operating system to detect and solve many problems occurring in operating system and to manage the computer resources appropriately.

Prerequisite: Topics covered in the courses are **Data Structures (CST 201)** and **Programming in C (EST 102)**

Course Outcomes: After the completion of the course the student will be able to

CO1	Explain the relevance, structure and functions of Operating Systems in computing devices. (Cognitive knowledge: Understand)
CO2	Illustrate the concepts of process management and process scheduling mechanisms employed in Operating Systems. (Cognitive knowledge: Understand)
CO3	Explain process synchronization in Operating Systems and illustrate process synchronization mechanisms using Mutex Locks, Semaphores and Monitors (Cognitive knowledge: Understand)
CO4	Explain any one method for detection, prevention, avoidance and recovery for managing deadlocks in Operating Systems. (Cognitive knowledge: Understand)
CO5	Explain the memory management algorithms in Operating Systems. (Cognitive knowledge: Understand)
CO6	Explain the security aspects and algorithms for file and storage management in Operating Systems. (Cognitive knowledge: Understand)

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓							✓		✓
CO2	✓	✓	✓	✓						✓		✓
CO3	✓	✓	✓	✓						✓		✓
CO4	✓	✓	✓	✓						✓		✓
CO5	✓	✓	✓	✓						✓		✓
CO6	✓	✓	✓	✓						✓		✓

Abstract POs defined by National Board of Accreditation			
PO#	Broad PO	PO#	Broad PO
PO1	Engineering Knowledge	PO7	Environment and Sustainability
PO2	Problem Analysis	PO8	Ethics
PO3	Design/Development of solutions	PO9	Individual and team work
PO4	Conduct investigations of complex problems	PO10	Communication
PO5	Modern tool usage	PO11	Project Management and Finance
PO6	The Engineer and Society	PO12	Life long learning

Assessment Pattern

Bloom's Category	Test 1 (Marks in percentage)	Test 2 (Marks in percentage)	End Semester Examination (Marks in percentage)
Remember	30	30	30
Understand	30	30	30
Apply	40	40	40
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3

Continuous Internal Evaluation Pattern:

Attendance : 10 marks

Continuous Assessment Test : 25 marks

Continuous Assessment Assignment : 15 marks

Internal Examination Pattern:

Each of the two internal examinations has to be conducted out of 50 marks. First series test shall be preferably conducted after completing the first half of the syllabus and the second series test shall be preferably conducted after completing remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly completed module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly completed module), each with 7 marks. Out of the 7 questions, a student should answer any 5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which a student should answer any one. Each question can have maximum 2 sub-divisions and carries 14 marks.

Syllabus**Module I**

Introduction: Operating system overview – Operations, Functions, Service – System calls, Types – Operating System structure - Simple structure, Layered approach, Microkernel, Modules – System boot process.

Module II

Processes - Process states, Process control block, threads, scheduling, Operations on processes - process creation and termination – Inter-process communication - shared memory systems, Message passing systems.

Process Scheduling – Basic concepts- Scheduling criteria -scheduling algorithms- First come First Served, Shortest Job First, Priority scheduling, Round robin scheduling

Module III

Process synchronization- Race conditions – Critical section problem – Peterson's solution, Synchronization hardware, Mutex Locks, Semaphores, Monitors – Synchronization problems - Producer Consumer, Dining Philosophers and Readers-Writers.

Deadlocks: Necessary conditions, Resource allocation graphs, Deadlock prevention, Deadlock avoidance – Banker's algorithms, Deadlock detection, Recovery from deadlock.

Module IV

Memory Management: Concept of address spaces, Swapping, Contiguous memory allocation, fixed and variable partitions, Segmentation, Paging. Virtual memory, Demand paging, Page replacement algorithms.

Module V

File System: File concept - Attributes, Operations, types, structure – Access methods, Protection. File-system implementation, Directory implementation. Allocation methods.

Storage Management: Magnetic disks, Solid-state disks, Disk Structure, Disk scheduling, Disk formatting.

Text Book

Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, ' Operating System Concepts' 9th Edition, Wiley India 2015.

Reference Books:

1. Andrew S Tanenbaum, "Modern Operating Systems", 4th Edition, Prentice Hall, 2015.
2. William Stallings, "Operating systems", 6th Edition, Pearson, Global Edition, 2015.
3. Garry Nutt, Nabendu Chaki, Sarmistha Neogy, "Operating Systems", 3rd Edition, Pearson Education.
4. D.M.Dhamdhare, "Operating Systems", 2nd Edition, Tata McGraw Hill, 2011.
5. Sibsanakar Halder, Alex A Aravind, "Operating Systems", Pearson Education.

Sample Course Level Assessment Questions

Course Outcome1 (CO1): What is the main advantage of the micro kernel approach to system design? How do user program and system program interact in a microkernel architecture?

Course Outcome 2 (CO2): Define process. With the help of a neat diagram explain different states of process.

Course Outcome 3 (CO3): What do you mean by binary semaphore and counting semaphore? With C, explain implementation of wait () and signal().

Course Outcome 4 (CO4): Describe resource allocation graph for the following. a) with a deadlock b) with a cycle but no deadlock.

Course Outcome 5 (CO5): Consider the following page reference string 1, 2, 3, 4, 2, 1, 5, 6, 2, 1, 2, 3, 7, 6, 3, 2, 1, 2, 3, 6. Find out the number of page faults if there are 4 page frames, using the following page replacement algorithms. i) LRU ii) FIFO iii) Optimal

Course Outcome 6 (CO6): Explain the different file allocation methods with advantages and disadvantages.

Model Question Paper

QP CODE: _____

PAGES: ____

Reg No: _____

Name: _____

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
FOURTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR**

Course Code: CST 206

Course name : OPERATING SYSTEMS

Max Marks: 100

Duration: 3 Hours

PART-A

(Answer All Questions. Each question carries 3 marks)

1. How does hardware find the Operating System kernel after system switch-on?
2. What is the purpose of system call in operating system?
3. Why is context switching considered as an overhead to the system?

4. How is inter process communication implemented using shared memory?
5. Describe resource allocation graph for the following.
 - a) with a deadlock
 - b) with a cycle but no deadlock.
6. What is critical section? What requirement should be satisfied by a solution to the critical section problem?
7. Consider the reference string 1, 2, 3, 4, 2, 1, 5, 6, 2, 1, 2, 3, 7, 6, 3, 2, 1, 2, 3, 6. How many page faults occur while using FCFS for the following cases.
 - a) frame=2
 - b) frame=3
8. Differentiate between internal and external fragmentations.
9. Compare sequential access and direct access methods of storage devices.
10. Define the terms (i) Disk bandwidth (ii) Seek time.

PART-B(Answer any one question from each module)

11. a) Explain the following structures of operating system (i) Monolithic systems (ii) Layered Systems (iii) Micro Kernel (iv) Modular approach. **(12)**
b) Under what circumstances would a user be better off using a time sharing system than a PC or a single user workstation? **(2)**
OR
12. a) What is the main advantage of the micro kernel approach to system design? How do user program and system program interact in a microkernel architecture? **(8)**
b) Describe the differences between symmetric and asymmetric multiprocessing? What are the advantages and disadvantages of multiprocessor systems? **(6)**
OR
13. a) Define process. With the help of a neat diagram explain different states of process. **(8)**
b) Explain how a new process can be created in Unix using fork system call. **(6)**
OR
14. a) Find the average waiting time and average turnaround time for the processes given in the table below using:- i) SRT scheduling algorithm ii) Priority scheduling algorithm **(9)**

Process	Arrival Time (ms)	CPU Burst Time (ms)	Priority
P1	0	5	3
P2	2	4	1
P3	3	1	2
P4	5	2	4

b) What is a Process Control Block? Explain the fields used in a Process Control Block. (5)

15. Consider a system with five processes P_0 through P_4 and three resources of type A, B, C. Resource type A has 10 instances, B has 5 instances and C has 7 instances. Suppose at time t_0 following snapshot of the system has been taken:

Process	Allocation			Max			Available		
	A	B	C	A	B	C	A	B	C
P_0	0	1	0	7	5	3	3	3	2
P_1	2	0	0	3	2	2			
P_2	3	0	2	9	0	2			
P_3	2	1	1	2	2	2			
P_4	0	0	2	4	3	3			

- i) What will be the content of the Need matrix? Is the system in a safe state? If Yes, then what is the safe sequence? (8)
- iii) What will happen if process P_1 requests one additional instance of resource type A and two instances of resource type C? (6)

OR

16. a) State dining philosopher's problem and give a solution using semaphores. (7)
- b) What do you mean by binary semaphore and counting semaphore? With C struct, explain implementation of wait () and signal() (7)

17. a) Consider the following page reference string 1, 2, 3, 4, 2, 1, 5, 6, 2, 1, 2, 3, 7, 6, 3, 2, 1, 2, 3, 6. Find out the number of page faults if there are 4 page frames, using the following page replacement algorithms i) LRU ii) FIFO iii) Optimal (9)
- b) Explain the steps involved in handling a page fault. (5)

OR

18. a) With a diagram, explain how paging is done with TLB. (5)
- b) Memory partitions of sizes 100 kb, 500 kb, 200 kb, 300 kb, 600 kb are available, how would best, worst and first fit algorithms place processes of size 212 kb, 417 kb, 112 kb, 426 kb in order. Rank the algorithms in terms of how efficiently they use memory. (9)
19. a) Suppose that a disk drive has 5000 cylinders, numbered 0 to 4999. the drive currently services a request at cylinder 143, and the previous request was at cylinder 125. the queue of pending request in FIFO order is 86, 1470, 913, 1774, 948, 1509, 1022, 1750, 130. Starting from the current position, what is the total distance (in cylinders) that the disk arm moves to satisfy all pending requests for each of the following algorithms
- i) FCFS ii) SSFT iii) SCAN iv) LOOK v) C-SCAN (10)
- b) What is the use of access matrix in protection mechanism? (4)

OR

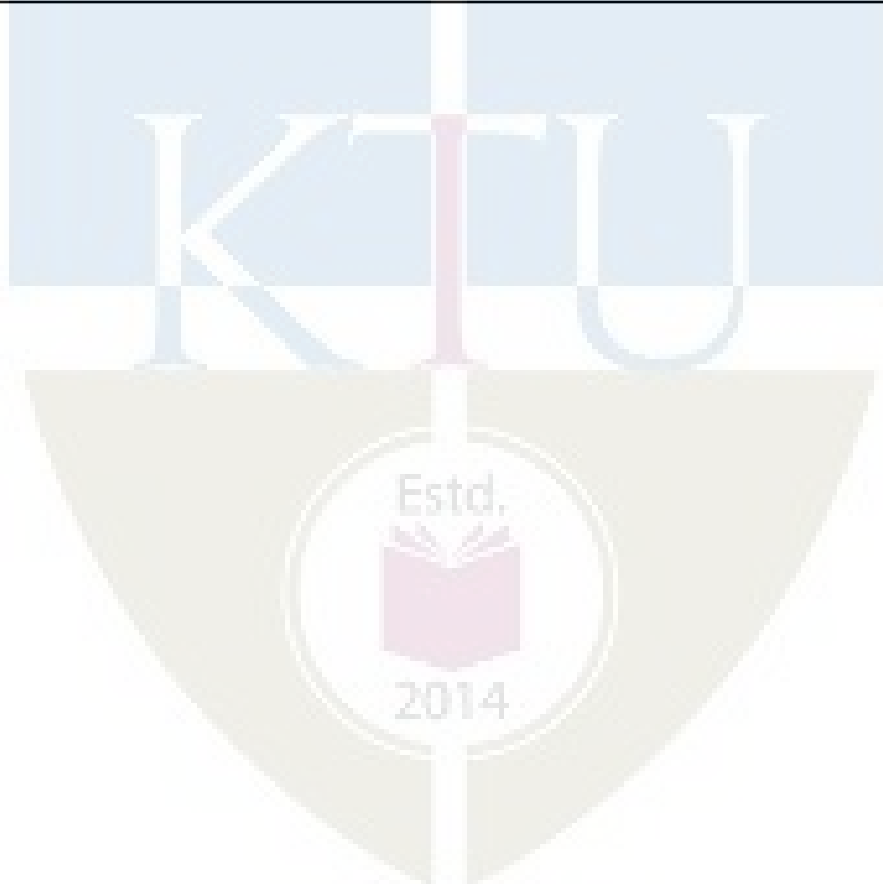
20. a) Explain the different file allocation operations with advantages and disadvantages. (8)
- b) Explain the following i) file types ii) file operation iii) file attributes (6)

Teaching Plan

	Module 1 - Introduction	5 Hours
1.1	Introduction to Operating System	1
1.2	Operating System operations, functions, service	1
1.3	System calls, Types	1
1.4	Operating System Structure: Simple, Layered, Microkernel, Modules	1
1.5	System Boot Process	1
	Module 2 – Processes and Process Scheduling	9 Hours
2.1	Processes, Process states	1
2.2	Process Control Block, Threads	1

2.3	Scheduling	1
2.4	Operations on processes: process creation and termination	1
2.5	Inter-process communication: Shared memory systems, Message Passing	1
2.6	Process Scheduling – Basic concepts, Scheduling Criteria	1
2.7	Scheduling algorithms - Basics	1
2.8	First come First Served, Shortest Job First	1
2.9	Priority scheduling, Round Robin Scheduling	1
	Module 3 - Process synchronization and Dead locks	13 Hours
3.1	Process synchronization, Race conditions	1
3.2	Critical Section problem, Peterson's solution	1
3.3	Synchronization hardware, Mutex Locks	1
3.4	Semaphores	1
3.5	Monitors	1
3.6	Synchronization problem examples (Lecture 1)	1
3.7	Synchronization problem examples (Lecture 2)	1
3.8	Deadlocks: Necessary conditions, Resource Allocation Graphs	1
3.9	Deadlock prevention	1
3.10	Deadlock avoidance	1
3.11	Banker's algorithm	1
3.12	Deadlock detection	1
3.13	Deadlock recovery	1
	Module 4 - Memory Management	9 Hours
4.1	Memory Management: Concept of Address spaces	1
4.2	Swapping	1
4.3	Contiguous memory allocation, fixed and variable partitions	1
4.4	Segmentation.	1
4.5	Paging (Lecture 1)	1
4.6	Paging (Lecture 2)	1
4.7	Virtual memory, Demand Paging	1

4.8	Page replacement algorithms (Lecture 1)	1
4.9	Page replacement algorithms (Lecture 2)	1
	Module 5 - File and Disk management	9 Hours
5.1	File concept, Attributes, Operations, types, structure	1
5.2	Access methods	1
5.3	Protection	1
5.4	File-System implementation	1
5.5	Directory implementation	1
5.6	Allocation methods	1
5.7	Magnetic disks, Solid-state disks, Disk structure	1
5.8	Disk scheduling	1
5.9	Disk formatting	1



CCL202	SCRIPTING LANGUAGES FOR SECURITY	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		PCC	0	0	3	2	2020

Preamble: The course aims to offer hands-on experience for learners in Python programming and Shell Scripting for security implementations. It covers basic shell commands, shell scripting, python programming constructs and its use in security applications. The course helps the learners to get practical exposure on security related issues and its solutions.

Prerequisite: Basic concepts in any Programming Language

Course Outcomes:

At the end of the course, the student should be able to

CO1	Develop simple applications and file operations in shell script (Cognitive Knowledge Level: Apply)
CO2	Illustrate the use of shell scripting in security applications (Cognitive Knowledge Level: Apply)
CO3	Implement control structures, iterations, string operations and recursive functions in Python (Cognitive Knowledge Level: Apply)
CO4	Implement security operations on files using python (Cognitive Knowledge Level: Apply)
CO5	Develop security related programs using python libraries(Cognitive Knowledge Level: Apply)

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												

CO5												

Abstract Pos defined by National Board of Accreditation

PO#	Broad PO	PO#	Broad PO
PO1	Engineering Knowledge	PO7	Environment and Sustainability
PO2	Problem Analysis	PO8	Ethics
PO3	Design/Development of solutions	PO9	Individual and teamwork
PO4	Conduct investigations of complex problems	PO10	Communication
PO5	Modern tool usage	PO11	Project Management and Finance
PO6	The Engineer and Society	PO12	Lifelong learning

Assessment Pattern

Bloom's Category	Continuous Assessment Test (Internal Exam) Mark in Percentage	End Semester Examination Mark in Percentage
Remember	20	20
Understand	20	20
Apply	60	60
Analyze		
Evaluate		
Create		

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	75	75	3hours

Continuous Internal Evaluation Pattern:

Attendance	:	15marks
Continuous Evaluation in Lab	:	30marks
Continuous Assessment Test	:	15marks
Viva-voce	:	15marks

Internal Examination Pattern: The marks will be distributed as Algorithm 20 marks, Program 30 marks, Output 20 marks and Viva 30 marks. Total 100 marks which will be converted out of 15 while calculating Internal Evaluation marks.

End Semester Examination Pattern: The marks will be distributed as Algorithm 20 marks, Program 30 marks, Output 20 marks and Viva 30 marks. Total 100 marks will be converted out of 75 for End Semester Examination.

Operating System to Use in Lab : Unix/Linux

Compiler/Software to Use in Lab : Bash Shell / Python

Interpreter Language to Use in Lab : Shell Script / Python

Fair Lab Record:

All Students attending the Scripting Languages for security lab should have a Fair Record. The fair record should be produced in the University Lab Examination. Every experiment conducted in the lab should be noted in the fair record. For every experiment in the fair record the right-hand page should contain Experiment Heading, Experiment Number, Date of Experiment, Aim of Experiment, Details of Experiment including Algorithm and Result of Experiment. The left-hand page should contain a print out of the code used for the experiment and sample output obtained for a set of inputs.

SYLLABUS

Shell Scripting

Programs using Basic Linux Shell Commands : Interactive shell script, Positional parameters, Arithmetic operators, Logical operators, Selection and Iterative Control statements, Meta characters

Programs using Basic Unix Shell Commands: Creation of class directory, User file creation, User log history, Script escalation, Hash for files, Denial of Execution.

Python

Variables, Expressions Decision making, Branching, Conditional statements, Iterative statements.

Function: Function calls, Math functions, Parameters and arguments, Adding new functions, Recursion

Files: Operations, Access Privileges

MD5 Hash, Primality Testing: Miller-Rabin Method, Pseudo Random number Generation, Packet Capture

PRACTICAL QUESTIONS IN SHELL SCRIPTING

1. Write a shell script to create a file in \$USER/class/batch directory
2. Write a shell script to display the list of files in a directory?
3. Write shell script for showing the count of users logged in.
4. Write a shell script to print file names in directory showing date of creation & serial number of file.
5. Write a shell script to count lines, words & characters in its input.(do not use wc)
6. Write a shell script to print end of a Glossary file in reverse order using array.
7. Write a shell script to check whether a user has logged in, continue checking further after every 30 seconds till success.
8. Write a shell script to check access to root and stop escalation to root from another script.
9. Write a shell script to test file integrity. Create hash for files and check changes.
10. Write a shell script to check access from users other than in white list
11. Write a shell script to check any shell script running.
12. Write a shell script to deny exec right to another program.

PRACTICAL QUESTIONS IN PYTHON

(Implement minimum of 6 experiments from Part B)

PART A

1. Write a program to print the factors of a given number.
2. Write a program to check whether a given number is prime or not
3. Write a program to check whether a number is palindrome or not
4. Write a Python program to read a list of numbers and sort the list in a non-decreasing order without using any built-in functions. Separate function should be written to sort the list where in the name of the list is passed as the parameter.
5. Find the factorial of a given Natural Number *n* using recursive functions.

PART B

6. Write a program to check the complexity of a password.
7. Write a program to implement Primality testing using Miller-Rabin Method
8. Write a program to implement MD5 hash
9. Write a program to search for deleted files in python
10. Write a program to check for presence of dark web.
11. Write a program to implement privilege escalation and evasion
12. Write a Key logger / key logger detection tool program using python
13. Write a program to detect access from invalid IP address using packet capture.
14. Write a program to implement pseudo random number generation
15. Write a program to list images, pdf in a file given.

Micro Project: Students are expected to do a micro project preferably related to the security aspects(Python).



CCL204	OS AND DBMS LAB	CATEGORY	L	T	P	CREDITS
		PCC	0	0	3	2

Preamble: The course aims to offer students a hands-on experience on Operating System concepts and Database design. This course helps the learners to get practical exposure on Process synchronization, CPU scheduling, deadlock, memory allocation, memory management, database creation, SQL queries creation and PL/SQL. The course enables the students to develop real world application involving OS and Database constructs.

Prerequisite: A sound knowledge of the basics of relational DBMS and Operating Systems.

Course Outcomes: After the completion of the course the student will be able to

CO1	Implement Process Creation, Inter Process Communication and CPU Scheduling algorithms in Operating Systems. (Cognitive knowledge: Apply)
CO2	Illustrate the performance of First In First Out, Least Recently Used and Least Frequently Used Page Replacement Algorithms.
CO3	Implement modules for Deadlock Detection and Deadlock Avoidance in Operating Systems. (Cognitive knowledge: Apply)
CO4	Construct queries using SQL for database creation, interaction, modification, and updation. (Cognitive Knowledge Level: Apply)
CO5	Implement procedures, functions, and control structures using PL/SQL. (Cognitive Knowledge Level: Apply)
CO6	Develop database applications using front-end tools and back-end DBMS. (Cognitive Knowledge Level: Create)

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓	✓			✓		✓		✓
CO2	✓	✓	✓	✓	✓			✓		✓		✓
CO3	✓	✓	✓	✓	✓			✓		✓		✓
CO4	✓	✓	✓		✓			✓		✓		✓
CO5	✓	✓	✓	✓	✓			✓		✓		✓
CO6	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓

Abstract POs defined by National Board of Accreditation			
PO#	Broad PO	PO#	Broad PO
PO1	Engineering Knowledge	PO7	Environment and Sustainability
PO2	Problem Analysis	PO8	Ethics
PO3	Design/Development of solutions	PO9	Individual and team work
PO4	Conduct investigations of complex Problems	PO10	Communication
PO5	Modern tool usage	PO11	Project Management and Finance
PO6	The Engineer and Society	PO12	Life long learning

Assessment Pattern:

Bloom's Category	Continuous Assessment Test (Internal Exam) Marks in percentage	End Semester Examination Marks in percentage
Remember	20	20
Understand	20	20
Apply	60	60
Analyze		
Evaluate		
Create		

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	75	75	3 hours

Continuous Internal Evaluation Pattern:

Attendance	:	15 marks
Continuous Evaluation in Lab	:	30 marks
Continuous Assessment Test	:	15 marks
Viva Voce	:	15 marks

Internal Examination Pattern: The marks will be distributed as Algorithm 30 marks, 20 marks for program, 20 marks for output and 30 marks for viva. In DBMS experiments, marks will be distributed as Schema/Form Design/Queries 50 marks, 20 marks for output, and 30 marks for viva. Total 100 marks which will be converted out of 15 while calculating Internal Evaluation marks.

End Semester Examination Pattern: The percentage of marks will be distributed as Algorithm 30 marks, Program 20 marks, Output 20 marks and Viva 30 marks. Total 75 marks.

Operating System to Use in Lab : Linux/Windows

Compiler/Software to Use in Lab : gcc

Programming Language to Use in Lab : Ansi C

DBMS software: Oracle, MySQL

Front end Tool: Java

Fair Lab Record:

All Students attending the OS AND DBMS Lab should have a Fair Record. The fair record should be produced in the University Lab Examination. Every experiment conducted in the lab should be noted in the fair record. For every experiment in the fair record, the right hand page should contain experiment heading, experiment number, date of experiment.

In the case Operating System experiments, the right hand page also contains aim, algorithm and output. The left hand page should contain a print out of the code used for experiment and sample output obtained for a set of input.

In the case of DBMS Lab, the right hand page also contains Schemas/Menu & Form Design, and Query questions. The left hand page should contain queries and sample output (relations created, Form, and Menu Output) obtained for a set of input.

SYLLABUS

Operating System

1. Implement programs for Inter Process Communication using Shared Memory.
2. Implement Semaphores.
3. Implementation of CPU scheduling algorithms. a) Round Robin b) SJF c) FCFS d) Priority
4. Implementation of the Memory Allocation Methods for fixed partition.
 - i. First Fit b) Worst Fit c) Best Fit
5. Implement page replacement algorithms a) FIFO b) LRU c) LFU
6. Implement the Banker's algorithm for deadlock avoidance.
7. Implementation of Deadlock detection algorithm.

Database Management System

8. Creation, modification, configuration, and deletion of databases using UI and SQL Commands.
9. DDL and DML commands -(insertion, updating, set constraints, altering, deletion of data, and viewing/querying records based on condition in databases) .
10. Implementation of built-in functions in RDBMS .
11. Implementation of Order By, Group By & Having clause .
12. Implementation of various control structures like IF-THEN, IF-THEN-ELSE, IF-THEN-ELIF, CASE, WHILE using PL/SQL .
13. Implementation of set operators nested queries, and join queries

14. Design a database application using any front end tool for any problem selected. The application constructed should have five or more tables.

OS AND DBMS LAB-PRACTICE QUESTIONS
(Minimum six experiments from Operating Systems)

1. Given the list of processes, their CPU burst times and arrival times, print the Gantt chart for FCFS and SJF. For each of the scheduling policies, compute and print the average waiting time and average turnaround time
2. Write a C program to simulate following non-pre-emptive CPU scheduling algorithms to find turnaround time and waiting time.
a) FCFS b) SJF c) Round Robin (pre-emptive) d) Priority
3. Write a C program to simulate following contiguous memory allocation techniques
a) Worst-fit b) Best-fit c) First-fit
4. Write a C program to simulate paging technique of memory management.
5. Write a C program to simulate Banker's algorithm for the purpose of deadlock avoidance.
6. Write a C program to simulate disk scheduling algorithms a) FCFS b) SCAN c) C-SCAN
7. Write a C program to simulate page replacement algorithms a) FIFO b) LRU c) LFU
8. Write a C program to simulate producer-consumer problem using semaphores.
9. Write a C program to simulate algorithm for deadlock prevention.
10. Creation of a database using DDL commands and write DQL queries to retrieve information from the database.
11. Performing DML commands like Insertion, Deletion, Modifying, Altering, and Updating records based on conditions.
12. Creating a database to set various constraints.
13. Practice of SQL TCL commands like Rollback, Commit, Savepoint.
14. Creation of Views and Assertions
15. Implementation of Built-in functions in RDBMS
16. Implementation of various aggregate functions in SQL
17. Implementation of Order By, Group By & Having clause.
18. Implementation of set operators, nested queries and Join queries
19. Implementation of various control structures using PL/SQL
20. Mini project (Application Development using Oracle/ MySQL using Database connectivity like)
 - a. Hospital Management System.
 - b. Railway Reservation System.
 - c. Personal Information System.
 - d. Web Based User Identification System.
 - e. Timetable Management System.
 - f. Hotel Management System.

APJ ABDUL KALAM
TECHNOLOGICAL
UNIVERSITY

SEMESTER IV

HONOURS



CCT292	SECURE MOBILE APPLICATION DEVELOPMENT	CATEGORY	L	T	P	CREDITS
		VAC	3	1	0	4

Preamble: This course helps the learners to make awareness about strong theoretical concept in the development of mobile applications and its challenges. It covers the concepts of Mobile App and Mobile Interface, key concepts of Android, 2D graphics and multimedia in Android, User interface design, SQLite database, mobile embedded system architecture and mobile cloud. This course enables the learners to develop the ability to create Android based applications for different domains.

Prerequisite: A sound knowledge in Java.

Course Outcomes: After the completion of the course the student will be able to

CO#	CO
CO1	Describe the concepts, security challenges in mobile system and mobile applications (Cognitive Knowledge level: Understand)
CO2	Implement 2D graphics, Graphical User Interface and incorporate multimedia in Android applications (Cognitive Knowledge level: Apply)
CO3	Explain the concepts of general and Android based mobile embedded systems and its application, processor technology and scheduling algorithms(Cognitive Knowledge level: Understand)
CO4	Illustrate the storage of data from mobile applications to a mobile device (Cognitive Knowledge level: Apply)
CO5	Describe the techniques employed in mobile cloud(Cognitive Knowledge level: Understand)

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

Abstract POs defined by National Board of Accreditation			
PO#	Broad PO	PO#	Broad PO
PO1	Engineering Knowledge	PO7	Environment and Sustainability
PO2	Problem Analysis	PO8	Ethics
PO3	Design/Development of solutions	PO9	Individual and team work
PO4	Conduct investigations of complex problems	PO10	Communication
PO5	Modern tool usage	PO11	Project Management and Finance
PO6	The Engineer and Society	PO12	Life long learning

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination Marks (%)
	Test 1 (%)	Test 2 (%)	
Remember	30	30	30
Understand	40	40	40
Apply	30	30	30
Analyze			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3

Continuous Internal Evaluation Pattern:

Attendance	10 marks
Continuous Assessment Tests (Average of Series Tests 1 & 2)	25 marks
Continuous Assessment Assignment	15 marks

Internal Examination Pattern:

Each of the two internal examinations has to be conducted out of 50 marks. The first series test shall be preferably conducted after completing the first half of the syllabus and the second series test shall be preferably conducted after completing the remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly completed module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly completed module), each with 7 marks. Out of the 7 questions, a student should answer any 5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 full questions from each module of which student should answer any one full question. Each question can have maximum 2 sub-divisions and carries 14 marks.

SYLLABUS

Module – 1(Overview of Mobile App and Mobile Interface)

Mobile Systems. Mobile Interface and Applications - Optimizations in Mobile Systems, Mobile Embedded System. Mobile Cloud - Big Data Application in Mobile Systems, Data Security and Privacy Protection in Mobile Systems, Concept of Mobile Apps, Brief Introduction of Android and its Framework. Installation and creation of Android application. Introduction to Key Concepts of Android- App Components, App Resources, App Manifest.

Module - 2(2D Graphics and Multimedia in Android)

Introduction to 2-D Graphics Techniques. Advanced UI Design. Overview of Multimedia in Android. Audio Implementation in Android. Executing Video in Android.

Module - 3 (Mobile Embedded System Architecture)

Embedded Systems. Scheduling algorithms – FCFS, SJF, Multiprocessors, Priority scheduling, As-Soon-As-Possible(ASAP) and As-Late-As-Possible(ALAP). Memory Technology. Mobile Embedded systems. Messaging and Communication mechanisms.

Module - 4 (Data storage and SQLite Operations)

Local Data - Internal and External Storage, Save a File on Internal Storage, Save a File on External Storage, Delete a File, Query the Space. SQLite Database - Table Structure, CRUD Operations, Usage of SQLite Techniques. Content Provider.

Module - 5 (Mobile Cloud Computing in Mobile Applications Deployment)

Concepts of mobile cloud computing - Technological Structure, Differences between Cloud Computing and Mobile Cloud, Mobile Computing, Wireless LAN, Wireless, WAN and Cellular

networks. Main techniques of mobile cloud computing – Virtualization, Parallel Programming Model, Mass Distributed Storage. Mobile Cloud Computing Architecture.

Text Books

1. Meikang Qiu, Wenyun Dai, and Keke Gai, Mobile Applications Development with Android Technologies and Algorithms, Taylor and Francis, 2017

References

- 1) Corinne Hoisington, Android Boot Camp for Developers using Java™, Comprehensive: A Beginner's Guide to Creating Your First Android Apps, 3e, 2017
- 2) James C. Sheusi, Android Application Development for Java, 2013

Course Level Assessment Questions

Course Outcome 1 (CO1):

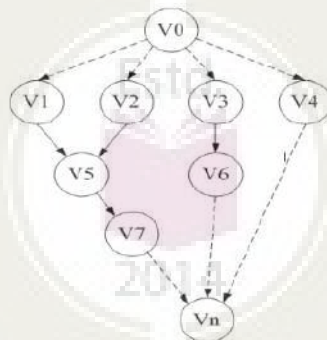
1. Explain the process of producing an Android app in mobile.
2. Illustrate the importance of look and feel of on screen system in mobile applications.

Course Outcome 2 (CO2):

1. Implement an Android project named “Rock-Paper-Scissors” Game (Programming Assignment). The basic function may cover the following aspects:
 - a. Basic UI of this Android Project
 - b. Basic functions of this Android Project

Course Outcome 3 (CO3):

1. Consider the figure given below and use the ASAP and ALAP algorithms to analyze them, and draw charts to explain them.



A DAG $G=(V, E, D)$ and
 $d1=d2=d3=d4=d5=d6=d7=1; d0=d_n=0$

2. Consider that there are six jobs with different completion times and arrival times, as shown in below. Use the FCFS scheduling algorithm to schedule these jobs. You can draw a chart to answer this question.

Jobs	Arrival Time	Processing Time
j1	0.0	7
j2	2.0	4
j3	3.0	1
j4	5.0	4
j5	6.0	5
j6	8.0	3

Course Outcome 4 (CO4):

1. Implement the CRUD operations possible in SQLite in an Android application (Programming Assignment).
2. Illustrate data sharing concepts among multiple applications in Android.

Course Outcome 5 (CO5):

1. Explain mobile cloud computing architecture with proper illustrations.
2. Compare any five wireless network types with respect to various possible parameters.

Model Question Paper

QP CODE:

Reg No: _____

Name: _____

PAGES : 4

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FOURTH SEMESTER B.TECH DEGREE(HONOURS) EXAMINATION, MONTH & YEAR

Course Code: CCT292

Course Name: Secure Mobile Application Development

Max. Marks : 100

Duration: 3 Hours

PART A

Answer All Questions. Each Question Carries 3 Marks

1. List any three constraints in a mobile system.
2. Differentiate between an App and Application.
3. List three key functions of *Action bar* design element of Android.
4. Mention four basic properties of a well designed Custom view.
5. Give three reasons that justify the importance of Embedded system in Mobile applications.
6. What are the key metrics used to measure the memory performance of an Embedded system?

7. Specify common methods for reading and writing data provided by the *Context* class?
8. Write an Android code snippet to get the current available space and total space in the internal storage
9. Specify two main workload migrations of implementing mobile cloud computing.
10. Define cloud mass storage.

(10x3=30)

Part B

(Answer any one question from each module. Each question carries 14 Marks)

11. (a) Explain the process of developing an Android App. (5)
- (b) Describe the structure of Android system architecture. (9)

OR

12. (a) Explain the need of data security and privacy protection in mobile systems. (7)
- (b) Describe the main structure of mobile cloud computing and their challenges. (7)
13. (a) Describe different types of drawables supported by Android. (7)
- (b) Explain the life cycle of a Media player with a state diagram. (7)

OR

14. (a) Explain the steps involved in developing a program to execute a video in Android application. (9)
- (b) Explain persistent application data storage in Android. (5)
15. (a) Illustrate ASAP and ALAP scheduling algorithms. (10)
- (b) List five criteria that should be considered for developing a scheduling algorithm (4)

OR

16. (a) Illustrate the working of the kernel inside the Android. (7)

(b) Explain various Android message mechanisms. (7)

17. (a) Explain how a file can be saved in internal storage and external storage in an Android application. (10)

(b) Describe the mechanism used in Android to delete a file. (4)

OR

18. (a) Illustrate the CRUD operations possible in SQLite. (8)

(b) Explain how data sharing is achieved among multiple applications in Android. (6)

19. (a) Differentiate between mobile cloud and cloud computing with proper illustrations. (4)

(b) Compare any five wireless network types in terms of type, performance and coverage capability. (10)

OR

20. (a) Differentiate between Wimax and Wifi. (4)

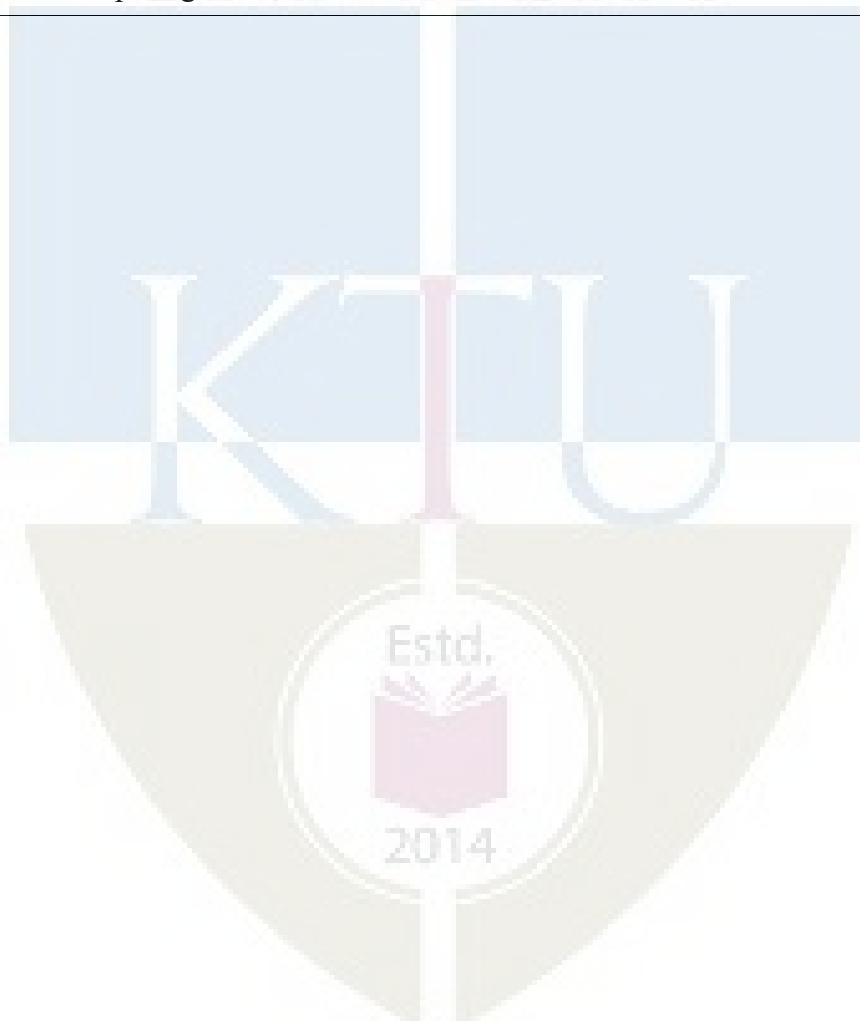
(b) Describe three schemas in mobile cloud computing architecture. (10)

TEACHING PLAN

No	Contents	No of Lecture Hrs (45 Hours)
Module – 1 (Overview of Mobile App and Mobile Interface) (10 hrs)		
1.1	Mobile Systems. Mobile Interface And Applications- Optimizations in Mobile Systems, Mobile Embedded System.	1
1.2	Mobile Cloud- Big Data Application in Mobile Systems, Data Security and Privacy Protection in Mobile Systems	1
1.3	Concept of Mobile Apps, Brief Introduction of Android	1
1.4	Android Device distribution	1
1.5	Android SDK	1
1.6	Installation and creation of Android application	1

1.7	Introduction to Key Concepts of Android- App Components, App Resources	1
1.8	Introduction to App Manifest	1
1.9	Illustration of App Manifest	1
1.10	Illustration of App Manifest	1
Module - 2 (2D graphics techniques and Multimedia in Android) (10 hrs)		
2.1	Introduction of 2D graphics techniques	1
2.2	Illustration of usage of graphics tool to draw the screen	1
2.3	Illustration of usage of graphics tool to draw the screen	1
2.4	Advanced UI design-Multiple screens	1
2.5	Advanced UI design-Action bar and Custom view	1
2.6	Developing UI design of an Android system	1
2.7	Overview of multimedia in Android	1
2.8	Audio implementation in Android	1
2.9	Executing video in Android	1
2.10	Developing program to execute multimedia in Android	1
Module - 3 (Mobile Embedded System Architecture) (10 hrs)		
3.1	Embedded system Overview, Introduction to scheduling algorithm	1
3.2	FCFS,SJF	1
3.3	Multiprocessor scheduling algorithm, priority scheduling	1
3.4	As Soon As Possible(ASAP)	1
3.5	As Late As Possible(ALAP)	1
3.6	Embedded system in Mobile devices	1
3.7	Embedded Systems in Android	1
3.8	Power Management of Android	1
3.9	Embedded Systems in Mobile Apps	1
3.10	Messaging and Communication Mechanisms	1
Module - 4 (Data storage and SQLite Operations (9 hrs)		
4.1	Local Data - Internal and External Storage-Save a file	1
4.2	Local Data - Delete file, Query the space	1
4.3	SQLite Database - Table Structure	1
4.4	SQLite Database - CRUD Operations	1
4.5	Illustration of CRUD Operations in SQLite Database	1
4.6	Usage of SQLite Techniques	1
4.7	Illustration of the usage of SQLite Techniques	1

4.8	Content Provider	1
4.9	Content Provider	1
Module - 5 (Mobile Cloud Computing in Mobile Applications Deployment)(6 hrs)		
5.1	Introduction of mobile cloud computing - Technological Structure, Differences between Cloud Computing and Mobile Cloud	1
5.2	Concepts of mobile cloud computing and mobile computing	1
5.3	Wireless LAN, Wireless WAN and Cellular networks	1
5.4	Main techniques of mobile cloud computing – Virtualization	1
5.5	Parallel Programming Model, Mass Distributed Storage	1
5.6	Mobile Cloud Computing Architecture	1



CODE CST294	COMPUTATIONAL FUNDAMENTALS FOR MACHINE LEARNING	CATEGORY	L	T	P	CREDIT
		VAC	3	1	0	4

Preamble: This is the foundational course for awarding B. Tech. Honours in Computer Science and Engineering with specialization in *Machine Learning*. The purpose of this course is to introduce mathematical foundations of basic Machine Learning concepts among learners, on which Machine Learning systems are built. This course covers Linear Algebra, Vector Calculus, Probability and Distributions, Optimization and Machine Learning problems. Concepts in this course help the learners to understand the mathematical principles in Machine Learning and aid in the creation of new Machine Learning solutions, understand & debug existing ones, and learn about the inherent assumptions & limitations of the current methodologies.

Prerequisite: A sound background in higher secondary school Mathematics.

Course Outcomes: After the completion of the course the student will be able to

CO 1	Make use of the concepts, rules and results about linear equations, matrix algebra, vector spaces, eigenvalues & eigenvectors and orthogonality & diagonalization to solve computational problems (Cognitive Knowledge Level: Apply)
CO 2	Perform calculus operations on functions of several variables and matrices, including partial derivatives and gradients (Cognitive Knowledge Level: Apply)
CO 3	Utilize the concepts, rules and results about probability, random variables, additive & multiplicative rules, conditional probability, probability distributions and Bayes' theorem to find solutions of computational problems (Cognitive Knowledge Level: Apply)
CO 4	Train Machine Learning Models using unconstrained and constrained optimization methods (Cognitive Knowledge Level: Apply)
CO 5	Illustrate how the mathematical objects - linear algebra, probability, and calculus can be used to design machine learning algorithms (Cognitive Knowledge Level: Understand)

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	√	√	√	√								√
CO 2	√	√	√									√
CO 3	√	√	√	√								√
CO 4	√	√	√	√		√						√
CO 5	√	√	√	√	√	√				√		√

Abstract POs defined by National Board of Accreditation			
PO#	Broad PO	PO#	Broad PO
PO1	Engineering Knowledge	PO7	Environment and Sustainability
PO2	Problem Analysis	PO8	Ethics
PO3	Design/Development of solutions	PO9	Individual and team work
PO4	Conduct investigations of complex problems	PO10	Communication
PO5	Modern tool usage	PO11	Project Management and Finance
PO6	The Engineer and Society	PO12	Life long learning

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	20%	20%	20%
Understand	40%	40%	40%
Apply	40%	40%	40%
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks

Continuous Assessment Tests : 25 marks

Continuous Assessment Assignment : 15 marks

Internal Examination Pattern:

Each of the two internal examinations has to be conducted out of 50 marks

First Internal Examination shall be preferably conducted after completing the first half of the syllabus and the Second Internal Examination shall be preferably conducted after completing remaining part of the syllabus.

There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly covered module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly covered module), each with 7 marks. Out of the 7 questions in Part B, a student should answer any 5.

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer anyone. Each question can have maximum 2 sub-divisions and carries 14 marks.



Syllabus

Module 1

LINEAR ALGEBRA : Systems of Linear Equations – Matrices, Solving Systems of Linear Equations. Vector Spaces - Linear Independence, Basis and Rank, Linear Mappings, Norms, - Inner Products - Lengths and Distances - Angles and Orthogonality - Orthonormal Basis - Orthogonal Complement - Orthogonal Projections. Matrix Decompositions - Determinant and Trace, Eigenvalues and Eigenvectors, Cholesky Decomposition, Eigen decomposition and Diagonalization, Singular Value Decomposition, Matrix Approximation.

Module 2

VECTOR CALCULUS : Differentiation of Univariate Functions - Partial Differentiation and Gradients, Gradients of Vector Valued Functions, Gradients of Matrices, Useful Identities for Computing Gradients. Back propagation and Automatic Differentiation - Higher Order Derivatives- Linearization and Multivariate Taylor Series.

Module 3

Probability and Distributions : Construction of a Probability Space - Discrete and Continuous Probabilities, Sum Rule, Product Rule, and Bayes' Theorem. Summary Statistics and Independence – Important Probability distributions - Conjugacy and the Exponential Family - Change of Variables/Inverse Transform.

Module 4

Optimization : Optimization Using Gradient Descent - Gradient Descent With Momentum, Stochastic Gradient Descent. Constrained Optimization and Lagrange Multipliers - Convex Optimization - Linear Programming - Quadratic Programming.

Module 5

CENTRAL MACHINE LEARNING PROBLEMS : Data and Learning Model- Empirical Risk Minimization - Parameter Estimation - Directed Graphical Models.

Linear Regression - Bayesian Linear Regression - Maximum Likelihood as Orthogonal Projection.

Dimensionality Reduction with Principal Component Analysis - Maximum Variance Perspective, Projection Perspective. Eigenvector Computation and Low Rank Approximations.

Density Estimation with Gaussian Mixture Models - Gaussian Mixture Model, Parameter Learning via Maximum Likelihood, EM Algorithm.

Classification with Support Vector Machines - Separating Hyperplanes, Primal Support Vector Machine, Dual Support Vector Machine, Kernels.

Text book:

1. Mathematics for Machine Learning by Marc Peter Deisenroth, A. Aldo Faisal, and Cheng Soon Ong published by Cambridge University Press (freely available at <https://mml-book.github.io>)

Reference books:

1. Linear Algebra and Its Applications, 4th Edition by Gilbert Strang
2. Linear Algebra Done Right by Axler, Sheldon, 2015 published by Springer
3. Introduction to Applied Linear Algebra by Stephen Boyd and Lieven Vandenberghe, 2018 published by Cambridge University Press
4. Convex Optimization by Stephen Boyd and Lieven Vandenberghe, 2004 published by Cambridge University Press
5. Pattern Recognition and Machine Learning by Christopher M Bishop, 2006, published by Springer
6. Learning with Kernels – Support Vector Machines, Regularization, Optimization, and Beyond by Bernhard Scholkopf and Smola, Alexander J Smola, 2002, published by MIT Press
7. Information Theory, Inference, and Learning Algorithms by David J. C MacKay, 2003 published by Cambridge University Press
8. Machine Learning: A Probabilistic Perspective by Kevin P Murphy, 2012 published by MIT Press.
9. The Nature of Statistical Learning Theory by Vladimir N Vapnik, 2000, published by Springer

Sample Course Level Assessment Questions.

Course Outcome 1 (CO1):

1. Find the set $\mathcal{S}$ of all solutions in $\mathbf{x}$ of the following inhomogeneous linear systems $A\mathbf{x} = \mathbf{b}$, where A and $\mathbf{b}$ are defined as follows:

$$A = \begin{bmatrix} 1 & -1 & 0 & 0 & 1 \\ 1 & 1 & 0 & -3 & 0 \\ 2 & -1 & 0 & 1 & -1 \\ -1 & 2 & 0 & -2 & -1 \end{bmatrix}, \quad \mathbf{b} = \begin{bmatrix} 3 \\ 6 \\ 5 \\ -1 \end{bmatrix}$$

2. Determine the inverses of the following matrix if possible

$$A = \begin{bmatrix} 1 & 0 & 1 & 0 \\ 0 & 1 & 1 & 0 \\ 1 & 1 & 0 & 1 \\ 1 & 1 & 1 & 0 \end{bmatrix}$$

3. Are the following sets of vectors linearly independent?

$$\mathbf{x}_1 = \begin{bmatrix} 2 \\ -1 \\ 3 \end{bmatrix}, \quad \mathbf{x}_2 = \begin{bmatrix} 1 \\ 1 \\ -2 \end{bmatrix}, \quad \mathbf{x}_3 = \begin{bmatrix} 3 \\ -3 \\ 8 \end{bmatrix}$$

4. A set of n linearly independent vectors in $\mathbf{R}^n$ forms a basis. Does the set of vectors $(2, 4, -3)$, $(0, 1, 1)$, $(0, 1, -1)$ form a basis for $\mathbf{R}^3$? Explain your reasons.
5. Consider the transformation $T(\mathbf{x}, \mathbf{y}) = (\mathbf{x} + \mathbf{y}, \mathbf{x} + 2\mathbf{y}, 2\mathbf{x} + 3\mathbf{y})$. Obtain $\ker T$ and use this to calculate the nullity. Also find the transformation matrix for T .
6. Find the characteristic equation, eigenvalues, and eigenspaces corresponding to each eigenvalue of the following matrix

$$\begin{bmatrix} 2 & 0 & 4 \\ 0 & 3 & 0 \\ 0 & 1 & 2 \end{bmatrix}$$

7. Diagonalize the following matrix, if possible

$$\begin{bmatrix} 3 & 0 & 0 & 0 \\ 0 & 2 & 0 & 0 \\ 0 & 0 & 2 & 0 \\ 1 & 0 & 0 & 3 \end{bmatrix}$$

8. Find the singular value decomposition (SVD) of the following matrix

$$\begin{bmatrix} 0 & 1 & 1 \\ \sqrt{2} & 2 & 0 \\ 0 & 1 & 1 \end{bmatrix}$$

Course Outcome 2 (CO2):

1. For a scalar function $f(x, y, z) = x^2 + 3y^2 + 2z^2$, find the gradient and its magnitude at the point $(1, 2, -1)$.
2. Find the maximum and minimum values of the function $f(x, y) = 4x + 4y - x^2 - y^2$ subject to the condition $x^2 + y^2 \leq 2$.
3. Suppose you were trying to minimize $f(x, y) = x^2 + 2y + 2y^2$. Along what vector should you travel from $(5, 12)$?
4. Find the second order Taylor series expansion for $f(x, y) = (x + y)^2$ about $(0, 0)$.
5. Find the critical points of $f(x, y) = x^2 - 3xy + 5x - 2y + 6y^2 + 8$.
6. Compute the gradient of the Rectified Linear Unit (ReLU) function $\text{ReLU}(z) = \max(0, z)$.
7. Let $L = \|Ax - b\|_2^2$, where A is a matrix and x and b are vectors. Derive dL in terms of dx .

Course Outcome 3 (CO3):

1. Let J and T be independent events, where $P(J)=0.4$ and $P(T)=0.7$.
 - i. Find $P(J \cap T)$
 - ii. Find $P(J \cup T)$
 - iii. Find $P(J \cap T')$
2. Let A and B be events such that $P(A)=0.45$, $P(B)=0.35$ and $P(A \cup B)=0.5$. Find $P(A|B)$.
3. A random variable R has the probability distribution as shown in the following table:

r	1	2	3	4	5
$P(R=r)$	0.2	a	b	0.25	0.15

- i. Given that $E(R)=2.85$, find a and b .
 - ii. Find $P(R>2)$.
4. A biased coin (with probability of obtaining a head equal to $p > 0$) is tossed repeatedly and independently until the first head is observed. Compute the probability that the first head appears at an even numbered toss.
5. Two players A and B are competing at a trivia quiz game involving a series of questions. On any individual question, the probabilities that A and B give the correct answer are p and q respectively, for all questions, with outcomes for different questions being independent. The game finishes when a player wins by answering a question correctly. Compute the probability that A wins if
 - i. A answers the first question,
 - ii. B answers the first question.
6. A coin for which $P(\text{heads}) = p$ is tossed until two successive tails are obtained. Find the probability that the experiment is completed on the n^{th} toss.
7. You roll a fair dice twice. Let the random variable X be the product of the outcomes of the two rolls. What is the probability mass function of X ? What are the expected value and the standard deviation of X ?

8. While watching a game of Cricket, you observe someone who is clearly supporting Mumbai Indians. What is the probability that they were actually born within 25KM of Mumbai? Assume that:
- the probability that a randomly selected person is born within 25KM of Mumbai is $1/20$;
 - the chance that a person born within 25KMs of Mumbai actually supports MI is $7/10$;
 - the probability that a person not born within 25KM of Mumbai supports MI with probability $1/10$.
9. What is an exponential family? Why are exponential families useful?
10. Let Z_1 and Z_2 be independent random variables each having the standard normal distribution. Define the random variables X and Y by $X = Z_1 + 3Z_2$ and $Y = Z_1 + Z_2$. Argue that the joint distribution of (X, Y) is a bivariate normal distribution. What are the parameters of this distribution?
11. Given a continuous random variable x , with cumulative distribution function $F_x(x)$, show that the random variable $y = F_x(x)$ is uniformly distributed.
12. Explain Normal distribution, Binomial distribution and Poisson distribution in the exponential family form.

Course Outcome 4(CO4):

1. Find the extrema of $f(x, y) = x$ subject to $g(x, y) = x^2 + 2y^2 = 3$.
2. Maximize the function $f(x, y, z) = xy + yz + xz$ on the unit sphere $g(x, y, z) = x^2 + y^2 + z^2 = 1$.
3. Provide necessary and sufficient conditions under which a quadratic optimization problem be written as a linear least squares problem.
4. Consider the univariate function $f(x) = x^3 + 6x^2 - 3x - 5$. Find its stationary points and indicate whether they are maximum, minimum, or saddle points.
5. Consider the update equation for stochastic gradient descent. Write down the update when we use a mini-batch size of one.

6. Consider the function

$$f(x) = (x_1 - x_2)^2 + \frac{1}{1 + x_1^2 + x_2^2}.$$

- i. Is $f(x)$ a convex function? Justify your answer.
 - ii. Is $(1, -1)$ a local/global minimum? Justify your answer.
7. Is the function $f(x, y) = 2x^2 + y^2 + 6xy - x + 3y - 7$ convex, concave, or neither? Justify your answer.
8. Consider the following convex optimization problem

$$\text{minimize } \frac{x^2}{2} + x + 4y^2 - 2y$$

Subject to the constraint $x + y \geq 4, x, y \geq 1$.

Derive an explicit form of the Lagrangian dual problem.

9. Solve the following LP problem with the simplex method.

$$\max 5x_1 + 6x_2 + 9x_3 + 8x_4$$

subject to the constraints

$$\begin{aligned} x_1 + 2x_2 + 3x_3 + x_4 &\leq 5 \\ x_1 + x_2 + 2x_3 + 3x_4 &\leq 3 \\ x_1, x_2, x_3, x_4 &\geq 0 \end{aligned}$$

Course Outcome 5 (CO5):

1. What is a loss function? Give examples.
2. What are training/validation/test sets? What is cross-validation? Name one or two examples of cross-validation methods.
3. Explain generalization, overfitting, model selection, kernel trick, Bayesian learning

4. Distinguish between Maximum Likelihood Estimation (MLE) and Maximum A Posteriori Estimation (MAP)?
5. What is the link between structural risk minimization and regularization?
6. What is a kernel? What is a dot product? Give examples of kernels that are valid dot products.
7. What is ridge regression? How can one train a ridge regression linear model?
8. What is Principal Component Analysis (PCA)? Which eigen value indicates the direction of largest variance? In what sense is the representation obtained from a projection onto the eigen directions corresponding the the largest eigen values optimal for data reconstruction?
9. Suppose that you have a linear support vector machine (SVM) binary classifier. Consider a point that is currently classified correctly, and is far away from the decision boundary. If you remove the point from the training set, and re-train the classifier, will the decision boundary change or stay the same? Explain your answer in one sentence.
10. Suppose you have n independent and identically distributed (i.i.d) sample data points $\mathbf{x}_1, \dots, \mathbf{x}_n$. These data points come from a distribution where the probability of a given datapoint $\mathbf{x}$ is

$$P(x) = \frac{1}{\theta} e^{-\frac{1}{\theta}x}.$$

Prove that the MLE estimate of parameter is the sample mean.

11. Suppose the data set $\mathbf{y}_1, \dots, \mathbf{y}_n$ is a drawn from a random sample consisting of i.i.d. discrete uniform distributions with range 1 to N . Find the maximum likelihood estimate of N .
12. Ram has two coins: one fair coin and one biased coin which lands heads with probability $3/4$. He picks one coin at random (50-50) and flips it repeatedly until he gets a tails. Given that he observes 3 heads before the first tails, find the posterior probability that he picked each coin.
 - i. What are the prior and posterior odds for the fair coin?
 - ii. What are the prior and posterior predictive probabilities of heads on the next flip? Here prior predictive means prior to considering the data of the first four flips.

Model Question paper

QP Code :

Total Pages: 4

Reg No.: _____

Name: _____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

IV SEMESTER B.TECH (HONOURS) DEGREE EXAMINATION, MONTH and YEAR

Course Code: CST 294

**Course Name: COMPUTATIONAL FUNDAMENTALS FOR MACHINE
LEARNING**

Max. Marks: 100

Duration: 3 Hours

PART A

Answer all questions, each carries 3 marks.

Marks

- 1 Show that with the usual operation of scalar multiplication but with addition on reals given by $x \# y = 2(x + y)$ is not a vector space.
- 2 Find the eigenvalues of the following matrix in terms of k . Can you find an eigenvector corresponding to each of the eigenvalues?
$$\begin{bmatrix} 1 & k \\ 2 & 1 \end{bmatrix}$$
- 3 Let $f(x, y, z) = xye^r$, where $r = x^2 + z^2 - 5$. Calculate the gradient of f at the point $(1, 3, -2)$.
- 4 Compute the Taylor polynomials T_n , $n = 0, \dots, 5$ of $f(x) = \sin(x) + \cos(x)$ at $x_0 = 0$.
- 5 Let X be a continuous random variable with probability density function on $0 \leq x \leq 1$ defined by $f(x) = 3x^2$. Find the pdf of $Y = X^2$.
- 6 Show that if two events A and B are independent, then A and B' are independent.
- 7 Explain the principle of the gradient descent algorithm.

- 8 Briey explain the difference between (batch) gradient descent and stochastic gradient descent. Give an example of when you might prefer one over the other.
- 9 What is the empirical risk? What is “empirical risk minimization”?
- 10 Explain the concept of a Kernel function in Support Vector Machines. Why are kernels so useful? What properties a kernel should posses to be used in an SVM?

PART B

Answer any one Question from each module. Each question carries 14 Marks

- 11 a) i. Find all solutions to the system of linear equations (6)

$$\begin{aligned} -4x + 5z &= -2 \\ -3x - 3y + 5z &= 3 \\ -x + 2y + 2z &= -1 \end{aligned}$$

- ii. Prove that all vectors orthogonal to $[2, -3, 1]^T$ forms a subspace W of R^3 . What is $\dim(W)$ and why?

- b) Use the Gramm-Schmidt process to find an orthogonal basis for the column space of the following matrix (8)

$$\begin{bmatrix} 2 & 1 & 0 \\ 1 & -1 & 1 \\ 0 & 3 & 1 \\ 1 & 1 & 1 \end{bmatrix}$$

OR

- 12 a) i. Let L be the line through the origin in $\mathbf{R}^2$ that is parallel to the vector

$[3, 4]^T$. Find the standard matrix of the orthogonal projection onto L . Also find the point on L which is closest to the point $(7, 1)$ and find the point on L which is closest to the point $(-3, 5)$.

- ii. Find the rank-1 approximation of

$$\begin{bmatrix} 3 & 2 & 2 \\ 2 & 3 & -2 \end{bmatrix}$$

- b) i. Find an orthonormal basis of $\mathbf{R}^3$ consisting of eigenvectors for the following matrix

$$\begin{bmatrix} 1 & 0 & -2 \\ 0 & 5 & 0 \\ -2 & 0 & 4 \end{bmatrix}$$

- ii. Find a 3×3 orthogonal matrix S and a 3×3 diagonal matrix D such that $A = SDS^T$.

- 13 a) A skier is on a mountain with equation $z = 100 - 0.4x^2 - 0.3y^2$, where z denotes height. (8)

- i. The skier is located at the point with xy-coordinates $(1, 1)$, and wants to ski downhill along the steepest possible path. In which direction (indicated by a vector (a, b) in the xy-plane) should the skier begin skiing.
- ii. The skier begins skiing in the direction given by the xy-vector (a, b) you found in part (i), so the skier heads in a direction in space given by the vector (a, b, c) . Find the value of c .

- b) Find the linear approximation to the function $f(x, y) = 2 - \sin(-x - 3y)$ at the point $(0, \pi)$, and then use your answer to estimate $f(0.001, \pi)$. (6)

OR

- 14 a) Let g be the function given by (8)

$$g(x, y) = \begin{cases} \frac{x^2 y}{x^2 + y^2} & \text{if } (x, y) \neq (0, 0); \\ 0 & \text{if } (x, y) = (0, 0). \end{cases}$$

- i. Calculate the partial derivatives of g at $(0, 0)$.
 ii. Show that g is not differentiable at $(0, 0)$.
 b) Find the second order Taylor series expansion for $f(x, y) = e^{-(x^2+y^2)} \cos(xy)$ (6)
 about $(0, 0)$.

- 15 a) There are two bags. The first bag contains four mangos and two apples; (6)
 the second bag contains four mangos and four apples. We also have a
 biased coin, which shows “heads” with probability 0.6 and “tails” with
 probability 0.4. If the coin shows “heads”. we pick a fruit at
 random from bag 1; otherwise we pick a fruit at random from bag 2. Your
 friend flips the coin (you cannot see the result), picks a fruit at random
 from the corresponding bag, and presents you a mango.

What is the probability that the mango was picked from bag 2?

- b) Suppose that one has written a computer program that sometimes (8)
 compiles and sometimes not (code does not change). You decide to model
 the apparent stochasticity (success vs. no success) x of the compiler using
 a Bernoulli distribution with parameter μ :

$$p(x | \mu) = \mu^x (1 - \mu)^{1-x}, \quad x \in \{0, 1\}$$

Choose a conjugate prior for the Bernoulli likelihood and compute the
 posterior distribution $p(\mu | x_1, \dots, x_N)$.

OR

- 16 a) Consider a mixture of two Gaussian distributions (8)

$$0.4\mathcal{N}\left(\begin{bmatrix} 10 \\ 2 \end{bmatrix}, \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}\right) + 0.6\mathcal{N}\left(\begin{bmatrix} 0 \\ 0 \end{bmatrix}, \begin{bmatrix} 8.4 & 2.0 \\ 2.0 & 1.7 \end{bmatrix}\right)$$

- i. Compute the marginal distributions for each dimension.
 - ii. Compute the mean, mode and median for each marginal distribution.
 - iii. Compute the mean and mode for the two-dimensional distribution.
- b) Express the Binomial distribution as an exponential family distribution. (6)
Also express the Beta distribution as an exponential family distribution.
Show that the product of the Beta and the Binomial distribution is also a member of the exponential family.
- 17 a) Find the extrema of $f(x,y,z) = x - y + z$ subject to $g(x,y,z) = x^2 + y^2 + z^2 = 2$. (8)
- b) Let

$$P = \begin{bmatrix} 13 & 12 & -2 \\ 12 & 17 & 6 \\ -2 & 6 & 12 \end{bmatrix}, q = \begin{bmatrix} -22.0 \\ -14.5 \\ 13.0 \end{bmatrix}, \text{ and } r = 1.$$

Show that $x^* = (1, 1/2, -1)$ is optimal for the optimization problem

$$\begin{array}{ll} \min & \frac{1}{2}x^T Px + q^T x + r \\ \text{s.t.} & -1 \leq x_i \leq 1, i = 1, 2, 3. \end{array} \quad (6)$$

OR

- 18 a) Derive the gradient descent training rule assuming that the target function (8)
is represented as $o_d = w_0 + w_1x_1 + \dots + w_nx_n$. Define explicitly the cost/error function E , assuming that a set of training examples D is provided, where each training example $d \in D$ is associated with the target output t_d .

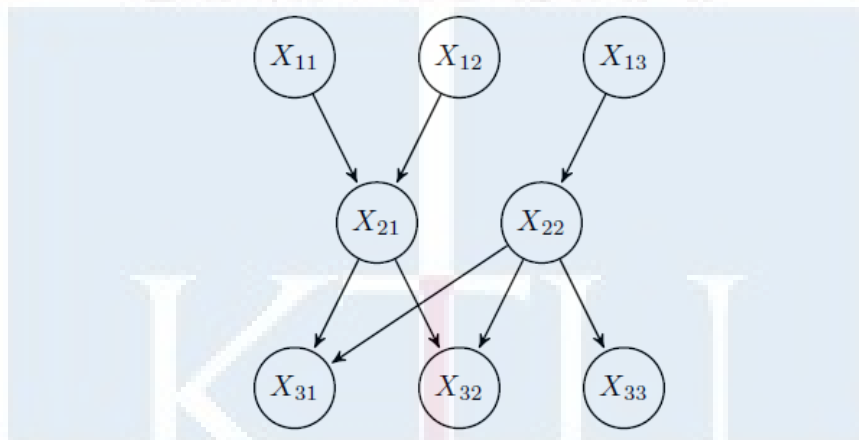
- b) Find the maximum value of $f(x,y,z) = xyz$ given that $g(x,y,z) = x + y + z = 3$ and $x,y,z \geq 0$. (6)

- 19 a) Consider the following probability distribution (7)

$$P_{\theta}(x) = 2\theta x e^{-\theta x^2}$$

where θ is a parameter and x is a positive real number. Suppose you get m i.i.d. samples x_i drawn from this distribution. Compute the maximum likelihood estimator for θ based on these samples.

- b) Consider the following Bayesian network with boolean variables. (7)



- i. List variable(s) conditionally independent of X_{33} given X_{11} and X_{12}
- ii. List variable(s) conditionally independent of X_{33} and X_{22}
- iii. Write the joint probability $P(X_{11}, X_{12}, X_{13}, X_{21}, X_{22}, X_{31}, X_{32}, X_{33})$ factored according to the Bayes net. How many parameters are necessary to define the conditional probability distributions for this Bayesian network?
- iv. Write an expression for $P(X_{13} = 0, X_{22} = 1, X_{33} = 0)$ in terms of the conditional probability distributions given in your answer to part (iii). Justify your answer.

OR

- 20 a) Consider the following one dimensional training data set, 'x' denotes negative examples and 'o' positive examples. The exact data points and their labels are given in the table below. Suppose a SVM is used to classify this data. (6)



x	1	1.5	2.5	3	4	4.5	5	5.6
y	-1	-1	-1	1	1	1	1	1

- Indicate which are the support vectors and mark the decision boundary.
- Give the value of the cost function and the model parameter after training.

- b) Suppose that we are fitting a Gaussian mixture model for data items consisting of a single real value, x , using $K = 2$ components. (8)

We have $N = 5$ training cases, in which the values of x are as **5, 15, 25, 30, 40**. Using the EM algorithm to find the maximum likelihood estimates for the model parameters, what are the mixing proportions for the two components, π_1 and π_2 , and the means for the two components, μ_1 and μ_2 . The standard deviations for the two components are fixed at 10.

Suppose that at some point in the EM algorithm, the E step found that the responsibilities of the two components for the five data items were as follows:

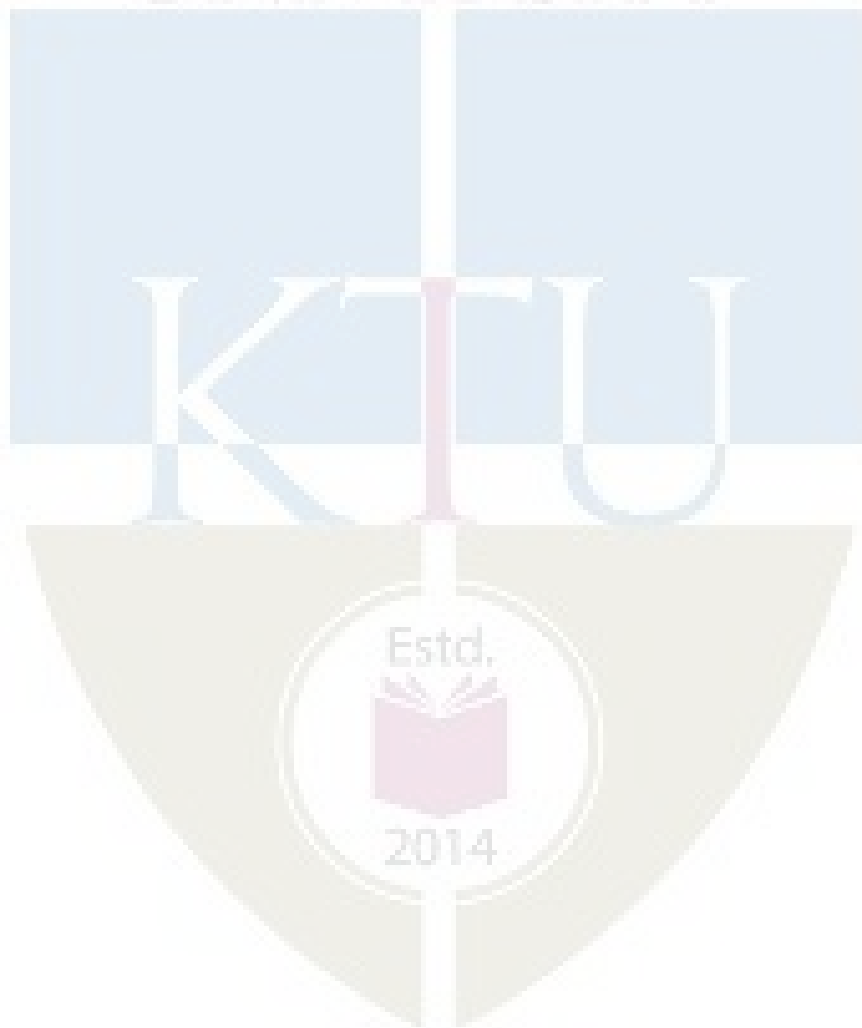
r_{i1}	r_{i2}
0.2	0.8
0.2	0.8
0.8	0.2
0.9	0.1
0.9	0.1

What values for the parameters π_1, π_2, μ_1 , and μ_2 will be found in the next **M** step of the algorithm?

Teaching Plan		
No	Topic	No. of Lectures (45)
1	Module-I (LINEAR ALGEBRA)	8
1.	Systems of Linear Equations – Matrices, Solving Systems of Linear Equations. Vector Spaces - Linear Independence.	1
2.	Vector Spaces - Basis and Rank	1
3.	Linear Mappings	1
4.	Norms, Inner Products, Lengths and Distances, Angles and Orthogonality, Orthonormal Basis, Orthogonal Complement	1
5.	Orthogonal Projections, Matrix Decompositions, Determinant and Trace.	1
6.	Eigenvalues and Eigenvectors	1
7.	Cholesky Decomposition, Eigen decomposition and Diagonalization	1
8.	Singular Value Decomposition - Matrix Approximation	1
	Module-II (VECTOR CALCULUS)	6
1	Differentiation of Univariate Functions, Partial Differentiation and Gradients	1
2	Gradients of Vector Valued Functions, Gradients of Matrices	1
3	Useful Identities for Computing Gradients	1
4	Backpropagation and Automatic Differentiation	1
5	Higher Order Derivatives	1
6	Linearization and Multivariate Taylor Series	1
3	Module-III (Probability and Distributions)	10
1	Construction of a Probability Space - Discrete and Continuous Probabilities (Lecture 1)	1

2	Construction of a Probability Space - Discrete and Continuous Probabilities (Lecture 2)	1
3	Sum Rule, Product Rule	1
4	Bayes' Theorem	1
5	Summary Statistics and Independence	1
6	Important probability Distributions (Lecture 1)	1
7	Important probability Distributions (Lecture 2)	1
8	Conjugacy and the Exponential Family (Lecture 1)	1
9	Conjugacy and the Exponential Family (Lecture 2)	1
10	Change of Variables/Inverse Transform	1
4	Module-IV (Optimization)	7
1	Optimization Using Gradient Descent.	1
2	Gradient Descent With Momentum, Stochastic Gradient Descent	1
3	Constrained Optimization and Lagrange Multipliers (Lecture 1)	1
4	Constrained Optimization and Lagrange Multipliers (Lecture 2)	1
5	Convex Optimization	1
6.	Linear Programming	1
7.	Quadratic Programming	1
5	Module-V (CENTRAL MACHINE LEARNING PROBLEMS)	14
1.	Data and Learning models - Empirical Risk Minimization,	1
2.	Parameter Estimation	1
3.	Directed Graphical Models	1
4.	Linear Regression	1
5.	Bayesian Linear Regression	1
6.	Maximum Likelihood as Orthogonal Projection	1
7.	Dimensionality Reduction with Principal Component Analysis - Maximum Variance Perspective, Projection Perspective.	1
8.	Eigenvector Computation and Low Rank Approximations	1
9.	Density Estimation with Gaussian Mixture Models	1

10.	Parameter Learning via Maximum Likelihood	1
11.	EM Algorithm	1
12.	Classification with Support Vector Machines - Separating Hyperplanes	1
13.	Primal Support Vector Machines, Dual Support Vector Machines	1
14.	Kernels	1
*Assignments may include applications of the above theory. With respect to module V, programming assignments may be given.		



ADT296	ADVANCED TOPICS IN COMPUTER GRAPHICS	CATEGORY	L	T	P	CREDITS
		VAC	3	1	0	4

Preamble: This course helps the learners to make awareness about strong theoretical concept in computer graphics. It covers the three-dimensional environment representation in a computer, transformation of 2D/3D objects, basic mathematical techniques and algorithms used to build useful applications. This course enables the learners to develop the ability to create image processing frameworks for different domains and develops algorithms for emerging display technologies.

Prerequisite: A sound knowledge of Mathematics and concepts of any programming language.

Course Outcomes: After the completion of the course the student will be able to

CO#	CO
CO1	Describe the working principles of graphics devices(Cognitive Knowledge level: Understand)
CO2	Illustrate line drawing, circle drawing and polygon filling algorithms(Cognitive Knowledge level: Apply)
CO3	Demonstrate geometric representations and transformations on 2D & 3D objects. (Cognitive Knowledge level: Apply)
CO4	Demonstrate the working of various clipping algorithms and projection algorithms. (Cognitive Knowledge level: Apply)
CO5	Summarize visible surface detection methods(Cognitive Knowledge level: Understand)
CO6	Explain the concept of realism in a scene and its performance preservation(Cognitive Knowledge level: Understand)

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												
CO6												

Abstract POs defined by National Board of Accreditation			
PO#	Broad PO	PO#	Broad PO
PO1	Engineering Knowledge	PO7	Environment and Sustainability
PO2	Problem Analysis	PO8	Ethics
PO3	Design/Development of solutions	PO9	Individual and team work
PO4	Conduct investigations of complex problems	PO10	Communication
PO5	Modern tool usage	PO11	Project Management and Finance
PO6	The Engineer and Society	PO12	Life long learning

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination Marks (%)
	Test 1 (%)	Test 2 (%)	
Remember	30	30	30
Understand	30	30	30
Apply	40	40	40
Analyze			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3

Continuous Internal Evaluation Pattern:

Attendance	10 marks
Continuous Assessment Tests (Average of Series Tests 1 & 2)	25 marks
Continuous Assessment Assignment	15 marks

Internal Examination Pattern:

Each of the two internal examinations has to be conducted out of 50 marks. The first series test shall be preferably conducted after completing the first half of the syllabus and the second series test shall be preferably conducted after completing the remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly completed module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly completed module), each with 7 marks. Out of the 7 questions, a student should answer any 5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 full questions from each module of which student should answer any one full question. Each question can have maximum 2 sub-divisions and carries 14 marks.

SYLLABUS

Module – 1(Line and Circle drawing algorithms)

Basics of Computer Graphics and its applications. Video Display devices - Refresh Cathode Ray Tubes, Random Scan Displays and systems, Raster scan displays and systems, Color CRT displays, Flat panel display and its categories. Line drawing algorithms - DDA, Bresenham's algorithm. Circle drawing algorithms - Midpoint Circle generation algorithm, Bresenham's algorithm.

Module - 2(Filled Area Primitives and Two dimensional transformations)

Filled Area Primitives- Scan line polygon filling, Boundary filling and flood filling. Two dimensional transformations-Translation, Rotation, Scaling, Reflection and Shearing, Composite transformations, Matrix representations and homogeneous coordinates.

Module - 3 (Clipping and 3D transformations)

Window to viewport transformation. Cohen Sutherland and Midpoint subdivision line clipping algorithms, Sutherland Hodgeman and Weiler Atherton Polygon clipping algorithms. Three dimensional viewing pipeline. Basic 3D transformations.

Module - 4 (Projections and Visible Surface detection)

Projections- Parallel and Perspective projections. Visible surface detection algorithms- Back face detection, Depth buffer algorithm, Scan line algorithm, A buffer algorithm

Module - 5 (Realism and performance)

Realism - Illumination Shading, Shadows, Texture mapping, Bump mapping, Environment mapping, Transparency, Accumulation Buffer, Back face Culling, Visibility Culling.

Text Books

1. Donald Hearn and M. Pauline Baker, Computer Graphics, PHI, 2e, 1996
2. Aditi Majumder and M.Gopi , Introduction to VISUAL COMPUTING Core Concepts in Computer Vision, Graphics, and Image Processing, 2018

References

- 1) William M. Newman and Robert F. Sproull, Principles of Interactive Computer Graphics. McGraw Hill, 2001
- 2) Zhigang Xiang and Roy Plastock, Computer Graphics (Schaum's outline Series), McGraw Hill, 2019.
- 3) David F. Rogers , Procedural Elements for Computer Graphics, Tata McGraw Hill, 2001.
- 4) Donald Hearn, M. Pauline Baker and Warren Carithers, Computer Graphics with OpenGL, PHI, 4e, 2013

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Compare the working principle of raster scan systems and random scan systems.
2. How much time is spent scanning across each row of pixels during screen refresh on a raster system with resolution of 1280*1024 and a refresh rate of 60 frames per second?

Course Outcome 2 (CO2):

1. Rasterize the line with end points accepted from the user(2,3) and (5,8) using Bresenham's line drawing algorithm and implement it using any appropriate programming language. (Assignment)
2. Illustrate how the 4-connected area filling approach differs from 8- connected area filling in boundary filling algorithm and implement it using any appropriate programming language.(Assignment)

Course Outcome 3 (CO3):

1. Rotate a triangle ABC 45 degree counter clockwise about the pivot point (10,3) , where the position vector of the coordinate ABC is given as A(4,1), B(5,2) and C(4,3).
2. Implement the above transformation using any appropriate programming language with user inputs. (Assignment)

Course Outcome 4 (CO4):

1. Given a clipping window A(20,20), B(60,20), C(60,40) and D(20,40). Using Cohen Sutherland algorithm, find the visible portion of the line segment joining the points P(40,80) and Q(120,30).
2. Implement Cohen Sutherland clipping algorithm using any appropriate programming language with user inputs. (Assignment)

Course Outcome 5 (CO5):

1. Explain scan line algorithm for detecting visible surfaces in an object.

Course Outcome 6 (CO6):

1. You are rendering a black and white checkered tiled floor using a single texture mapped polygon. The view is simulating a person standing on the floor and looking at a point far away from him on the floor. (1) Artifacts at the distant end of the floor can be seen. How would you remove these artifacts? (2) How can you explain why this method works using the sampling theorem?
2. You are seeing an object which is either texture mapped, bump mapped or displacement mapped but you don't know which one. However, you have the liberty to move the light and the viewpoint of an object and see it from different angles and for different positions of the light. How will you figure out which technique was used?

Model Question Paper

QP CODE:

Reg No: _____

Name: _____

PAGES : 4

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FOURTH SEMESTER B.TECH DEGREE (HONOURS) EXAMINATION, MONTH & YEAR

Course Code: ADT296

Course Name: Advanced Topics in Computer Graphics

Max. Marks : 100

Duration: 3 Hours

PART A

Answer All Questions. Each Question Carries 3 Marks

1. Consider a raster system with a resolution of 1024×1024 . Compute the size of the raster needed to store 4 bits per pixel? How much storage is needed if 8 bits per pixel are to be stored?
2. How 8-way symmetry of circle can be used for writing circle drawing algorithms? Write the symmetric points if (x, y) is a point on the circle with centre at origin.
3. Show that two successive reflections about either of the coordinate axes is equivalent to a single rotation about the coordinate origin.
4. Determine a sequence of basic transformations that are equivalent to the x-direction shearing matrix.

5. Find the window to viewport normalization transformation with window lower left corner at (1,1) and upper right corner at (2,6).
 6. How does Cohen Sutherland algorithm determine whether a line is visible, invisible or a candidate for clipping based on the region codes assigned to the end points of the line?
 7. Define the terms (i) Centre of projection (ii) Principal vanishing point
 8. Differentiate between the object space and image space method for the hidden surface removal of an image.
 9. Describe the steps used to convert the normal map to bump mapping.
 10. One artifact of Gouraud shading is that it can miss specular highlights in the interior of the triangles. How can this be explained as an aliasing artifact?
- (10x3=30)**

Part B

(Answer any one question from each module. Each question carries 14 Marks)

11. (a) Derive the initial decision parameter of Bresenham's line drawing algorithm and rasterize a line with endpoints (2,2) and (10,10). **(8)**
- (b) Draw the architecture of raster scan display systems and explain its working principle **(6)**

OR

12. (a) Explain the working principle of a Refresh CRT monitor with suitable diagrams. **(7)**
- (b) Write Midpoint circle drawing algorithm and plot a circle with radius=20 and center (50,30) using the algorithm. **(7)**
13. (a) Differentiate between boundary fill and flood fill algorithms. **(5)**
- (b) Reflect a triangle ABC about the line $3x-4y+8=0$, where the position vector of the coordinate ABC is given as A(4,1), B(5,2) and C(4,3). **(9)**

OR

14. (a) A diamond shaped polygon is located at P(-1,0), Q(0,-2), R(1,0) and S(0,2). Find the transformation matrix which would rotate the triangle by 90 degree counter clockwise about the point Q. Using the transformation matrix, find the coordinates of the rotated polygon. **(7)**

(b) Illustrate the working principle of scan line polygon filling algorithm (7)

15. (a) Illustrate Weiler – Atherton polygon clipping algorithm. (6)

(b) Explain Cohen-Sutherland line clipping algorithm. Use the algorithm to clip line P1 (70, 20) and P2(100,10) against a window lower left hand corner (50,10) and upper right hand corner (80,40). (8)

OR

16. (a) Describe the steps required for a general 3D rotation if the rotation axis is not parallel to any one of the principal axis. The rotation axis is defined by the points P1(x1,y1,z1) and P2(x2,y2,z2). Give its composite matrix representation (6)

(b) Describe Sutherland Hodgeman polygon clipping algorithm and list out its limitations (8)

17. (a) Explain how visible surfaces can be detected using depth buffer algorithm. (7)

(b) Define parallel projection. Describe orthographic and oblique parallel projection. (7)

OR

18. (a) Illustrate the scan line method used in visible surface detection. (7)

(b) Explain the steps involved in performing perspective projections (7)

19. (a) Specify any three shading algorithms used in interactive graphics. (6)

(b) Explain the procedure of texture to object space mapping. (8)

OR

20. (a) Explain the mapping scheme in which the effects of small bumps on the surface of an object can be simulate without changing the number of primitives (8)

(b) Describe about object to screen space mapping. (6)

Computer Science and Engineering (Cyber Security)
TEACHING PLAN

No	Contents	No of Lecture Hrs
Module – 1 (Line and Circle drawing algorithms) (10 hrs)		
1.1	Basics of Computer Graphics and applications	1
1.2	Refresh Cathode Ray Tubes	1
1.3	Random and Raster Scan Displays and systems,	1
1.4	Color CRT displays	1
1.5	Flat panel display and its categories.	1
1.6	DDA Line drawing Algorithm	1
1.7	Bresenham's line drawing algorithm	1
1.8	Midpoint Circle generation algorithm	1
1.9	Bresenham's Circle generation algorithm	1
1.10	Illustration of line and circle drawing algorithms	1
Module - 2 (Filled Area Primitives and Two dimensional transformations) (9 hrs)		
2.1	Scan line polygon filling	1
2.2	Boundary filling and flood filling	1
2.3	Basic 2D transformations-Translation	1
2.4	Basic 2D transformations- Rotation	1
2.5	Basic 2D transformations- Scaling	1
2.6	Reflection and Shearing	1
2.7	Illustration of Basic 2D Transformations	1
2.8	Composite transformations	1
2.9	Matrix representations and homogeneous coordinates	1
Module - 3 (Clipping and 3D transformations) (8 hrs)		
3.1	Window to viewport transformation	1
3.2	Cohen Sutherland Line clipping algorithm	1
3.3	Midpoint subdivision Line clipping algorithm	1
3.4	Sutherland Hodgeman Polygon clipping algorithm	1
3.5	Weiler Atherton Polygon clipping algorithm	1
3.6	Three dimensional viewing pipeline	1

3.7	Basic 3D transformation-Translation and scaling	1
3.8	Basic 3D transformation-Rotation	1
Module - 4 (Projections and Visible Surface detection) (7 hrs)		
4.1	Projections-Parallel projections	1
4.2	Projections- Perspective projections	1
4.3	Illustration of projection methods	1
4.4	Visible surface detection algorithms- Back face detection	1
4.5	Depth buffer algorithm	1
4.6	Scan line visible surface detection algorithm	1
4.7	<i>A buffer</i> algorithm	1
Module - 5 (Realism and performance)(10 hrs)		
5.1	Illumination	1
5.2	Shading and Shadows	1
5.3	Texture mapping-Texture to object space mapping	1
5.4	Texture mapping-Object to screen space mapping and Mip Mapping	1
5.5	Bump mapping	1
5.6	Bump mapping-Illustration	1
5.7	Environment mapping and Transparency	1
5.8	Accumulation Buffer and Back face Culling	1
5.9	Visibility Culling	1
5.10	Visibility Culling	1



COMMON COURSES S3 & S4

SEMESTER -3

CODE	SUSTAINABLE ENGINEERING	CATEGORY	L	T	P	CREDIT
MCN201			2	0	0	NIL

Preamble: Objective of this course is to inculcate in students an awareness of environmental issues and the global initiatives towards attaining sustainability. The student should realize the potential of technology in bringing in sustainable practices.

Prerequisite: NIL

Course Outcomes: After the completion of the course the student will be able to

CO 1	Understand the relevance and the concept of sustainability and the global initiatives in this direction
CO 2	Explain the different types of environmental pollution problems and their sustainable solutions
CO 3	Discuss the environmental regulations and standards
CO 4	Outline the concepts related to conventional and non-conventional energy
CO 5	Demonstrate the broad perspective of sustainable practices by utilizing engineering knowledge and principles

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1						2	3					2
CO 2						2	3					2
CO 3						2	3					2
CO 4						2	3					2
CO 5						2	3					2

Assessment Pattern

Mark distribution

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	20	20	40
Understand	20	20	40
Apply	10	10	20
Analyse			
Evaluate			
Create			

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
 Continuous Assessment Test (2 numbers) : 25 marks
 Assignment/Quiz/Course project : 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Course Level Assessment Questions

Course Outcome 1 (CO1): Understand the relevance and the concept of sustainability and the global initiatives in this direction

1. Explain with an example a technology that has contributed positively to sustainable development.
2. Write a note on Millennium Development Goals.

Course Outcome 2 (CO2): Explain the different types of environmental pollution problems and their sustainable solutions

1. Explain the 3R concept in solid waste management?
2. Write a note on any one environmental pollution problem and suggest a sustainable solution.
3. In the absence of green house effect the surface temperature of earth would not have been suitable for survival of life on earth. Comment on this statement.

Course Outcome 3 (CO3): Discuss the environmental regulations and standards

1. Illustrate Life Cycle Analysis with an example of your choice.
2. “Nature is the most successful designer and the most brilliant engineer that has ever evolved”. Discuss.

Course Outcome 4 (CO4): Outline the concepts related to conventional and non-conventional energy

1. Suggest a sustainable system to generate hot water in a residential building in tropical climate.
2. Enumerate the impacts of biomass energy on the environment.

Course Outcome 5 (CO5): Demonstrate the broad perspective of sustainable practices by utilizing engineering knowledge and principles

1. Suggest suitable measures to make the conveyance facilities used by your institution sustainable.

Model Question paper

Part A

(Answer all questions. Each question carries 3 marks each)

1. Define sustainable development.
2. Write a short note on Millennium Development Goals.
3. Describe carbon credit.
4. Give an account of climate change and its effect on environment.
5. Describe biomimicry? Give two examples.
6. Explain the basic concept of Life Cycle Assessment.
7. Name three renewable energy sources.

8. Mention some of the disadvantages of wind energy.
9. Enlist some of the features of sustainable habitat.
10. Explain green engineering.

Part B

(Answer one question from each module. Each question carries 14 marks)

11. Discuss the evolution of the concept of sustainability. Comment on its relevance in the modern world.
OR
12. Explain Clean Development Mechanism.
13. Explain the common sources of water pollution and its harmful effects.
OR
14. Give an account of solid waste management in cities.
15. Explain the different steps involved in the conduct of Environmental Impact Assessment.
OR
16. Suggest some methods to create public awareness on environmental issues.
17. Comment on the statement, “Almost all energy that man uses comes from the Sun”.
OR
18. Write notes on:
 - a. Land degradation due to water logging.
 - b. Over exploitation of water.
19. Discuss the elements related to sustainable urbanisation.
OR
20. Discuss any three methods by which you can increase energy efficiency in buildings.

Syllabus

Sustainability- need and concept, technology and sustainable development-Natural resources and their pollution, Carbon credits, Zero waste concept. Life Cycle Analysis, Environmental Impact Assessment studies, Sustainable habitat, Green buildings, green materials, Energy, Conventional and renewable sources, Sustainable urbanization, Industrial Ecology.

Module 1

Sustainability: Introduction, concept, evolution of the concept; Social, environmental and economic sustainability concepts; Sustainable development, Nexus between Technology and Sustainable development; Millennium Development Goals (MDGs) and Sustainable Development Goals (SDGs), Clean Development Mechanism (CDM).

Module 2

Environmental Pollution: Air Pollution and its effects, Water pollution and its sources, Zero waste concept and 3 R concepts in solid waste management; Greenhouse effect, Global warming, Climate change, Ozone layer depletion, Carbon credits, carbon trading and carbon foot print, legal provisions for environmental protection.

Module 3

Environmental management standards: ISO 14001:2015 frame work and benefits, Scope and goal of Life Cycle Analysis (LCA), Circular economy, Bio-mimicking, Environment Impact Assessment (EIA), Industrial ecology and industrial symbiosis.

Module 4

Resources and its utilisation: Basic concepts of Conventional and non-conventional energy, General idea about solar energy, Fuel cells, Wind energy, Small hydro plants, bio-fuels, Energy derived from oceans and Geothermal energy.

Module 5

Sustainability practices: Basic concept of sustainable habitat, Methods for increasing energy efficiency in buildings, Green Engineering, Sustainable Urbanisation, Sustainable cities, Sustainable transport.

Reference Books

1. Allen, D. T. and Shonnard, D. R., Sustainability Engineering: Concepts, Design and Case Studies, Prentice Hall.
2. Bradley. A.S; Adebayo,A.O., Maria, P. Engineering applications in sustainable design and development, Cengage learning
3. Environment Impact Assessment Guidelines, Notification of Government of India, 2006
4. Mackenthun, K.M., Basic Concepts in Environmental Management, Lewis Publication, London, 1998
5. ECBC Code 2007, Bureau of Energy Efficiency, New Delhi Bureau of Energy Efficiency Publications-Rating System, TERI Publications - GRIHA Rating System
6. Ni bin Chang, Systems Analysis for Sustainable Engineering: Theory and Applications, McGraw-Hill Professional.
7. Twidell, J. W. and Weir, A. D., Renewable Energy Resources, English Language Book Society (ELBS).
8. Purohit, S. S., Green Technology - An approach for sustainable environment, Agrobios Publication

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	Sustainability	
1.1	Introduction, concept, evolution of the concept	1
1.2	Social, environmental and economic sustainability concepts	1
1.3	Sustainable development, Nexus between Technology and Sustainable development	1
1.4	Millennium Development Goals (MDGs) and Sustainable Development Goals (SDGs)	1
1.5	Clean Development Mechanism (CDM)	1
2	Environmental Pollution	
2.1	Air Pollution and its effects	1
2.2	Water pollution and its sources	1
2.3	Zero waste concept and 3 R concepts in solid waste management	1
2.4	Greenhouse effect, Global warming, Climate change, Ozone layer depletion	1
2.5	Carbon credits, carbon trading and carbon foot print.	1
2.6	Legal provisions for environmental protection.	1
3	Environmental management standards	
3.1	Environmental management standards	1
3.2	ISO 14001:2015 frame work and benefits	1
3.3	Scope and Goal of Life Cycle Analysis (LCA)	1
3.4	Circular economy, Bio-mimicking	1
3.5	Environment Impact Assessment (EIA)	1
3.6	Industrial Ecology, Industrial Symbiosis	1
4	Resources and its utilisation	
4.1	Basic concepts of Conventional and non-conventional energy	1
4.2	General idea about solar energy, Fuel cells	1
4.3	Wind energy, Small hydro plants, bio-fuels	1
4.4	Energy derived from oceans and Geothermal energy	1
5	Sustainability Practices	
5.1	Basic concept of sustainable habitat	1
5.2	Methods for increasing energy efficiency of buildings	1
5.3	Green Engineering	1
5.4	Sustainable Urbanisation, Sustainable cities, Sustainable transport	1

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
			2	0	0	2
EST 200	DESIGN AND ENGINEERING					

Preamble:

The purpose of this course is to

- i) introduce the undergraduate engineering students the fundamental principles of design engineering,
- ii) make them understand the steps involved in the design process and
- iii) familiarize them with the basic tools used and approaches in design.

Students are expected to apply design thinking in learning as well as while practicing engineering, which is very important and relevant for today. Case studies from various practical situations will help the students realize that design is not only concerned about the function but also many other factors like customer requirements, economics, reliability, etc. along with a variety of life cycle issues.

The course will help students to consider aesthetics, ergonomics and sustainability factors in designs and also to practice professional ethics while designing.

Prerequisite:

Nil. The course will be generic to all engineering disciplines and will not require specialized preparation or prerequisites in any of the individual engineering disciplines.

Course Outcomes:

After the completion of the course the student will be able to

CO 1	Explain the different concepts and principles involved in design engineering.
CO 2	Apply design thinking while learning and practicing engineering.
CO 3	Develop innovative, reliable, sustainable and economically viable designs incorporating knowledge in engineering.

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	2	1					1			1		
CO 2		2				1		1				2
CO 3			2			1	1		2	2		1

Assessment Pattern**Continuous Internal Evaluation (CIE) Pattern:**

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25 marks
Assignment/Quiz/Course project	: 15 marks

End Semester Examination (ESE) Pattern: There will be two parts; Part A and Part B.

Part A : 30 marks

part B : 70 marks

Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions.

Part B contains 2 case study questions from each module of which student should answer any one. Each question carry 14 marks and can have maximum 2 sub questions.

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	5	5	10
Understand	10	10	20
Apply	35	35	70
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-

Course Level Assessment Questions

Course Outcome 1 (CO1): Appreciate the different concepts and principles involved in design engineering.

1. State how engineering design is different from other kinds of design
2. List the different stages in a design process.
3. Describe design thinking.
4. State the function of prototyping and proofing in engineering design.
5. Write notes on the following concepts in connection with design engineering 1) Modular Design, 2) Life Cycle Design, 3) Value Engineering, 4) Concurrent Engineering, and 5) Reverse Engineering
6. State design rights.

Course Outcome 2 (CO2) Apply design thinking while learning and practicing engineering.

1. Construct the iterative process for design thinking in developing simple products like a pen, umbrella, bag, etc.
2. Show with an example how divergent-convergent thinking helps in generating alternative designs and then how to narrow down to the best design.
3. Describe how a problem-based learning helps in creating better design engineering solutions.
4. Discuss as an engineer, how ethics play a decisive role in your designs

Course Outcome 3 (CO3): Develop innovative, reliable, sustainable and economically viable designs incorporating different segments of knowledge in engineering.

1. Illustrate the development of any simple product by passing through the different stages of design process
2. Show the graphical design communication with the help of detailed 2D or 3D drawings for any simple product.
3. Describe how to develop new designs for simple products through bio-mimicry.

Model Question paper

Page 1 of 2

Reg No.: _____ Name: _____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
THIRD/FOURTH SEMESTER B.TECH DEGREE EXAMINATION

Course Code: EST 200

Course Name: DESIGN AND ENGINEERING

Max. Marks: 100 Duration: 3 Hours

PART A

Answer all questions, each question carries 3 marks

Use only hand sketches

- (1) Write about the basic design process.
- (2) Describe how to finalize the design objectives.
- (3) State the role of divergent-convergent questioning in design thinking.
- (4) Discuss how to perform design thinking in a team managing the conflicts.
- (5) Show how engineering sketches and drawings convey designs.
- (6) Explain the role of mathematics and physics in design engineering process.
- (7) Distinguish between project-based learning and problem-based learning in design engineering.
- (8) Describe how concepts like value engineering, concurrent engineering and reverse engineering influence engineering designs?
- (9) Show how designs are varied based on the aspects of production methods, life span, reliability and environment?
- (10) Explain how economics influence the engineering designs?

(10x3 marks =30 marks)

Part B

Answer any ONE question from each module. Each question carry 14 marks

Module 1

- (11) Show the designing of a wrist watch going through the various stages of the design process. Use hand sketches to illustrate the processes.

or

- (12) Find the customer requirements for designing a new car showroom. Show how the design objectives were finalized considering the design constraints?

Module 2

- (13) Illustrate the design thinking approach for designing a bag for college students within a limited budget. Describe each stage of the process and the iterative procedure involved. Use hand sketches to support your arguments.

or

- (14) Construct a number of possible designs and then refine them to narrow down to the best design for a drug trolley used in hospitals. Show how the divergent-convergent thinking helps in the process. Provide your rationale for each step by using hand sketches only.

Module 3

- (15) Graphically communicate the design of a thermo flask used to keep hot coffee. Draw the detailed 2D drawings of the same with design detailing, material selection, scale drawings, dimensions, tolerances, etc. Use only hand sketches.

or

- (16) Describe the role of mathematical modelling in design engineering. Show how mathematics and physics play a role in designing a lifting mechanism to raise 100 kg of weight to a floor at a height of 10 meters in a construction site.

Module 4

- (17) Show the development of a nature inspired design for a solar powered bus waiting shed beside a highway. Relate between natural and man-made designs. Use hand sketches to support your arguments.

or

- (18) Show the design of a simple sofa and then depict how the design changes when considering 1) aesthetics and 2) ergonomics into consideration. Give hand sketches and explanations to justify the changes in designs.

Module 5

- (19) Examine the changes in the design of a foot wear with constraints of 1) production methods, 2) life span requirement, 3) reliability issues and 4) environmental factors. Use hand sketches and give proper rationalization for the changes in design.

or

- (20) Describe the how to estimate the cost of a particular design using ANY of the following:
i) a website, ii) the layout of a plant, iii) the elevation of a building, iv) an electrical or electronic system or device and v) a car.

Show how economics will influence the engineering designs. Use hand sketches to support your arguments.

(5x14 marks =70 marks)

Syllabus**Module 1**

Design Process:- Introduction to Design and Engineering Design, Defining a Design Process:-Detailing Customer Requirements, Setting Design Objectives, Identifying Constraints, Establishing Functions, Generating Design Alternatives and Choosing a Design.

Module 2

Design Thinking Approach:-Introduction to Design Thinking, Iterative Design Thinking Process Stages: Empathize, Define, Ideate, Prototype and Test. Design Thinking as Divergent-Convergent Questioning. Design Thinking in a Team Environment.

Module 3

Design Communication (Languages of Engineering Design):-Communicating Designs Graphically, Communicating Designs Orally and in Writing. Mathematical Modeling In Design, Prototyping and Proofing the Design.

Module 4

Design Engineering Concepts:-Project-based Learning and Problem-based Learning in Design.Modular Design and Life Cycle Design Approaches. Application of Bio-mimicry,Aesthetics and Ergonomics in Design. Value Engineering, Concurrent Engineering, and Reverse Engineering in Design.

Module 5

Expediency, Economics and Environment in Design Engineering:-Design for Production, Use, and Sustainability. Engineering Economics in Design. Design Rights. Ethics in Design

Text Books

- 1) YousefHaik, SangarappillaiSivaloganathan, Tamer M. Shahin, Engineering Design Process, Cengage Learning 2003, Third Edition, ISBN-10: 9781305253285,
- 2) Voland, G., Engineering by Design, Pearson India 2014, Second Edition, ISBN 9332535051

Reference Books

- 1.Philip Kosky, Robert Balmer, William Keat, George Wise, Exploring Engineering, Fourth Edition: An Introduction to Engineering and Design, Academic Press 2015, 4th Edition, ISBN: 9780128012420.
2. Clive L. Dym, Engineering Design: A Project-Based Introduction, John Wiley & Sons, New York 2009, Fourth Edition, ISBN: 978-1-118-32458-5
3. Nigel Cross, Design Thinking: Understanding How Designers Think and Work, Berg Publishers 2011, First Edition, ISBN: 978-1847886361
4. Pahl, G., Beitz, W., Feldhusen, J., Grote, K.-H., Engineering Design: A Systematic Approach, Springer 2007, Third Edition, ISBN 978-1-84628-319-2

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	<u>Module 1: Design Process</u>	
1.1	Introduction to Design and Engineering Design. <i>What does it mean to design something? How Is engineering design different from other kinds of design? Where and when do engineers design? What are the basic vocabulary in engineering design? How to learn and do engineering design.</i>	1
1.2	Defining a Design Process:- Detailing Customer Requirements. <i>How to do engineering design? Illustrate the process with an example. How to identify the customer requirements of design?</i>	1
1.3	Defining a Design Process:- Setting Design Objectives, Identifying Constraints, Establishing Functions. <i>How to finalize the design objectives? How to identify the design constraints? How to express the functions a design in engineering terms?</i>	1
1.4	Defining a Design Process:- Generating Design Alternatives and Choosing a Design. <i>How to generate or create feasible design alternatives? How to identify the "best possible design"?</i>	1
1.5	Case Studies:- Stages of Design Process. <i>Conduct exercises for designing simple products going through the different stages of design process.</i>	1
2	<u>Module 2: Design Thinking Approach</u>	
2.1	Introduction to Design Thinking <i>How does the design thinking approach help engineers in creating innovative and efficient designs?</i>	1
2.2	Iterative Design Thinking Process Stages: Empathize, Define, Ideate, Prototype and Test. <i>How can the engineers arrive at better designs utilizing the iterative design thinking process (in which knowledge acquired in the later stages can be applied back to the earlier stages)?</i>	1
2.3	Design Thinking as Divergent-Convergent Questioning. <i>Describe how to create a number of possible designs and then how to refine and narrow down to the 'best design'.</i>	1
2.4	Design Thinking in a Team Environment. <i>How to perform design thinking as a team managing the conflicts ?</i>	1
2.5	Case Studies: Design Thinking Approach. <i>Conduct exercises using the design thinking approach for</i>	1

	<i>designing any simple products within a limited time and budget</i>	
3	<u>Module 3: Design Communication (Languages of Engineering Design)</u>	
3.1	Communicating Designs Graphically. <i>How do engineering sketches and drawings convey designs?</i>	1
3.2	Communicating Designs Orally and in Writing. <i>How can a design be communicated through oral presentation or technical reports efficiently?</i>	1
First Series Examination		
3.3	Mathematical Modelling in Design. <i>How do mathematics and physics become a part of the design process?</i>	1
3.4	Prototyping and Proofing the Design. <i>How to predict whether the design will function well or not?</i>	1
3.5	Case Studies: Communicating Designs Graphically. <i>Conduct exercises for design communication through detailed 2D or 3D drawings of simple products with design detailing, material selection, scale drawings, dimensions, tolerances, etc.</i>	1
4	<u>Module 4: Design Engineering Concepts</u>	
4.1	Project-based Learning and Problem-based Learning in Design. <i>How engineering students can learn design engineering through projects?</i> <i>How students can take up problems to learn design engineering?</i>	1
4.2	Modular Design and Life Cycle Design Approaches. <i>What is modular approach in design engineering? How it helps?</i> <i>How the life cycle design approach influences design decisions?</i>	1
4.3	Application of Bio-mimicry, Aesthetics and Ergonomics in Design. <i>How do aesthetics and ergonomics change engineering designs?</i> <i>How do the intelligence in nature inspire engineering designs? What are the common examples of bio-mimicry in engineering?</i>	1
4.4	Value Engineering, Concurrent Engineering, and Reverse Engineering in Design. <i>How do concepts like value engineering , concurrent engineering and reverse engineering influence engineering designs?</i>	1
4.5	Case Studies: Bio-mimicry based Designs. <i>Conduct exercises to develop new designs for simple</i>	1

	<i>products using bio-mimicry and train students to bring out new nature inspired designs.</i>	
5	<u>Module 5: Expediency, Economics and Environment in Design Engineering</u>	
5.1	Design for Production, Use, and Sustainability. <i>How designs are finalized based on the aspects of production methods, life span, reliability and environment?</i>	1
5.2	Engineering Economics in Design. <i>How to estimate the cost of a particular design and how will economics influence the engineering designs?</i>	1
5.3	Design Rights. <i>What are design rights and how can an engineer put it into practice?</i>	1
5.4	Ethics in Design. <i>How do ethics play a decisive role in engineering design?</i>	1
5.5	Case Studies: Design for Production, Use, and Sustainability. <i>Conduct exercises using simple products to show how designs change with constraints of production methods, life span requirement, reliability issues and environmental factors.</i>	1
Second Series Examination		

Code.	Course Name	L	T	P	Hrs	Credit
HUT 200	Professional Ethics	2	0	0	2	2

Preamble: To enable students to create awareness on ethics and human values.

Prerequisite: Nil

Course Outcomes: After the completion of the course the student will be able to

CO 1	Understand the core values that shape the ethical behaviour of a professional.
CO 2	Adopt a good character and follow an ethical life.
CO 3	Explain the role and responsibility in technological development by keeping personal ethics and legal ethics.
CO 4	Solve moral and ethical problems through exploration and assessment by established experiments.
CO 5	Apply the knowledge of human values and social values to contemporary ethical values and global issues.

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12
CO 1								2			2	
CO 2								2			2	
CO 3								3			2	
CO 4								3			2	
CO 5								3			2	

Assessment Pattern

Bloom's category	Continuous Assessment Tests		End Semester Exam
	1	2	
Remember	15	15	30
Understood	20	20	40
Apply	15	15	30

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance	: 10 marks
Continuous Assessment Tests (2 Nos)	: 25 marks
Assignments/Quiz	: 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions**Course Outcome 1 (CO1):**

1. Define integrity and point out ethical values.
2. Describe the qualities required to live a peaceful life.
3. Explain the role of engineers in modern society.

Course Outcome 2 (CO2)

1. Derive the codes of ethics.
2. Differentiate consensus and controversy.
3. Discuss in detail about character and confidence.

Course Outcome 3(CO3):

1. Explain the role of professional's ethics in technological development.
2. Distinguish between self interest and conflicts of interest.
3. Review on industrial standards and legal ethics.

Course Outcome 4 (CO4):

1. Illustrate the role of engineers as experimenters.
2. Interpret the terms safety and risk.
3. Show how the occupational crimes are resolved by keeping the rights of employees.

Course Outcome 5 (CO5):

1. Exemplify the engineers as managers.
2. Investigate the causes and effects of acid rain with a case study.
3. Explore the need of environmental ethics in technological development.

Model Question paper

QP CODE:

Reg No: _____

PAGES:3

Name : _____

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY THIRD/FOURTH SEMESTER
B.TECH DEGREE EXAMINATION, MONTH & YEAR****Course Code: HUT 200****Course Name: PROFESSIONAL ETHICS****Max. Marks: 100****Duration: 3 Hours****(2019-Scheme)****PART A****(Answer all questions, each question carries 3 marks)**

1. Define empathy and honesty.
2. Briefly explain about morals, values and ethics.
3. Interpret the two forms of self-respect.
4. List out the models of professional roles.
5. Indicate the advantages of using standards.
6. Point out the conditions required to define a valid consent?
7. Identify the conflicts of interests with an example?
8. Recall confidentiality.
9. Conclude the features of biometric ethics.
10. Name any three professional societies and their role relevant to engineers.

(10x3 = 30 marks)**PART B****(Answer one full question from each module, each question carries 14 marks)****MODULE I**

- 11. a)** Classify the relationship between ethical values and law?

b) Compare between caring and sharing.

(10+4 = 14 marks)**Or**

- 12. a)** Exemplify a comprehensive review about integrity and respect for others.

b) Discuss about co-operation and commitment.

(8+6 = 14 marks)

MODULE II

13.a) Explain the three main levels of moral developments, devised by Kohlberg.

b) Differentiate moral codes and optimal codes.

(10+4 = 14 marks)

Or

14. a) Extrapolate the duty ethics and right ethics.

b) Discuss in detail the three types of inquiries in engineering ethics

(8+6 = 14 marks)

MODULE III

Summarize the following features of morally responsible engineers.

(i) Moral autonomy

(ii) Accountability

b) Explain the rights of employees

(8+6 = 14 marks)

Or

16. a) Explain the reasons for Chernobyl mishap ?

b) Describe the methods to improve collegiality and loyalty.

(8+6 = 14 marks)

MODULE IV

17.a) Execute collegiality with respect to commitment, respect and connectedness.

b) Identify conflicts of interests with an example.

(8+6 = 14 marks)

Or

18. a) Explain in detail about professional rights and employee rights.

b) Exemplify engineers as managers.

MODULE V

19.a) Evaluate the technology transfer and appropriate technology.

b) Explain about computer and internet ethics.

(8+6 = 14 marks)

Or

20. a) Investigate the causes and effects of acid rain with a case study.

b) Conclude the features of ecocentric and biocentric ethics.

(8+6 = 14 marks)

Syllabus**Module 1 – Human Values.**

Morals, values and Ethics – Integrity- Academic integrity-Work Ethics- Service Learning- Civic Virtue- Respect for others- Living peacefully- Caring and Sharing- Honestly- courage-Cooperation commitment- Empathy-Self Confidence -Social Expectations.

Module 2 - Engineering Ethics & Professionalism.

Senses of Engineering Ethics - Variety of moral issues- Types of inquiry- Moral dilemmas –Moral Autonomy – Kohlberg's theory- Gilligan's theory- Consensus and Controversy-Profession and Professionalism- Models of professional roles-Theories about right action –Self interest-Customs and Religion- Uses of Ethical Theories.

Module 3- Engineering as social Experimentation.

Engineering as Experimentation – Engineers as responsible Experimenters- Codes of Ethics- Plagiarism- A balanced outlook on law - Challenges case study- Bhopal gas tragedy.

Module 4- Responsibilities and Rights.

Collegiality and loyalty – Managing conflict- Respect for authority- Collective bargaining- Confidentiality- Role of confidentiality in moral integrity-Conflicts of interest- Occupational crime- Professional rights- Employee right- IPR Discrimination.

Module 5- Global Ethical Issues.

Multinational Corporations- Environmental Ethics- Business Ethics- Computer Ethics -Role in Technological Development-Engineers as Managers- Consulting Engineers- Engineers as Expert witnesses and advisors-Moral leadership.

Text Book

1. M Govindarajan, S Natarajan and V S Senthil Kumar, Engineering Ethics, PHI Learning Private Ltd, New Delhi,2012.
2. R S Naagarazan, A text book on professional ethics and human values, New age international (P) limited ,New Delhi,2006.

Reference Books

1. Mike W Martin and Roland Schinzinger, Ethics in Engineering,4th edition, Tata McGraw Hill Publishing Company Pvt Ltd, New Delhi,2014.
2. Charles D Fleddermann, Engineering Ethics, Pearson Education/ Prentice Hall of India, New Jersey,2004.
3. Charles E Harris, Michael S Protchard and Michael J Rabins, Engineering Ethics- Concepts and cases, Wadsworth Thompson Learning, United states,2005.
4. <http://www.slideword.org/slidestag.aspx/human-values-and-Professional-ethics>.

Course Contents and Lecture Schedule

SL.No	Topic	No. of Lectures 25
1	Module 1 – Human Values.	
1.1	Morals, values and Ethics, Integrity, Academic Integrity, Work Ethics	1
1.2	Service Learning, Civic Virtue, Respect for others, Living peacefully	1
1.3	Caring and Sharing, Honesty, Courage, Co-operation commitment	2
1.4	Empathy, Self Confidence, Social Expectations	1
2	Module 2- Engineering Ethics & Professionalism.	
2.1	Senses of Engineering Ethics, Variety of moral issues, Types of inquiry	1
2.2	Moral dilemmas, Moral Autonomy, Kohlberg's theory	1
2.3	Gilligan's theory, Consensus and Controversy, Profession & Professionalism, Models of professional roles, Theories about right action	2
2.4	Self interest-Customs and Religion, Uses of Ethical Theories	1
3	Module 3- Engineering as social Experimentation.	
3.1	Engineering as Experimentation, Engineers as responsible Experimenters	1
3.2	Codes of Ethics, Plagiarism, A balanced outlook on law	2
3.3	Challenger case study, Bhopal gas tragedy	2
4	Module 4- Responsibilities and Rights.	
4.1	Collegiality and loyalty, Managing conflict, Respect for authority	1
4.2	Collective bargaining, Confidentiality, Role of confidentiality in moral integrity, Conflicts of interest	2
4.3	Occupational crime, Professional rights, Employee right, IPR Discrimination	2
5	Module 5- Global Ethical Issues.	
5.1	Multinational Corporations, Environmental Ethics, Business Ethics, Computer Ethics	2
5.2	Role in Technological Development, Moral leadership	1
5.3	Engineers as Managers, Consulting Engineers, Engineers as Expert witnesses and advisors	2



SEMESTER -4

CODE MCN202	COURSE NAME CONSTITUTION OF INDIA	CATEGORY	L	T	P	CREDIT
			2	0	0	NIL

Preamble:

The study of their own country constitution and studying the importance environment as well as understanding their own human rights help the students to concentrate on their day to day discipline. It also gives the knowledge and strength to face the society and people.

Prerequisite: Nil

Course Outcomes: After the completion of the course the student will be able to

CO 1	Explain the background of the present constitution of India and features.
CO 2	Utilize the fundamental rights and duties.
CO 3	Understand the working of the union executive, parliament and judiciary.
CO 4	Understand the working of the state executive, legislature and judiciary.
CO 5	Utilize the special provisions and statutory institutions.
CO 6	Show national and patriotic spirit as responsible citizens of the country

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1						2	2	2		2		
CO 2						3	3	3		3		
CO 3						3	2	3		3		
CO 4						3	2	3		3		
CO 5						3	2	3		3		
CO 6						3	3	3		2		

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	20	20	40
Understand	20	20	40
Apply	10	10	20
Analyse			

Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25 marks
Assignment/Quiz/Course project	: 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions**Course Outcome 1 (CO1):**

- 1 Discuss the historical background of the Indian constitution.
- 2 Explain the salient features of the Indian constitution.
- 3 Discuss the importance of preamble in the implementation of constitution.

Course Outcome 2 (CO2)

- 1 What are fundamental rights ? Examine each of them.
- 2 Examine the scope of freedom of speech and expression underlying the constitution.
- 3 The thumb impression of an accused is taken by the police against his will. He contends that this is a violation of his rights under Art 20(3) of the constitution. Decide.

Course Outcome 3(CO3):

- 1 Explain the powers of the President to suspend the fundamental rights during emergency.

- 2 Explain the salient features of appeal by special leave.
3. List the constitutional powers of President.

Course Outcome 4 (CO4):

- 1 Discuss the constitutional powers of Governor.
- 2 Examine the writ jurisdiction of High court.
- 3 Discuss the qualification and disqualification of membership of state legislature.

Course Outcome 5 (CO5):

- 1 Discuss the duties and powers of comptroller of auditor general.
- 2 Discuss the proclamation of emergency.
- 3 A state levies tax on motor vehicles used in the state, for the purpose of maintaining roads in the state. X challenges the levy of the tax on the ground that it violates the freedom of interstate commerce guaranteed under Art 301. Decide.

Course Outcome 6 (CO6):

- 1 Explain the advantages of citizenship.
- 2 List the important principles contained in the directive principles of state policy.
- 3 Discuss the various aspects contained in the preamble of the constitution

Model Question paper

PART A

(Answer all questions. Each question carries 3 marks)

- 1 Define and explain the term constitution.
- 2 Explain the need and importance of Preamble.
- 3 What is directive principle of state policy?
- 4 Define the State.
- 5 List the functions of Attorney general of India.

- 6 Explain the review power of Supreme court.
- 7 List the qualifications of Governor.
- 8 Explain the term and removal of Judges in High court.
- 9 Explain the powers of public service commission.
- 10 List three types of emergency under Indian constitution.

(10X3=30marks)

PART B

(Answer on question from each module. Each question carries 14 marks)

Module 1

- 11 Discuss the various methods of acquiring Indian citizenship.
- 12 Examine the salient features of the Indian constitution.

Module 2

- 13 A high court passes a judgement against X. X desires to file a writ petition in the supreme court under Art32, on the ground that the judgement violates his fundamental rights. Advise him whether he can do so.
- 14 What is meant by directive principles of State policy? List the directives.

Module3

- 15 Describe the procedure of election and removal of the President of India.
- 16 Supreme court may in its discretion grant special leave to appeal. Examine the situation.

Module 4

- 17 Discuss the powers of Governor.
- 18 X filed a writ petition under Art 226 which was dismissed. Subsequently, he filed a writ petition under Art 32 of the constitution, seeking the same remedy. The Government argued that the writ petition should be dismissed, on the ground of res judicata. Decide.

Module 5

19 Examine the scope of the financial relations between the union and the states.

20 Discuss the effects of proclamation of emergency.

(14X5=70marks)

Syllabus

Module 1 Definition, historical back ground, features, preamble, territory, citizenship.

Module 2 State, fundamental rights, directive principles, duties.

Module 3 The machinery of the union government.

Module 4 Government machinery in the states

Module 5 The federal system, Statutory Institutions, miscellaneous provisions.

Text Books

1 D D Basu, Introduction to the constitution of India, Lexis Nexis, New Delhi, 24e, 2019

2 PM Bhakshi, The constitution of India, Universal Law, 14e, 2017

Reference Books

1 Ministry of law and justice, The constitution of India, Govt of India, New Delhi, 2019.

2 JN Pandey, The constitutional law of India, Central Law agency, Allahabad, 51e, 2019

3 MV Pylee, India's Constitution, S Chand and company, New Delhi, 16e, 2016

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	Module 1	
1.1	Definition of constitution, historical back ground, salient features of the constitution.	1
1.2	Preamble of the constitution, union and its territory.	1
1.3	Meaning of citizenship, types, termination of citizenship.	2
2	Module 2	
2.1	Definition of state, fundamental rights, general nature, classification, right to equality ,right to freedom , right against exploitation	2

HUMANITIES

2.2	Right to freedom of religion, cultural and educational rights, right to constitutional remedies. Protection in respect of conviction for offences.	2
2.3	Directive principles of state policy, classification of directives, fundamental duties.	2
3	Module 3	
3.1	The Union executive, the President, the vice President, the council of ministers, the Prime minister, Attorney-General, functions.	2
3.2	The parliament, composition, Rajya sabha, Lok sabha, qualification and disqualification of membership, functions of parliament.	2
3.3	Union judiciary, the supreme court, jurisdiction, appeal by special leave.	1
4	Module 4	
4.1	The State executive, the Governor, the council of ministers, the Chief minister, advocate general, union Territories.	2
4.2	The State Legislature, composition, qualification and disqualification of membership, functions.	2
4.3	The state judiciary, the high court, jurisdiction, writs jurisdiction.	1
5	Module 5	
5.1	Relations between the Union and the States, legislative relation, administrative relation, financial Relations, Inter State council, finance commission.	1
5.2	Emergency provision, freedom of trade commerce and inter course, comptroller and auditor general of India, public Services, public service commission, administrative Tribunals.	2
5.3	Official language, elections, special provisions relating to certain classes, amendment of the Constitution.	2

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
			2	0	0	2
EST 200	DESIGN AND ENGINEERING					

Preamble:

The purpose of this course is to

- i) introduce the undergraduate engineering students the fundamental principles of design engineering,
- ii) make them understand the steps involved in the design process and
- iii) familiarize them with the basic tools used and approaches in design.

Students are expected to apply design thinking in learning as well as while practicing engineering, which is very important and relevant for today. Case studies from various practical situations will help the students realize that design is not only concerned about the function but also many other factors like customer requirements, economics, reliability, etc. along with a variety of life cycle issues.

The course will help students to consider aesthetics, ergonomics and sustainability factors in designs and also to practice professional ethics while designing.

Prerequisite:

Nil. The course will be generic to all engineering disciplines and will not require specialized preparation or prerequisites in any of the individual engineering disciplines.

Course Outcomes:

After the completion of the course the student will be able to

CO 1	Explain the different concepts and principles involved in design engineering.
CO 2	Apply design thinking while learning and practicing engineering.
CO 3	Develop innovative, reliable, sustainable and economically viable designs incorporating knowledge in engineering.

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	2	1					1			1		
CO 2		2				1		1				2
CO 3			2			1	1		2	2		1

Assessment Pattern**Continuous Internal Evaluation (CIE) Pattern:**

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25 marks
Assignment/Quiz/Course project	: 15 marks

End Semester Examination (ESE) Pattern: There will be two parts; Part A and Part B.

Part A : 30 marks

part B : 70 marks

Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions.

Part B contains 2 case study questions from each module of which student should answer any one. Each question carry 14 marks and can have maximum 2 sub questions.

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	5	5	10
Understand	10	10	20
Apply	35	35	70
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-

Course Level Assessment Questions

Course Outcome 1 (CO1): Appreciate the different concepts and principles involved in design engineering.

1. State how engineering design is different from other kinds of design
2. List the different stages in a design process.
3. Describe design thinking.
4. State the function of prototyping and proofing in engineering design.
5. Write notes on the following concepts in connection with design engineering 1) Modular Design, 2) Life Cycle Design, 3) Value Engineering, 4) Concurrent Engineering, and 5) Reverse Engineering
6. State design rights.

Course Outcome 2 (CO2) Apply design thinking while learning and practicing engineering.

1. Construct the iterative process for design thinking in developing simple products like a pen, umbrella, bag, etc.
2. Show with an example how divergent-convergent thinking helps in generating alternative designs and then how to narrow down to the best design.
3. Describe how a problem-based learning helps in creating better design engineering solutions.
4. Discuss as an engineer, how ethics play a decisive role in your designs

Course Outcome 3(CO3): Develop innovative, reliable, sustainable and economically viable designs incorporating different segments of knowledge in engineering.

1. Illustrate the development of any simple product by passing through the different stages of design process
2. Show the graphical design communication with the help of detailed 2D or 3D drawings for any simple product.
3. Describe how to develop new designs for simple products through bio-mimicry.

Model Question paper

Page 1 of 2

Reg No.: _____ Name: _____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
THIRD/FOURTH SEMESTER B.TECH DEGREE EXAMINATION

Course Code: EST 200

Course Name: DESIGN AND ENGINEERING

Max. Marks: 100 Duration: 3 Hours

PART A

Answer all questions, each question carries 3 marks

Use only hand sketches

- (1) Write about the basic design process.
- (2) Describe how to finalize the design objectives.
- (3) State the role of divergent-convergent questioning in design thinking.
- (4) Discuss how to perform design thinking in a team managing the conflicts.
- (5) Show how engineering sketches and drawings convey designs.
- (6) Explain the role of mathematics and physics in design engineering process.
- (7) Distinguish between project-based learning and problem-based learning in design engineering.
- (8) Describe how concepts like value engineering, concurrent engineering and reverse engineering influence engineering designs?
- (9) Show how designs are varied based on the aspects of production methods, life span, reliability and environment?
- (10) Explain how economics influence the engineering designs?

(10x3 marks =30 marks)

Part B

Answer any ONE question from each module. Each question carry 14 marks

Module 1

- (11) Show the designing of a wrist watch going through the various stages of the design process. Use hand sketches to illustrate the processes.

or

- (12) Find the customer requirements for designing a new car showroom. Show how the design objectives were finalized considering the design constraints?

Module 2

- (13) Illustrate the design thinking approach for designing a bag for college students within a limited budget. Describe each stage of the process and the iterative procedure involved. Use hand sketches to support your arguments.

or

- (14) Construct a number of possible designs and then refine them to narrow down to the best design for a drug trolley used in hospitals. Show how the divergent-convergent thinking helps in the process. Provide your rationale for each step by using hand sketches only.

Module 3

- (15) Graphically communicate the design of a thermo flask used to keep hot coffee. Draw the detailed 2D drawings of the same with design detailing, material selection, scale drawings, dimensions, tolerances, etc. Use only hand sketches.

or

- (16) Describe the role of mathematical modelling in design engineering. Show how mathematics and physics play a role in designing a lifting mechanism to raise 100 kg of weight to a floor at a height of 10 meters in a construction site.

Module 4

- (17) Show the development of a nature inspired design for a solar powered bus waiting shed beside a highway. Relate between natural and man-made designs. Use hand sketches to support your arguments.

or

- (18) Show the design of a simple sofa and then depict how the design changes when considering 1) aesthetics and 2) ergonomics into consideration. Give hand sketches and explanations to justify the changes in designs.

Module 5

- (19) Examine the changes in the design of a foot wear with constraints of 1) production methods, 2) life span requirement, 3) reliability issues and 4) environmental factors. Use hand sketches and give proper rationalization for the changes in design.

or

- (20) Describe the how to estimate the cost of a particular design using ANY of the following:
i) a website, ii) the layout of a plant, iii) the elevation of a building, iv) an electrical or electronic system or device and v) a car.

Show how economics will influence the engineering designs. Use hand sketches to support your arguments.

(5x14 marks =70 marks)

Syllabus**Module 1**

Design Process:- Introduction to Design and Engineering Design, Defining a Design Process:-Detailing Customer Requirements, Setting Design Objectives, Identifying Constraints, Establishing Functions, Generating Design Alternatives and Choosing a Design.

Module 2

Design Thinking Approach:-Introduction to Design Thinking, Iterative Design Thinking Process Stages: Empathize, Define, Ideate, Prototype and Test. Design Thinking as Divergent-Convergent Questioning. Design Thinking in a Team Environment.

Module 3

Design Communication (Languages of Engineering Design):-Communicating Designs Graphically, Communicating Designs Orally and in Writing. Mathematical Modeling In Design, Prototyping and Proofing the Design.

Module 4

Design Engineering Concepts:-Project-based Learning and Problem-based Learning in Design.Modular Design and Life Cycle Design Approaches. Application of Bio-mimicry,Aesthetics and Ergonomics in Design. Value Engineering, Concurrent Engineering, and Reverse Engineering in Design.

Module 5

Expediency, Economics and Environment in Design Engineering:-Design for Production, Use, and Sustainability. Engineering Economics in Design. Design Rights. Ethics in Design

Text Books

- 1) YousefHaik, SangarappillaiSivaloganathan, Tamer M. Shahin, Engineering Design Process, Cengage Learning 2003, Third Edition, ISBN-10: 9781305253285,
- 2) Voland, G., Engineering by Design, Pearson India 2014, Second Edition, ISBN 9332535051

Reference Books

- 1.Philip Kosky, Robert Balmer, William Keat, George Wise, Exploring Engineering, Fourth Edition: An Introduction to Engineering and Design, Academic Press 2015, 4th Edition, ISBN: 9780128012420.
2. Clive L. Dym, Engineering Design: A Project-Based Introduction, John Wiley & Sons, New York 2009, Fourth Edition, ISBN: 978-1-118-32458-5
3. Nigel Cross, Design Thinking: Understanding How Designers Think and Work, Berg Publishers 2011, First Edition, ISBN: 978-1847886361
4. Pahl, G., Beitz, W., Feldhusen, J., Grote, K.-H., Engineering Design: A Systematic Approach, Springer 2007, Third Edition, ISBN 978-1-84628-319-2

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	<u>Module 1: Design Process</u>	
1.1	Introduction to Design and Engineering Design. <i>What does it mean to design something? How Is engineering design different from other kinds of design? Where and when do engineers design? What are the basic vocabulary in engineering design? How to learn and do engineering design.</i>	1
1.2	Defining a Design Process:- Detailing Customer Requirements. <i>How to do engineering design? Illustrate the process with an example. How to identify the customer requirements of design?</i>	1
1.3	Defining a Design Process:- Setting Design Objectives, Identifying Constraints, Establishing Functions. <i>How to finalize the design objectives? How to identify the design constraints? How to express the functions a design in engineering terms?</i>	1
1.4	Defining a Design Process:- Generating Design Alternatives and Choosing a Design. <i>How to generate or create feasible design alternatives? How to identify the "best possible design"?</i>	1
1.5	Case Studies:- Stages of Design Process. <i>Conduct exercises for designing simple products going through the different stages of design process.</i>	1
2	<u>Module 2: Design Thinking Approach</u>	
2.1	Introduction to Design Thinking <i>How does the design thinking approach help engineers in creating innovative and efficient designs?</i>	1
2.2	Iterative Design Thinking Process Stages: Empathize, Define, Ideate, Prototype and Test. <i>How can the engineers arrive at better designs utilizing the iterative design thinking process (in which knowledge acquired in the later stages can be applied back to the earlier stages)?</i>	1
2.3	Design Thinking as Divergent-Convergent Questioning. <i>Describe how to create a number of possible designs and then how to refine and narrow down to the 'best design'.</i>	1
2.4	Design Thinking in a Team Environment. <i>How to perform design thinking as a team managing the conflicts ?</i>	1
2.5	Case Studies: Design Thinking Approach. <i>Conduct exercises using the design thinking approach for</i>	1

	<i>designing any simple products within a limited time and budget</i>	
3	<u>Module 3: Design Communication (Languages of Engineering Design)</u>	
3.1	Communicating Designs Graphically. <i>How do engineering sketches and drawings convey designs?</i>	1
3.2	Communicating Designs Orally and in Writing. <i>How can a design be communicated through oral presentation or technical reports efficiently?</i>	1
First Series Examination		
3.3	Mathematical Modelling in Design. <i>How do mathematics and physics become a part of the design process?</i>	1
3.4	Prototyping and Proofing the Design. <i>How to predict whether the design will function well or not?</i>	1
3.5	Case Studies: Communicating Designs Graphically. <i>Conduct exercises for design communication through detailed 2D or 3D drawings of simple products with design detailing, material selection, scale drawings, dimensions, tolerances, etc.</i>	1
4	<u>Module 4: Design Engineering Concepts</u>	
4.1	Project-based Learning and Problem-based Learning in Design. <i>How engineering students can learn design engineering through projects?</i> <i>How students can take up problems to learn design engineering?</i>	1
4.2	Modular Design and Life Cycle Design Approaches. <i>What is modular approach in design engineering? How it helps?</i> <i>How the life cycle design approach influences design decisions?</i>	1
4.3	Application of Bio-mimicry, Aesthetics and Ergonomics in Design. <i>How do aesthetics and ergonomics change engineering designs?</i> <i>How do the intelligence in nature inspire engineering designs? What are the common examples of bio-mimicry in engineering?</i>	1
4.4	Value Engineering, Concurrent Engineering, and Reverse Engineering in Design. <i>How do concepts like value engineering , concurrent engineering and reverse engineering influence engineering designs?</i>	1
4.5	Case Studies: Bio-mimicry based Designs. <i>Conduct exercises to develop new designs for simple</i>	1

	<i>products using bio-mimicry and train students to bring out new nature inspired designs.</i>	
5	<u>Module 5: Expediency, Economics and Environment in Design Engineering</u>	
5.1	Design for Production, Use, and Sustainability. <i>How designs are finalized based on the aspects of production methods, life span, reliability and environment?</i>	1
5.2	Engineering Economics in Design. <i>How to estimate the cost of a particular design and how will economics influence the engineering designs?</i>	1
5.3	Design Rights. <i>What are design rights and how can an engineer put it into practice?</i>	1
5.4	Ethics in Design. <i>How do ethics play a decisive role in engineering design?</i>	1
5.5	Case Studies: Design for Production, Use, and Sustainability. <i>Conduct exercises using simple products to show how designs change with constraints of production methods, life span requirement, reliability issues and environmental factors.</i>	1
Second Series Examination		

Code.	Course Name	L	T	P	Hrs	Credit
HUT 200	Professional Ethics	2	0	0	2	2

Preamble: To enable students to create awareness on ethics and human values.

Prerequisite: Nil

Course Outcomes: After the completion of the course the student will be able to

CO 1	Understand the core values that shape the ethical behaviour of a professional.
CO 2	Adopt a good character and follow an ethical life.
CO 3	Explain the role and responsibility in technological development by keeping personal ethics and legal ethics.
CO 4	Solve moral and ethical problems through exploration and assessment by established experiments.
CO 5	Apply the knowledge of human values and social values to contemporary ethical values and global issues.

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12
CO 1								2			2	
CO 2								2			2	
CO 3								3			2	
CO 4								3			2	
CO 5								3			2	

Assessment Pattern

Bloom's category	Continuous Assessment Tests		End Semester Exam
	1	2	
Remember	15	15	30
Understood	20	20	40
Apply	15	15	30

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance	: 10 marks
Continuous Assessment Tests (2 Nos)	: 25 marks
Assignments/Quiz	: 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions**Course Outcome 1 (CO1):**

1. Define integrity and point out ethical values.
2. Describe the qualities required to live a peaceful life.
3. Explain the role of engineers in modern society.

Course Outcome 2 (CO2)

1. Derive the codes of ethics.
2. Differentiate consensus and controversy.
3. Discuss in detail about character and confidence.

Course Outcome 3(CO3):

1. Explain the role of professional's ethics in technological development.
2. Distinguish between self interest and conflicts of interest.
3. Review on industrial standards and legal ethics.

Course Outcome 4 (CO4):

1. Illustrate the role of engineers as experimenters.
2. Interpret the terms safety and risk.
3. Show how the occupational crimes are resolved by keeping the rights of employees.

Course Outcome 5 (CO5):

1. Exemplify the engineers as managers.
2. Investigate the causes and effects of acid rain with a case study.
3. Explore the need of environmental ethics in technological development.

Model Question paper

QP CODE:

Reg No: _____

PAGES:3

Name : _____

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY THIRD/FOURTH SEMESTER
B.TECH DEGREE EXAMINATION, MONTH & YEAR****Course Code: HUT 200****Course Name: PROFESSIONAL ETHICS****Max. Marks: 100****Duration: 3 Hours****(2019-Scheme)****PART A****(Answer all questions, each question carries 3 marks)**

1. Define empathy and honesty.
2. Briefly explain about morals, values and ethics.
3. Interpret the two forms of self-respect.
4. List out the models of professional roles.
5. Indicate the advantages of using standards.
6. Point out the conditions required to define a valid consent?
7. Identify the conflicts of interests with an example?
8. Recall confidentiality.
9. Conclude the features of biometric ethics.
10. Name any three professional societies and their role relevant to engineers.

(10x3 = 30 marks)**PART B****(Answer one full question from each module, each question carries 14 marks)****MODULE I**

- 11. a)** Classify the relationship between ethical values and law?

b) Compare between caring and sharing.

(10+4 = 14 marks)**Or**

- 12. a)** Exemplify a comprehensive review about integrity and respect for others.

b) Discuss about co-operation and commitment.

(8+6 = 14 marks)

MODULE II

13.a) Explain the three main levels of moral developments, devised by Kohlberg.

b) Differentiate moral codes and optimal codes.

(10+4 = 14 marks)

Or

14. a) Extrapolate the duty ethics and right ethics.

b) Discuss in detail the three types of inquiries in engineering ethics

(8+6 = 14 marks)

MODULE III

Summarize the following features of morally responsible engineers.

(i) Moral autonomy

(ii) Accountability

b) Explain the rights of employees

(8+6 = 14 marks)

Or

16. a) Explain the reasons for Chernobyl mishap ?

b) Describe the methods to improve collegiality and loyalty.

(8+6 = 14 marks)

MODULE IV

17.a) Execute collegiality with respect to commitment, respect and connectedness.

b) Identify conflicts of interests with an example.

(8+6 = 14 marks)

Or

18. a) Explain in detail about professional rights and employee rights.

b) Exemplify engineers as managers.

MODULE V

19.a) Evaluate the technology transfer and appropriate technology.

b) Explain about computer and internet ethics.

(8+6 = 14 marks)

Or

20. a) Investigate the causes and effects of acid rain with a case study.

b) Conclude the features of ecocentric and biocentric ethics.

(8+6 = 14 marks)

Syllabus

Module 1 – Human Values.

Morals, values and Ethics – Integrity- Academic integrity-Work Ethics- Service Learning- Civic Virtue- Respect for others- Living peacefully- Caring and Sharing- Honestly- courage-Cooperation commitment- Empathy-Self Confidence -Social Expectations.

Module 2 - Engineering Ethics & Professionalism.

Senses of Engineering Ethics - Variety of moral issues- Types of inquiry- Moral dilemmas –Moral Autonomy – Kohlberg's theory- Gilligan's theory- Consensus and Controversy-Profession and Professionalism- Models of professional roles-Theories about right action –Self interest-Customs and Religion- Uses of Ethical Theories.

Module 3- Engineering as social Experimentation.

Engineering as Experimentation – Engineers as responsible Experimenters- Codes of Ethics- Plagiarism- A balanced outlook on law - Challenges case study- Bhopal gas tragedy.

Module 4- Responsibilities and Rights.

Collegiality and loyalty – Managing conflict- Respect for authority- Collective bargaining- Confidentiality- Role of confidentiality in moral integrity-Conflicts of interest- Occupational crime- Professional rights- Employee right- IPR Discrimination.

Module 5- Global Ethical Issues.

Multinational Corporations- Environmental Ethics- Business Ethics- Computer Ethics -Role in Technological Development-Engineers as Managers- Consulting Engineers- Engineers as Expert witnesses and advisors-Moral leadership.

Text Book

1. M Govindarajan, S Natarajan and V S Senthil Kumar, Engineering Ethics, PHI Learning Private Ltd, New Delhi,2012.
2. R S Naagarazan, A text book on professional ethics and human values, New age international (P) limited ,New Delhi,2006.

Reference Books

1. Mike W Martin and Roland Schinzinger, Ethics in Engineering,4th edition, Tata McGraw Hill Publishing Company Pvt Ltd, New Delhi,2014.
2. Charles D Fleddermann, Engineering Ethics, Pearson Education/ Prentice Hall of India, New Jersey,2004.
3. Charles E Harris, Michael S Protchard and Michael J Rabins, Engineering Ethics- Concepts and cases, Wadsworth Thompson Learning, United states,2005.
4. <http://www.slideword.org/slidestag.aspx/human-values-and-Professional-ethics>.

Course Contents and Lecture Schedule

SL.No	Topic	No. of Lectures 25
1	Module 1 – Human Values.	
1.1	Morals, values and Ethics, Integrity, Academic Integrity, Work Ethics	1
1.2	Service Learning, Civic Virtue, Respect for others, Living peacefully	1
1.3	Caring and Sharing, Honesty, Courage, Co-operation commitment	2
1.4	Empathy, Self Confidence, Social Expectations	1
2	Module 2- Engineering Ethics & Professionalism.	
2.1	Senses of Engineering Ethics, Variety of moral issues, Types of inquiry	1
2.2	Moral dilemmas, Moral Autonomy, Kohlberg's theory	1
2.3	Gilligan's theory, Consensus and Controversy, Profession & Professionalism, Models of professional roles, Theories about right action	2
2.4	Self interest-Customs and Religion, Uses of Ethical Theories	1
3	Module 3- Engineering as social Experimentation.	
3.1	Engineering as Experimentation, Engineers as responsible Experimenters	1
3.2	Codes of Ethics, Plagiarism, A balanced outlook on law	2
3.3	Challenger case study, Bhopal gas tragedy	2
4	Module 4- Responsibilities and Rights.	
4.1	Collegiality and loyalty, Managing conflict, Respect for authority	1
4.2	Collective bargaining, Confidentiality, Role of confidentiality in moral integrity, Conflicts of interest	2
4.3	Occupational crime, Professional rights, Employee right, IPR Discrimination	2
5	Module 5- Global Ethical Issues.	
5.1	Multinational Corporations, Environmental Ethics, Business Ethics, Computer Ethics	2
5.2	Role in Technological Development, Moral leadership	1
5.3	Engineers as Managers, Consulting Engineers, Engineers as Expert witnesses and advisors	2

APJ ABDUL KALAM
TECHNOLOGICAL
UNIVERSITY

SEMESTER V

KTU

Estd.



2014

CST 301	FORMAL LANGUAGES AND AUTOMATA THEORY	Category	L	T	P	Credit	Year of Introduction
		PCC	3	1	0	4	2019

Preamble: This is a core course in theoretical computer science. It covers automata and grammar representations for languages in Chomsky Hierarchy. For regular languages, it also covers representations using regular expression and Myhill-Nerode Relation. The topics covered in this course have applications in various domains including compiler design, decidability and complexity theory, software testing, formal modelling and verification of hardware and software.

Prerequisite: Basic knowledge about the following topic is assumed: sets, relations - equivalence relations, functions, proof by Principle of Mathematical Induction.

Course Outcomes: After the completion of the course the student will be able to

CO1	Classify a given formal language into Regular, Context-Free, Context Sensitive, Recursive or Recursively Enumerable. [Cognitive knowledge level: Understand]
CO2	Explain a formal representation of a given regular language as a finite state automaton, regular grammar, regular expression and Myhill-Nerode relation. [Cognitive knowledge level: Understand]
CO3	Design a Pushdown Automaton and a Context-Free Grammar for a given context-free language. [Cognitive knowledge level : Apply]
CO4	Design Turing machines as language acceptors or transducers. [Cognitive knowledge level: Apply]
CO5	Explain the notion of decidability. [Cognitive knowledge level: Understand]

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												

CO2												
CO3												
CO4												
CO5												

Abstract POs defined by National Board of Accreditation			
PO#	Broad PO	PO#	Broad PO
PO1	Engineering Knowledge	PO7	Environment and Sustainability
PO2	Problem Analysis	PO8	Ethics
PO3	Design/Development of solutions	PO9	Individual and team work
PO4	Conduct investigations of complex problems	PO10	Communication
PO5	Modern tool usage	PO11	Project Management and Finance
PO6	The Engineer and Society	PO12	Life long learning

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination Marks
	Test 1 (Marks)	Test 2 (Marks)	
Remember	30	30	30
Understand	30	30	30
Apply	40	40	40
Analyze			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : **10 marks**

Continuous Assessment - Test : **25 marks**

Continuous Assessment - Assignment : **15 marks**

Internal Examination Pattern:

Each of the two internal examinations has to be conducted out of 50 marks. The first series test shall be preferably conducted after completing the first half of the syllabus and the second series test shall be preferably conducted after completing the remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly completed module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly completed module), each with 7 marks. Out of the 7 questions, a student should answer any 5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which a student should answer any one. Each question can have maximum 2 sub-divisions and carries 14 marks.

Syllabus

CST 301 Formal Languages and Automata Theory

Module - 1 (Introduction to Formal Language Theory and Regular Languages)

Introduction to formal language theory– Alphabets, Strings, Concatenation of strings, Languages.

Regular Languages - Deterministic Finite State Automata (DFA) (Proof of correctness of construction not required), Nondeterministic Finite State Automata (NFA), Equivalence of DFA and NFA, Regular Grammar (RG), Equivalence of RGs and DFA.

Module - 2 (More on Regular Languages)

Regular Expression (RE), Equivalence of REs and DFA, Homomorphisms, Necessary conditions for regular languages, Closure Properties of Regular Languages, DFA state minimization (No proof required).

Module - 3 (Myhill-Nerode Relations and Context Free Grammars)

Myhill-Nerode Relations (MNR)- MNR for regular languages, Myhill-Nerode Theorem (MNT) (No proof required), Applications of MNT.

Context Free Grammar (CFG)- CFG representation of Context Free Languages (proof of correctness is required), derivation trees and ambiguity, Normal forms for CFGs.

Module - 4 (More on Context-Free Languages)

Nondeterministic Pushdown Automata (PDA), Deterministic Pushdown Automata (DPDA), Equivalence of PDAs and CFGs (Proof not required), Pumping Lemma for Context-Free Languages (Proof not required), Closure Properties of Context Free Languages.

Module - 5 (Context Sensitive Languages, Turing Machines)

Context Sensitive Languages - Context Sensitive Grammar (CSG), Linear Bounded Automata.

Turing Machines - Standard Turing Machine, Robustness of Turing Machine, Universal Turing Machine, Halting Problem, Recursive and Recursively Enumerable Languages.

Chomsky classification of formal languages.

Text Book

1. Dexter C. Kozen, Automata and Computability, Springer (1999)

Reference Materials

1. John E Hopcroft, Rajeev Motwani and Jeffrey D Ullman, Introduction to Automata Theory, Languages, and Computation, 3/e, Pearson Education, 2007
2. Michael Sipser, Introduction To Theory of Computation, Cengage Publishers, 2013.

Sample Course Level Assessment Questions

Course Outcome 1 (CO1): Identify the class of the following languages in Chomsky Hierarchy:

- $L_1 = \{a^p \mid p \text{ is a prime number}\}$
- $L_2 =$

$\{x \in \{0,1\}^* \mid x \text{ is the binary representation of a decimal number which is a multiple of } 5\}$

- $L_3 = \{a^n b^n c^n \mid n \geq 0\}$
- $L_4 = \{a^m b^n c^{m+n} \mid m > 0, n \geq 0\}$
- $L_5 = \{M\#x \mid M \text{ halts on } x\}$. Here, M is a binary encoding of a Turing Machine and x is a binary input to the Turing Machine.

Course Outcome 2 (CO2):

- (i) Design a DFA for the language $L = \{axb \mid x \in \{a,b\}^*\}$
- (ii) Write a Regular Expression for the language: $L = \{x \in \{a,b\}^* \mid \text{third last symbol in } x \text{ is } b\}$
- (iii) Write a Regular Grammar for the language: $L = \{x \in \{0,1\}^* \mid \text{there are no consecutive zeros in } x\}$
- (iv) Show the equivalence classes of the canonical Myhill-Nerode relation induced by the language: $L = \{x \in \{a,b\}^* \mid x \text{ contains even number of } a\text{'s and odd number of } b\text{'s}\}$.

Course Outcome 3 (CO3):

- (i) Design a PDA for the language $L = \{ww^R \mid w \in \{a,b\}^*\}$. Here, the notation w^R represents the reverse of the string w .
- (ii) Write a Context-Free Grammar for the language $L = \{a^n b^{2n} \mid n \geq 0\}$.

Course Outcome 4 (CO4):

- (i) Design a Turing Machine for the language $L = \{a^n b^n c^n \mid n \geq 0\}$
- (ii) Design a Turing Machine to compute the square of a natural number. Assume that the input is provided in unary representation.

Course Outcome 5 (CO5): Argue that it is undecidable to check whether a Turing Machine enters a given state during the computation of a given input x .

Model Question paper**QP CODE:****PAGES:3****Reg No:** _____**Name :** _____**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY****FIFTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR****Course Code: CST301****Course Name: Formal Languages and Automata Theory****Max.Marks:100****Duration: 3 Hours****PART A****Answer all Questions. Each question carries 3 Marks**

1. Design a DFA for the language $L = \{x \in \{a, b\}^* | aba \text{ is not a substring in } x\}$.
2. Write a Regular Grammar for the language: $L = \{axb | x \in \{a, b\}^*\}$
3. Write a Regular Expression for the language:
 $L = \{x \in \{0,1\}^* | \text{there are no consecutive 1's in } x\}$
4. Prove that the language $L_1 = \{a^{n!} | n \in N\}$ is not regular.
5. List out the applications of Myhill-Nerode Theorem.
6. Write a Context-Free Grammar for the language: $L = \{x \in \{a, b\}^* | \#_a(x) = \#_b(x)\}$. Here, the notation $\#_1(w)$ represents the number of occurrences of the symbol 1 in the string w .
7. Design a PDA for the language of odd length binary palindromes (no explanation is required, just list the transitions in the PDA).
8. Prove that Context Free Languages are closed under set union.
9. Write a Context Sensitive Grammar for the language $L = \{a^n b^n c^n | n \geq 0\}$ (no explanation is required, just write the set of productions in the grammar).

10. Differentiate between Recursive and Recursively Enumerable Languages.

(10x3=30)

Part B

(Answer any one question from each module. Each question carries 14 Marks)

11. (a) Draw the state-transition diagram showing an NFA N for the following language L . Obtain the DFAD equivalent to N by applying the subset construction algorithm. (7)

$$L = \{x \in \{a, b\}^* \mid \text{the second last symbol in } x \text{ is } b\}$$

- (b) Draw the state-transition diagram showing a DFA for recognizing the following language: (7)

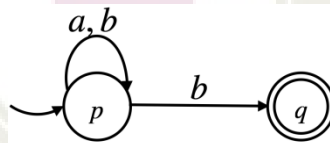
$$L = \{x \in \{0,1\}^* \mid x \text{ is a binary representation of a natural number which is a multiple of 5}\}$$

OR

12. (a) Write a Regular grammar G for the following language L defined as: $L = \{x \in \{a, b\}^* \mid x \text{ does not contain consecutive } b\text{'s}\}$. (7)

- (b) Obtain the DFA A_G over the alphabet set $\Sigma = \{a, b\}$, equivalent to the regular grammar G with start symbol S and productions: $S \rightarrow aA$ and $A \rightarrow aA \mid bA \mid b$. (7)

13. (a) Using Kleen's construction, obtain the regular expression for the language represented by the following NFA

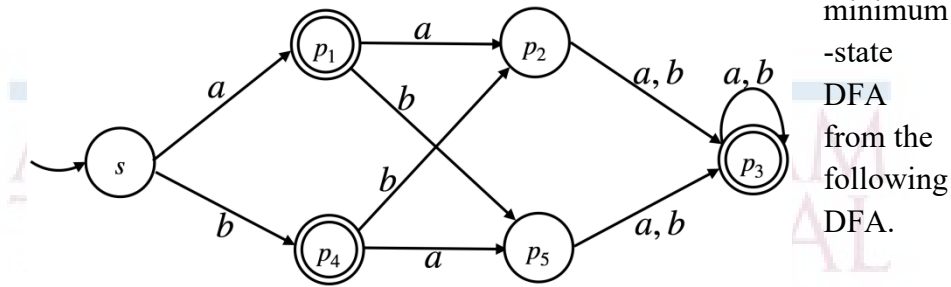


- (b) Using pumping lemma for regular languages, prove that the language $L = \{a^n b^n \mid n \geq 0\}$ is not regular. (7)

OR

14. (a)

Obtain the minimum-state DFA from the following DFA. (8)



(b) Using ultimate periodicity for regular languages, prove that the language $L = \{a^{n^2} | n \geq 0\}$ is not regular. (6)

15. (a) Show the equivalence classes of the canonical Myhill-Nerode relation for the language of binary strings with odd number of 1's and even number of 0s. (7)

(b) With an example, explain ambiguity in Context Free Grammar (7)

OR

16. (a) Convert the Context-Free Grammar with productions: $\{S \rightarrow aSb | \epsilon\}$ into Greibach Normal form. (8)

(b) Convert the Context-Free Grammar with productions: $\{S \rightarrow aSa | bSb | SS | \epsilon\}$ into Chomsky Normal form. (6)

17. (a) Design a PDA for the language $L = \{a^m b^n c^{m+n} | n \geq 0, m \geq 0\}$. Also illustrate the computation of the PDA on a string in the language (7)

(b) With an example illustrate how a multi-state PDA can be transformed into an equivalent single-state PDA. (7)

OR

18. (a) Using pumping lemma for context-free languages, prove that the language:
 $L = \{ww|w \in \{a, b\}^*\}$ is not a context-free language. (6)
- (b) With an example illustrate how a CFG can be converted to a single-state PDA (8)
19. (a) Design a Turing machine to obtain the sum of two natural numbers a and b , both represented in unary on the alphabet set $\{1\}$. Assume that initially the tape contains $\vdash 1^a 0 1^b \vdash$. The Turing Machine should halt with $\vdash 1^{a+b} \vdash$ as the tape content. Also, illustrate the computation of your Turing Machine on the input $a = 3$ and $b = 2$. (7)
- (b) With an example illustrate how a CFG can be converted to a single-state PDA. (7)

OR

20. (a) Design a Turing machine to obtain the sum of two natural numbers a and b , both represented in unary on the alphabet set $\{1\}$. Assume that initially the tape contains $\vdash 1^a 0 1^b \vdash$. The Turing Machine should halt with $\vdash 1^{a+b} \vdash$ as the tape content. Also, illustrate the computation of your Turing Machine on the input $a = 3$ and $b = 2$. (7)
- (b) Write a context sensitive grammar for the language $L = \{a^n b^n c^n | n \geq 0\}$. Also illustrate how the string $a^2 b^2 c^2$ can be derived from the start symbol of the proposed grammar. (7)

Estd.



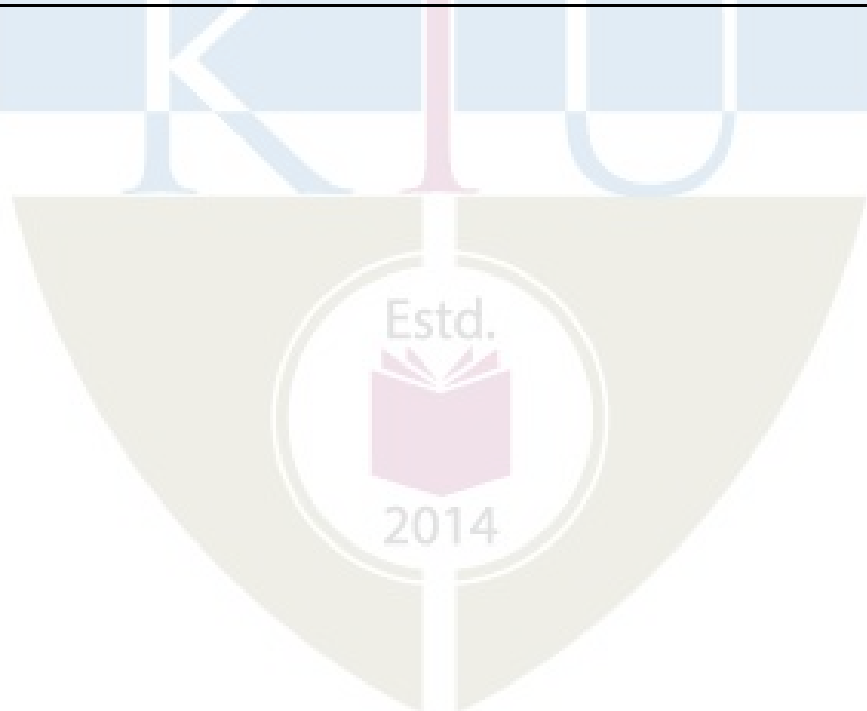
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Teaching Plan

Sl. No	Topic	No. of Hours (45 hrs)
Module - 1 (Introduction to Formal Language Theory and Regular Languages)		9 Hours
1.1	Introduction to formal language theory – Alphabets, strings, concatenation of strings, Languages	1 Hour
1.2	Deterministic Finite State Automata (DFA) – Example DFA (Proof of correctness of construction not required)	1 Hour
1.3	Formal definition of DFA, Language accepted by the class of DFA	1 Hour
1.4	Nondeterministic Finite State Automata (NFA) – Example NFA	1 Hour
1.5	Formal definition of NFA, NFA with ϵ transitions - examples, formal definition	1 Hour
1.6	Equivalence of DFA and NFA with and without ϵ transitions - Subset construction	1 Hour
1.7	Regular Grammar (RG) – Example RGs, derivation of sentences	1 Hour
1.8	Formal definition of RG, Language represented by a RG	1 Hour
1.9	Equivalence of RG and DFA	1 Hour
Module - 2 (More on Regular Languages)		9 Hours
2.1	Regular Expression (RE) - Example REs and formal definition	1 Hour
2.2	Conversion of RE to NFA with ϵ transition	1 Hour
2.3	Conversion of NFA with ϵ transition to RE (Kleen's construction)	1 Hour
2.4	Homomorphisms	1 Hour
2.5	Pumping Lemma for regular languages	1 Hour
2.6	Ultimate periodicity	1 Hour
2.7	Closure Properties of Regular Languages (proof not required)	1 Hour

2.8	DFA state minimization - Quotient construction	1 Hour
2.9	State Minimization Algorithm - Example	1 Hour
Module - 3 (Myhill-Nerode Relations and Context Free Grammars)		10 Hours
3.1	Myhill-Nerode Relations (MNR) - Example, Properties of MyhillNerode Relation	1 Hour
3.2	Conversion of DFA to MNR (Proof of correctness not required)	1 Hour
3.3	Conversion of MNR to DFA(Proof of correctness not required)	1 Hour
3.4	Myhill-Nerode Theorem (MNT)	1 Hour
3.5	Applications of MNT	1 Hour
3.6	Context Free Grammar (CFG) - Example CFGs and formal definition	1 Hour
3.7	Proving correctness of CFGs	1 Hour
3.8	Derivation Trees and ambiguity	1 Hour
3.9	Chomsky Normal Form	1 Hour
3.10	Greibach Normal Form	1 Hour
Module - 4 (More on Context-Free Languages)		8 Hours
4.1	Nondeterministic Pushdown Automata (PDA) – Example PDAs, formal definition	1 Hour
4.2	Acceptance criteria - equivalence	1 Hour
4.3	Deterministic PDA	1 Hour
4.4	Conversion of CFG to PDA (No proof required)	1 Hour
4.5	Conversion of PDA to CGF - Part I (No proof required)	1 Hour
4.6	Conversion of PDA to CGF - Part II (No proof required)	1 Hour
4.7	Pumping Lemma for context-free languages (No proof required)	1 Hour
4.8	Closure Properties of Context Free Languages	1 Hour

Module - 5 (Context Sensitive Languages, Turing Machines)		9 Hours
5.1	Context Sensitive Grammar (CSG) - Examples, formal definition	1 Hour
5.2	Linear Bounded Automata (LBA) - Example LBA, formal definition	1 Hour
5.3	Turing Machine (TM) - TM as language acceptors - examples, formal definition	1 Hour
5.4	TM as transducers - examples	1 Hour
5.5	Robustness of the standard TM model - Multi-tape TMs, Nondeterministic TM	1 Hour
5.6	Universal Turing Machine	1 Hour
5.7	Halting Problem of TM - proof of its undecidability	1 Hour
5.8	Recursive and Recursively Enumerable Languages	1 Hour
5.9	Chomsky classification of formal languages	1 Hour



CST 303	COMPUTER NETWORKS	Category	L	T	P	Credit	Year of Introduction
		PCC	3	1	0	4	2019

Preamble: Study of this course provides the learners a clear understanding of how computer networks from local area networks to the massive and global Internet are built, how they allow computers to share information and communicate with one another. This course covers the physical aspects of computer networks, layers of OSI Reference model, and inter-networking. The course helps the learners to compare and analyze the existing network technologies and choose a suitable network design for a given system.

Prerequisite: Nil

Course Outcomes: After the completion of the course, the student will be able to

CO#	Course Outcomes
CO1	Explain the features of computer networks, protocols, and network design models (Cognitive Knowledge: Understand)
CO2	Describe the fundamental characteristics of the physical layer and identify the usage in network communication (Cognitive Knowledge: Apply)
CO3	Explain the design issues of data link layer, link layer protocols, bridges and switches (Cognitive Knowledge: Understand)
CO4	Illustrate wired LAN protocols (IEEE 802.3) and wireless LAN protocols (IEEE 802.11) (Cognitive Knowledge: Understand)
CO5	Select appropriate routing algorithms, congestion control techniques, and Quality of Service requirements for a network (Cognitive Knowledge: Apply)
CO6	Illustrate the functions and protocols of the network layer, transport layer, and application layer in inter-networking (Cognitive Knowledge: Understand)

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓										✓
CO2	✓	✓	✓									✓
CO3	✓	✓	✓									✓
CO4	✓	✓	✓									✓
CO5	✓	✓	✓	✓								✓
CO6	✓	✓	✓			✓						✓

Abstract POs defined by National Board of Accreditation			
PO#	Broad PO	PO#	Broad PO
PO1	Engineering Knowledge	PO7	Environment and Sustainability
PO2	Problem Analysis	PO8	Ethics
PO3	Design/Development of solutions	PO9	Individual and teamwork
PO4	Conduct investigations of complex problems	PO10	Communication
PO5	Modern tool usage	PO11	Project Management and Finance
PO6	The Engineer and Society	PO12	Lifelong learning

Assessment Pattern

Bloom's Category	Test 1 (Marks in percentage)	Test 2 (Marks in percentage)	End Semester Examination (Marks in percentage)
Remember	40	30	30

Understand	50	50	50
Apply	10	20	20
Analyze			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3

Continuous Internal Evaluation Pattern:

Attendance : 10 marks

Continuous Assessment Test : 25 marks

Continuous Assessment Assignment : 15 marks

Internal Examination Pattern:

Each of the two internal examinations has to be conducted out of 50 marks. The first series test shall be preferably conducted after completing the first half of the syllabus. The second series test shall be preferably conducted after completing the remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly completed module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly completed module), each with 7 marks. Out of the 7 questions, a student should answer any 5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which a student should answer anyone. Each question can have maximum 2 sub-divisions and carries 14 marks.

Syllabus

Module - 1 (Introduction and Physical Layer)

Introduction – Uses of computer networks, Network hardware, Network software. Reference models – The OSI reference model, The TCP/IP reference model, Comparison of OSI and TCP/IP reference models.

Physical Layer – Modes of communication, Physical topologies, Signal encoding, Repeaters and hub, Transmission media overview. Performance indicators – Bandwidth, Throughput, Latency, Queuing time, Bandwidth–Delay product.

Module - 2 (Data Link Layer)

Data link layer - Data link layer design issues, Error detection and correction, Sliding window protocols, High-Level Data Link Control(HDLC)protocol. Medium Access Control (MAC) sublayer –Channel allocation problem, Multiple access protocols, Ethernet, Wireless LANs - 802.11, Bridges & switches - Bridges from 802.x to 802.y, Repeaters, Hubs, Bridges, Switches, Routers and Gateways.

Module - 3 (Network Layer)

Network layer design issues. Routing algorithms - The Optimality Principle, Shortest path routing, Flooding, Distance Vector Routing, Link State Routing, Multicast routing, Routing for mobile hosts. Congestion control algorithms. Quality of Service (QoS) - requirements, Techniques for achieving good QoS.

Module - 4 (Network Layer in the Internet)

IP protocol, IP addresses, Internet Control Message Protocol (ICMP), Address Resolution Protocol (ARP), Reverse Address Resolution Protocol (RARP), Bootstrap Protocol (BOOTP), Dynamic Host Configuration Protocol (DHCP). Open Shortest Path First(OSPF) Protocol, Border Gateway Protocol (BGP), Internet multicasting, IPv6, ICMPv6.

Module – 5 (Transport Layer and Application Layer)

Transport service – Services provided to the upper layers, Transport service primitives. User Datagram Protocol (UDP). Transmission Control Protocol (TCP) – Overview of TCP, TCP segment header, Connection establishment &release, Connection management modeling, TCP retransmission policy, TCP congestion control.

Application Layer –File Transfer Protocol (FTP), Domain Name System (DNS), Electronic mail, Multipurpose Internet Mail Extension (MIME), Simple Network Management Protocol

(SNMP), World Wide Web(WWW) – Architectural overview.

Text Books

1. Andrew S. Tanenbaum, Computer Networks, 4/e, PHI (Prentice Hall India).
2. Behrouz A Forouzan, Data Communication and Networking, 4/e, Tata McGraw Hill

Reference Books

1. Larry L Peterson and Bruce S Dave, Computer Networks – A Systems Approach, 5/e, Morgan Kaufmann.
2. Fred Halsall, Computer Networking and the Internet, 5/e.
3. James F. Kurose, Keith W. Ross, Computer Networking: A Top-Down Approach, 6/e.
4. Keshav, An Engineering Approach to Computer Networks, Addison Wesley, 1998.
5. W. Richard Stevens. TCP/IP Illustrated Volume 1, Addison-Wesley, 2005.
6. William Stallings, Computer Networking with Internet Protocols, Prentice-Hall, 2004.
7. Request for Comments (RFC) Pages - IETF -<https://www.ietf.org/rfc.html>

Course Level Assessment Questions

Course Outcome1 (CO1)

1. Compare TCP/IP and OSI reference model.
2. The purpose of physical layer is to transport a raw bit stream from one machine to another. Justify.

Course Outcome2 (CO2)

1. Write the physical and transmission characteristics of Optical Fibre Cable guided transmission media.
2. The distance between the sender and receiver systems is about 200 KM. The speed of transmission is 2GB/s. Find out the propagation time?

Course Outcome3 (CO3)

1. Ethernet frames must be at least 64 bytes long to ensure that the transmitter is still going in the event of a collision at the far end of the cable. Fast Ethernet has the same 64-byte minimum frame size but can get the bits out ten times faster. How is it possible to maintain the same minimum frame size?
2. What do you mean by bit stuffing?

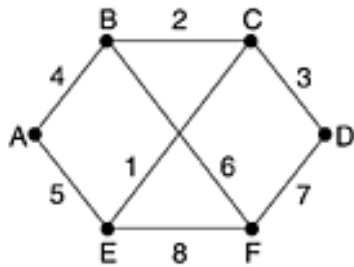
Course Outcome4 (CO4)

1. Draw and explain the frame format for Ethernet.
2. Give the differences between CSMA/CD and CSMA/CA protocol.

Course Outcome5 (CO5)

1. Consider the given subnet in which distance vector routing is used, and the vectors just come in to router C as follows: from B: (5, 0, 8, 12, 6, 2); from D: (16, 12, 6, 0, 9, 10);

and from E: (7, 6, 3, 9, 0, 4). The measured delays from C to B, D, and E, are 6, 3, and 5, respectively. What is C's new routing table? Give both the outgoing line to use and the expected delay.



2. Illustrate the leaky bucket congestion control technique.

Course Outcome 6 (CO6)

1. How do you subnet the Class C IP Address 206.16.2.0 so as to have 30 subnets. What is the subnet mask for the maximum number of hosts? How many hosts can each subnet have?
2. Give the architecture of World Wide Web.

Model Question Paper

QP CODE:

PAGES:

Reg No: _____

Name: _____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FIFTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: CST 303

Course Name : Computer Networks

Max Marks: 100

Duration: 3 Hours

PART-A

(Answer All Questions. Each question carries 3 marks)

1. What does "negotiation" mean when discussing network protocols in a layered architecture? Give an example.

2. Define simplex, half-duplex, and full-duplex transmission modes. Give one example for each.
3. Data link protocols almost always put the CRC in a trailer rather than in a header. Why?
4. An 8-bit byte with binary value 10101111 is to be encoded using an even-parity Hamming code. What is the binary value after encoding?
5. Illustrate the Count to Infinity problem in routing.
6. Describe two major differences between the warning bit method and the Random Early Detection (RED) method.
7. The Protocol field used in the IPv4 header is not present in the fixed IPv6 header. Why?
8. How many octets does the smallest possible IPv6 (IP version 6) datagram contain?
9. Can Transmission Control Protocol(TCP) be used directly over a network (e. g. an Ethernet) without using IP? Justify your answer.
10. When Web pages are sent out, they are prefixed by MIME headers. Why?

(10x3=30)**Part B**

(Answer any one question from each module. Each question carries 14 Marks)

11. (a) With a neat diagram, explain Open Systems Interconnection (OSI) Reference Model. **(8)**
- (b) Compare Twisted Pair, Coaxial Cable and Optical Fibre guided transmission media. **(6)**

OR

12. (a) Consider two networks providing reliable connection-oriented service. One of them offers a reliable byte stream and the other offers a reliable message stream. Are they identical? Justify your answer. **(8)**
- (b) Sketch the waveform in Manchester and Differential Manchester Encoding for the bitstream 11000110010. **(6)**

13. (a) A bit stream 10011101 is transmitted using the standard CRC method. The generator polynomial is $x^3 + 1$. Show the actual bit string transmitted. Suppose the third bit from the left is inverted during transmission. Show that this error is detected at the receiver's end. (8)
- (b) Explain the working of High-Level Data Link Control (HDLC) protocol. (6)
- OR**
14. (a) Explain the working of IEEE 802.11 MAC sublayer. (10)
- (b) Distinguish between Bridges and Switches. (4)
15. (a) Illustrate Distance Vector Routing algorithm with an example. (8)
- (b) Explain the characteristics of Routing Information Protocol (RIP). (6)
- OR**
16. (a) A computer on a 6-Mbps network is regulated by a token bucket. The token bucket is filled at a rate of 1 Mbps. It is initially filled to capacity with 8 megabits. How long can the computer transmit at the full 6 Mbps? (8)
- (b) Explain how routing is performed for mobile hosts. (6)
17. (a) Explain the address resolution problem using Address Resolution Protocol (ARP) and Reverse Address Resolution Protocol (RARP) with an example network. (10)
- (b) A network on the Internet has a subnet mask of 255.255.240.0. What is the maximum number of hosts it can handle? (4)
- OR**
18. (a) How do you subnet the Class C IP address 195.1.1.0 so as to have 10 subnets with a maximum of 12 hosts in each subnet. (6)
- (b) Draw IPv6 Datagram format and explain its features. (8)
19. (a) Distinguish the header formats of Transmission Control protocol (TCP) and User Datagram Protocol (UDP). (8)
- (b) Explain the principal Domain Name System (DNS) resource record types for (6)

IPv4.

OR

20. (a) What is the role of Simple Mail Transfer Protocol (SMTP) in E- mail? (6)
- (b) With the help of a basic model, explain the working of World Wide Web (WWW). (8)

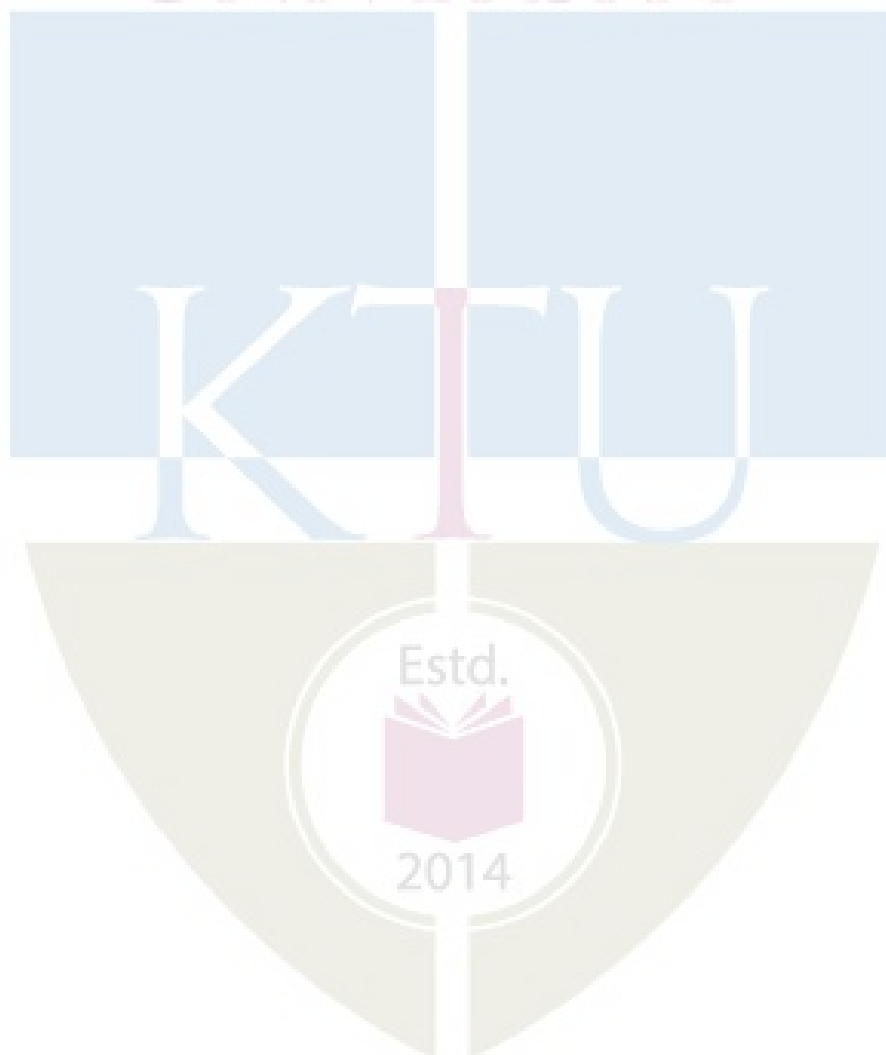
Teaching Plan

No	Contents	No of Lecture Hrs
Module – 1 (Introduction and Physical Layer) (10 hrs)		
1.1	Introduction, Uses of computer networks.	1 hour
1.2	Network Hardware, Local Area Networks (LAN), Metropolitan Area Networks (MAN), Wide Area Networks (WAN), Wireless networks, Home networks, Internetworks.	1 hour
1.3	Network Software, Protocol hierarchies, Design issues for the layers.	1 hour
1.4	Connection-oriented and Connectionless services, Service primitives, Relationship of services to protocols.	1 hour
1.5	Reference models, The OSI reference model.	1 hour
1.6	The TCP/IP reference model, Comparison of OSI and TCP/IP reference models.	1 hour
1.7	Physical layer, Modes of communication, Simplex, Half-duplex, and Full-duplex, Physical topologies, Mesh, Star, Bus, Ring, Hybrid.	1 hour
1.8	Signal encoding, Manchester, Differential Manchester.	1 hour
1.9	Transmission media overview, Guided media (twisted pair, coaxial and fiber optic media), Unguided/wireless media (radio, microwave, and infrared).	1 hour
1.10	Performance indicators, Bandwidth (in Hertz and in Bits per Seconds),	1 hour

	Throughput, Latency (Delay), Queuing time, Bandwidth-Delay product.	
Module 2 – (Data Link Layer) (10 hrs)		
2.1	Data link layer design issues.	1 hour
2.2	Error detection and correction, Error correcting codes	1 hour
2.3	Error detecting codes.	1 hour
2.4	Sliding window protocols.	1 hour
2.5	High-Level Data Link Control(HDLC) protocol.	1 hour
2.6	Medium Access Control (MAC) sublayer, Channel allocation problem, Multiple access protocols.	1 hour
2.7	Ethernet, Ethernet cabling, Manchester encoding, Ethernet MAC sublayer protocol, Binary Exponential Backoff algorithm.	1 hour
2.8	Ethernet performance, Switched Ethernet, Fast Ethernet, Gigabit Ethernet, IEEE 802.2: Logical Link Control.	1 hour
2.9	Wireless LANs, 802.11 protocol stack, Physical layer, MAC Sublayer protocol, Frame structure.	1 hour
2.10	Bridges & switches, Bridges from 802.x to 802.y, Repeaters, Hubs, Bridges, Switches, Routers, and Gateways.	1 hour
Module 3 - (Network Layer) (8 hrs)		
3.1	Network layer design issues.	1 hour
3.2	Routing algorithms, The Optimality Principle, Shortest path routing, Flooding.	1 hour
3.3	Distance Vector Routing.	1 hour
3.4	Link State Routing.	1 hour
3.5	Multicast routing, Routing for mobile hosts.	1 hour

3.6	General principles of congestion control, Congestion prevention policies, Congestion control in virtual circuit subnets.	1 hour
3.7	Congestion control algorithms, Congestion control in Datagram subnets, Load shedding, Jitter control.	1 hour
3.8	Quality of Service, Requirements, Techniques for achieving good Quality of Service.	1 hour
Module 4 – (Network Layer in the Internet) (9 hrs)		
4.1	Network layer in the Internet, Internet Protocol (IP).	1 hour
4.2	IP Addresses, Subnets, Classless Inter-Domain Routing (CIDR).	1 hour
4.3	IP Addresses, Network Address Translation (NAT).	1 hour
4.4	Internet Control Message Protocol (ICMP), Address Resolution Protocol (ARP), Reverse Address Resolution Protocol (RARP).	1 hour
4.5	Bootstrap Protocol (BOOTP), Dynamic Host Configuration Protocol (DHCP).	1 hour
4.6	Open Shortest Path First (OSPF) protocol.	1 hour
4.7	Border Gateway Protocol (BGP).	1 hour
4.8	Internet multicasting.	1 hour
4.9	IPv6, Header format, Extension headers, Internet Control Message Protocol version 6 (ICMPv6).	1 hour
Module 5 - (Transport Layer and Application Layer) (8 hrs)		
5.1	Transport Service, Services provided to the upper layers, Transport service primitives. User Datagram Protocol (UDP).	1 hour
5.2	Transmission Control Protocol (TCP), TCP segment header, Connection establishment & release, Connection management modeling.	1 hour
5.3	TCP retransmission policy, TCP congestion control.	1 hour
5.4	Application layer, File Transfer Protocol (FTP).	1 hour

5.5	Domain Name System (DNS).	1 hour
5.6	Electronic Mail, Multipurpose Internet Mail Extension (MIME).	1 hour
5.7	Simple Network Management Protocol (SNMP).	1 hour
5.8	World Wide Web, Architectural overview.	1 hour



Preamble: Study of this course provides the learners a clear understanding of the fundamental concepts of network and wireless security and the processes and means required to implement a secure network. It covers the techniques to transfer a message securely over insecure channel. This course covers the security measures in Windows and Linux operating systems. The course helps the learners to understand the various threats faced in the Internet and web services.

Prerequisite: Sound knowledge in Computer Networks.

CO#	Course Outcomes
C01	Explain the techniques for network protection and explore new tools and attacks in network security domain(Cognitive Knowledge Level: Understand)
C02	Identify the challenges, attacks and defences in Operating Systems.(Cognitive Knowledge Level: Understand)
C03	Summarize the basic functionalities of Windows and Linux Hardening(Cognitive Knowledge Level: Understand)
C04	Illustrate the characteristics and applications of cryptography and steganography principles.(Cognitive Knowledge Level: Apply)
C05	Explain the various attacks as well as security in Internet and Web services. (Cognitive Knowledge Level: Understand)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12
CO1												
CO2												
CO3												
CO4												
CO5												
CO6												

Abstract POs defined by National Board of Accreditation			
PO#	Broad PO	PO#	Broad PO
PO1	Engineering Knowledge	PO7	Environment and Sustainability
PO2	Problem Analysis	PO8	Ethics
PO3	Design/Development of solutions	PO9	Individual and team work
PO4	Conduct investigations of complex problems	PO10	Communication
PO5	Modern tool usage	PO11	Project Management and Finance
PO6	The Engineer and Society	PO12	Lifelong learning

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination Marks(%)
	Test1(%)	Test2(%)	
Remember	30	30	30
Understand	50	50	50
Apply	20	20	20
Analyze			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks

Continuous Assessment Test : 25 marks

Continuous Assessment Assignment : 15 marks

Internal Examination Pattern: Each of the two internal examinations has to be conducted out of 50 marks. The first series test shall be preferably conducted after completing the first half of the syllabus. The second series test shall be preferably conducted after completing the remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly completed module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly completed module), each with 7 marks. Out of the 7 questions, a student should answer any 5.

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which a student should answer anyone. Each question can have maximum 2 sub-divisions and carries 14 marks.

Syllabus**Module-1 (Principles of Network Security)**

Network Security Terminologies, Network Security and Data Availability, Components of Network Security, Network Security Policies.

Network segments-Perimeter Defense, NAT, Basic architecture issues, Subnetting, Switching and VLANs, Address Resolution protocol and media access control, Dynamic Host Configuration Protocol and Addressing Control.

Module-2(Windows Security)

Windows Security at the heart of the defense, Out-of-the-box Operating system hardening, Installing applications, Putting the workstation on the network, Operating Windows safely, Upgrades and Patches, Maintain and test the security, Attacks against the Windows workstation.

Linux Security- Physical security, Controlling the configuration, Operating Linux safely, Hardening Linux.

Module-3 (Web Browser Security)

Web Browser and Client risk- How a web browser works, Web browser attacks, Operating safely, Web security- How HTTP works, Server and Client contents, State, Attacking Web servers, Web Services. E-mail security- The e-mail risk, Protocols, Authentication, Operating safely when using email, Domain Name System – DNS basics, Purpose of DNS, Security Issues with DNS, DNS attacks.

Module-4 (Cryptography and Steganography)

Cryptography- Principles, four cryptographic primitives, Proprietary versus open source algorithms. Steganography - overview, Core areas of network security and their relation to steganography, Principles of Steganography, Types of Steganography, Steganography Versus Digital Watermarking, Types of Digital Watermarking, Goals of Digital Watermarking.

Module-5 (Network Security)

Security In Data Networks: Wireless Device security issues-GPRS security, GSM security, IP security. Wireless Transport Layer Security: Secure Socket Layer - Wireless Transport Layer Security - WAP Security Architecture - WAP Gateway.

Firewalls-types, rules, personal firewalls, Intrusion detection systems, responses to intrusion detection, Penetration testing, Auditing and Monitoring.

Text Books

1. Eric Cole, Ronald Krutz, James W. Conley, “Network Security Bible”, First Edition Wiley India Pvt Ltd, 2010
2. Michael A Whitman, Herbert J.Mattord, “Principles of Information Security”,Cengage Learning, Fourth Edition, 2016.

References

1. William Stallings, “Network Security Essentials”,Pearson Education, 4th Edition, 2011
2. Eric Maiwald, ”Fundamentals of Network Security”, Tata McGraw-Hill, 2011

Sample Course Level Assessment Questions

CourseOutcome1(CO1):A class B network on the internet has a subnet mask of 255.255.240.0. What is the maximum number of hosts per subnet?

CourseOutcome2(CO2): What are the different steps involved while hardening Windows and Linux OS?

CourseOutcome3 (CO3): Describe the basic request and response model in an HTTP session.

Course Outcome4 (CO4): Explain the Insertion-based steganography, Algorithmic-based steganography and Grammar-based steganography.

Course Outcome 5 (CO5): What is tiered architecture in the perspective of firewalls?

Model Question Paper

QP CODE:

Reg No: _____

Name : _____

PAGES : 3

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
FIFTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR**

Course Code: CCT 305

Course Name: Systems & Network Security

Max.Marks:100

Duration: 3 Hours

PART A

Answer all Questions. Each question carries 3 Marks

1. What is Network Address Translation?
2. How can you create a VLAN environment?
3. Describe the steps to be followed before putting a workstation on any network?
4. What is Defense-in-depth methodology?
5. Explain the role of Web servers.
6. What is reverse lookup of DNS?
7. What are keyed hash functions?
8. Briefly explain the principles of steganography.
9. What are the disadvantages of firewalls?
10. Differentiate white-box, grey-box and black-box testing. **(10 x 3 = 30 Marks)**

PART B

Answer any one Question from each module.

Each question carries 14 Marks

11. a) Explain the principles of network security and network security policies. **(8 Marks)**
b) Explain the different types of ARP. **(6 Marks)**

OR

12. a) What is DHCP and why it is used? **(8 Marks)**
b) What are the different ways to protect a computer network? **(6 Marks)**

13. a) What are the steps to be followed while putting a windows workstation on the network? **(8 Marks)**
b) Why Linux is considered less attractive target for security attacks? **(6 Marks)**

OR

14. a) How can you prepare a UNIX workstation for the inevitable attack? **(8 Marks)**
b) Briefly describe the general process of windows system hardening. **(6 Marks)**
15. a) Explain the working of HTTP with neat diagram? **(8 Marks)**
b) What are the problems that are caused due to DNS misconfiguration? **(6 Marks)**

OR

16. a) Explain in detail account harvesting and SQL injection. **(6 Marks)**
b) What do you mean by
(i) Hijacking attack (ii) Replay attack (iii) Browser Parasites **(8 Marks)**
17. a) Explain the four cryptographic primitives. **(8 Marks)**
b) Discuss the difference between proprietary and Open Source Algorithms. **(6 Marks)**

OR

18. a) What is Steganography, how does it differ from Digital Watermarking? **(8 Marks)**
b) What are the different types of steganography? **(6 Marks)**
19. a) Describe the WAP architecture. **(8 Marks)**
b) Explain the different types of firewall . **(6 Marks)**

OR

20. a) With a neat diagram explain the SSL handshaking protocol. **(8 Marks)**
b) Draw the packet format of ESP and AH protocol. **(6 Marks)**

TEACHING PLAN

Sl.No.	Contents	No. of Lecture Hours
Module-1(Principles of Network Security)(7 hrs)		
1.1	Principles of Network Security, Network Security Terminologies	1 hour
1.2	Network Security and Data Availability,	1 hour
1.3	Components of Network Security, Network Security Policies	1 hour
1.4	Network segments-Perimeter Defense, NAT	1 hour
1.5	Basic architecture issues, Subnetting , switching and VLANs,	1 hour
1.6	Address Resolution protocol and media access control,	1 hour
1.7	Dynamic Host Configuration Protocol	1 hour
Module-2 (Windows Security)(10 hrs)		
2.1	Windows Security- Windows Security at the heart of the defense	1 hour
2.2	Out-of the-box Operating system hardening	1 hour
2.3	Installing applications	1 hour
2.4	Putting the workstation on the network, Operating Windows safely	1 hour
2.5	Upgrades and Patches	1 hour
2.6	Maintain and test the security	1 hour
2.7	Attacks against the Windows workstation	1 hour
2.8	Linux Security- Physical security	1 hour

2.9	Controlling the configuration, Operating Linux safely	1 hour
2.10	Hardening Linux	1 hour
Module-3 (Web Browser Security)(11 hrs)		
3.1	Components of Internet, Weak points of Internet, Techniques of Web Hacking	1 hour
3.2	Methods of Attacking users. Web Browser and Client risk-	1 hour
3.3	How a web browser works	1 hour
3.4	Web browser attacks	1 hour
3.5	Operating safely, Web security- How HTTP works	1 hour
3.6	Server and Client contents	1 hour
3.7	State, Attacking Web servers, Web Services	1 hour
3.8	E-mail security- The e-mail risk	1 hour
3.9	Protocols, Authentication	1 hour
3.10	Operating safely when using email, Domain Name System – DNS basics	1 hour
3.11	Purpose of DNS, Security Issues with DNS, DNS attacks.	1 hour
Module-4 (Cryptography and Steganography)(8 hrs)		
4.1	Cryptography- Principles	1 hour
4.2	four cryptographic primitives	1 hour
4.3	Proprietary versus open source algorithms. Steganography - overview	1 hour
4.4	Core areas of network security and their relation to steganography	1 hour

4.5	Principles of Steganography, Types of Steganography	1 hour
4.6	Steganography Versus Digital Watermarking,	1 hour
4.7	Types of Digital Watermarking	1 hour
4.8	Goals of Digital Watermarking	1 hour
Module-5 (Network Security)(9 hrs)		
5.1	Security In Data Networks: Wireless Device security issues	1 hour
5.2	GPRS security	1 hour
5.3	GSM security	1 hour
5.4	Wireless Transport Layer Security: Secure Socket Layer	1 hour
5.5	Wireless Transport Layer Security - WAP Security	1 hour
5.6	WAP Security Architecture - WAP Gateway	1 hour
5.7	Firewalls-types, rules, personal firewalls,	1 hour
5.8	Intrusion detection systems, responses to intrusion detection	1 hour
5.9	Penetration testing, Auditing and Monitoring	1 hour

Estd.



2014

Abstract POs defined by National Board of Accreditation			
PO#	Broad PO	PO#	Broad PO
PO1	Engineering Knowledge	PO7	Environment and Sustainability
PO2	Problem Analysis	PO8	Ethics
PO3	Design/Development of solutions	PO9	Individual and teamwork
PO4	Conduct investigations of complex problems	PO10	Communication
PO5	Modern tool usage	PO11	Project Management and Finance
PO6	The Engineer and Society	PO12	Lifelong learning

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination Marks(%)
	Test1(%)	Test2(%)	
Remember	30	30	30
Understand	40	40	40
Apply	30	30	30
Analyze			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3hours

Continuous Internal Evaluation Pattern:

CSE(CYBER SECURITY)

Attendance	:10 marks
Continuous Assessment Tests	: 25 marks
Continuous Assessment Assignment	: 15 marks

Internal Examination Pattern:

Each of the two internal examinations has to be conducted out of 50 marks.

First Internal Examination shall be preferably conducted after completing the first half of the syllabus and the Second Internal Examination shall be preferably conducted after completing the remaining part of the syllabus.

There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly covered module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly covered module), each with 7 marks. Out of the 7 questions in Part B, a student should answer any 5. End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which a student should answer anyone. Each question can have a maximum of 2 subdivisions and carries 14 marks.

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which a student should answer any one. Each question can have a maximum of 2 subdivisions and carries 14 marks.

Syllabus

Module -1(Basic Concepts of Cryptography)

Attacks on Computers and Computer Security-Introduction, The need for security, Security approaches, Principles of security, Types of Security attacks, Security services, Security Mechanisms.

Cryptography: Concepts and Techniques-Introduction, plaintext and cipher text, substitution techniques, transposition techniques, encryption and decryption, symmetric and asymmetric key cryptography, stenography, key range and key size, possible types of attacks.

Module-2 (Symmetric and Asymmetric Cryptography)

Symmetric key Ciphers-Block Cipher principles & Algorithms (DES, AES, Blowfish), Differential and Linear Cryptanalysis, Block cipher modes of operation, Stream ciphers, RC4, Location and placement of encryption function, Key distribution.

Asymmetric key Ciphers- Principles of public key cryptosystems, Public key Infrastructure, Algorithms (RSA, Diffie-Hellman, ECC), Key Distribution.

Module-3 (Message Authentication Algorithms)

Message Authentication Algorithms and Hash Functions- Authentication requirements, Authentication functions, Message authentication codes (MAC), Hash functions, Security of Hash functions and MAC, Message Digest 5 (MD5), Secure Hash Algorithm (SHA)-512, Hash-based Message Authentication Code (HMAC), Cipher-based Message Authentication Code (CMAC), X.509 Authentication services.

Module-4(Cryptographic Applications)

Authentication Applications- Kerberos, X.509 Authentication Service, Public – Key Infrastructure, Biometric Authentication, Multi factor Authentication.

Cryptographic Protocols-Types of protocols, Trust and computation, Validating Cryptographic protocols and attacks.Digital Signatures and Certificates-Digital Signatures, Digital Certificates,PKI and Certificate Authorities.

Module -5(Applications of Cryptography)

User authentication- password, challenge-response and zero-knowledge protocols, server authentication; application secure online banking; digital cash, application keeping/storing secrets, block chain, application crypto currencies, implementation aspects: weakest key, key modularity, key management in cryptography, clear text cryptography.

Quantum computing, quantum-resistant cryptography, implementation aspects: creating correct and secure programs, quality of code, side-channel attacks, implementation flaws, Quantum safe cryptography, Cloud security.

Text Books

1. William Stallings, “Cryptography and Network Security Principles and Practice”, Pearson Education, 6th Edition, 2013.
2. Bruce Schneier, “Applied Cryptography Protocols, Algorithms and source code in C”, John Wiley, 2nd Edition, 1995.

References

1. Behrouz A. Forouzan, “Cryptography and Network Security”, McGraw Hill, 2nd Edition, 2010.
2. Hans Delfs and Helmut Knebl, “Introduction to Cryptography: Principles and Applications”, 2nd Edition, 2007.
3. Douglas R and Stinson, “Cryptography Theory and Practice”, Chapman & Hall/CRC, 3rd Edition, 2006.
4. Bernard Menezes, “Network Security and Cryptography”, Cengage Learning, First Edition, 2010
5. Jonathan Katz, Yehuda Lindell, “Introduction to Modern Cryptography”, Chapman and Hall/CRC, First Edition, 2007.

Sample Course Level Assessment Questions**Course Outcome1 (CO1):**

1. Consider an automated teller machine (ATM) in which users provide a personal identification number (PIN) and a card for account access. Give examples of confidentiality, integrity, and availability requirements associated with the system and, in each case, indicate the degree of importance of the requirement.

Course Outcome2 (CO2):

1. The encryption key in a transposition cipher is (3,2,6,1,5,4). Find the decryption key.

Course Outcome3 (CO3):

1. Consider the following elliptic curve signature scheme. We have a global elliptic curve, prime p , and “generator” G . Alice picks a private signing key X_A and forms the public verifying $Y_A = X_A G$. To sign a message M :
 - Alice picks a value k
 - Alice sends Bob M , k and the signature $S = M - kX_A G$.
 - Bob verifies that $M = S + kY_A$.

Show that the verification process produces equality if the signature is valid.

Course Outcome4 (CO4):

1. How can a message encrypted with the Public Key be decrypted with the receiver's appropriate Private Key?

Course Outcome 5 (CO5):

1. State the value of the length field in SHA-512 if the length of the message is 1919 bits and 1920 bits.

QP CODE:

Reg No: _____

Name : _____

PAGES : 2

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FIFTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: CCT 307

Course Name: APPLIED CRYPTOGRAPHY

Max. Marks: 100.

Duration: 3 Hours.

PART A

Answer all Questions. Each question carries 3 marks.

1. State the two approaches in attacking a cipher.
2. Compare Substitution and Transposition techniques.
3. Write down the purpose of S-Boxes in Data Encryption Standard (DES).
4. What is diffusion and confusion?
5. Perform encryption and decryption using RSA Algorithm for the following $p=7$; $q=11$; $e=17$; $M=8$.
6. Is Diffie-Hellman key exchange protocol vulnerable? Justify.
7. What is symmetric key distribution?
8. List the components of Public Key Infrastructure.
9. Define the classes of Message Authentication Function.
10. When a combination of symmetric encryption and an error control code is used for message authentication, in what order must the two functions be performed?

(10 x 3 = 30 Marks)

PART B

(Answer any one Question from each module. Each question carries 14 Marks)

11. a) With a neat sketch, Explain OSI Security architecture model. **(8 Marks)**
b) How does link encryption differ from end-to-end encryption? Explain. **(6 Marks)**

OR

12. a) Encrypt the message “meet me at the usual place at ten rather than eight o’clock” using the Hill

Cipher with the key $\begin{pmatrix} 9 & 4 \\ 5 & 7 \end{pmatrix}$. Show the calculations.

(8 Marks)

- b) State the steps involved in encrypting a plain text using playfair cipher.

(6 Marks)

13. a) Explain in detail the block cipher modes of operation. **(8 Marks)**
 b) Explain Stream ciphers. **(6 Marks)**

OR

14. a) Compare the substitution method in DES and AES. **(7 Marks)**
 b) Why do we need only one substitution table in AES, but several in DES? **(7 Marks)**
15. a) Explain about Hash based Message Authentication Code. **(7 Marks)**
 b) Explain about Cipher based Message Authentication Code. **(7 Marks)**

OR

16. a) User A and B use the Diffie Hellman key exchange technique with a common prime $q=71$ and primitive root $\alpha=7$,
 i. If user A has private key $X_A=3$, What is A's public key Y_A
 ii. If user B has private key $X_B=6$, What is A's public key Y_B **(10 Marks)**
- b) Explain about various Authentication requirements and functions **(4 Marks)**
17. a) Explain the problems with key management and how it affects symmetric cryptography. **(7 Marks)**
 b) How the process of Cryptographic Protocols and attacks can be validated? **(7 Marks)**

OR

18. a) Describe the following
 (i) Updating keys **(3 Marks)**
 (ii) Compromised Keys **(3 Marks)**
 b) What are the core components of a PKI? Describe each component. **(8 Marks)**
19. a) Describe how Quantum Computing can be applied in Cloud Security. **(7 Marks)**
 b) Explain about Block chain and Crypto currencies. **(7 Marks)**

OR

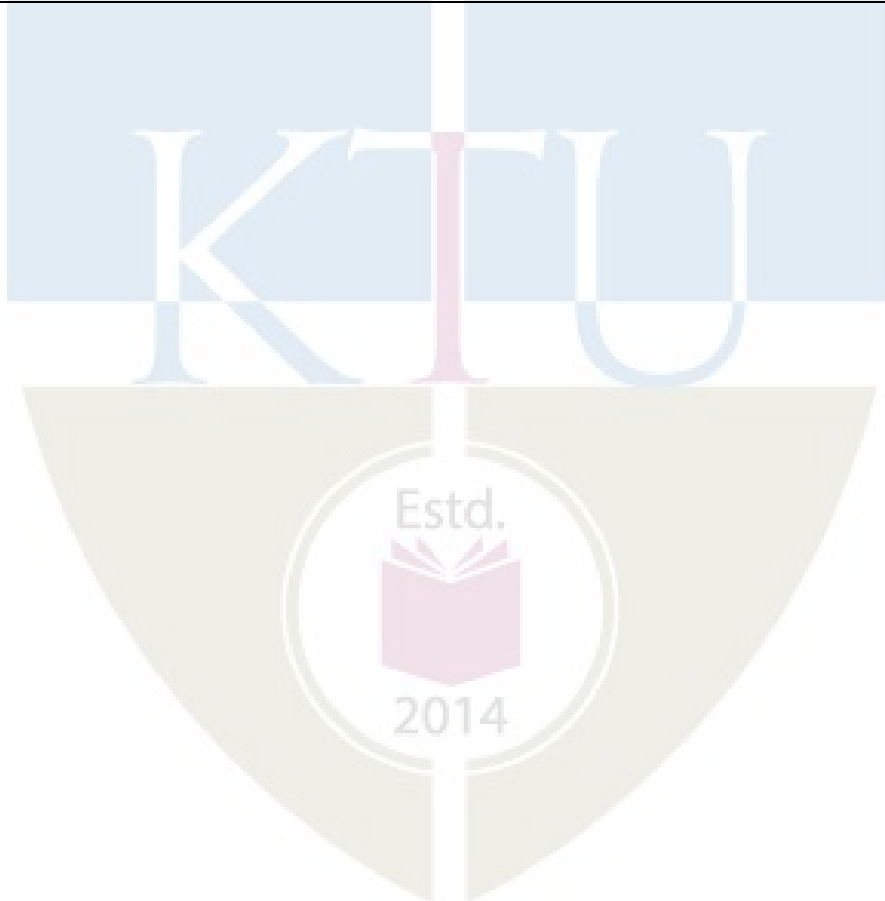
20. a) Write the format for X.509 certificate. How are user's certificates obtained? **(6 Marks)**
 b) With Suitable diagram, explain the types of functions that may be used to produce an authenticator. **(8 Marks)**

TEACHING PLAN

No.	Contents	No. of Lecture Hrs
Module-1 (Basic Concepts of Cryptography) (9hrs)		
1.1	Introduction, Need for Security, Security Approaches, Principles of Security.	1
1.2	Types of Security Attacks, Security Services, Security Mechanisms	1
1.3	OSI Security Architecture	1
1.4	Introduction, plain text and cipher text, Encryption and Decryption.	1
1.5	Classical Encryption Techniques: Substitution Techniques	1
1.6	Classical Encryption Techniques: Transposition Techniques	1
1.7	Stream Cipher, Block Cipher, Public- key cryptosystems vs. Symmetric key cryptosystems	1
1.8	Encrypting Communication channels	1
1.9	Stenography, Key range and Key size, Possible types of Attacks.	1
Module-2(Symmetric and Asymmetric Cryptography)(12hrs)		
2.1	Overview of symmetric key cryptography	1
2.2	Block Cipher Principles	1
2.3	Data Encryption Standard (DES)	1
2.4	Differential and Linear Cryptanalysis	1
2.5	Double DES, Triple DES	1
2.6	Advanced Encryption Algorithm (AES)	1
2.7	Block Cipher modes of Operation	1
2.8	Stream Cipher, RC4	1

2.9	Location and placement of encryption function, Key distribution	1
2.10	RSA Algorithm	1
2.11	Diffie-Hellman Key Exchange Algorithm	1
2.12	Elliptical Curve Cryptosystems	1
Module-3 (Message Authentication Algorithms)(8 hrs)		
3.1	Authentication requirements, Authentication functions	1
3.2	Message authentication codes (MAC), Hash functions	1
3.3	Security of Hash functions and MAC	1
3.4	Message Digest 5 (MD5)	1
3.5	Hash-based Message Authentication Code (HMAC)	1
3.6	Secure Hash Algorithm (SHA)-512	1
3.7	Cipher-based Message Authentication Code (CMAC)	1
3.8	X.509 Authentication services	1
Module-4(Cryptographic Applications)(8 hrs)		
4.1	Authentication Applications: Kerberos, X.509 Authentication Service.	1
4.2	Public – Key Infrastructure,	1
4.3	Biometric Authentication, Multi factor Authentication.	1
4.4	Validating Cryptographic protocols and attacks.	1
4.5	Types of protocols, Trust and computation	1
4.6	Digital Signatures, Digital Certificates,	1
4.7	PKI and Certificate Authorities	1
4.8	Public Key Infrastructure	1
Module-5(Applications of Cryptography)(8hrs)		

5.1	User authentication : password, challenge-response and zero-authentication	1
5.2	Application secure online banking; digital cash	1
5.3	Application keeping/storing secrets, block chain,	1
5.4	Application crypto currencies; implementation aspects: weakest key,	1
5.5	key modularity, key management in cryptography, clear text cryptography	1
5.6	Quantum computing, quantum-resistant cryptography;	1
5.7	Implementation aspects,creating correct and secure programs, quality of code	1
5.8	Quantum safe cryptography. Cloud security.	1



CST 309	MANAGEMENT OF SOFTWARE SYSTEMS	Category	L	T	P	Credit	Year of Introduction
		PCC	3	0	0	3	2019

Preamble: This course provides fundamental knowledge in the Software Development Process. It covers Software Development, Quality Assurance, Project Management concepts and technology trends. This course enables the learners to apply state of the art industry practices in Software development.

Prerequisite: Basic understanding of Object Oriented Design and Development.

Course Outcomes: After the completion of the course the student will be able to

CO1	Demonstrate Traditional and Agile Software Development approaches (Cognitive Knowledge Level: Apply)
CO2	Prepare Software Requirement Specification and Software Design for a given problem. (Cognitive Knowledge Level: Apply)
CO3	Justify the significance of design patterns and licensing terms in software development, prepare testing, maintenance and DevOps strategies for a project. (Cognitive Knowledge Level: Apply)
CO4	Make use of software project management concepts while planning, estimation, scheduling, tracking and change management of a project, with a traditional/agile framework. (Cognitive Knowledge Level: Apply)
CO5	Utilize SQA practices, Process Improvement techniques and Technology advancements in cloud based software models and containers & microservices. (Cognitive Knowledge Level: Apply)

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓		✓						✓
CO2	✓	✓	✓	✓		✓				✓	✓	✓
CO3	✓	✓	✓	✓				✓		✓	✓	✓
CO4	✓	✓	✓	✓		✓			✓	✓	✓	✓
CO5	✓	✓	✓	✓		✓						✓

Abstract POs defined by National Board of Accreditation			
PO#	Broad PO	PO#	Broad PO
PO1	Engineering Knowledge	PO7	Environment and Sustainability
PO2	Problem Analysis	PO8	Ethics
PO3	Design/Development of solutions	PO9	Individual and team work
PO4	Conduct investigations of complex problems	PO10	Communication
PO5	Modern tool usage	PO11	Project Management and Finance
PO6	The Engineer and Society	PO12	Lifelong learning

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination Marks
	Test1 (Percentage)	Test2 (Percentage)	
Remember	30	30	30
Understand	40	40	50
Apply	30	30	20
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks

Continuous Assessment Tests : 25 marks

Continuous Assessment Assignment : 15 marks (Each student shall identify a software development problem and prepare Requirements Specification, Design Document, Project Plan and Test case documents for the identified problem as the assignment.)

Internal Examination Pattern:

Each of the two internal examinations has to be conducted out of 50 marks.

First Internal Examination shall be preferably conducted after completing the first half of the syllabus and the Second Internal Examination shall be preferably conducted after completing the remaining part of the syllabus.

There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly covered module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly covered module), each with 7 marks. Out of the 7 questions in Part B, a student should answer any 5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which a student should answer any one. Each question can have a maximum of 2 subdivisions and carries 14 marks.

Syllabus

Module 1 : Introduction to Software Engineering (7 hours)

Introduction to Software Engineering - Professional software development, Software engineering ethics. Software process models - The waterfall model, Incremental development. Process activities - Software specification, Software design and implementation, Software validation, Software evolution. Coping with change - Prototyping, Incremental delivery, Boehm's Spiral Model. Agile software development - Agile methods, agile manifesto - values and principles. Agile development techniques, Agile Project Management. Case studies : An insulin pump control system. Mentcare - a patient information system for mental health care.

Module 2 : Requirement Analysis and Design (8 hours)

Functional and non-functional requirements, Requirements engineering processes. Requirements elicitation, Requirements validation, Requirements change, Traceability Matrix. Developing use cases, Software Requirements Specification Template, Personas, Scenarios, User stories, Feature identification. Design concepts - Design within the context of software engineering, Design Process, Design concepts, Design Model. Architectural Design - Software Architecture, Architectural Styles, Architectural considerations, Architectural Design Component level design - What is a component?, Designing Class-Based Components, Conducting Component level design, Component level design for web-apps. Template of a Design Document as per “IEEE Std 1016-2009 IEEE Standard for Information Technology Systems Design Software Design Descriptions”. Case study: The Ariane 5 launcher failure.

Module 3 : Implementation and Testing (9 hours)

Object-oriented design using the UML, Design patterns, Implementation issues, Open-source development - Open-source licensing - GPL, LGPL, BSD. Review Techniques - Cost impact of Software Defects, Code review and statistical analysis. Informal Review, Formal Technical Reviews, Post-mortem evaluations. Software testing strategies - Unit Testing, Integration Testing, Validation testing, System testing, Debugging, White box testing, Path testing, Control Structure testing, Black box testing, Testing Documentation and Help facilities. Test automation, Test-driven development, Security testing. Overview of DevOps and Code Management - Code management, DevOps automation, Continuous Integration, Delivery, and Deployment (CI/CD/CD). Software Evolution - Evolution processes, Software maintenance.

Module 4 : Software Project Management (6 hours)

Software Project Management - Risk management, Managing people, Teamwork. Project Planning, Software pricing, Plan-driven development, Project scheduling, Agile planning. Estimation techniques, COCOMO cost modeling. Configuration management, Version management, System building, Change management, Release management, Agile software management - SCRUM framework. Kanban methodology and lean approaches.

Module 5 : Software Quality, Process Improvement and Technology trends (6 hours)

Software Quality, Software Quality Dilemma, Achieving Software Quality Elements of Software Quality Assurance, SQA Tasks, Software measurement and metrics. Software Process Improvement(SPI), SPI Process CMMI process improvement framework, ISO 9001:2000 for Software. Cloud-based Software - Virtualisation and containers, Everything as a service(IaaS, PaaS), Software as a service. Microservices Architecture - Microservices, Microservices architecture, Microservice deployment.

Text Books

1. Book 1 - Ian Sommerville, Software Engineering, Pearson Education, Tenth edition, 2015.
2. Book 2 - Roger S. Pressman, Software Engineering : A practitioner's approach, McGraw Hill publication, Eighth edition, 2014
3. Book 3 - Ian Sommerville, Engineering Software Products: An Introduction to Modern Software Engineering, Pearson Education, First Edition, 2020.

References

1. IEEE Std 830-1998 - IEEE Recommended Practice for Software Requirements Specifications
2. IEEE Std 1016-2009 IEEE Standard for Information Technology—Systems Design—Software Design Descriptions

3. David J. Anderson, Kanban, Blue Hole Press 2010
4. David J. Anderson, Agile Management for Software Engineering, Pearson, 2003
5. Walker Royce, Software Project Management : A unified framework, Pearson Education, 1998
6. Steve. Denning, The age of agile, how smart companies are transforming the way work gets done. New York, Amacom, 2018.
7. Satya Nadella, Hit Refresh: The Quest to Rediscover Microsoft's Soul and Imagine a Better Future for Everyone, Harper Business, 2017
8. Henrico Dolfing, Project Failure Case Studies: Lessons learned from other people's mistakes, Kindle edition
9. Mary Poppendieck, Implementing Lean Software Development: From Concept to Cash, Addison-Wesley Signature Series, 2006
10. StarUML documentation - <https://docs.staruml.io/>
11. OpenProject documentation - <https://docs.openproject.org/>
12. BugZilla documentation - <https://www.bugzilla.org/docs/>
13. GitHub documentation - <https://guides.github.com/>
14. Jira documentation - <https://www.atlassian.com/software/jira>

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. What are the advantages of an incremental development model over a waterfall model?
2. Illustrate how the process differs in agile software development and traditional software development with a socially relevant case study. (Assignment question)

Course Outcome 2 (CO2):

1. How to prepare a software requirement specification?
2. Differentiate between Architectural design and Component level design.
3. How does agile approaches help software developers to capture and define the user requirements effectively?
4. What is the relevance of the SRS specification in software development?
5. Prepare a use case diagram for a library management system.

Course Outcome 3 (CO3):

1. Differentiate between the different types of software testing strategies.
2. Justify the need for DevOps practices?
3. How do design patterns help software architects communicate the design of a complex system effectively?

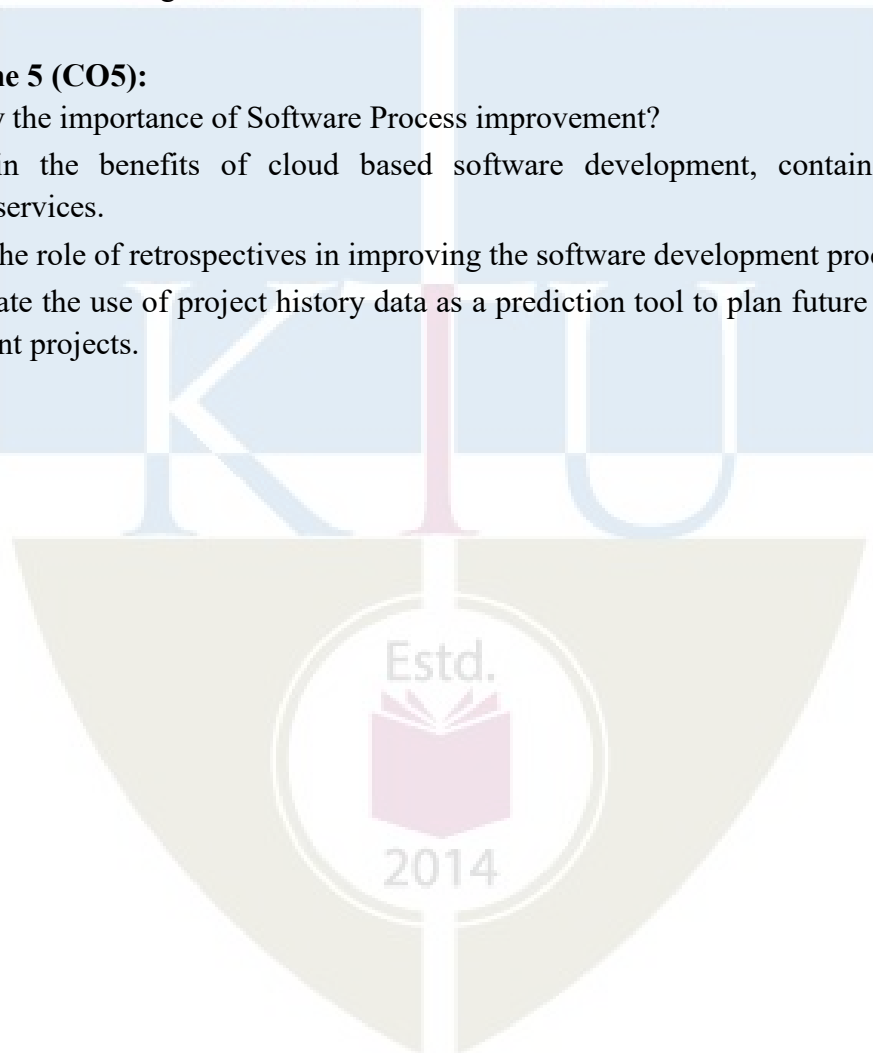
4. What are the proactive approaches one can take to optimise efforts in the testing phase?

Course Outcome 4 (CO4):

1. Illustrate the activities involved in software project management for a socially relevant problem?
2. How do SCRUM, Kanban and Lean methodologies help software project management?
3. Is rolling level planning in software project management beneficial? Justify your answer.
4. How would you assess the risks in your software development project? Explain how you can manage identified risks?

Course Outcome 5 (CO5):

1. Justify the importance of Software Process improvement?
2. Explain the benefits of cloud based software development, containers and microservices.
3. Give the role of retrospectives in improving the software development process.
4. Illustrate the use of project history data as a prediction tool to plan future socially relevant projects.



Model Question Paper

QP CODE:

Reg No: _____

Name : _____

PAGES : 3

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
FIFTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR**

Course Code: CST 309

Course Name: Management of Software Systems

Duration: 3 Hrs

Max. Marks :100

PART A

Answer all Questions. Each question carries 3 marks

1. Why professional software that is developed for a customer is not simply the programs that have been developed and delivered.
2. Incremental software development could be very effectively used for customers who do not have a clear idea about the systems needed for their operations. Justify.
3. Identify any four types of requirements that may be defined for a software system
4. Describe software architecture
5. Differentiate between GPL and LGPL?
6. Compare white box testing and black box testing.
7. Specify the importance of risk management in software project management?
8. Describe COCOMO cost estimation model.
9. Discuss the software quality dilemma
10. List the levels of the CMMI model? (10x3=30)

Part B

(Answer any one question from each module. Each question carries 14 Marks)

11. (a) Compare waterfall model and spiral model

(8)

- (b) Explain Agile ceremonies and Agile manifesto (6)

12. (a) Illustrate software process activities with an example. (8)

- (b) Explain Agile Development techniques and Agile Project Management (6)

13. (a) What are functional and nonfunctional requirements? Imagine that you are developing a library management software for your college, list eight functional requirements and four nonfunctional requirements. (10)

- (b) List the components of a software requirement specification? (4)

OR

14. (a) Explain Personas, Scenarios, User stories and Feature identification? (8)

- (b) Compare Software Architecture design and Component level design (6)

15. (a) Explain software testing strategies. (8)

- (b) Describe the formal and informal review techniques. (6)

OR

16. (a) Explain Continuous Integration, Delivery, and Deployment CI/CD/CD) (8)

- (b) Explain test driven development (6)

17. (a) What is a critical path and demonstrate its significance in a project schedule with the help of a sample project schedule. (8)

- (b) Explain plan driven development and project scheduling. (6)

OR

18. (a) Explain elements of Software Quality Assurance and SQA Tasks. (6)

- (b) What is algorithmic cost modeling? What problems does it suffer from when (8)

compared with other approaches to cost estimation?

19. (a) Explain elements of Software Quality Assurance and SQA Tasks. (8)

(b) Illustrate SPI process with an example. (6)

OR

20. (a) Compare CMMI and ISO 9001:2000. (8)

(b) How can Software projects benefit from Container deployment and Micro service deployment? (6)

Teaching Plan

No	Contents	No of Lecture Hrs
Module 1 : Introduction to Software Engineering (7 hours)		
1.1	Introduction to Software Engineering.[Book 1, Chapter 1]	1 hour
1.2	Software process models [Book 1 - Chapter 2]	1 hour
1.3	Process activities [Book 1 - Chapter 2]	1 hour
1.4	Coping with change [Book 1 - Chapter 2, Book 2 - Chapter 4]	1 hour
1.5	Case studies : An insulin pump control system. Mentcare - a patient information system for mental health care. [Book 1 - Chapter 1]	1 hour
1.6	Agile software development [Book 1 - Chapter 3]	1 hour
1.7	Agile development techniques, Agile Project Management.[Book 1 - Chapter 3]	1 hour
Module 2 : Requirement Analysis and Design (8 hours)		
2.1	Functional and non-functional requirements, Requirements engineering processes [Book 1 - Chapter 4]	1 hour
2.2	Requirements elicitation, Requirements validation, Requirements change, Traceability Matrix [Book 1 - Chapter 4]	1 hour
2.3	Developing use cases, Software Requirements Specification Template [Book 2 - Chapter 8]	1 hour

2.4	Personas, Scenarios, User stories, Feature identification [Book 3 - Chapter 3]	1 hour
2.5	Design concepts [Book 2 - Chapter 12]	1 hour
2.6	Architectural Design [Book 2 - Chapter 13]	1 hour
2.7	Component level design [Book 2 - Chapter 14]	1 hour
2.8	Design Document Template. Case study: The Ariane 5 launcher failure. [Ref - 2, Book 2 - Chapter 16]	1 hour
Module 3 : Implementation and Testing (9 hours)		
3.1	Object-oriented design using the UML, Design patterns [Book 1 - Chapter 7]	1 hour
3.2	Implementation issues, Open-source development - Open-source licensing - GPL, LGPL, BSD [Book 1 - Chapter 7]	1 hour
3.3	Review Techniques - Cost impact of Software Defects, Code review and statistical analysis. [Book 2 - Chapter 20]	1 hour
3.4	Informal Review, Formal Technical Reviews, Post-mortem evaluations. [Book 2 - Chapter 20]	1 hour
3.5	Software testing strategies - Unit Testing, Integration Testing, Validation testing, System testing and Debugging (basic concepts only). [Book 2 - Chapter 22]	1 hour
3.6	White box testing, Path testing, Control Structure testing, Black box testing. Test documentation [Book 2 - Chapter 23]	1 hour
3.7	Test automation, Test-driven development, Security testing. [Book 3 - Chapter 9]	1 hour
3.8	DevOps and Code Management - Code management, DevOps automation, CI/CD/CD. [Book 3 - Chapter 10]	1 hour
3.9	Software Evolution - Evolution processes, Software maintenance. [Book 1 - Chapter 9]	1 hour
Module 4 : Software Project Management (6 hours)		
4.1	Software Project Management - Risk management, Managing people, Teamwork [Book 1 - Chapter 22]	1 hour
4.2	Project Planning - Software pricing, Plan-driven development, Project scheduling, Agile planning [Book 1 - Chapter 23]	1 hour
4.3	Estimation techniques [Book 1 - Chapter 23]	1 hour
4.4	Configuration management [Book 1 - Chapter 25]	1 hour

4.5	Agile software management - SCRUM framework [Book 2 - Chapter 5]	1 hour
4.6	Kanban methodology and lean approaches.[Ref 9 - Chapter 2]	1 hour
Module 5 : Software Quality, Process Improvement and Technology trends (6 hours)		
5.1	Software Quality, Software Quality Dilemma, Achieving Software Quality. [Book 2 - Chapter 19]	1 hour
5.2	Elements of Software Quality Assurance, SQA Tasks , Software measurement and metrics. [Book 3 - Chapter 21]	1 hour
5.3	Software Process Improvement (SPI), SPI Process [Book 2 - Chapter 37]	1 hour
5.4	CMMI process improvement framework, ISO 9001:2000 for Software. [Book 2 - Chapter 37]	1 hour
5.5	Cloud-based Software - Virtualisation and containers, IaaS, PaaS, SaaS.[Book 3 - Chapter 5]	1 hour
5.6	Microservices Architecture - Microservices, Microservices architecture, Microservice deployment [Book 3 - Chapter 6]	1 hour



Preamble: The aim of the Course is to give practical exposure on basic security attacks encryption algorithms, and authentication techniques.

Prerequisite: Sound knowledge in Applied Cryptography and programming in C/ Java.

Course Outcomes: After the completion of the course the student will be able to

Prerequisite: Sound knowledge in Applied Cryptography and programming in C/ Java.

Course Outcomes: After the completion of the course the student will be able to

CO1	Use the different cipher techniques for securing information(Cognitive Knowledge Level: Apply)
CO2	Familiarize symmetric and asymmetric cryptography. (Cognitive Knowledge Level: Apply)
CO3	Demonstrate cryptographic principles and its applications. (Cognitive Knowledge Level: Apply)
CO4	Explain various approaches to Encryption techniques and message Authentication Codes. (Cognitive Knowledge Level: Apply)
CO5	Implement the algorithms DES,RSA(Cognitive Knowledge Level: Apply)
CO6	Write a program using linked lists to simulate Memory Allocation and Garbage Collection(Cognitive Knowledge Level: Apply)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✔	✔	✔	✔								✔
CO2	✔	✔	✔	✔								✔
CO3	✔	✔	✔	✔								✔
CO4	✔	✔	✔	✔								✔
CO5	✔	✔	✔									✔
CO6	✔	✔	✔									✔

Abstract POs defined by National Board of Accreditation			
PO#	Broad PO	PO#	Broad PO
PO1	Engineering Knowledge	PO7	Environment and Sustainability
PO2	Problem Analysis	PO8	Ethics
PO3	Design/Development of solutions	PO9	Individual and teamwork
PO4	Conduct investigations of complex problems	PO10	Communication
PO5	Modern tool usage	PO11	Project Management and Finance
PO6	The Engineer and Society	PO12	Lifelong learning

Assessment Pattern

Bloom's Category	Continuous Assessment Test(Internal Exam) (%)	End Semester Examination (%)
Remember	20	20
Understand	20	20
Apply	60	60
Analyze		
Evaluate		
Create		

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	75	75	3hours

Continuous Internal Evaluation Pattern:

Attendance:15 marks

Continuous Evaluation in Lab :30 marks

Continuous Assessment Test : 15 marks

Viva-voce:15 marks

Internal Examination Pattern:

The marks will be distributed as Algorithm 30 marks, Program 20 marks, Output 20 marks and Viva 30 marks. Total 100 marks which will be converted out of 75 while calculating Internal Evaluation marks.

End Semester Examination Pattern:

The marks will be distributed as Algorithm 30 marks, Program 20 marks, Output 20 marks and Viva 30 marks. Total 100 marks will be converted out of 75 for End Semester Examination.

Operating System to Use in Lab :Linux

Compiler/Software to Use in Lab:gcc

Programming Language to Use in Lab :Ansi C and Java

Fair Lab Record:

All Students attending the Lab should have a Fair Record. The fair record should be produced in the University Lab Examination. Every experiment conducted in the lab should be noted in the fair record. For every experiment in the fair record the right hand page should contain Experiment Heading, Experiment Number, Date of Experiment, Aim of Experiment, Data Structure used and the operations performed on them, Details of Experiment including algorithm and Result of Experiment. The left hand page should contain a print out of the code used for the experiment and sample output obtained for a set of input.

Syllabus

*mandatory

1. Represent a string (char pointer) with a value "Hello world". The program should XOR each character in this string with 0 and displays the result.*
2. Represent string (char pointer) with a value "Hello world" The program should AND or and XOR each character in this string with 127 and display the result.
3. Perform encryption and decryption using the following algorithms*
 - a. Ceaser cipher b. Substitution cipher c. Hill Cipher
4. Implementation of Encryption and Decryption using DES*
5. Implementation of RSA Encryption Algorithm
6. Implementation of Hash Functions*
7. Implementation of Blowfish algorithm logic*
8. Implement the Diffie-Hellman Key Exchange mechanism

9. Implement RC4 logic using Java*
10. Encrypt the text “Hello world” using Blowfish.
11. Implement the SIGNATURE SCHEME –Digital Signature Standard*

PRACTICE QUESTIONS

1. Write a C program that contains a string (char pointer) with a value “Hello world”. The program should XOR each character in this string with 0 and displays the result.
2. Write a C program that contains a string (char pointer) with a value „Hello world“. The program should AND or and XOR each character in this string with 127 and display the result.
3. Write a Java program to perform encryption and decryption using the following algorithms
 - a. Caesar cipher
 - b. Substitution cipher
 - c. Hill Cipher
4. Write a C/JAVA program to implement DES Encryption and Decryption
5. Write a C/JAVA program to implement RSA Encryption Algorithm
6. Write a C/JAVA program to implementation of Hash Functions.
7. Write a C/JAVA program to implement the Blowfish algorithm logic.
8. Write the RC4 logic in Java Using Java cryptography; encrypt the text Hello world using Blowfish. Create your own key using Java key tool.
9. Write a C/JAVA program to implement the Diffie-Hellman Key Exchange mechanism
10. Implement the SIGNATURE SCHEME –Digital Signature Standard

CCL333	SYSTEM AND NETWORK SECURITY LAB	CATEGORY	L	T	P	CREDITS
		PCC	0	0	4	2

Preamble: The course aims to offer students a hands-on experience on network related commands and configuration files in Linux operating system. This course also introduces tools for network traffic analysis and network monitoring and also provides hands-on experience in tools used in security.

Prerequisite: C programming, Operating Systems and Computer Networks.

Course Outcomes: At the end of the course the student will be able to

CO1	Familiarize tools to prevent latest threats (Cognitive Knowledge Level : Understand)
CO2	Analyze the network traffic using sniffing tools. (Cognitive Knowledge Level : Apply)
CO3	Use network scanning tools (Cognitive Knowledge Level : Apply)
CO4	Familiarize various Steganography tools (Cognitive Knowledge Level : Understand)
CO5	Use tools for Penetration testing (Cognitive Knowledge Level : Understand)

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓		✓							✓
CO2	✓	✓	✓		✓							✓
CO3	✓	✓	✓		✓							✓
CO4	✓	✓	✓		✓							✓
CO5	✓	✓	✓		✓							✓
CO6	✓	✓	✓		✓							✓

Abstract Pos defined by National Board of Accreditation			
PO#	Broad PO	PO#	Broad PO
PO1	EngineeringKnowledge	PO7	EnvironmentandSustainability
PO2	ProblemAnalysis	PO8	Ethics
PO3	Design/Developmentofsolutions	PO9	Individualandteamwork
PO4	Conduct investigations of complexproblems	PO10	Communication
PO5	Moderntoolusage	PO11	ProjectManagementandFinance
PO6	TheEngineerandSociety	PO12	Lifelong learning

Assessment Pattern:

Bloom's Category	Continuous Assessment Test(Internal Exam) Marks inpercentage	EndSemesterExamination Marks inpercentage
Remember	20	20
Understand	20	20
Apply	60	60
Analyze		
Evaluate		
Create		

Mark Distribution:

TotalMarks	CIE Marks	ESE Marks	ESE Duration
150	75	75	3hours

Continuous Internal Evaluation Pattern:

Attendance	: 15
Continuous Evaluation in Lab	: 30
ContinuousAssessmentTest	: 15
VivaVoce	: 15

Internal Examination Pattern:

The marks will be distributed as Algorithm 30 marks, Program 20 marks, Output 20 marks and Viva 30 marks. Total 100 marks which will be converted out of 15 while calculating Internal Evaluation marks.

End Semester Examination Pattern:

The percentage of marks will be distributed as Algorithm 30 marks, Program 20 marks, Output 20 marks and Viva 30 marks. Total 75 marks.

Operating System to Use in Lab : Linux

Compiler/Software to Use in Lab : gcc

Programming Language to Use in Lab : Ansic

Fair Lab Record:

All Students attending the System and Network Security Lab should have a Fair Record. The fair record should be produced in the University Lab Examination. Every experiment conducted in the lab should be noted in the fair record. For every experiment in the fair record, the right hand page should contain Experiment Heading, Experiment Number, Date of experiment, Aim of the Experiment and the operations performed on them, Details of experiment including algorithm and result of Experiment. The left hand page should contain a print out of the code used for experiment and sample output obtained for a set of input.

Syllabus**SYSTEM & NETWORK SECURITY LAB**

* mandatory

1. Preventing PC against latest threats using Windows Defender*.
2. Protecting PC using Microsoft Security Essentials*.
3. Steganographic Tools*
4. Website mirroring using HTTrack*
5. Monitoring Live Network capturing packets and analyzing over the live network using Wireshark*
6. Network discovery and security auditing with nmap.*
7. Password Guessing and Password cracking*
8. Port Scanning using Superscan
9. Monitoring Network Communication: Working with Trojans, Backdoors and

sniffer*

CSE(CYBER SECURITY)

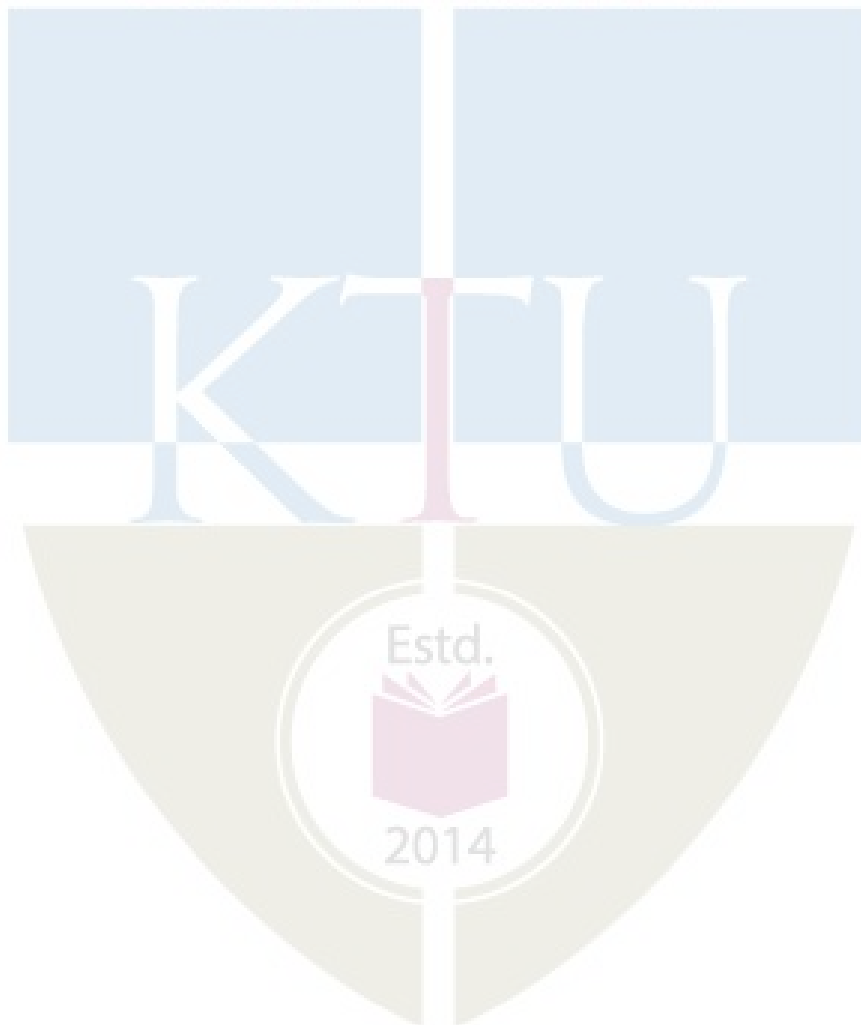
10. Penetration testing and justification of penetration testing through risk analysis
11. Vulnerability Scanning*
12. Monitoring Network Communication: Working with Trojans, Backdoors and sniffer*

PRACTICE QUESTIONS

1. Write a program to create a process in Linux.
2. Write programs using the following system calls of Linux operating system:
fork, exec, getpid, exit, wait, close, stat, opendir, readdir
3. Write programs using the I/O system calls of Linux operating system(open,read,write)
4. Given the list of processes, their CPU burst times and arrival times, display/print the Gantt chart for FCFS and SJF. For each of the scheduling policies, compute and print the average waiting time and average turn around time.
5. Write a C program to simulate following non-preemptive CPU scheduling algorithms to find turn a round time and waiting time.
a)FCFS b)SJF c)Round Robin(pre-emptive) d)Priority
6. Write a program to prevent PC against latest threats using Windows Defender.
7. Write a program to Protect PC using Microsoft Security Essentials.
8. a) View the configuration, including addresses of your computers network interfaces.
b) Test the network connectivity between your computer and several other computers.
c) View the active TCP connections in the computer after visiting a website.
d) Find the hardware/MAC address of another computer in the network using ARP.
9. Write a program to implement Client-Server communication using Socket Programming and TCP as transport layerprotocol.
10. Write a program to implement Client-Server communication using Socket Programming and UDP as transport layerprotocol.
11. Write a program to implement a multi user chat server using TCP as transport layer protocol.
12. Write a program to implement a simple web proxy server that accepts HTTP requests and forwardingto remote servers and returning data to the client using TCP.
13. Write a program to implement Concurrent Time Server application using UDP to execute the program at remote server. Client sends a time request to the server; server

sends its system time back to the client. Client displays the result.

14. Write a program to implement Simple Mail Transfer Protocol.
15. Develop concurrent file server which will provide the file requested by client if it exists. If not server sends appropriate message to the client. Server should also send its process ID (PID) to clients for display along with file or the message.
16. Develop a packet capturing and filtering application using raw sockets.
17. Design and configure a network with multiple subnets with wired and wireless LANs using required network devices. Configure the following services in the network- TELNET, SSH, FTP server, Web server, File server, DHCP server and DNS server.



APJ ABDUL KALAM
TECHNOLOGICAL
UNIVERSITY

SEMESTER V

MINOR



CST 381	CONCEPTS IN SOFTWARE ENGINEERING	Category	L	T	P	Credit	Year of Introduction
		VAC	3	1	0	4	2019

Preamble: This course provides fundamental knowledge in the Software Development Process. It covers Software Development, Quality Assurance and Project Management concepts. This course enables the learners to apply state of the art industry practices in Software development.

Prerequisite: Basic understanding of Object Oriented Design and Development.

Course Outcomes: After the completion of the course the student will be able to

CO1	Differentiate Traditional and Agile Software Development approaches (Cognitive Knowledge Level: Understand)
CO2	Prepare Software Requirement Specification and Software Design for a given problem. (Cognitive Knowledge Level: Apply)
CO3	Justify the significance of design patterns and licensing terms in software development, prepare testing, maintenance and DevOps strategies for a project. (Cognitive Knowledge Level: Apply)
CO4	Make use of software project management concepts while planning, estimation, scheduling, tracking and change management of a project, with proper application of SCRUM, Kanban and Lean frameworks. (Cognitive Knowledge Level: Apply)
CO5	Utilize SQA practices, Process Improvement techniques and Technology improvements namely cloud based software model and containers & microservices in a Software Development Process. (Cognitive Knowledge Level: Apply)

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓		✓						✓
CO2	✓	✓	✓	✓		✓				✓	✓	✓

CO3	✓	✓	✓	✓				✓		✓	✓	✓
CO4	✓	✓	✓	✓		✓			✓	✓	✓	✓
CO5	✓	✓	✓	✓		✓						✓

Abstract POs defined by National Board of Accreditation			
PO#	Broad PO	PO#	Broad PO
PO1	Engineering Knowledge	PO7	Environment and Sustainability
PO2	Problem Analysis	PO8	Ethics
PO3	Design/Development of solutions	PO9	Individual and team work
PO4	Conduct investigations of complex problems	PO10	Communication
PO5	Modern tool usage	PO11	Project Management and Finance
PO6	The Engineer and Society	PO12	Lifelong learning

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination Marks
	Test1 (Percentage)	Test2 (Percentage)	
Remember	30	30	30
Understand	30	30	30

Apply	40	40	40
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks

Continuous Assessment Tests : 25 marks

Continuous Assessment Assignment : 15 marks (Each student shall identify a software development problem and prepare Requirements Specification, Design Document, Project Plan and Test case documents for the identified problem as the assignment.)

Internal Examination Pattern:

Each of the two internal examinations has to be conducted out of 50 marks.

First Internal Examination shall be preferably conducted after completing the first half of the syllabus and the Second Internal Examination shall be preferably conducted after completing the remaining part of the syllabus.

There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly covered module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly covered module), each with 7 marks. Out of the 7 questions in Part B, a student should answer any 5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which a student should answer any one. Each question can have a maximum of 2 subdivisions and carries 14 marks.

Syllabus**Module 1 : Introduction to Software Engineering (8 hours)**

Introduction to Software Engineering - Professional software development, Software engineering ethics. Software process models - The waterfall model, Incremental development. Process activities - Software specification, Software design and implementation, Software validation, Software evolution. Coping with change - Prototyping, Incremental delivery, Boehm's Spiral Model. Agile software development - Agile methods, agile manifesto - values and principles. Agile development techniques, Agile Project Management. Case studies : An insulin pump control system. Mentcare - a patient information system for mental health care.

Module 2 : Requirement Analysis and Design (10 hours)

Functional and non-functional requirements, Requirements engineering processes. Requirements elicitation, Requirements validation, Requirements change, Traceability Matrix. Developing use cases, Software Requirements Specification Template, Personas, Scenarios, User stories, Feature identification. Design concepts - Design within the context of software engineering, Design Process, Design concepts, Design Model. Architectural Design - Software Architecture, Architectural Styles, Architectural considerations, Architectural Design Component level design - What is a component?, Designing Class-Based Components, Conducting Component level design, Component level design for web-apps. Template of a Design Document as per “IEEE Std 1016-2009 IEEE Standard for Information Technology Systems Design Software Design Descriptions”. Case study: The Ariane 5 launcher failure.

Module 3 : Implementation and Testing (12 hours)

Object-oriented design using the UML, Design patterns, Implementation issues, Open-source development - Open-source licensing - GPL, LGPL, BSD. Review Techniques - Cost impact of Software Defects, Code review and statistical analysis. Informal Review, Formal Technical Reviews, Post-mortem evaluations. Software testing strategies - Unit Testing, Integration Testing, Validation testing, System testing, Debugging, White box testing, Path testing, Control Structure testing, Black box testing, Testing Documentation and Help facilities. Test automation, Test-driven development, Security testing. Overview of DevOps and Code Management - Code management, DevOps automation, CI/CD/CD. Software Evolution - Evolution processes, Software maintenance.

Module 4 : Software Project Management (8 hours)

Software Project Management - Risk management, Managing people, Teamwork. Project Planning, Software pricing, Plan-driven development, Project scheduling, Agile planning. Estimation techniques, COCOMO cost modeling. Configuration management, Version management, System building, Change management, Release management, Agile software management - SCRUM framework. Kanban methodology and lean approaches.

Module 5 : Software Quality and Process Improvement (6 hours)

Software Quality, Software Quality Dilemma, Achieving Software Quality Elements of Software Quality Assurance, SQA Tasks , Software measurement and metrics. Software Process Improvement(SPI), SPI Process CMMI process improvement framework, ISO 9001:2000 for Software.

Text Books

1. Book 1 - Ian Sommerville, Software Engineering, Pearson Education, Tenth edition, 2015.
2. Book 2 - Roger S. Pressman, Software Engineering : A practitioner's approach, McGraw Hill publication, Eighth edition, 2014
3. Book 3 - Ian Sommerville, Engineering Software Products: An Introduction to Modern Software Engineering, Pearson Education, First Edition, 2020.

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7. Satya Nadella, Hit Refresh: The Quest to Rediscover Microsoft's Soul and Imagine a Better Future for Everyone, Harper Business, 2017
8. Henrico Dolfing, Project Failure Case Studies: Lessons learned from other people's mistakes, Kindle edition
9. Mary Poppendieck, Implementing Lean Software Development: From Concept to Cash, Addison-Wesley Signature Series, 2006
10. StarUML documentation - <https://docs.staruml.io/>
11. OpenProject documentation - <https://docs.openproject.org/>

12. BugZilla documentation - <https://www.bugzilla.org/docs/>
13. GitHub documentation - <https://guides.github.com/>
14. Jira documentation - <https://www.atlassian.com/software/jira>

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. What are the advantages of an incremental development model over a waterfall model?
2. Compare agile software development with traditional software development?

Course Outcome 2 (CO2):

1. How to prepare a software requirement specification?
2. Differentiate between Architectural design and Component level design.
3. How do agile approaches help software developers to capture and define the user requirements effectively?
4. What is the relevance of the SRS specification in software development?
5. Prepare a use case diagram for a library management system.

Course Outcome 3 (CO3):

1. Differentiate between the different types of software testing strategies.
2. What are the benefits of DevOps?
3. How do design patterns help software architects communicate the design of a complex system effectively?
4. What are the proactive approaches one can take to optimise efforts in the testing phase?

Course Outcome 4 (CO4):

1. What are the activities involved in software project management?
2. What is the need for SCRUM, Kanban and Lean methodologies?
3. What are the benefits of rolling level planning in software project management and how would you implement it?
4. How would you assess the risks in your software development project? How would you plan for risk mitigation and contingency?

Course Outcome 5 (CO5):

1. What is the importance of Software Process improvement?
2. How will retrospectives help in improving the software development process?
3. What are the important skills required for the SQA role?
4. How would you use project history data as a prediction tool to plan future projects?

Model Question Paper

QP CODE:

Reg No: _____

Name : _____

PAGES : 3

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
FIFTH SEMESTER B.TECH DEGREE EXAMINATION(MINOR), MONTH & YEAR

Course Code: CST 381

Course Name: Concepts in Software Engineering

Duration: 3 Hrs

Max. Marks : 100

PART A

Answer all Questions. Each question carries 3 Marks

1. Explain why professional software that is developed for a customer is not simply the programs that have been developed and delivered
2. Incremental software development could be very effectively used for customers who do not have a clear idea about the systems needed for their operations. Discuss.
3. Identify and briefly describe four types of requirements that may be defined for a computer based system.
4. Describe software architecture in your own words.
5. What are the major differences between GPL and LGPL?
6. Compare between white box testing and black box testing.
7. What is the importance of risk management in software project management?
8. Explain COCOMO cost estimation model
9. Describe the software quality dilemma in your own words
10. Which are the levels of the CMMI model?

(10x3=30)

Part B

(Answer any one question from each module. Each question carries 14 marks)

11. (a) Compare between waterfall model and spiral model (8)
- (b) Explain Agile methods and Agile manifesto (6)
- OR**
12. (a) Explain software process activities (7)
- (b) Explain Agile Development techniques and Agile Project Management. (7)
13. (a) What are functional and nonfunctional requirements? Imagine that you are developing a library management software for your college, identify at least 8 functional requirements and 4 nonfunctional requirements. (10)
- (b) What are the contents of a software requirement specification? (4)
- OR**
14. (a) Explain Personas, Scenarios, User stories and Feature identification? (8)
- (b) Compare between Software Architecture design and Component level design (6)
15. (a) Describe the formal and informal review techniques in detail. (6)
- (b) Explain various software testing strategies. (8)
- OR**
16. (a) Explain DevOps CI/CD/CD in detail. (8)
- (b) Explain test driven development. (6)
17. (a) What is a critical path and demonstrate its significance in a project schedule with the help of a sample project schedule. (6)
- (b) Explain plan driven development and project scheduling (6)

OR

18. (a) Explain the SCRUM framework. (8)

(b) What is algorithmic cost modeling? What problems does it suffer from when compared with other approaches to cost estimation? (6)

19. (a) Explain elements of Software Quality Assurance and SQA Tasks. (8)

(b) Explain the SPI process. (6)

OR

20. (a) Compare between CMMI and ISO 9001:2000 (8)

(b) Compare Quality Control and Quality Assurance. (6)

Teaching Plan [44 hours]		
Module 1 : Introduction to Software Engineering (8 hours)		Hours
1.1	Introduction to Software Engineering. [Book 1, Chapter 1]	1 hour
1.2	Software process models [Book 1 - Chapter 2]	1 hour
1.3	Process activities [Book 1 - Chapter 2]	1 hour
1.4	Coping with change [Book 1 - Chapter 2, Book 2 - Chapter 4]	1 hour
1.5	Agile software development [Book 1 - Chapter 3]	1 hour
1.6	Agile development techniques [Book 1 - Chapter 3]	1 hour
1.7	Agile Project Management.[Book 1 - Chapter 3]	1 hour
1.8	Case studies : An insulin pump control system. Mentcare - a patient information system for mental health care. [Book 1 - Chapter 1]	1 hour
Module 2 : Requirement Analysis and Design (10 hours)		
2.1	Functional and non-functional requirements, Requirements engineering processes [Book 1 - Chapter 4]	1 hour

2.2	Requirements elicitation, Requirements validation, Requirements change, Traceability Matrix [Book 1 - Chapter 4]	1 hour
2.3	Developing use cases, Software Requirements Specification Template [Book 2 - Chapter 8]	1 hour
2.4	Personas, Scenarios [Book 3 - Chapter 3]	1 hour
2.5	User stories, Feature identification [Book 3 - Chapter 3]	1 hour
2.6	Design concepts [Book 2 - Chapter 12]	1 hour
2.7	Architectural Design [Book 2 - Chapter 13]	1 hour
2.8	Component level design [Book 2 - Chapter 14]	1 hour
2.9	Component level design, Design Document Template. [Book 2 - Chapter 14, Ref - 2]	1 hour
2.10	Case study: The Ariane 5 launcher failure. [Book 2 - Chapter 16]	1 hour
Module 3 : Implementation and Testing (12 hours)		
3.1	Object-oriented design using the UML, Design patterns [Book 1 - Chapter 7]	1 hour
3.2	Implementation issues, Open-source development - Open-source licensing - GPL, LGPL, BSD [Book 1 - Chapter 7]	1 hour
3.3	Review Techniques - Cost impact of Software Defects, Code review. [Book 2 - Chapter 20]	1 hour
3.4	Informal Review, Formal Technical Reviews, Post-mortem evaluations. [Book 2 - Chapter 20]	1 hour
3.5	Software testing strategies [Book 2 - Chapter 22]	1 hour
3.6	Software testing strategies [Book 2 - Chapter 22]	1 hour
3.7	White box testing, Path testing, Control Structure testing [Book 2 - Chapter 23]	1 hour
3.8	Black box testing. Test documentation [Book 2 - Chapter 23]	1 hour
3.9	Test automation, Test-driven development [Book 3 - Chapter 9]	1 hour
3.10	Security testing. DevOps and Code Management [Book 3 - Chapter 9, Chapter 10]	1 hour
3.11	DevOps and Code Management - Code management, DevOps automation, CI/CD/CD. [Book 3 - Chapter 10]	1 hour

3.12	Software Evolution - Evolution processes, Software maintenance. [Book 1 - Chapter 9]	1 hour
Module 4 : Software Project Management (8 hours)		
4.1	Software Project Management - Risk management, Managing people, Teamwork [Book 1 - Chapter 22]	1 hour
4.2	Project Planning - Software pricing, Plan-driven development, Project scheduling, Agile planning [Book 1 - Chapter 23]	1 hour
4.3	Estimation techniques [Book 1 - Chapter 23]	1 hour
4.4	Configuration management [Book 1 - Chapter 25]	1 hour
4.5	Agile software management - SCRUM framework [Book 2 - Chapter 5]	1 hour
4.6	Agile software management - SCRUM framework [Book 2 - Chapter 5]	1 hour
4.7	Kanban methodology and lean approaches. [Ref 9 - Chapter 2]	1 hour
4.8	Kanban methodology and lean approaches.[Ref 9 - Chapter 2]	1 hour
Module 5 : Software Quality, Process Improvement and Technology trends (6 hours)		
5.1	Software Quality, Software Quality Dilemma, Achieving Software Quality. [Book 2 - Chapter 19]	1 hour
5.2	Elements of Software Quality Assurance, SQA Tasks [Book 3 - Chapter 21]	1 hour
5.3	Software measurement and metrics. [Book 3 - Chapter 21]	1 hour
5.4	Software Process Improvement(SPI), SPI Process[Book 2 - Chapter 37]	1 hour
5.5	Software Process Improvement(SPI), SPI Process[Book 2 - Chapter 37]	1 hour
5.6	CMMI process improvement framework, ISO 9001:2000 for Software. [Book 2 - Chapter 37]	1 hour

CST 383	CONCEPTS IN MACHINE LEARNING	Category	L	T	P	Credit	Year of introduction
		VAC	3	1	0	4	2019

Preamble: This course enables the learners to understand the fundamental concepts and algorithms in machine learning. The course covers the standard and most popular supervised learning algorithms such as linear regression, logistic regression, decision trees, Bayesian learning & the naive Bayes algorithm, support vector machines & kernels, basic clustering algorithms and dimensionality reduction methods. This course helps the students to provide machine learning based solutions to real world problems.

Prerequisite: Familiarity with basics in linear algebra, probability and Python programming.

	Course Outcomes
CO1	Illustrate Machine Learning concepts and basic parameter estimation methods.(Cognitive Knowledge Level: Apply)
CO2	Demonstrate supervised learning concepts (regression, linear classification). (Cognitive Knowledge Level: Apply)
CO3	Illustrate the concepts of Multilayer neural network and Support Vector Machine (Cognitive Knowledge Level: Apply)
CO4	Describe unsupervised learning concepts and dimensionality reduction techniques. (Cognitive Knowledge Level: Apply)
CO5	Solve real life problems using appropriate machine learning models and evaluate the performance measures (Cognitive Knowledge Level: Apply)

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓	✓							✓
CO2	✓	✓	✓	✓	✓							✓
CO3	✓	✓	✓	✓	✓							✓

CO4	✓	✓	✓	✓	✓							✓
CO5	✓	✓	✓	✓	✓	✓						✓

Abstract POs defined by National Board of Accreditation			
PO#	Broad PO	PO#	Broad PO
PO1	Engineering Knowledge	PO7	Environment and Sustainability
PO2	Problem Analysis	PO8	Ethics
PO3	Design/Development of solutions	PO9	Individual and team work
PO4	Conduct investigations of complex problems	PO10	Communication
PO5	Modern tool usage	PO11	Project Management and Finance
PO6	The Engineer and Society	PO12	Life long learning

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination Marks
	Test1 (Percentage)	Test2 (Percentage)	
Remember	30	30	30
Understand	30	30	30
Apply	40	40	40
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
 Continuous Assessment Tests : 25 marks

Continuous Assessment Assignment : **15 marks**

Internal Examination Pattern:

Each of the two internal examinations has to be conducted out of 50 marks

First Internal Examination shall be preferably conducted after completing the first half of the syllabus and the Second Internal Examination shall be preferably conducted after completing remaining part of the syllabus.

There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly covered module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly covered module), each with 7 marks. Out of the 7 questions in Part B, a student should answer any 5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which a student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Syllabus

Module-1 (Overview of machine learning)

Machine learning paradigms-supervised, semi-supervised, unsupervised, reinforcement learning. Basics of parameter estimation - maximum likelihood estimation(MLE) and maximum a posteriori estimation(MAP). Introduction to Bayesian formulation.

Module-2 (Supervised Learning)

Regression - Linear regression with one variable, Linear regression with multiple variables, solution using gradient descent algorithm and matrix method, basic idea of overfitting in regression. Linear Methods for Classification- Logistic regression, Perceptron, Naive Bayes, Decision tree algorithm ID3.

Module-3 (Neural Networks (NN) and Support Vector Machines (SVM))

NN - Multilayer feed forward network, Activation functions (Sigmoid, ReLU, Tanh), Backpropagation algorithm.

SVM - Introduction, Maximum Margin Classification, Mathematics behind Maximum Margin Classification, Maximum Margin linear separators, soft margin SVM classifier, non-linear SVM, Kernels for learning non-linear functions, polynomial kernel, Radial Basis Function(RBF).

Module-4 (Unsupervised Learning)

Clustering - Similarity measures, Hierarchical Agglomerative Clustering, K-means partitioned clustering, Expectation maximization (EM) for soft clustering. Dimensionality reduction – Principal Component Analysis, factor Analysis, Multidimensional scaling, Linear Discriminant Analysis.

Module-5 (Classification Assessment)

Classification Performance measures - Precision, Recall, Accuracy, F-Measure, Receiver Operating Characteristic Curve(ROC), Area Under Curve(AUC. Bootstrapping, Cross Validation, Ensemble methods, Bias-Variance decomposition. Case Study: Develop a classifier for face detection.

Text Book

1. Ethem Alpaydin, Introduction to Machine Learning, 2nd edition, MIT Press 2010.
2. Mohammed J. Zaki and Wagner Meira, Data Mining and Analysis: Fundamental Concepts and Algorithms, Cambridge University Press, First South Asia edition, 2016.
3. Jake VanderPlas, Python Data Science Handbook, O'Reilly Media, 2016
4. Tom Mitchell, Machine Learning, McGraw-Hill, 1997.

Reference Books

1. Christopher Bishop. Neural Networks for Pattern Recognition, Oxford University Press, 1995.
2. Kevin P. Murphy. Machine Learning: A Probabilistic Perspective, MIT Press 2012.
3. Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements Of Statistical Learning, Second edition Springer 2007.
4. P. Langley, Elements of Machine Learning, Morgan Kaufmann, 1995.
5. Richert and Coelho, Building Machine Learning Systems with Python.
6. Davy Cielen, Arno DB Meysman and Mohamed Ali. Introducing Data Science: Big Data, Machine Learning, and More, Using Python Tools, Dreamtech Press 2016.

Sample Course Level Assessment Questions

Course Outcome1(CO1):

1. A coin is tossed 100 times and lands heads 62 times. What is the maximum likelihood estimate for θ , the probability of heads.
2. Suppose data $x_1, \dots, x_n$ are independent and identically distributed drawn from an exponential distribution $\exp(\lambda)$. Find the maximum likelihood for λ .
3. Suppose $x_1, \dots, x_n$ are independent and identically distributed(iid) samples from a distribution with density

$$f_X(x|\theta) = \begin{cases} \frac{\theta x^{\theta-1}}{3^\theta}, & 0 \leq x \leq 3 \\ 0, & \text{otherwise} \end{cases}$$

Find the maximum likelihood estimate(MLE) for θ .

4. Find the maximum likelihood estimator (MLE) and maximum a posteriori (MAP) estimator for the mean of a univariate normal distribution. Assume that we have N samples, $x_1, \dots, x_N$ independently drawn from a normal distribution with known variance σ^2 and unknown mean μ and the prior distribution for the mean is itself a normal distribution with mean ν and variance β^2 . What happens to the MLE and MAP estimators as the number of samples goes to infinity.

Course Outcome 2 (CO2):

1. Explain the difference between (batch) gradient descent and stochastic gradient descent. Give an example of when you might prefer one over the other.
2. Suppose that you are asked to perform linear regression to learn the function that outputs y , given the D -dimensional input x . You are given N independent data points, and that all the D attributes are linearly independent. Assuming that D is around 100, would you prefer the closed form solution or gradient descent to estimate the regressor?
3. Suppose you have a three class problem where class label $y \in 0, 1, 2$ and each training example X has 3 binary attributes $X_1, X_2, X_3 \in 0, 1$. How many parameters (probability distribution) do you need to know to classify an example using the Naive Bayes classifier?

Course Outcome 3 (CO3):

1. What are support vectors and list any three properties of the support vector classifier solution?
2. Why do you use kernels to model a projection from attributes into a feature space, instead of simply projecting the dataset directly?
3. Describe how Support Vector Machines can be extended to make use of kernels. Illustrate with reference to the Gaussian kernel $K(x, y) = e^{-z}$, where $z = (x-y)^2$.

4. Briefly explain one way in which using tanh instead of logistic activations makes optimization easier.
5. ReLU activation functions are most used in neural networks instead of the tanh activation function. Draw both activation functions and give a) an advantage of the ReLU function compared to the tanh function. b) a disadvantage of the ReLU function compared to the tanh function.

Course Outcome 4(CO4):

1. Describe cluster analysis? Identify two applications where cluster analysis can be applied to multimedia data?
2. Given two objects represented by the tuples (22, 1, 42, 10) and (20, 0, 36, 8):
 - (i) Compute the Euclidean distance between the two objects.
 - (ii) Compute the Manhattan distance between the two objects.
3. Use PCA to reduce the dimension from 2 to 1 for the design matrix X .

$$X = \begin{bmatrix} 6 & -4 \\ -3 & 5 \\ -2 & 6 \\ 7 & -3 \end{bmatrix}$$

4. What is Principal Component Analysis (PCA)? Which eigen value indicates the direction of largest variance?
5. Suppose that one runs a principal component analysis on a data set and tells that the percentage of variance explained by the first 3 components is 80%. How is this percentage of variance explained?

Course Outcome 5 (CO5):

1. Suppose that you are contacted by a food processing company that wants you to develop a classifier that detects whether a rat is present in an image. You collect a large dataset of images by crawling the web, and have annotators determine which images contain rats. This set of images can then be used as the training set for your classifier.
 - a. Suggest a machine learning method to use for this classification task and evaluate its performance.
 - b. After you have delivered your solution to the company, they get back to you and complain that when they evaluate on a new test set, they get precision and recall values that are much lower than what you reported to them. Explain what might have gone wrong and propose remedial measures .
2. A real estate firm would like to build a system that predicts the sale prices of a house. They create a spreadsheet containing information about 1,500 house sales in the Kochi

area. In addition to the price, there are 10 features describing the house, such as number of bedrooms, total indoor area, lot area, a swimming pool, location, etc. Explain how you would implement a machine learning model that would solve this prediction task. Give all steps you would carry out when developing it. Explain why the model you built is probably useless in the long run.

3. For a classifier, the confusion matrix is given by:

	+	-
+	9	9
-	1	5

What is the precision, recall and accuracy of that classifier?

Model Question Paper

QP CODE:

PAGES:3

Reg No: _____

Name: _____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
FIFTH SEMESTER B.TECH DEGREE EXAMINATION(MINOR), MONTH &
YEAR

Course Code: CST 383

Course Name: CONCEPTS IN MACHINE LEARNING

Max.Marks:100
Hours

Duration: 3

PART A

Answer all Questions. Each question carries 3 Marks

1. Define supervised learning? Name special cases of supervised learning depending on whether the inputs/outputs are categorical, or continuous.
2. Differentiate between Maximum Likelihood estimation (MLE) and Maximum a Posteriori (MAP) estimation?
3. What is overfitting and why is it a problem? Give an example of a method to reduce the risk of overfitting.
4. Specify the basic principle of gradient descent algorithm.
5. Suppose that you have a linear support vector machine(SVM) binary classifier. Consider a point that is currently classified correctly, and is far away from the decision boundary. If you

remove the point from the training set, and re-train the classifier, will the decision boundary change or stay the same? Justify your answer.

6. Mention the primary motivation for using the kernel trick in machine learning algorithms?
7. Expectation maximization (EM) is designed to find a maximum likelihood setting of the parameters of a model when some of the data is missing. Does the algorithm converge? If so, do you obtain a locally or globally optimal set of parameters?
8. Illustrate the strength and weakness of k-means algorithm.
9. Classifier A attains 100% accuracy on the training set and 70% accuracy on the test set. Classifier B attains 70% accuracy on the training set and 75% accuracy on the test set. Which one is a better classifier. Justify your answer.
10. How does bias and variance trade-off affect machine learning algorithms?

(10x3=30)

Part B

Answer any one Question from each module. Each question carries 14 Marks

11. a) Suppose that X is a discrete random variable with the following probability mass function: where $0 \leq \theta \leq 1$ is a parameter. The following 10 independent observations

X	0	1	2	3
$P(X)$	$2\theta/3$	$\theta/3$	$2(1 - \theta)/3$	$(1 - \theta)/3$

were taken from such a distribution: $(3, 0, 2, 1, 3, 2, 1, 0, 2, 1)$. What is the maximum likelihood estimate of θ . (6)

- b) A gamma distribution with parameters α, β has the following density function, where $\Gamma(t)$ is the gamma function.

$$p(x) = \frac{\beta^\alpha}{\Gamma(\alpha)} x^{\alpha-1} e^{-\beta x}$$

If the posterior distribution is in the same family as the prior distribution, then we say that the prior distribution is the conjugate prior for the likelihood function. Using the Gamma distribution as a prior, show that the Exponential distribution is a conjugate prior of the Gamma distribution. Also, find the maximum a posteriori estimator for the parameter of the Exponential distribution as a function of α and β . (8)

OR

12. a) Traffic between 8AM and 9AM at a certain place was measured by counting the number of vehicles that passed at that time. Suppose the counts follow a Poisson process. A random sample of 9 observations was collected, having observed the following number of vehicles: (95, 100, 80, 70, 110, 98, 97, 90, 70). Derive the maximum likelihood estimator for the

average number of vehicles that pass by that place between 8 AM and 9 AM, and compute the corresponding estimate using the given sample. (7)

- b) Find the maximum a posteriori (MAP) estimator for the mean of a univariate normal distribution. Assume that we have N samples, $x_1, \dots, x_N$ independently drawn from a normal distribution with known variance σ^2 and unknown mean μ and the prior distribution for the mean is itself a normal distribution with mean ν and variance β^2 . (7)

- 13.a) Derive the gradient descent training rule assuming for the target function $o_d = w_0 + w_1 x_1 + \dots + w_n x_n$. Define explicitly the squared cost/error function E , assuming that a set of training examples D is provided, where each training example $d \in D$ is associated with the target output t_d . (10)

- b) How can we interpret the output of a two-class logistic regression classifier as a probability? (4)

OR

14. a) In a two-class logistic regression model, the weight vector $w = [4, 3, 2, 1, 0]$. We apply it to some object that we would like to classify; the vectorized feature representation of this object is $x = [-2, 0, -3, 0.5, 3]$. What is the probability, according to the model, that this instance belongs to the positive class? (6)

- b) The following dataset can be used to train a classifier that determines whether a given person is likely to own a car or not. There are three features: education level (primary, secondary, or university); residence (city or country); gender (female, male).

education	residence	gender	has car?
sec	country	female	yes
univ	country	female	yes
prim	city	male	no
univ	city	male	no
sec	city	female	no
sec	country	male	yes
prim	country	female	yes
univ	country	male	yes
sec	city	male	yes
prim	city	female	no
univ	city	female	no
prim	country	male	yes

Find the root attribute and justify your answer

(8)

15. a) Consider a support vector machine whose input space is 2-D, and the inner products are computed by means of the kernel $K(\mathbf{x}, \mathbf{y}) = (\mathbf{x} \cdot \mathbf{y} + 1)^2 - 1$, where $\mathbf{x} \cdot \mathbf{y}$ denotes the ordinary inner product. Show that the mapping to feature space that is implicitly defined by this kernel is the mapping to 5-D given by

(10)

$$\mathbf{x} = \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} \rightarrow \phi(\mathbf{x}) = \begin{bmatrix} x_1^2 \\ x_2^2 \\ \sqrt{2} x_1 x_2 \\ \sqrt{2} x_1 \\ \sqrt{2} x_2 \end{bmatrix}$$

- b) What is the basic idea of a Support Vector Machine?

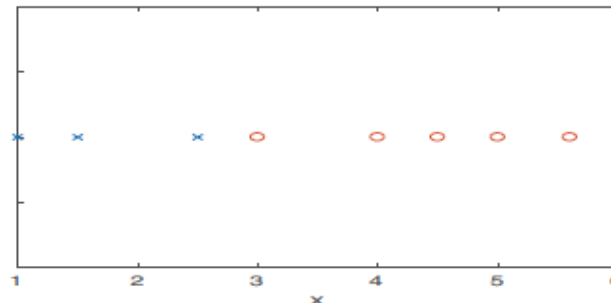
(4)

OR

16. a) Explain how back propagation can be used to solve XOR problem which is not linearly separable.

(8)

- b) Consider the following one dimensional training data set, 'x' denotes negative examples and 'o' positive examples. The exact data points and their labels are given in the table. Suppose a SVM is used to classify this data. Indicate which are the support vectors and mark the decision boundary. Find the equation of the hyperplane. (6)



x	1	1.5	2.5	3	4	4.5	5	5.6
y	-1	-1	-1	1	1	1	1	1

17. a) Suppose that we have the following data (one variable). Use single linkage Agglomerative clustering to identify the clusters.

Daa: (2, 5, 9, 15, 16, 18, 25, 33, 33, 45).

(8)

- b) Given two objects represented by the tuples (22, 1, 42, 10) and (20, 0, 36, 8):

- (i) Compute the Euclidean distance between the two objects.
(ii) Compute the Manhattan distance between the two objects.

- (iii) Compute the Minkowski distance between the two objects, using $p = 3$ (6)

OR

18. a) Suppose that we have the following data:

<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>	<i>f</i>	<i>g</i>	<i>h</i>	<i>i</i>	<i>j</i>
(2,0)	(1,2)	(2,2)	(3,2)	(2,3)	(3,3)	(2,4)	(3,4)	(4,4)	(3,5)

Identify the cluster by applying the k-means algorithm, with $k = 2$. Try using initial cluster centers as far apart as possible. (10)

- b) List the steps involved in Principal Component Analysis. (4)

19. a) Suppose the dataset had 9700 cancer-free images from 10000 images from cancer patients. Find precision, recall and accuracy? Is it a good classifier? Justify. (8)

Actual Class\ Predicted class	cancer = yes	cancer = no	Total
cancer = yes	90	210	300
cancer = no	140	9560	9700
Total	230	9770	10000

- b) Suppose that you have a classification problem where our feature representation contains about 10,000,000 features. We would like to develop a classifier that can be deployed in a mobile phone, so preferably it should have a small memory footprint. Discuss one solution for how this can be done. (6)

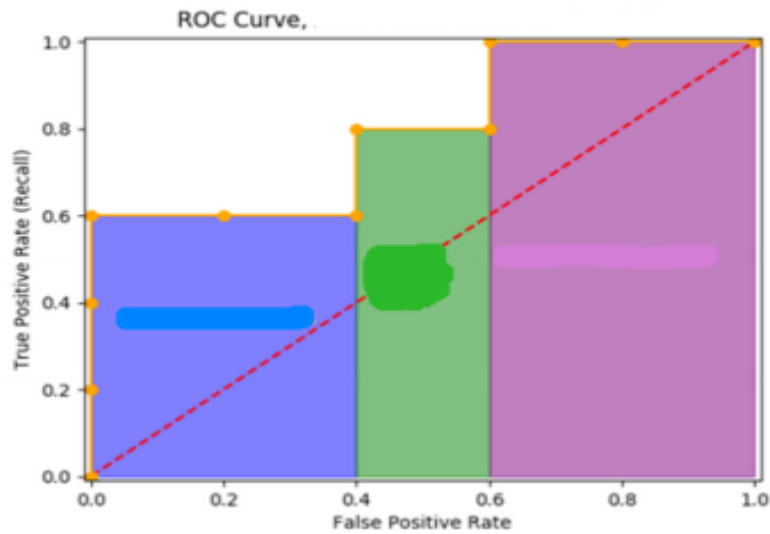
OR

20. a) What are ROC space and ROC curve in machine learning? In ROC space, which points correspond to perfect prediction, always positive prediction and always negative prediction? Why? (6)

- b) Suppose there are three classifiers A, B and C. The (FPR, TPR) measures of the three classifiers are as follows – A (0, 1), B (1, 1), C (1, 0.5). Which can be considered as a perfect classifier? Justify your answer. (4)

c) Given the following ROC Curve? Find the AUC?

(4)



Teaching Plan

No	Contents	No of Lecture Hrs
Module 1 :Overview of machine learning (7 hours)		
1.1	Supervised, semi-supervised, unsupervised learning, reinforcement learning (Text Book (TB) 1: Chapter 1)	1hour
1.2	Maximum likelihood estimation(MLE) (TB 1: Section 4.2)	1hour
1.3	Maximum likelihood estimation (MLE)- example (TB 1: Section 4.2)	1hour
1.4	Maximum a posteriori estimation(MAP) (TB 4: Section 6.2)	1hour
1.5	Maximum a posteriori estimation(MAP)-example (TB 4: Section 6.2)	1hour
1.6	Bayesian formulation (TB 1: Section 14.1, 14.2)	1hour
1.7	Bayesian formulation -example (TB 1: Section 14.1, 14.2)	1hour
Module 2 : Supervised Learning (8 hours)		

2.1	Linear regression with one variable (TB 1: Section 2.6)	1 hour
2.2	Multiple variables, Solution using gradient descent algorithm and matrix method (No derivation required) (TB 1: Section 5.8)	1 hour
2.3	Overfitting in regression, Lasso and Ridge regularization	1 hour
2.4	Logistic regression	1 hour
2.5	Perceptron	1 hour
2.6	Naive Bayes (TB 2: Section 18.2)	1 hour
2.7	Decision trees (TB 2: Chapter 19)	1 hour
2.8	Decision trees- ID3 algorithm (TB 2: Chapter 19)	1 hour
Module 3 : Neural Networks and Support Vector Machines (TB 2: Chapter 21) (11 hours)		
3.1	Multilayer Feed forward Network, Activation Functions (Sigmoid, ReLU, Tanh)	1 hour
3.2	Back Propagation Algorithm	1 hour
3.3	Illustrative Example for Back Propagation	1 hour
3.4	Introduction, Maximum Margin Hyperplane,	1 hour
3.5	Mathematics behind Maximum Margin Classification	1 hour
3.6	Formulation of maximum margin hyperplane and solution	1 hour
3.7	Soft margin SVM	1 hour
3.8	Solution of Soft margin SVM	1 hour
3.9	Non-linear SVM	1 hour
3.10	Kernels for learning non-linear functions and properties of kernel functions.	1 hour
3.11	Example Kernels functions- Linear, RBF, Polynomial.	1 hour
Module 4 : Unsupervised Learning (10 hours)		
4.1	Similarity measures- Minkowski distance measures(Manhattan, Euclidean), Cosine Similarity	1 hour
4.2	Clustering - Hierarchical Clustering (TB 2: Chapter 14)	1 hour
4.3	K-means partitional clustering (TB 2: Chapter 13)	1 hour
4.4	Expectation maximization (EM) for soft clustering (TB 2: Chapter 13)	1 hour
4.5	Expectation maximization (EM) for soft clustering (TB 2: Chapter 13)	1 hour

4.6	Dimensionality reduction – Principal Component Analysis (TB 1: Section 6.3)	1hour
4.7	Dimensionality reduction – Principal Component Analysis (TB 1: Section 6.3)	1hour
4.8	Factor Analysis (TB 1: Section 6.4)	1hour
4.9	Multidimensional scaling (TB 1: Section 6.5)	1hour
4.10	Linear Discriminant Analysis (TB 1: Section 6.6)	1hour
Module 5 : Classification Assessment (8 hours)		
5.1	Performance measures - Precision, Recall, Accuracy, F-Measure, ROC, AUC. (TB 2: Chapter 22.1)	1hour
5.2	Boot strapping, Cross validation	1hour
5.3	Ensemble methods- bagging	1hour
5.4	Ensemble methods- boosting	1hour
5.5	Bias-Variance decomposition (TB 2: Chapter 22.3)	1hour
5.6	Bias-Variance decomposition (TB 2: Chapter 22.3)	1hour
5.7	Face detection (TB 3: Chapter 5 Section Application: A Face Detection Pipeline)	1hour
5.8	Face detection (TB 3: Chapter 5 Section Application: A Face Detection Pipeline)	1hour



CST 385	CLIENT SERVER SYSTEMS	Category	L	T	P	Credit	Year of Introduction
		VAC	3	1	0	4	2019

Preamble:

The syllabus is prepared with the view of preparing the Engineering Graduates to build effective Client/Server applications. This course aims at providing a foundation in decentralized computer systems, using the client/server model. The course content is decided to cover the essential fundamentals which can be taught within the given slots in the curriculum.

Prerequisite: **Basic knowledge in Computer**

Course Outcomes: After the completion of the course the student will be able to

	Course Outcomes
CO 1	Identify the basics of client/server systems and the driving force behind the development of client/server systems(Cognitive Knowledge Level: Understand)
CO 2	Outline the architecture and classifications of client/server systems(Cognitive Knowledge Level: Understand)
CO 3	Summarize the client/server network services for an application(Cognitive Knowledge Level: Understand)
CO 4	Identify management services and issues in network (Cognitive Knowledge Level: Understand)
CO 5	Outline the Client/Server technology in respect of databases and Client/Server database architecture (Cognitive Knowledge Level: Understand)

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓										✓
CO2	✓	✓										✓
CO3	✓	✓										✓
CO4	✓											✓
CO5	✓	✓										✓

Abstract POs defined by National Board of Accreditation			
PO#	Broad PO	PO#	Broad PO
PO1	Engineering Knowledge	PO7	Environment and Sustainability
PO2	Problem Analysis	PO8	Ethics
PO3	Design/Development of solutions	PO9	Individual and team work
PO4	Conduct investigations of complex problems	PO10	Communication
PO5	Modern tool usage	PO11	Project Management and Finance
PO6	The Engineer and Society	PO12	Life long learning

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination Marks
	Test 1 (Percentage)	Test 2 (Percentage)	
Remember	40	40	40
Understand	40	40	40
Apply	20	20	20
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks

Continuous Assessment Test 1 (for theory, for 2 hrs) : 20 marks

Continuous Assessment Test 2 (for lab, internal examination, for 2hrs) : 20 marks

Internal Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 5 questions with 2 questions from each module (2.5 modules x 2 = 5), having 3 marks for each question. Students should answer all questions. Part B also contains 5 questions with 2 questions from each module (2.5 modules

x 2 = 5), of which a student should answer any one. The questions should not have sub-divisions and each one carries 7 marks.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which a student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Sample Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Computing in client server architecture over Mainframe architecture has certain advantages and disadvantages. Describe at least three advantages and disadvantages for each architecture.

Course Outcome 2 (CO2):

1. Explain the role of mainframe-centric model in Client/Server computing?

Course Outcome 3(CO3):

1. Describe the client server system development methodology? Explain different phases of System Integration Life-Cycle.

Course Outcome 4 (CO4):

1. Explain about network management and remote system management. How can security be provided to the network?

Course Outcome 5 (CO5):

1. Explain various types of Client/Server Database Architecture

Syllabus

Module – 1 (Introduction)

Introduction to Client/Server computing - Basic Client/Server Computing Model, Server for Every Client- File Server, Print Server, Application Server, Mail Server, Directory Services Server, Web Server, Database Server, Transaction Servers. Client/Server-Fat or Thin, Stateless

or Stateful, Servers and Mainframes, Client/Server Functions. Driving Forces behind Client/Server Computing- Business Perspective, Technology Perspective.

Module -2 (Client/Server Classification)

Client/Server Types-Single Client/Single Server, Multiple Clients/Single Server, Multiple Clients/Multiple Servers, Integration With Distributed Computing, Alternatives To Client/Server Systems. Classification of Client/Server Systems- Two-Tier Computing, Middleware, Three-Tier Computing- Model View Controller (MVC), Principles behind Client/Server Systems. Client/Server Topologies. Existing Client/Server Architecture. Architecture for Business Information System.

Module -3 (Client/Server Application Components)

Client- Services, Request for services, RPC, Windows services, Print services, Remote boot services, other remote services, Utility Services. Server- Detailed server functionality, Network operating system, Available platforms, Server operating system. Organizational Expectations, Improving performance of client/server applications, Single system image, Downsizing and Rightsizing, Advantages and disadvantages of Client/Server computing, Applications of Client/Server.

Module -4 (Client/ Server Systems Services and Support)

Services and Support- System administration, Availability, Reliability, Scalability, Observability, Agility, Serviceability. Software Distribution, Performance, Network management. Remote Systems Management- RDP, Telnet, SSH, Security. LAN and Network Management issues.

Module -5(Client/Server Technology and Databases)

Client/Server Technology and Databases - Storing Data, Database System Architectures. Client/Server In Respect Of Databases- Client/Server Databases, Client/Server Database Computing, Database Computing Vs. Mainframe, PC/File Server Computing. Client/Server Database Architecture - Process-Per-Client Architecture, Multi-Threaded Architecture, Hybrid Architecture. Database Middleware Component - Application Programming Interface, Database Translator, Network Translator.

Text Book

1. Patrick Smith & Steve Guengerich, Client / Server Computing, PHI
2. Subhash Chandra Yadav, Sanjay Kumar Singh, An Introduction to Client/Server Computing, New Age International Publishers

Reference Books

1. Jeffrey D.Schank, “Novell’s Guide to Client-Server Application & Architecture” Novell Press
2. Robert Orfali, Dan Harkey, Jeri Edwards, Client/Server Survival Guide, Wiley-India Edition, Third Edition
3. Dawna Travis Dewire, Client Server Computing — McGraw Hill
4. W.H.Inman, Developing Client Server Applications, BPB

Model Question Paper

QP CODE: _____

PAGES: ____

Reg No: _____

Name: _____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FIFTH SEMESTER B.TECH DEGREE EXAMINATION(MINOR), MONTH & YEAR

Course Code: CST 385

Course Name : Client Server Systems

Max Marks: 100

Duration: 3 Hours

PART-A

(Answer All Questions. Each question carries 3 marks)

1. Differentiate between Stateful and Stateless servers
2. List the different phases and activities of client/server system development methodology.
3. How does transmission protocol work in client/server applications?
4. List any six services in single system image environment.
5. Specify the role of the client in Client/Server computing and also list any six services provided by the client.
6. Why do most RPC system support call by value semantics for parameter passing?
7. What do you mean by a thin client network? List three advantages of the Thin

Client Network system.

8. How are connectivity and interoperability between .client/server achieved?
9. One disadvantage of the Client/Server system is lack of control in a Database Management environment. Justify.
10. Explain the DBMS concept in client/server architecture.

(10x3=30)

Part B

(Answer any one question from each module. Each question carries 14 Marks)

11. (a) Differentiate between Transaction server and Data server system with examples. (7)
- (b) Computing in client server architecture over Mainframe architecture has certain advantages and disadvantages. Describe at least three advantages and disadvantages for each architecture. (7)

OR

12. (a) Explain various Clients/Server system development tools. (6)
- (b) Classify and describe the driving forces that drive the move to Client/Server computing. (8)
13. (a) Explain the role of mainframe-centric model in Client/Server computing? (5)
- (b) Describe the three types of Client/Server systems in existence (9)

OR

14. (a) List and explain the general forces behind the architecture for business information systems (7)
- (b) Explain the different distribution styles. (7)
15. (a) Illustrate the concept of rightsizing and downsizing in Client/Server Computing (7)
- (b) What is client server system development methodology? Explain the (7)

different phases of System Integration Life-Cycle.

OR

16. (a) In Client/Server computing, explain the following with examples (10)
- i. Dynamic Data Exchange
 - ii. RPC, Remote Procedure Call
 - iii. Remote Boot Service
 - iv. Diskless Computer
 - v. Object-linking and embedding
- (b) Explain the functions and features of Network Operating System (4)
17. (a) Explain about network management and remote system management. How can security be provided to the network ? (10)
- (b) In client server architecture, what do you mean by Availability, Reliability, Serviceability and Security? Explain with examples. (4)

OR

18. (a) Client server is modular infrastructure, this is intended to improve Usability, Flexibility, Interoperability and Scalability. Explain each term with an example, in each case how it helps to improve the functionality of client server architecture. (7)
- (b) Explain about network management and remote system management. How can security be provided to network? (7)
19. (a) Explain the different types of Client/Server Database Architecture (9)
- (b) List and explain the main components of Database middleware (5)
- OR**
20. (a) Discuss types of database utilities, tools and their functions (7)
- (b) Discuss about the role of traditional and web databases in handling client/server based applications. (7)

Teaching Plan

Module- 1(Introduction)		(10 hours)
1.1	Basic Client/Server Computing Model	1 hour
1.2	Server for Every Client- File Server, Print Server	1 hour
1.3	Application Server, Mail Server, Directory Services Server	1 hour
1.4	Web Server, Database Server	1 hour
1.5	Transaction Servers	1 hour
1.6	Client/Server-Fat or Thin	1 hour
1.7	Stateless or Stateful	1 hour
1.8	Servers and Mainframes	1 hour
1.9	Client/Server Functions	1 hour
1.10	Driving Forces behind Client/Server Computing- Business Perspective, Technology Perspective	1 hour
Module- 2 (Client/Server Classification)		(10 hours)
2.1	Client/Server Types-Single Client/Single Server	1 hour
2.2	Multiple Clients/Single Server, Multiple Clients/Multiple Servers	1 hour
2.3	Integration With Distributed Computing	1 hour
2.4	Alternatives To Client/Server Systems	1 hour
2.5	Classification of Client/Server Systems- Two-Tier Computing, Middleware	1 hour
2.6	Three-Tier Computing- Model View Controller (MVC)	1 hour
2.7	Principles behind Client/Server Systems.	1 hour
2.8	Client/Server Topologies	1 hour
2.9	Existing Client/Server Architecture	1 hour
2.10	Architecture for Business Information System	1 hour
Module -3 (Client/Server Application Components)		(9 hours)
3.1	The client: Services, Request for services, RPC	1 hour
3.2	Windows services, Print services, Remote boot services	1 hour

3.3	Utility Services & Other Services	1 hour
3.4	Server- Detailed server functionality, Network operating system	1 hour
3.5	Available platforms, Server operating system	1 hour
3.6	Organizational Expectations, Improving performance of client/server applications	1 hour
3.7	Single system image, Downsizing and Rightsizing	1 hour
3.8	Advantages and disadvantages of Client/Server computing	1 hour
3.9	Applications of Client/Server	1 hour
Module -4 (Client/ Server Systems Services and Support)		(8 hours)
4.1	Services and Support, System administration	1 hour
4.2	Availability, Reliability	1 hour
4.3	Scalability, Observability, Agility	1 hour
4.4	Serviceability, Software Distribution	1 hour
4.5	Performance	1 hour
4.6	Network management	1 hour
4.7	Remote Systems Management- RDP, Telnet, SSH	1 hour
4.8	Security, LAN and Network Management issues	1 hour
Module -5(Client/Server Technology and Databases)		(8 hours)
5.1	Client/Server Technology and Databases - Storing Data	1 hour
5.2	Database System Architectures	1 hour
5.3	Client/Server In Respect Of Databases- Client/Server Databases	1 hour
5.4	Client/Server Database Computing	1 hour
5.5	Database Computing Vs. Mainframe, PC/File Server Computing	1 hour
5.	Client/Server Database Architecture - Process-Per-Client Architecture	1 hour
5.7	Multi-Threaded Architecture, Hybrid Architecture	1 hour
5.8	Database Middleware Component - Application Programming Interface, Database Translator, Network Translator	1 hour

APJ ABDUL KALAM
TECHNOLOGICAL
UNIVERSITY

SEMESTER V

HONOURS



CCT393	WEB APPLICATION SECURITY	CATEGORY	L	T	P	CREDITS
		VAC	4	0	0	4

Preamble: This course basically aims at exploring the fundamentals of Web applications & Common Vulnerabilities and exploits. This course also covers the different information Gathering methodologies and the different mitigation and management strategies. The concepts covered in this course also enable the learners in effective use of web application development Technologies and to identify the security threats in computing.

Prerequisite: Knowledge in fundamental concepts of security.

Course Outcomes: After the completion of the course, the student will be able to

CO#	Course Outcomes
CO1	Identify the basic type of web application security testing, vulnerabilities and countermeasures. (Cognitive Knowledge Level: Understand)
CO2	Trace out the different Information Gathering methodologies. (Cognitive Knowledge Level: Apply)
CO3	Interpret and detect the different vulnerabilities and exploits prone to systems. (Cognitive Knowledge Level: Apply)
CO4	Discover Web Application Vulnerabilities & threats and adopt mitigation and management Strategies. (Cognitive Knowledge Level: Understand)
CO5	Summarize the different web application development Technologies. (Cognitive Knowledge Level: Understand)

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓								✓
CO2	✓	✓	✓	✓	✓							✓
CO3	✓	✓	✓	✓	✓							✓
CO4	✓	✓	✓	✓								✓
CO5	✓	✓	✓	✓								✓

Abstract POs defined by National Board of Accreditation			
PO#	Broad PO	PO#	Broad PO
PO1	Engineering Knowledge	PO7	Environment and Sustainability
PO2	Problem Analysis	PO8	Ethics
PO3	Design/Development of solutions	PO9	Individual and team work
PO4	Conduct investigations of complex problems	PO10	Communication
PO5	Modern tool usage	PO11	Project Management and Finance
PO6	The Engineer and Society	PO12	Lifelong learning

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination Marks (%)
	Test 1 (%)	Test 2 (%)	
Remember	20	20	20
Understand	50	50	50
Apply	30	30	30
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance	10 marks
Continuous Assessment Tests (Average of Series Tests 1 & 2)	25 marks
Continuous Assessment Assignment	15 marks

Internal Examination Pattern:

Each of the two internal examinations has to be conducted out of 50 marks. First series test shall be preferably conducted after completing the first half of the syllabus and the second series test shall be preferably conducted after completing remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly completed module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly completed module), each with 7 marks. Out of the 7 questions, a student should answer any 5.

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which a student should answer any one. Each question can have maximum 2 sub-divisions and carries 14 marks.

Syllabus

Module -1 (Introduction to Web Application)

Web Application, Web Client, History of Web Application, Web Application Security Terminology, Types of Web Application Security Testing, Web Application Vulnerabilities and Counter measures.

Module -2 (Reconnaissance)

Web Application Reconnaissance: Information Gathering, Web Application Mapping. Finding Subdomains- Multiple Applications per Domain, Browser's Built-in Network Analysis Tools, Public Records, Brute Forcing Subdomain, Dictionary Attacks.

Module -3 (Web Application Offense)

Cross-Site Scripting (XSS)- XSS Discovery & Exploitation, Stored XSS, Reflected XSS. Cross-Site Request Forgery- Query Parameter Tampering. XML External Entity(XXE)- Direct XXE, Indirect XXE. Injection- SQL Injection, Code Injection. Denial of Service- Logical DoS Vulnerabilities, Distributed DoS.

Module -4 (Securing and Hardening Web Applications)

Securing Modern Web Applications- Defensive Software Architecture, Vulnerability Discovery, Vulnerability Analysis, Vulnerability Management, Mitigation Strategies. Secure Application Architecture: Authentication and Authorization. Vulnerability Discovery: Security Automation. Vulnerability Management: Common Vulnerability Scoring System. Securing Sessions: Different types of Sessions, Data Transmission Security: SSL/TLS: Certificate Validation Types and Authorities, Creating Self-Signed Certificate for Testing, OWASP Top 10 Vulnerabilities.

Module -5 (Web Application Development Technologies)

Basic workflow with a text editor, version control system, and web browser, user interface with HTML, styles with CSS, JQuery and JavaScript, AJAX, JavaScript objects, and JSON, Server-side programming with Node.js, Storage with Redis and MongoDB, Cloud uploading Cloud Foundry.

Text Books

1. Ron Lepofsky, “The Manager’s Guide to Web Application Security: A Concise Guide to the weaker side of the web”, First Edition, Apress, 2015.
2. Andrew Hoffman “Web Application Security: Exploitation and Countermeasures for Modern Web Applications”, O’Reilly, First Edition, 2020.
3. Semmy Purewal “Learning Web App Development”, O’Reilly Media, Inc., First Edition, 2014

References

1. Jonathan LeBlanc & Tim Messerschmidt ,”Identity and Data Security for Web Development”, O’Reilly, First Edition, 2016
2. Bryan Sullivan, Vincent Liu “Web Application Security, A Beginners Guide”, McGraw-Hill First Edition, 2011

Course Level Assessment Questions**Course Outcome 1 (CO1):**

1. Consider an automated teller machine (ATM) in which users provide a personal identification number (PIN) and a card for account access. Give examples of confidentiality, integrity, and availability requirements associated with the system and, in each case, indicate the degree of importance of the requirement.

Course Outcome 2 (CO2):

1. Information about a particular website is crucial for the hackers and intruders to pierce into the system. Explain how the information be gathered and give what all information are crucial for the users to safeguard their systems from intruder attacks. Use any appropriate tool.

Course Outcome 3 (CO3):

1. What is Cross site Scripting? How is it identified on a website?
2. What is SQL injection? How can you find whether the website is affected by SQL injection?

Course Outcome 4 (CO4):

1. What is vulnerability? How is it identified?
2. How Vulnerability management is done?

Course Outcome 5 (CO5):

1. Discuss the different web development technologies used for Creating Styles.
2. Explain how data is shared to cloud using Cloud Front.

Model Question Paper

QP CODE:

PAGES: ____

Reg No: _____

Name: _____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
FIFTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR
Course Code: CST 393
Course Name : WEB APPLICATION SECURITY

Max Marks: 100

Duration: 3 Hours

PART A
(Answer All Questions. Each question carries 3 marks)

1. Explain the history of Web Application.
2. Compare Penetration Testing and manual testing techniques.
3. What is Reconnaissance?
4. How can you analyze the Network Traffic going through your browser?
5. What is Cross site Request Forgery?
6. What is Denial of Service attack?
7. Differentiate between authentication and Authorization.
8. List the latest OWASP Top Ten Vulnerabilities.
9. Enumerate how to Structure a user interface with HTML, and include styles with CSS.
10. Explain how to Store data outside your application with Redis and MongoDB

(10x3=30 Marks)

Part B

**(Answer any one question from each module. Each question carries
14 Marks)**

11. Define the following web application security terminologies
- (a) (i) Temporal Risk (ii) Breach (8 Marks)
(iii) Mitigation (iv) Vulnerability
- (b) Explain any three web application vulnerabilities and the damages they cause (6 Marks)
- OR**
12. (a) Explain Weak Access Control Vulnerability and how to mitigate the vulnerability. (6 Marks)
- (b) Write down the components of a Web Application (8 Marks)
13. (a) Define Brute Force Attack. Explain how to brute forcing the subdomain. (6 Marks)
- (b) Explain how subdomain information about a website is found. (8 Marks)
- OR**
14. (a) List out the different Built-in Network Analysis Tools found in a browser. (7 Marks)
- (b) How a network analysis is done using the Built-in Network Analysis Tools found in a browser? (7 Marks)
15. (a) What is Query Parameter Tampering? How is it identified? (7 Marks)
- (b) What is Direct XXE? How is it identified? (7 Marks)
- OR**
16. (a) Give the different Logical DoS Vulnerabilities with suitable examples (6 Marks)
- (b) What is XML External Entity(XEE)? How is affects a website? (8 Marks)
17. (a) Explain how vulnerability can be discovered. (4 Marks)
- (b) How Vulnerability Management is done using Common Vulnerability Scoring System. (10 Marks)

OR

18. (a) Write down the methods used for securing sessions. **(7 Marks)**
 (b) Explain how SSL/TLS validation can be done. **(7 Marks)**
19. (a) What is JSON? Explain its relevance in Website development. **(6 Marks)**
 (b) Give the role of HTML5 in Web development. **(8 Marks)**
- OR**
20. (a) Describe how server side programming be done with Node.js. **(8 Marks)**
 (b) Explain the difference in usage of JQuery and JavaScript. **(6 Marks)**

Teaching Plan

No	Contents	No.of Lecture Hrs
Module -1 (Introduction to Web Application) (6 hrs)		
1.1	Web Application and Web Client	1
1.2	History of Web Application	1
1.3	Web Application Security Terminology	1
1.4	Types of Web Application Security Testing- Lecture 1	1
1.5	Types of Web Application Security Testing- Lecture 2	1
1.6	Web Application Vulnerabilities and Counter measures	1
Module -2 (Reconnaissance) (9 hrs)		
2.1	Web Application Reconnaissance: Information Gathering	1
2.2	Web Application Mapping	1
2.3	Finding Subdomains	1
2.4	Multiple Applications per Domain	1
2.5	Browser's Built-in Network Analysis Tools- Lecture 1	1

2.6	Browser's Built-in Network Analysis Tools- Lecture 2	1
2.7	Public Records	1
2.8	Brute Forcing Subdomain	1
2.9	Dictionary Attacks	1
Module -3 (Web Application Offense) (11 hrs)		
3.1	Cross-Site Scripting(XSS)	1
3.2	XSS Discovery & Exploitation	1
3.3	Stored XSS	1
3.4	Reflected XSS	1
3.5	Cross- Site Request Forgery- Query Parameter Tampering	1
3.6	XML External Entity(XXE)	1
3.7	Direct XXE	1
3.8	Indirect XXE	1
3.9	Injection- SQL Injection, Code Injection	1
3.10	Denial of Service- Logical DoS Vulnerabilities	1
3.11	Distributed DoS	1
Module –4 (Securing and Hardening Web Applications) (11 hrs)		
4.1	Securing Modern Web Applications	1
4.2	Defensive Software Architecture, Vulnerability Discovery	1
4.3	Vulnerability Analysis, Vulnerability Management	1
4.4	Mitigation Strategies	1
4.5	Secure Application Architecture: Authentication and Authorization.	1
4.6	Vulnerability Discovery: Security Automation.	1
4.7	Vulnerability Management: Common Vulnerability Scoring System.	1

4.8	Securing Sessions: Different types of Sessions,	1
4.9	Data Transmission Security: SSL/TLS: Certificate Validation Types and Authorities, Creating Self-Signed Certificate for Testing,	1
4.10	OWASP Top 10 Vulnerabilities-Lecture 1	1
4.11	OWASP Top 10 Vulnerabilities-Lecture 2	1
Module –5 (Web Application Development Technologies) (8 hrs)		
5.1	Basic workflow with a text editor, version control system, and web browser	1
5.2	User interface with HTML	1
5.3	Styles with CSS	1
5.4	JQuery and JavaScript	1
5.5	AJAX, JavaScript objects, and JSON	1
5.6	Server-side programming with Node.js	1
5.7	Storage with Redis and MongoDB	1
5.8	Cloud uploading CloudFoundry	1



CST 395	NEURAL NETWORKS AND DEEP LEARNING	Category	L	T	P	Credit	Year of Introduction
		VAC	3	1	0	4	2019

Preamble:

Neural networks is a biologically inspired programming paradigm which enables a computer to learn from observational data and deep learning is a powerful set of techniques for training neural networks. This course introduces the key concepts in neural networks, its architecture and learning paradigms, optimization techniques, basic concepts in deep learning, Convolutional Neural Networks and Recurrent Neural Networks. The students will be able to provide best solutions to real world problems in domains such as computer vision and natural language processing.

Prerequisite: A Sound knowledge in Computational fundamentals of machine learning

Course Outcomes: After the completion of the course the student will be able to

CO1	Demonstrate the basic concepts of machine learning models and performance measures. (Cognitive Knowledge Level : Understand)
CO2	Illustrate the basic concepts of neural networks and its practical issues (Cognitive Knowledge Level : Apply)
CO3	Outline the standard regularization and optimization techniques for deep neural networks (Cognitive Knowledge Level : Understand)
CO4	Build CNN and RNN models for different use cases. (Cognitive Knowledge Level : Apply)
CO5	Explain the concepts of modern RNNs like LSTM, GRU (Cognitive Knowledge Level : Understand)

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓								✓
CO2	✓	✓	✓	✓								✓
CO3	✓	✓	✓	✓								✓
CO4	✓	✓	✓	✓	✓	✓						✓
CO5	✓	✓	✓	✓								✓

Abstract POs defined by National Board of Accreditation			
PO#	Broad PO	PO#	Broad PO
PO1	Engineering Knowledge	PO7	Environment and Sustainability
PO2	Problem Analysis	PO8	Ethics
PO3	Design/Development of solutions	PO9	Individual and team work
PO4	Conduct investigations of complex problems	PO10	Communication
PO5	Modern tool usage	PO11	Project Management and
PO6	The Engineer and Society	PO12	Life long learning

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination Marks
	Test1 (%)	Test2 (%)	
Remember	30	30	30
Understand	40	40	40
Apply	30	30	30
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance **10 marks**

Continuous Assessment Tests **25 marks**

Continuous Assessment Assignment **15 marks**

Internal Examination Pattern:

Each of the two internal examinations has to be conducted out of 50 marks. First Internal Examination shall be preferably conducted after completing the first half of the syllabus and the Second Internal Examination shall be preferably conducted after completing the remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly covered module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly covered module), each with 7 marks. Out of the 7 questions in Part B, a student should answer any 5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B

contains 2 questions from each module of which a student should answer any one. Each question can have a maximum 2 subdivisions and carry 14 marks.

Syllabus

Module - 1 (Basics of Machine Learning)

Machine Learning basics - Learning algorithms - Supervised, Unsupervised, Reinforcement, Overfitting, Underfitting, Hyper parameters and Validation sets, Estimators -Bias and Variance. Challenges in machine learning. Simple Linear Regression, Logistic Regression, Performance measures - Confusion matrix, Accuracy, Precision, Recall, Sensitivity, Specificity, Receiver Operating Characteristic curve(ROC), Area Under Curve(AUC).

Module -2 (Neural Networks)

Introduction to neural networks -Single layer perceptrons, Multi Layer Perceptrons (MLPs), Representation Power of MLPs, Activation functions - Sigmoid, Tanh, ReLU, Softmax. Risk minimization, Loss function, Training MLPs with backpropagation, Practical issues in neural network training - The Problem of Overfitting, Vanishing and exploding gradient problems, Difficulties in convergence, Local and spurious Optima, Computational Challenges. Applications of neural networks.

Module 3 (Deep learning)

Introduction to deep learning, Deep feed forward network, Training deep models, Optimization techniques - Gradient Descent (GD), GD with momentum, Nesterov accelerated GD, Stochastic GD, AdaGrad, RMSProp, Adam. Regularization Techniques - L1 and L2 regularization, Early stopping, Dataset augmentation, Parameter sharing and tying, Injecting noise at input, Ensemble methods, Dropout, Parameter initialization.

Module -4 (Convolutional Neural Network)

Convolutional Neural Networks – Convolution operation, Motivation, Pooling, Convolution and Pooling as an infinitely strong prior, Variants of convolution functions, Structured outputs, Data types, Efficient convolution algorithms. Practical use cases for CNNs, Case study - Building CNN model AlexNet with handwritten digit dataset MNIST.

Module- 5 (Recurrent Neural Network)

Recurrent neural networks – Computational graphs, RNN design, encoder – decoder sequence to sequence architectures, deep recurrent networks, recursive neural networks, modern RNNs LSTM and GRU, Practical use cases for RNNs. Case study - Natural Language Processing.

Text Book

1. Goodfellow, I., Bengio, Y., and Courville, A., Deep Learning, MIT Press, 2016.
2. Neural Networks and Deep Learning, Aggarwal, Charu C., c Springer International Publishing AG, part of Springer Nature 2018
3. Fundamentals of Deep Learning: Designing Next-Generation Machine Intelligence Algorithms (1st. ed.). Nikhil Buduma and Nicholas Locascio. 2017. O'Reilly Media, Inc.

Reference Books

1. Satish Kumar, Neural Networks: A Classroom Approach, Tata McGraw-Hill Education, 2004.
2. Yegnaranarayana, B., Artificial Neural Networks PHI Learning Pvt. Ltd, 2009.
3. Michael Nielsen, Neural Networks and Deep Learning, 2018

Course Level Assessment Questions**Course Outcome 1 (CO1):**

1. Predict the price of a 1000 square feet house using the regression model generated from the following data.

No.	Square feet	Price(Lakhs)
1	500	5
2	900	10
3	1200	13
4	1500	18
5	2000	25
6	2500	32
7	2700	35

2. Consider a two-class classification problem of predicting whether a photograph contains a man or a woman. Suppose we have a test dataset of 10 records with expected outcomes and a set of predictions from our classification algorithm. Compute the confusion matrix, accuracy, precision, recall, sensitivity and specificity on the following data.

Sl.No.	Actual	Predicted
1	man	woman
2	man	man
3	woman	woman
4	man	man

5	man	woman
6	woman	woman
7	woman	man
8	man	man
9	man	woman
10	woman	woman

Course Outcome 2 (CO2):

1. Suppose you have a 3-dimensional input $x = (x_1, x_2, x_3) = (2, 2, 1)$ fully connected with weights $(0.5, 0.3, 0.2)$ to one neuron which is in the hidden layer with sigmoid activation function. Calculate the output of the hidden layer neuron.
2. Consider the case of the XOR function in which the two points $\{(0, 0), (1, 1)\}$ belong to one class, and the other two points $\{(1, 0), (0, 1)\}$ belong to the other class. Design a multilayer perceptron for this binary classification problem.

Course Outcome 3 (CO3):

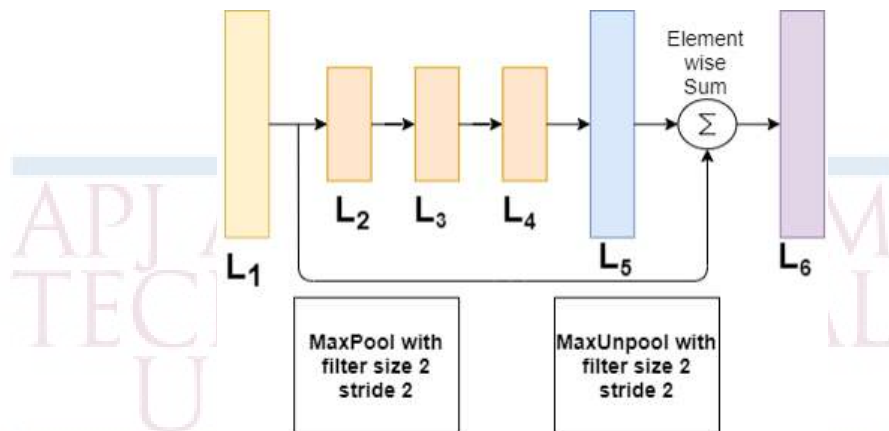
1. Derive a mathematical expression to show L2 regularization as weight decay.
2. Explain how L2 regularization improves the performance of deep feed forward neural networks.
3. Explain how L1 regularization method leads to weight sparsity.

Course Outcome 4 (CO4):

1. Draw and explain the architecture of convolutional neural networks.
2. You are given a classification problem to classify the handwritten digits. Suggest a learning and/or inference machine with its architecture, an objective function, and an optimization routine, along with how input and output will be prepared for the classifier.
3. In a Deep CNN architecture the feature map L_1 was processed by the following operations as shown in the figure. First down sampled using max pool operation of size 2 and stride 2, and three convolution operations and finally max unpool operation and followed by an element wise sum. The feature map L_1 and L_4 are given below. Compute the matrix L_6 .

$$L_1 = \begin{bmatrix} 10 & 20 & 15 & 22 \\ 20 & 16 & 28 & 30 \\ 30 & 12 & 20 & 16 \\ 20 & 20 & 40 & 12 \end{bmatrix}$$

$$L_4 = \begin{bmatrix} 10 & 20 \\ 20 & 30 \end{bmatrix}$$



4. Illustrate the workings of the RNN with an example of a single sequence defined on a vocabulary of four words.

Course Outcome 5 (CO5):

1. Draw and explain the architecture of LSTM.
2. List the differences between LSTM and GRU

Model Question Paper

QP CODE:

PAGES:4

Reg No: _____

Name: _____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FIFTH SEMESTER B.TECH DEGREE EXAMINATION(HONORS), MONTH & YEAR

Course Code: CST 395

Course Name: Neural Networks and Deep Learning

Max.Marks:100

Duration:3 Hours

PART A

Answer all Questions. Each question carries 3 Marks

1. List and compare the types of machine learning algorithms
2. Suppose 10000 patients get tested for flu; out of them, 9000 are actually healthy and 1000 are actually sick. For the sick people, a test was positive for 620 and negative for 380. For healthy people, the same test was positive for 180 and negative for 8820. Construct a confusion matrix for the data and compute the

accuracy, precision and recall for the data

3. Illustrate the limitation of a single layer perceptron with an example
4. Specify the advantages of ReLU over sigmoid activation function.
5. Derive weight updating rule in gradient descent when the error function is a) mean squared error b) cross entropy
6. List any three methods to prevent overfitting in neural networks
7. What happens if the stride of the convolutional layer increases? What can be the maximum stride? Justify your answer.
8. Consider an activation volume of size $13 \times 13 \times 64$ and a filter of size $3 \times 3 \times 64$. Discuss whether it is possible to perform convolutions with strides 2, 3 and 5. Justify your answer in each case.
9. How does a recursive neural network work?
10. List down three differences between LSTM and RNN

(10x3=30
)

Part B

(Answer any one question from each module. Each question carries 14 Marks)

11. (a) Prove that the decision boundary of binary logistic regression is linear
- (b) Given the following data, construct the ROC curve of the data. Compute the AUC.

(9)

Threshold	TP	TN	FP	FN
1	0	25	0	29
2	7	25	0	22
3	18	24	1	11
4	26	20	5	3
5	29	11	14	0

(5)

6	29	0	25	0
7	29	0	25	0

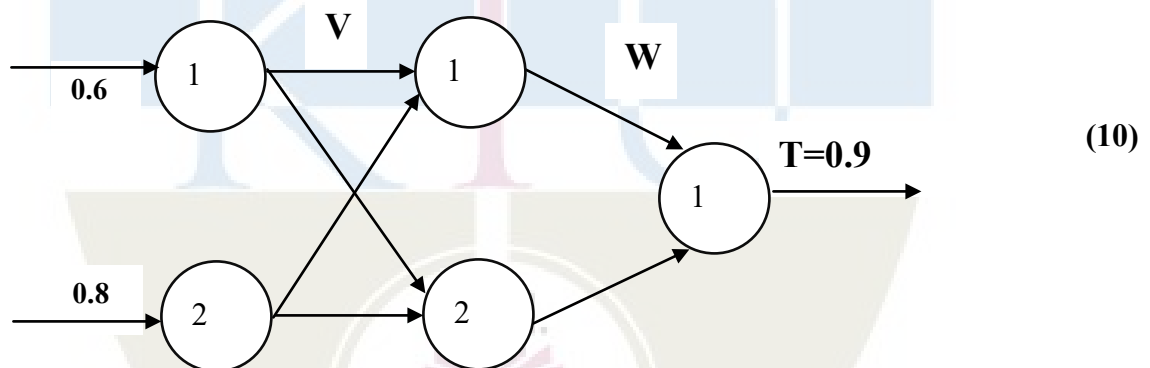
OR

12. (a) With an example classification problem, explain the following terms:
 a) Hyper parameters b) Training set c) Validation sets d) Bias e) Variance (8)

- (b) Determine the regression equation by finding the regression slope coefficient and the intercept value using the following data. (6)

x	55	60	65	70	80
y	52	54	56	58	62

13. (a) Update the parameters V_{11} in the given MLP using back propagation with learning rate as 0.5 and activation function as sigmoid. Initial weights are given as $V_{11}=0.2$, $V_{12}=0.1$, $V_{21}=0.1$, $V_{22}=0.3$, $V_{11}=0.2$, $W_{11}=0.5$, $W_{21}=0.2$

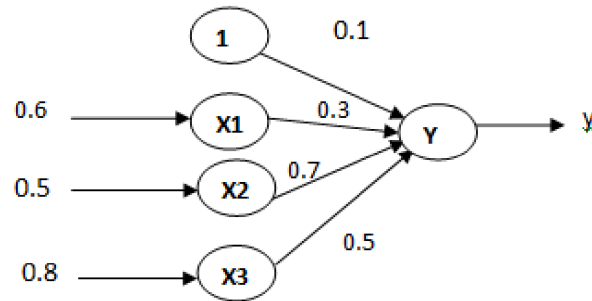


- (b) Explain the importance of choosing the right step size in neural networks (4)

OR

14. (a) Explain in detail any four practical issues in neural network training (8)

- (b) Calculate the output of the following neuron Y with the activation function as a) binary sigmoid b) tanh c) ReLU



(6)

15. (a) Explain, what might happen in ADAGRAD, where momentum is expressed as $\Delta \theta_j = -\eta \theta_j / \sqrt{\sum_{i=1}^n \theta_j^2}$ where the denominator computes the L2 norm of all previous gradients on a per-dimension basis and η is a global learning rate shared by all dimensions.

(6)

- (b) Differentiate gradient descent with and without momentum. Give equations for weight updation in GD with and without momentum. Illustrate plateaus, saddle points and slowly varying gradients.

(8)

OR

16. (a) Suppose a supervised learning problem is given to model a deep feed forward neural network. Suggest solutions for the following a) small sized dataset for training b) dataset with both labelled and unlabeled data c) large data set but data from different distribution

(9)

- (b) Describe the effect in bias and variance when a neural network is modified with more number of hidden units followed with dropout regularization.

(5)

17. (a) Draw and explain the architecture of Convolutional Neural Networks

(8)

- (b) Suppose that a CNN was trained to classify images into different categories. It performed well on a validation set that was taken from the same source as the training set but not on a testing set. What could be the problem with the training of such a CNN? How will you ascertain the problem? How can those problems be solved?

(6)

OR

18. (a) Explain the following convolution functions a) tensors b) kernel flipping c) down sampling d) strides e) zero padding.

(10)

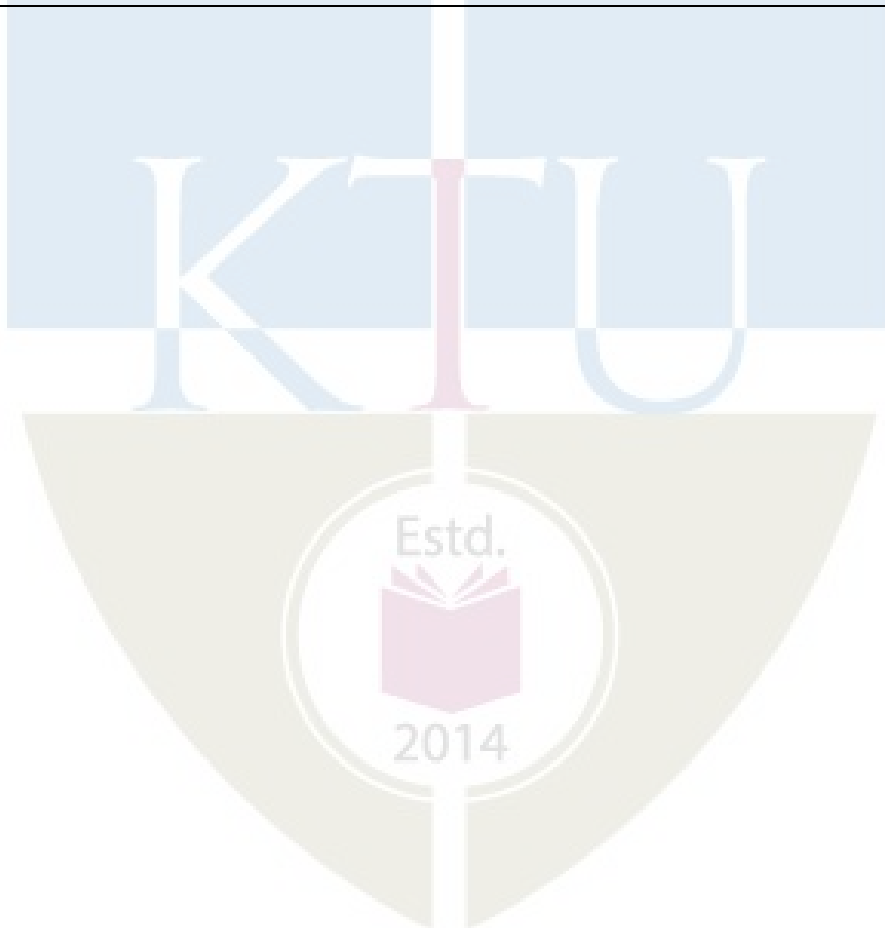
- (b) What is the motivation behind convolution neural networks? (4)
19. (a) Describe how an LSTM takes care of the vanishing gradient problem. Use some hypothetical numbers for input and output signals to explain the concept (8)
- (b) Explain the architecture of Recurrent Neural Networks (6)
- OR**
20. (a) Explain LSTM based solution for anyone of the problems in the Natural Language Processing domain. (8)
- (b) Discuss the architecture of GRU (6)

Teaching Plan

Module 1 : [Text book 1: Chapter 5, Textbook 2: Chapter 2](9 hours)		
1.1	Introduction, Learning algorithms - Supervised, Unsupervised, Reinforcement	1 hour
1.2	Overfitting, Underfitting, Hyperparameters	1 hour
1.3	Validation sets, Estimators -Bias and Variance. Challenges in machine learning.	1 hour
1.4	Simple Linear Regression	1 hour
1.5	Illustration of Linear Regression	1 hour
1.6	Logistic Regression	1 hour
1.7	Illustration of Logistic Regression	1 hour
1.8	Performance measures - Confusion matrix, Accuracy, Precision, Recall, Sensitivity, Specificity, ROC, AUC.	1 hour
1.9	Illustrative Examples for performance measures	1 hour
Module 2 : Text book 2, Chapter 1 (8 hours)		
2.1	Introduction to neural networks -Single layer perceptrons	1 hour
2.2	Multi Layer Perceptrons (MLPs), Representation Power of MLPs	1 hour
2.3	Activation functions - Sigmoid, Tanh, ReLU, Softmax. Risk minimization, Loss function	1 hour

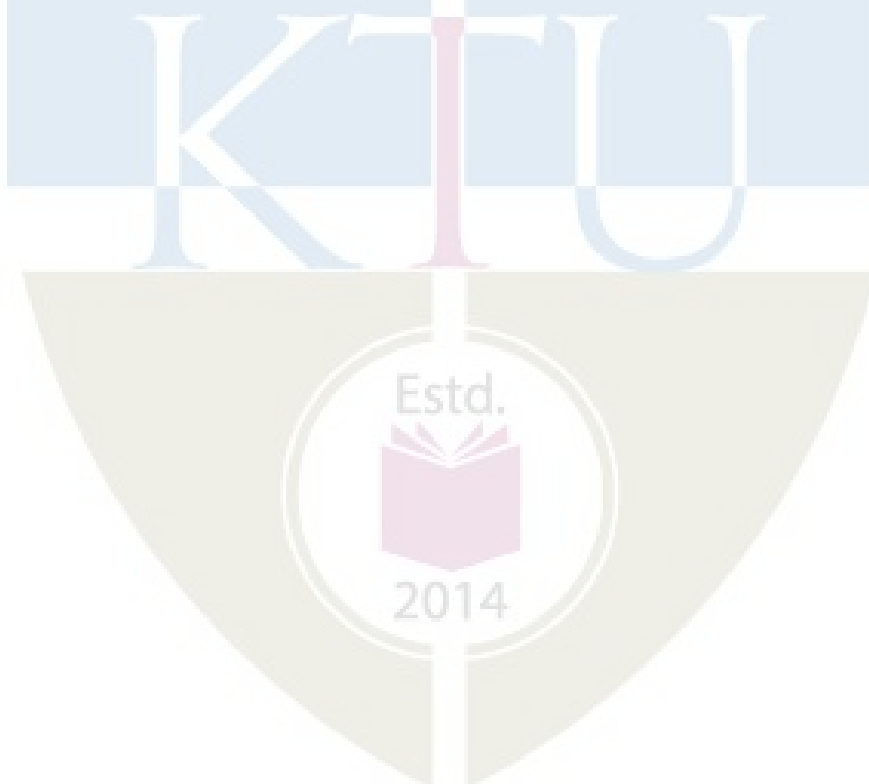
2.4	Training MLPs with backpropagation	1 hour
2.5	Illustration of back propagation algorithm	1 hour
2.6	Practical issues in neural network training - The Problem of Overfitting, Vanishing and exploding gradient problems	1 hour
2.7	Difficulties in convergence, Local and spurious Optima, Computational Challenges.	1 hour
2.8	Applications of neural networks	1 hour
Module 3 : Text book 1: Chapter 7, 8, Text book 2, Chapter 3, 4 (10 hours)		
3.1	Introduction to deep learning, Deep feed forward network	1 hour
3.2	Training deep models - Introduction, setup and initialization issues	1 hour
3.3	Solving vanishing and exploding gradient problems	1 hour
3.4	Concepts of optimization, Gradient Descent (GD), GD with momentum.	1 hour
3.5	Nesterov accelerated GD, Stochastic GD.	1 hour
3.6	AdaGrad, RMSProp, Adam.	1 hour
3.7	Concepts of Regularization, L1 and L2 regularization.	1 hour
3.8	Early stopping, Dataset augmentation	1 hour
3.9	Parameter sharing and tying, Injecting noise at input, Ensemble methods	1 hour
3.10	Dropout, Parameter initialization.	1 hour
Module 4 : Text book 1, Chapter 9, Text book 2: Chapter 8 (8 hours)		
4.1	Convolutional Neural Networks, architecture	1 hour
4.2	Convolution and Pooling operation with example	1 hour
4.3	Convolution and Pooling as an infinitely strong prior	1 hour
4.4	Variants of convolution functions, structured outputs, data types	1 hour
4.5	Efficient convolution algorithms.	1 hour
4.6	Practical use cases for CNNs	1 hour
4.7	Case study - Building CNN with MNIST and AlexNet.	1 hour
4.8	Case study - Building CNN with MNIST and AlexNet	1 hour
Module 5 : Text book 1 :Chapter 10, 11, Text book 2:Chapter 7 (10 hours)		

5.1	Recurrent neural networks – Computational graphs, RNN design	1 hour
5.2	Encoder – decoder sequence to sequence architectures	1 hour
5.3	Deep recurrent networks- Architecture	1 hour
5.4	Recursive neural networks	1 hour
5.5	Modern RNNs - LSTM	1 hour
5.6	Modern RNNs - LSTM	1 hour
5.7	GRU	1 hour
5.8	Practical use cases for RNNs.	1 hour
5.9	Case study - Natural Language Processing.	1 hour
5.10	Case study - Natural Language Processing.	1 hour



APJ ABDUL KALAM
TECHNOLOGICAL
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SEMESTER VI



CST 302	COMPILER DESIGN	Category	L	T	P	Credit	Year of Introduction
		PCC	3	1	0	4	2019

Preamble:

The purpose of this course is to create awareness among students about the phases of a compiler and the techniques for designing a compiler. This course covers the fundamental concepts of different phases of compilation such as lexical analysis, syntax analysis, semantic analysis, intermediate code generation, code optimization and code generation. Students can apply this knowledge in design and development of compilers.

Prerequisite: Sound knowledge in Data Structures, Formal Languages & Automata Theory.

Course Outcomes: After the completion of the course the student will be able to

CO1	Explain the phases in compilation process(lexical analysis, syntax analysis, semantic analysis, intermediate code generation, code optimization and code generation) and model a lexical analyzer (Cognitive Knowledge Level: Apply)
CO2	Model language syntax using Context Free Grammar and develop parse tree representation using leftmost and rightmost derivations (Cognitive Knowledge Level: Apply)
CO3	Compare different types of parsers(Bottom-up and Top-down) and construct parser for a given grammar (Cognitive Knowledge Level: Apply)
CO4	Build Syntax Directed Translation for a context free grammar, compare various storage allocation strategies and classify intermediate representations (Cognitive Knowledge Level: Apply)
CO5	Illustrate code optimization and code generation techniques in compilation (Cognitive Knowledge Level: Apply)

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

Abstract POs defined by National Board of Accreditation			
PO#	Broad PO	PO#	Broad PO
PO1	Engineering Knowledge	PO7	Environment and Sustainability
PO2	Problem Analysis	PO8	Ethics
PO3	Design/Development of solutions	PO9	Individual and team work
PO4	Conduct investigations of complex problems	PO10	Communication
PO5	Modern tool usage	PO11	Project Management and Finance
PO6	The Engineer and Society	PO12	Life long learning

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination Marks
	Test 1 (Marks)	Test 2 (Marks)	
Remember	20	20	20
Understand	40	40	40
Apply	40	40	40
Analyze			

Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : **10 marks**

Continuous Assessment - Test : **25 marks**

Continuous Assessment - Assignment : **15 marks**

Internal Examination Pattern:

Each of the two internal examinations has to be conducted out of 50 marks. First series test shall be preferably conducted after completing the first half of the syllabus and the second series test shall be preferably conducted after completing the remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly completed module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly completed module), each with 7 marks. Out of the 7 questions, a student should answer any 5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 full questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carries 14 marks.

Syllabus

Module - 1 (Introduction to compilers and lexical analysis)

Analysis of the source program - Analysis and synthesis phases, Phases of a compiler. Compiler writing tools. Bootstrapping. Lexical Analysis - Role of Lexical Analyser, Input Buffering, Specification of Tokens, Recognition of Tokens.

Module - 2 (Introduction to Syntax Analysis)

Role of the Syntax Analyser – Syntax error handling. Review of Context Free Grammars - Derivation and Parse Trees, Eliminating Ambiguity. Basic parsing approaches - Eliminating left recursion, left factoring. Top-Down Parsing - Recursive Descent parsing, Predictive Parsing, LL(1) Grammars.

Module - 3 (Bottom-Up Parsing)

Handle Pruning. Shift Reduce parsing. Operator precedence parsing (Concept only). LR parsing - Constructing SLR, LALR and canonical LR parsing tables.

Module - 4 (Syntax directed translation and Intermediate code generation)

Syntax directed translation - Syntax directed definitions, S-attributed definitions, L-attributed definitions, Bottom-up evaluation of S-attributed definitions. Run-Time Environments - Source Language issues, Storage organization, Storage-allocation strategies. Intermediate Code Generation - Intermediate languages, Graphical representations, Three-Address code, Quadruples, Triples.

Module 5 – (Code Optimization and Generation)

Code Optimization - Principal sources of optimization, Machine dependent and machine independent optimizations, Local and global optimizations. Code generation - Issues in the design of a code generator, Target Language, A simple code generator.

Text Books

1. Aho A.V., Ravi Sethi and D. Ullman. Compilers – Principles Techniques and Tools, Addison Wesley, 2006.

Reference Books

1. D.M.Dhamdhare, System Programming and Operating Systems, Tata McGraw Hill & Company, 1996.
2. Kenneth C. Loudon, Compiler Construction – Principles and Practice, Cengage Learning Indian Edition, 2006.

3. Tremblay and Sorenson, The Theory and Practice of Compiler Writing, Tata McGraw Hill & Company, 1984.

Sample Course Level Assessment Questions

Course Outcome 1 (CO1):

- 1) Explain the phases of a compiler with a neat diagram.
- 2) Define a token. Identify the tokens in the expression $a := b + 10$.

Course Outcome 2 (CO2):

- 1) Illustrate the process of eliminating ambiguity, left recursion and left factoring the grammar.
- 2) Is the following grammar ambiguous? If so eliminate ambiguity.

$$E \rightarrow E + E \mid E * E \mid (E) \mid \text{id}$$

Course Outcome 3 (CO3):

1. What are the different parsing conflicts in the SLR parsing table?
2. Design a recursive descent parser for the grammar

$$E \rightarrow E + T \mid T$$

$$T \rightarrow T * F \mid F$$

$$F \rightarrow (E) \mid \text{id}$$

3. Construct canonical LR(0) collection of items for the grammar below.

$$S \rightarrow L = R$$

$$S \rightarrow R$$

$$L \rightarrow * R$$

$$L \rightarrow \text{id}$$

$$R \rightarrow L$$

Also identify a shift reduce conflict in the LR(0) collection constructed above.

Course Outcome 4 (CO4):

1. Write the quadruple and triple representation of the following intermediate code

$$R1 = C * D$$

$$R2 = B + R1$$

$$A = R2$$

$$B[0] = A$$

2. Differentiate S-attributed Syntax Directed Translation(SDT) and L-attributed SDT. Write S - attributed SDT for a simple desktop calculator

Course Outcome 5 (CO5):

1. List out the examples of function preserving transformations.
2. What are the actions performed by a simple code generator for a typical three-address statement of the form $x := y \text{ op } z$.

Model Question Paper

QP CODE:

Reg No: _____

Name: _____

PAGES : 4

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
SIXTH SEMESTER B.TECH DEGREE EXAMINATION , MONTH & YEAR

Course Code: CST 302

Course Name: Compiler Design

Max.Marks:100
Hours

Duration: 3

PART A

Answer All Questions. Each Question Carries 3 Marks

1. Specify the analysis and synthesis parts of compilation.
2. Define the terms token, lexemes and patterns with examples.
3. Is the grammar $S \rightarrow S \mid (S) S / \epsilon$ ambiguous? Justify your answer.
4. What is left recursive grammar? Give an example. What are the steps in removing left recursion?
5. Compare different bottom-up parsing techniques.
6. What are the possible actions of a shift reduce parser.

7. Differentiate synthesized and inherited attributes with examples.

8. Translate $a[i] = b * c - b * d$, to quadruple.

9. What is the role of peephole optimization in the compilation process

10. What are the issues in the design of a code generator

(10x3=30)

Part B

(Answer any one question from each module. Each question carries 14 Marks)

11. (a) Explain the different phases of a compiler with a running example.

(9)

(b) List and explain any three compiler construction tools.

(5)

OR

12. (a) What is a regular definition? Give the regular definition of an unsigned integer

(7)

(b) Express the role of transition diagrams in recognition of tokens.

(7)

13. (a) What is Recursive Descent parsing? List the challenges in designing such a parser?

(4)

(b) Consider the following grammar

$E \rightarrow E \text{ or } T \mid T$

$T \rightarrow T \text{ and } F \mid F$

$F \rightarrow \text{not } F \mid (E) \mid \text{true} \mid \text{false}$

(10)

(i) Remove left recursion from the grammar.

(ii) Construct a predictive parsing table.

(iii) Justify the statement “The grammar is LL (1)”.

OR

14. (a) What is Recursive Descent parsing? List the problems in designing such a parser (4)

(b) Design a recursive descent parser for the grammar $S \rightarrow cAd$, $A \rightarrow ab/ b$ (5)

Find the FIRST and FOLLOW of the non-terminals S, A and B in the grammar (5)

$$S \rightarrow aABe$$

$$A \rightarrow Abc \mid b$$

$$B \rightarrow d$$

15. (a) Construct the LR(0) set of items and their GOTO function for the grammar $S \rightarrow S S + \mid S S * \mid a$ (10)

(b) Is the grammar SLR? Justify your answer (4)

OR

16. (a) Identify LR(1) items for the grammar $S \rightarrow CC$ (7)

$$C \rightarrow cC \mid d$$

(b) Construct LALR table for the above grammar (7)

17. (a) Design a Syntax Directed Translator(SDT) for the arithmetic expression $(4 * 7 + 19) * 2$ and draw an annotated parse tree for the same. (8)

(b) Consider the grammar with following translation rules and E as the start symbol (6)

$$E \rightarrow E1 \# T \{E.value = E1.value \times T.value ; \}$$

$$\mid T \{E.value = T.value ; \}$$

$$T \rightarrow T1 \& F \{ T.value = T1.value + F.value ; \}$$

$$\mid F \{ T.value = F.value ; \}$$

$$F \rightarrow \text{num} \{ F.value = \text{num.lvalue} ; \}$$

Compute E.value for the root of the parse tree for the expression

$2\#3 \& 5\# 6 \& 7$

OR

18. (a) Write Syntax Directed Translator (SDT) and parse tree for infix to postfix translation of an expression. (8)
- (b) Explain the storage allocation strategies. (6)
19. (a) Describe the principal sources of optimization (7)
- (b) Illustrate the optimization of basic blocks with examples. (7)

OR

20. (a) Write the Code Generation Algorithm and explain the *getreg* function (6)
- (b) Generate target code sequence for the following statement (8)
- $$d := (a-b)+(a-c)+(a-c).$$

Teaching Plan

No	Contents	No. of Lecture Hours
Module - 1(Introduction to Compilers and lexical analyzer) (8 hours)		
1.1	Introduction to compilers, Analysis of the source program	1 hour
1.2	Phases of the compiler – Analysis Phases	1 hour
1.3	Phases of the Compiler - Synthesis Phases	1 hour
1.4	Symbol Table Manager and Error Handler	1 hour
1.5	Compiler writing tools, bootstrapping	1 hour
1.6	The role of Lexical Analyzer , Input Buffering	1 hour
1.7	Specification of Tokens	1 hour
1.8	Recognition of Tokens	1 hour

Module – 2 (Introduction to Syntax Analysis) (10 hours)		
2.1	Role of the Syntax Analyser, Syntax error handling	1 hour
2.2	Review of Context Free Grammars	1 hour
2.3	Parse Trees and Derivations	1 hour
2.4	Grammar transformations, Eliminating ambiguity	1 hour
2.5	Eliminating left recursion	1 hour
2.6	Left factoring the grammar	1 hour
2.7	Recursive Descent parsing	1 hour
2.8	First and Follow	1 hour
2.9	Predictive Parsing table constructor	1 hour
2.10	LL(1) Grammars	1 hour
Module - 3 (Bottom up parsing) (9 hours)		
3.1	Bottom-up parsing - Handle Pruning	1 hour
3.2	Shift Reduce parsing	1 hour
3.3	Operator precedence parsing (Concept only)	1 hour
3.4	LR parsing , SLR Grammar, items	1 hour
3.5	Augmented Grammar, Canonical collection of LR(0) items	1 hour
3.6	SLR Parser Table Construction	1 hour
3.7	Constructing Canonical LR Parsing Tables	1 hour
3.8	Constructing LALR Parsing Tables	1 hour
3.9	LALR parser	1 hour
Module - 4 (Syntax Directed Translation and Intermediate code Generation) (9 hours)		
4.1	Syntax directed definitions	1 hour
4.2	S- attributed definitions, L- attributed definitions	1 hour
4.3	Bottom- up evaluation of S- attributed definitions.	1 hour
4.4	Source Language issues	1 hour
4.5	Storage organization	1 hour

4.6	Storage- allocation strategies	1 hour
4.7	Intermediate languages , Graphical representations	1 hour
4.8	Three-Address code	1 hour
4.9	Quadruples, Triples	1 hour
Module - 5 (Code Optimization and Generation) (9 hours)		
5.1	Principal sources of optimization	1 hour
5.2	Machine dependent optimizations	1 hour
5.3	Machine independent optimizations	1 hour
5.4	Local optimizations	1 hour
5.5	Global optimizations	1 hour
5.6	Issues in the design of a code generator – Lecture 1	1 hour
5.7	Issues in the design of a code generator – Lecture 2	1 hour
5.8	Target Language	1 hour
5.9	Design of a simple code generator.	1 hour



Abstract POs defined by National Board of Accreditation			
PO#	Broad PO	PO#	Broad PO
PO1	Engineering Knowledge	PO7	Environment and Sustainability
PO2	Problem Analysis	PO8	Ethics
PO3	Design/Development of solutions	PO9	Individual and team work
PO4	Conduct investigations of complex problems	PO10	Communication
PO5	Modern tool usage	PO11	Project Management and Finance
PO6	The Engineer and Society	PO12	Lifelong learning

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination Marks (%)
	Test1 (%)	Test2 (%)	
Remember	30	30	30
Understand	40	40	40
Apply	30	30	30
Analyze			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks

Continuous Assessment Tests : 25 marks

Continuous Assessment Assignment : 15 marks

Internal Examination Pattern:

Each of the two internal examinations has to be conducted out of 50 marks. First Internal Examination shall be preferably conducted after completing the first half of the syllabus and the Second Internal Examination shall be preferably conducted after completing the remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly covered module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly covered module), each with 7 marks. Out of the 7 questions in Part B, a student should answer any 5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which a student should answer any one. Each question can have a maximum 2 subdivisions and carries 14 marks.

Module-1 (Cyber Forensics)

Cyber Forensics: Cyber Technology- Technological Aspects of Cyber Forensics-Governance Aspects of Cyber Forensics- Judicial Aspects of Cyber Forensics- Legal Perspective of Cyber Forensic investigations.

Computer Forensic Investigations: -Preparing for computer investigations, understanding Public and private investigations Forensics Investigation Principles - Forensic Protocol for Evidence Acquisition - Digital Forensics Standards and Guidelines - Digital Evidence – Data Acquisition - storage formats for digital evidence, determining the best acquisition method, contingency planning for image acquisitions.

Module-2: (Cyber Forensics Tools and Types of Forensics)

Cyber Forensics Tools: Computer Forensics software and hardware tools -Open Source and Proprietary -Challenges in Cyber Forensics, Skills Required to Become a Cyber Forensic Expert-Physical Requirements of a Cyber forensics Lab, Types of Cyber forensics.

File System Forensics: Working with windows and DOS systems- file systems, exploring Microsoft file structures, examining FAT and NTFS disks, whole disk encryption, the windows registry, Microsoft and MS-DOS startup tasks, Examining UNIX and LINUX disk structures and boot processes, examining CD data structures, examining IDE/EIDE and SATA devices.

Module-3 (OS and Network Forensics)

Windows and Linux Forensics:

Windows Forensics-Live Response: Data Collection- Introduction , Locard's Exchange Principle, Order of Volatility - Volatile and Non Volatile Data Live-Response Methodologies: Data Analysis, Windows Memory Analysis, Rootkits and Rootkit detection. Linux Forensics: Live Response Data Collection- Data Analysis- Log Analysis, Keyword Searches, User Activity, Network Connections, Running Processes, Open File Handlers, The Hacking Top Ten, Reconnaissance Tools.

Network Forensics: The OSI Model, Forensic Footprints, Seizure of Networking Devices, Network Forensic Artifacts, ICMP Attacks, Drive-By Downloads, Network Forensic Analysis Tools, Case Study: Wireshark. Web Attack Forensics: OWASP Top 10, Web Attack Tests, Penetration Testing.

Module-4 (Cyber Security)

Cyber Security: Cybercrimes, Types of Cybercrimes –Cyber Security Steps taken to protect ICT and prevent Misuse of Internet- IT Act 2000- Social Cyber Media.

Module-5: (Anti-Forensics)

Anti-forensic Practices - Data Wiping and Shredding- Data Remanence, Degaussing, Case Study: USB Oblivion, Eraser - Trail Obfuscation: Spoofing, Data Modification, Case Study: Timestamp – Encryption, Case Study: VeraCrypt, Data Hiding: Steganography and Cryptography, Case Study: SilentEye, Anti-forensics Detection Techniques, Case Study: Stegdetect.

Text Books

1. Nishesh Sharma “Cyber Forensics in India- A Legal Perspective”, Universal Law Publishing, First Edition, March 2017
2. Bill Nelson, Amelia Philipps and Christopher Steuart, “Computer forensics- Guide to computer forensics and investigations”, Course Technology Inc, 3rd Edition, 2009
3. Brian Carrier “File System Forensic Analysis, Addison-Wesley, 1st Edition, 2005
4. Harlan Carvey, “Windows Forensics Windows Forensic Analysis DVD Toolkit” O’Reilly, 2nd Edition, 2018.
5. Chris Pogue , Cory Altheide, Todd Haverkos, “Linux Forensics- Unix and Linux Forensic Analysis DVD Toolkit”, Syngress, First Edition, 2008
6. William Stallings “Network Security Essentials Applications and Standards” Pearson Education, 4th Edition, 2011.
7. E. Maiwald, “Fundamentals of Network Security”, McGraw-Hill, First Edition, 2004

References

1. Michael. E. Whitman, Herbet. J. Mattord, “Cyber Security Principles of Information Security”, Course Technology Ptr , 4th Edition, 2011.
2. William Stallings “Cryptography and Network Security”, Pearson, 5th Edition, 2018.
3. Niranjana Reddy, “Practical Cyber Forensics: An Incident-Based Approach to Forensic Investigations”, Apress, First Edition, 2019

Course Level Assessment Questions**CourseOutcome1(CO1):**

1. Explain the Forensics principles and protocols for evidence acquisition.
2. Explain the different storage formats tools used for Digital evidence.

CourseOutcome2(CO2):

1. Explain the pros and cons of NTFS and FAT File systems. Also give the challenges the Investigators would face in extracting evidence from these file systems.

CourseOutcome3 (CO3):

1. Describe any memory forensics methodologies/tools to extract volatile and nonvolatile data from a Windows based system.
2. Use web attacks test tools like netcraft to identify web application vulnerabilities of a particular site say www.xyz.com

CourseOutcome4 (CO4):

1. Explain the different steps taken to protect ICT and prevent Misuse of Internet.

2. Explain the impact of Section 66 in IT Act to General Public. CSE(CYBER SECURITY)

Course Outcome 5 (CO5):

1. Explain the different anti-forensics practices used to destroy or conceal data in order to prevent others from accessing it.

Model Question Paper

QP CODE:

Reg No: _____

Name : _____

PAGES : 2

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
SIXTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR**

**Course Code: CcT304
Course Name: Cyber Forensics**

Max.Marks:100

Duration: 3 Hours

PART A

Answer all Questions. Each question carries 3 Marks

1. Distinguish between public and private investigations.
2. What are the three computer forensics data acquisitions formats?
3. List any three features of NTFS that the FAT does not have.
4. Define the terms file slack, RAM slack and drive slack.
5. Why is it important to collect nonvolatile information in forensic investigations?
6. Why would you conduct a live response on a running system?
7. What are the different tools used in Network Forensics?
8. Explain how Risk Analysis and Penetration Testing are different.
9. Define Steganography. Discuss its need.
10. How is data wiping done on the hard drive?

(10 x 3 = 30 Marks)

PART B

CSE(CYBER SECURITY)

(Answer any one Question from each module.Each question carries 14 Marks)

11. (a) Explain the different types of Investigations. **(8 marks)**
(b) Differentiate between Static acquisition and Live acquisition with example. **(6 marks)**

OR

12. (a) Explain the principles of Digital Forensic Investigation. Why is it important? **(8 marks)**
(b) When you perform an acquisition at a remote location, what should you consider to prepare for this task? **(6 marks)**

13. (a) Write down the FAT File Structure? **(8 marks)**
(b) Does Windows NT use FAT or NTFS. Explain. **(6 marks)**

OR

14. (a) Explain the different Open Source Tools used in Image Acquisition. **(6 marks)**
(b) What are the physical requirements of a Cyber Forensics Lab.? **(8 marks)**
15. (a) What is Locard's Exchange Principle? Explain with suitable examples. **(6 marks)**
(b) Explain the different types of volatile information in a live response system. List any two tools used for obtaining volatile information. **(8 marks)**

OR

16. (a) What is OWASP? Mention the Top 10 web application vulnerabilities in 2021. **(8 marks)**
(b) How would you set up Wireshark to monitor packets passing through an internet router? **(6 marks)**
17. (a) What is Cyber Security? Discuss the major Cyber Crimes? **(7 marks)**
(b) Explain the impact of Social Cyber Media. **(7 marks)**

OR

18. (a) What are the measures taken to prevent the misuse of the Internet? **(7 marks)**
(b) What is the the essence of IT Act 2000? **(7 marks)**
19. (i) How is Steganography done? **(7 marks)**
(ii) (a) Why does data need Cryptography? **(4 marks)**
(b) What is the difference between a Cryptographer and a Crypter? **(3 marks)**

OR

CSE(CYBER SECURITY)

20. (a) Explain the different types of Anti-forensics Detection Techniques.

(8 marks)

(b) What is Spoofing? How to prevent spoofing attacks?

(6 marks)

TEACHING PLAN

No.	Contents	No of Lecture Hrs
Module-1 (Cyber Forensics and Cyber Security) (11hrs)		
1.1	Cyber Technology- Technological Aspects of Cyber Forensics	1
1.2	Governance Aspects of Cyber Forensics- Judicial Aspects of Cyber Forensics	1
1.3	Legal Perspective of Cyber Forensic investigations	1
1.4	Preparing for computer investigations, understanding Public and private investigations	1
1.5	Forensics Investigation Principles - Forensic Protocol for Evidence Acquisition	1
1.6	Digital Forensics Standards and Guidelines	1
1.7	Digital Evidence	1
1.8	Data Acquisition	1
1.9	Storage formats for digital evidence	1
1.10	Determining the best acquisition method	1
1.11	Contingency planning for image acquisitions	1
Module-2 (Cyber Forensics Tools and Types of Forensics) (9hrs)		
2.1	Computer Forensics software and hardware tools -Open Source and Proprietary	1
2.2	Challenges in Cyber Forensics, Skills Required to Become a Cyber Forensic Expert	1
2.3	Physical Requirements of a Cyber forensics Lab, Types of Cyber forensics	1

2.4	Working with windows and DOS systems- file systems	1
2.5	Exploring Microsoft file structures, examining FAT and NTFS disks	1
2.6	Whole disk encryption, Windows registry	1
2.7	Microsoft and MS-DOS start up tasks, Examining UNIX and LINUX disk structures and boot processes,.	1
2.8	Examining CD data structures	1
2.9	Examining IDE/EIDE and SATA devices	
Module-3 (Operating System Forensics) (12hrs)		
3.1	Windows Forensics-Live Response: Data Collection- Introduction	1
3.2	Locard's Exchange Principle, Order of Volatility - Volatile and Non Volatile Data	1
3.3	Linux Forensics:Live Response Data Collection- Data Analysis- Log Analysis.	1
3.4	Keyword Searches, User Activity, Network Connections, Running Processes, Open File Handlers	1
3.5	The Hacking Top Ten, Reconnaissance Tools- I	1
3.6	The Hacking Top Ten, Reconnaissance Tools- II	1
3.7	The OSI Model, Forensic Footprints	1
3.8	Seizure of Networking Devices, Network Forensic Artifacts, ICMP Attacks	1
3.9	Drive-By Downloads, Network Forensic Analysis Tools	1
3.10	Case Study: Wireshark.	1
3.11	Web Attack Forensics: OWASP Top 10, Web Attack Tests,	1
3.12	Penetration Testing	1

Module-4 (Cyber Security) (7 hrs)		
4.1	Cybercrimes, Types of Cybercrimes	1
4.2	Cyber Security Steps taken to protect ICT and prevent Misuse of Internet	1
4.3	IT Act 2000- Lecture I	1
4.4	IT Act 2000- Lecture II	1
4.5	IT Act 2000- Lecture III	1
4.6	Social Cyber Media- Lecture I	1
4.7	Social Cyber Media- Lecture II	1
Module – 5 (Anti-Forensics) (6 Hrs)		
5.1	Anti-forensic Practices - Data Wiping and Shredding	1
5.2	Data Remanence, Degaussing	1
5.3	Trail Obfuscation: Spoofing, Data Modification	1
5.4	Role of Encryption in Forensics	1
5.5	Data Hiding: Steganography and Cryptography	1
5.6	Anti-forensics Detection Techniques	1

CST 306	ALGORITHM ANALYSIS AND DESIGN	Category	L	T	P	Credit	Year of Introduction
		PCC	3	1	0	4	2019

Preamble:

The course introduces students to the design of computer algorithms, as well as analysis of algorithms. Algorithm design and analysis provide the theoretical backbone of computer science and are a must in the daily work of the successful programmer. The goal of this course is to provide a solid background in the design and analysis of the major classes of algorithms. At the end of the course students will be able to develop their own versions for a given computational task and to compare and contrast their performance.

Prerequisite:

Strong Foundation in Mathematics, Programming in C, Data Structures and Graph Theory.

Course Outcomes: After the completion of the course the student will be able to

CO#	CO
CO1	Analyze any given algorithm and express its time and space complexities in asymptotic notations. (Cognitive Level: Apply)
CO2	Derive recurrence equations and solve it using Iteration, Recurrence Tree, Substitution and Master's Method to compute time complexity of algorithms. (Cognitive Level: Apply)
CO3	Illustrate Graph traversal algorithms & applications and Advanced Data structures like AVL trees and Disjoint set operations. (Cognitive Level: Apply)
CO4	Demonstrate Divide-and-conquer, Greedy Strategy, Dynamic programming, Branch-and Bound and Backtracking algorithm design techniques (Cognitive Level: Apply)
CO5	Classify a problem as computationally tractable or intractable, and discuss strategies to address intractability (Cognitive Level: Understand)
CO6	Identify the suitable design strategy to solve a given problem. (Cognitive Level: Analyze)

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												√
CO6												

Abstract POs defined by National Board of Accreditation			
PO#	Broad PO	PO#	Broad PO
PO1	Engineering Knowledge	PO7	Environment and Sustainability
PO2	Problem Analysis	PO8	Ethics
PO3	Design/Development of solutions	PO9	Individual and team work
PO4	Conduct investigations of complex problems	PO10	Communication
PO5	Modern tool usage	PO11	Project Management and Finance
PO6	The Engineer and Society	PO12	Life long learning

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination Marks (%)
	Test 1 (%)	Test 2 (%)	
Remember	30	30	30
Understand	30	30	30
Apply	40	40	40

Analyze			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3

Continuous Internal Evaluation Pattern:

Attendance	10 marks
Continuous Assessment Tests (Average of Series Tests 1 & 2)	25 marks
Continuous Assessment Assignment	15 marks

Internal Examination Pattern:

Each of the two internal examinations has to be conducted out of 50 marks. First series test shall be preferably conducted after completing the first half of the syllabus and the second series test shall be preferably conducted after completing remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly completed module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly completed module), each with 7 marks. Out of the 7 questions, a student should answer any 5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 full questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carries 14 marks.

Syllabus

Module-1 (Introduction to Algorithm Analysis)

Characteristics of Algorithms, Criteria for Analysing Algorithms, Time and Space Complexity - Best, Worst and Average Case Complexities, Asymptotic Notations - Big-Oh (O), Big- Omega (Ω), Big-Theta (Θ), Little-oh (o) and Little- Omega (ω) and their properties. Classifying functions by their asymptotic growth rate, Time and Space Complexity Calculation of simple algorithms.

Analysis of Recursive Algorithms: Recurrence Equations, Solving Recurrence Equations – Iteration Method, Recursion Tree Method, Substitution method and Master’s Theorem (Proof not required).

Module-2 (Advanced Data Structures and Graph Algorithms)

Self Balancing Tree - AVL Trees (Insertion and deletion operations with all rotations in detail, algorithms not expected); Disjoint Sets- Disjoint set operations, Union and find algorithms.

DFS and BFS traversals - Analysis, Strongly Connected Components of a Directed graph, Topological Sorting.

Module-3 (Divide & Conquer and Greedy Strategy)

The Control Abstraction of Divide and Conquer- 2-way Merge sort, Strassen’s Algorithm for Matrix Multiplication-Analysis. The Control Abstraction of Greedy Strategy- Fractional Knapsack Problem, Minimum Cost Spanning Tree Computation- Kruskal’s Algorithms - Analysis, Single Source Shortest Path Algorithm - Dijkstra’s Algorithm-Analysis.

Module-4 (Dynamic Programming, Back Tracking and Branch & Bound))

The Control Abstraction- The Optimality Principle- Matrix Chain Multiplication-Analysis, All Pairs Shortest Path Algorithm - Floyd-Warshall Algorithm-Analysis. The Control Abstraction of Back Tracking – The N Queen’s Problem. Branch and Bound Algorithm for Travelling Salesman Problem.

Module-5 (Introduction to Complexity Theory)

Tractable and Intractable Problems, Complexity Classes – P, NP, NP- Hard and NP-Complete Classes- NP Completeness proof of Clique Problem and Vertex Cover Problem- Approximation algorithms- Bin Packing, Graph Coloring. Randomized Algorithms (Definitions of Monte Carlo and Las Vegas algorithms), Randomized version of Quick Sort algorithm with analysis.

Text Books

1. T.H.Cormen, C.E.Leiserson, R.L.Rivest, C. Stein, Introduction to Algorithms, 2nd Edition, Prentice-Hall India (2001)
2. Ellis Horowitz, Sartaj Sahni, Sanguthevar Rajasekaran, “Fundamentals of Computer Algorithms”, 2nd Edition, Orient Longman Universities Press (2008)

3. Sara Baase and Allen Van Gelder —Computer Algorithms, Introduction to Design and Analysis, 3rd Edition, Pearson Education (2009)

Reference Books

1. Jon Kleinberg, Eva Tardos, “Algorithm Design”, First Edition, Pearson (2005)
2. Robert Sedgewick, Kevin Wayne, “Algorithms”, 4th Edition Pearson (2011)
3. Gilles Brassard, Paul Bratley, “Fundamentals of Algorithmics”, Pearson (1996)
4. Steven S. Skiena, “The Algorithm Design Manual”, 2nd Edition, Springer(2008)

Course Level Assessment Questions

Course Outcome 1 (CO1):

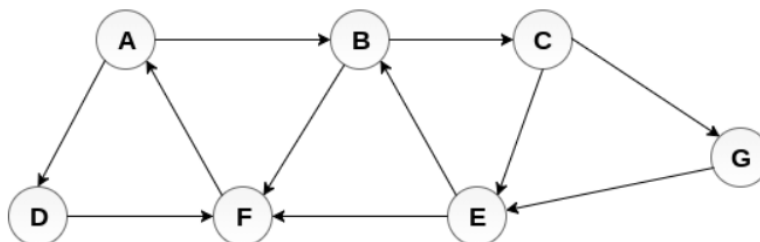
1. Is $2^{n+1} = O(2^n)$? Is $2^{2n} = O(2^n)$? Justify your answer.
2. What is the need of asymptotic analysis in calculating time complexity? What are the notations used for asymptotic analysis?
3. Calculate the time complexity for addition of two matrices.
4. Define time complexity and space complexity. Write an algorithm for adding n natural numbers and analyse the time and space requirements of the algorithm.

Course Outcome 2 (CO2):

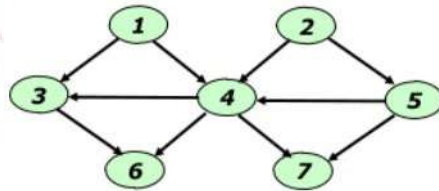
1. State Master’s theorem for solving recurrences.
2. Solve the recurrence $T(n) = 3T(n-2)$, using iteration method
3. State the conditions in recurrences where Master Theorem is not applicable.
4. Solve the following recurrence equations using Master’s theorem.
 - a) $T(n) = 8T(n/2) + 100n^2$
 - b) $T(n) = 2T(n/2) + 10n$
5. Using Recursion Tree method, Solve $T(n) = 2T(n/10) + T(9n/10) + n$. Assume constant time for small values of n.

Course Outcome 3 (CO3):

1. Explain the rotations performed for insertion in AVL tree with example.
2. Write down BFS algorithm and analyse the time complexity. Perform BFS traversal on the given graph starting from node A. If multiple node choices are available for next travel, choose the next node in alphabetical order.

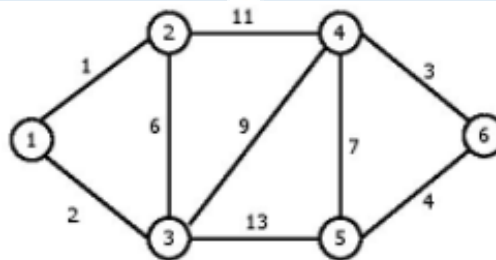


3. Find the minimum and maximum height of any AVL-tree with 7 nodes? Assume that the height of a tree with a single node is 0. (3)
4. Find any three topological orderings of the given graph.

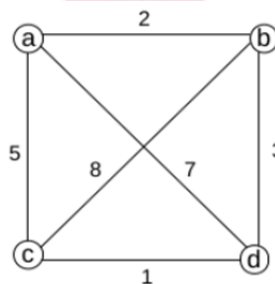


Course Outcome 4 (CO4):

1. Give the control abstraction for Divide and Conquer method.
2. Construct the minimum spanning tree for the given graph using Kruskal's algorithm. Analyse the complexity of the algorithm.



3. Compare Divide and Conquer and Dynamic programming methodologies
4. What is Principle of Optimality?
5. Define Travelling Salesman Problem (TSP). Apply branch and bound algorithm to solve TSP for the following graph, assuming the start city as 'a'. Draw the state space tree.



Course Outcome 5 (CO5):

1. Compare Tractable and Intractable Problems
2. With the help of suitable code sequence convince Vertex Cover Problem is an example of NP-Complete Problem

3. Explain Vertex Cover problem using an example. Suggest an algorithm for finding Vertex Cover of a graph.
4. Write short notes on approximation algorithms.
5. Compare Conventional quick sort algorithm and Randomized quicksort with the help of a suitable example?

Course Outcome 6 (CO6): (CO attainment through assignment only, not meant for examinations)

Choosing the best algorithm design strategy for a given problem after applying applicable design strategies – Sample Problems Given.

1. Finding the Smallest and Largest elements in an array of 'n' numbers
2. Fibonacci Sequence Generation.
3. Merge Sort
4. Travelling Sales Man Problem
5. 0/1 Knapsack Problem

Model Question Paper

QP CODE:

Reg No: _____

Name: _____

PAGES : 4

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SIXTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: CST 306

Course Name: Algorithm Analysis and Design

Max. Marks : 100

Duration: 3 Hours

PART A

Answer All Questions. Each Question Carries 3 Marks

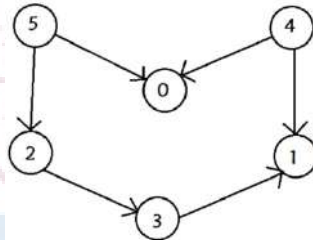
1. Define asymptotic notation? Arrange the following functions in increasing order of asymptotic growth rate.
 n^3 , 2^n , $\log n^3$, 2^{100} , $n^2 \log n$, n^n , $\log n$, $n^{0.3}$, $2^{\log n}$

2. State Master's Theorem. Find the solution to the following recurrence equations using Master's theorem.

a) $T(n) = 8T(n/2) + 100n^2$

b) $T(n) = 2T(n/2) + 10n$

3. Find any two topological ordering of the DAG given below.



4. Show the UNION operation using linked list representation of disjoint sets.
5. Write the control abstraction of greedy strategy to solve a problem.
6. Write an algorithm based on divide-and-conquer strategy to search an element in a given list. Assume that the elements of list are in sorted order.
7. List the sequence of steps to be followed in Dynamic Programming approach.
8. Illustrate how optimal substructure property could be maintained in Floyd-Warshall algorithm.
9. Differentiate between P and NP problems.
10. Specify the relevance of approximation algorithms.

(10x3=30)

Part B

(Answer any one question from each module. Each question carries 14 Marks)

11. (a) Define Big O, Big Ω and Big Θ Notation and illustrate them graphically. (7)
- (b) Solve the following recurrence equation using recursion tree method (7)
- $$T(n) = T(n/3) + T(2n/3) + n, \text{ where } n > 1$$
- $$T(n) = 1, \text{ Otherwise}$$

OR

12. (a) Explain the iteration method for solving recurrences and solve the following recurrence equation using iteration method. (7)

$$T(n) = 3T(n/3) + n; T(1) = 1$$

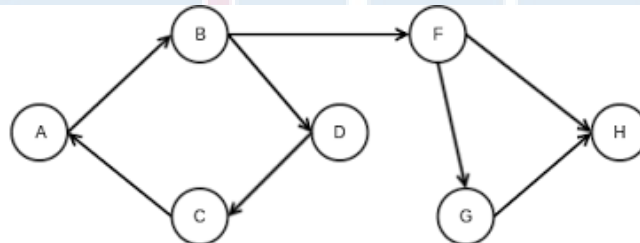
- (b) Determine the time complexities of the following two functions fun1() and fun2(). (7)

```
i) int fun1(int n)
{
    if (n <= 1) return n;
    return 2*fun1(n-1);
}
```

```
ii) int fun2 (int n)
{
    if (n <= 1) return n;
    return fun2 (n-1) + fun2 (n-1)
}
```

13. (a) Write DFS algorithm and analyse its time complexity. Illustrate the classification of edges in DFS traversal. (7)

- (b) Find the strongly connected components of the digraph given below: (7)



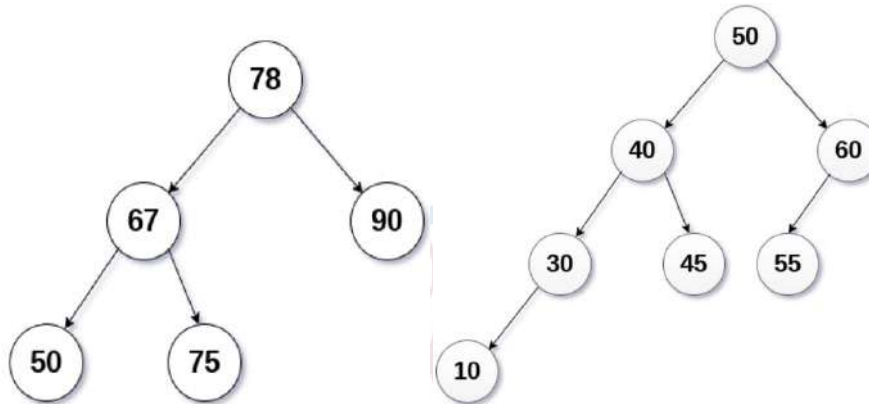
OR

14. (a) Illustrate the advantage of height balanced binary search trees over binary search trees? Explain various rotations in AVL trees with example. (7)

- (b) Perform the following operations in the given AVL trees. (7)

i) Insert 70

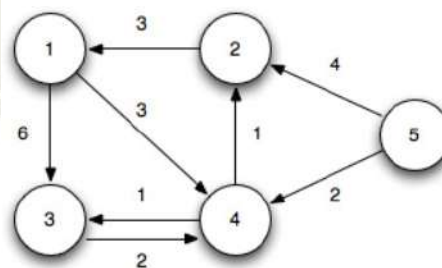
ii) Delete 55



15. (a) State Fractional Knapsack Problem and write Greedy Algorithm for Fractional Knapsack Problem. (7)
- (b) Find the optimal solution for the following Fractional Knapsack problem. (7)
 Given the number of items(n) = 7, capacity of sack(m) = 15,
 $W = \{2, 3, 5, 7, 1, 4, 1\}$ and $P = \{10, 5, 15, 7, 6, 18, 3\}$

OR

16. (a) Write and explain merge sort algorithm using divide and conquer strategy using the data $\{30, 19, 35, 3, 9, 46, 10\}$. Also analyse the time complexity. (7)
- (b) Write the pseudo code for Dijkstra's algorithm. Compute the shortest distance from vertex 1 to all other vertices using Dijkstra's algorithm. (7)

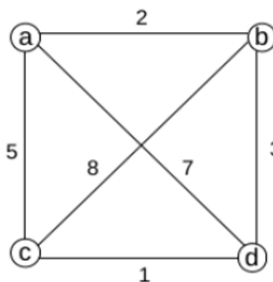


17. (a) Write Floyd-Warshall algorithm and analyse its complexity. (5)
- (b) Write and explain the algorithm to find the optimal parenthesization of matrix chain product whose sequence of dimension is $4 \times 10, 10 \times 3, 3 \times 12, 12 \times 20$. (9)

OR

18. (a) Explain the concept of Backtracking method using 4 Queens problem. (7)

- (b) Define Travelling Salesman Problem (TSP). Apply branch and bound algorithm to solve TSP for the following graph, assuming the start city as 'a'. Draw the state space tree. (7)



19. (a) State bin packing problem? Explain the first fit decreasing strategy (7)

- (b) Prove that the Clique problem is NP-Complete. (7)

OR

20. (a) Explain the need for randomized algorithms. Differentiate Las Vegas and Monte Carlo algorithms. (6)

- (b) Explain randomized quicksort and analyse the expected running time of randomized quicksort with the help of a suitable example? (9)

Teaching Plan

No	Topic	No. of Hours (45 hrs)
Module -1 (Introduction to Algorithm Analysis) 9 hrs.		
1.1	Introduction to Algorithm Analysis: Characteristics of Algorithms.	1 hour
1.2	Criteria for Analysing Algorithms, Time and Space Complexity - Best, Worst and Average Case Complexities.	1 hour
1.3	Asymptotic Notations - Properties of Big-Oh (O), Big- Omega (Ω), Big-Theta (Θ), Little-Oh (o) and Little- Omega (ω).	1 hour
1.4	Illustration of Asymptotic Notations	1 hour

1.5	Classifying functions by their asymptotic growth rate	1 hour
1.6	Time and Space Complexity Calculation of algorithms/code segments.	1 hour
1.7	Analysis of Recursive Algorithms: Recurrence Equations, Solving Recurrence Equations – Iteration Method.	1 hour
1.8	Recursion Tree Method	1 hour
1.9	Substitution method and Master's Theorem and its Illustration.	1 hour
Module-2 (Advanced Data Structures and Graph Algorithms) 10 Hrs.		
2.1	Self Balancing Trees - Properties of AVL Trees, Rotations of AVL Trees	1 hour
2.2	AVL Trees Insertion and Illustration	1 hour
2.3	AVL Trees Deletion and Illustration	1 hour
2.4	Disjoint set operations.	1 hour
2.5	Union and find algorithms.	1 hour
2.6	Illustration of Union and find algorithms	1 hour
2.7	Graph Algorithms: BFS traversal, Analysis.	1 hour
2.8	DFS traversal, Analysis.	1 hour
2.9	Strongly connected components of a Directed graph.	1 hour
2.10	Topological Sorting.	1 hour
Module-3 (Divide & Conquer and Greedy Method) 8 Hrs		
3.1	Divide and Conquer: The Control Abstraction.	1 hour
3.2	2-way Merge Sort, Analysis.	1 hour
3.3	Strassen's Algorithm for Matrix Multiplication, Analysis	1 hour

3.4	Greedy Strategy: The Control Abstraction.	1 hour
3.5	Fractional Knapsack Problem.	1 hour
3.6	Minimum Cost Spanning Tree Computation- Kruskal's Algorithm, Analysis.	1 hour
3.7	Single Source Shortest Path Algorithm - Dijkstra's Algorithm	1 hour
3.8	Illustration of Dijkstra's Algorithm-Analysis.	1 hour
Module-4 (Dynamic Programming, Back Tracking and Branch and Bound) 8 Hrs.		
4.1	Dynamic Programming: The Control Abstraction, The Optimality Principle.	1 hour
4.2	Matrix Chain Multiplication-Analysis.	1 hour
4.3	Illustration of Matrix Chain Multiplication-Analysis.	1 hour
4.4	All Pairs Shortest Path Algorithm- Analysis and Illustration of Floyd-Warshall Algorithm.	1 hour
4.5	Back Tracking: The Control Abstraction .	1 hour
4.6	Back Tracking: The Control Abstraction – The N Queen's Problem.	1 hour
4.7	Branch and Bound:- Travelling salesman problem.	1 hour
4.8	Branch and Bound:- Travelling salesman problem.	1 hour
Module-5 (Introduction to Complexity Theory) 10 Hrs		
5.1	Introduction to Complexity Theory: Tractable and Intractable Problems.	1 hour
5.2	Complexity Classes – P, NP.	1 hour
5.3	NP- Hard and NP-Complete Problems.	1 hour
5.4	NP Completeness Proof of Clique Problem.	1 hour

5.5	NP Completeness Proof of Vertex Cover Problem.	1 hour
5.6	Approximation algorithms- Bin Packing Algorithm and Illustration.	1 hour
5.7	Graph Colouring Algorithm and Illustration.	1 hour
5.8	Randomized Algorithms (definitions of Monte Carlo and Las Vegas algorithms).	1 hour
5.9	Randomized Version of Quick Sort Algorithm with Analysis.	1 hour
5.10	Illustration of Randomized Version of Quick Sort Algorithm with Analysis.	1 hour



CCT 308	COMPREHENSIVE COURSE WORK	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCT ION
		PCC	1	0	0	1	2019

Preamble:

The objective of this Course work is to ensure the comprehensive knowledge of each student in the most fundamental core courses in the curriculum. Six core courses credited from Semesters 3, 4 and 5 are chosen for the detailed study in this course work. This course helps the learner to become competent in cracking GATE, placement tests and other competitive examinations

Prerequisite:

1. Data Structures
2. Operating Systems
3. Computer Networks
4. Database Management Systems
5. Applied Cryptography

Course Outcomes: After the completion of the course the student will be able to

CO#	Course Outcomes
CO1	Comprehend the basic concepts and applications of data structures (Cognitive Knowledge Level: Understand)
CO2	Comprehend the basic concepts, functions and algorithms in Operating Systems (Cognitive Knowledge Level: Understand)
CO3	Comprehend the organization and architecture of computer Networks (Cognitive Knowledge Level: Understand)
CO4	Comprehend the fundamental principles of database design and manipulation (Cognitive Knowledge Level: Understand)
CO5	Comprehend the basic concepts and algorithms in Applied Cryptography (Cognitive Knowledge Level: Understand)

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

Assessment Pattern

Bloom's Category	End Semester Examination
Remember	10
Understand	20
Apply	20
Analyse	
Evaluate	
Create	

Mark distribution

Total Marks	CIE	ESE	ESE Duration
50	0	50	1 hour

End Semester Examination Pattern:

Objective Questions with multiple choice, a maximum of four options. Question paper includes fifty questions of one mark each, distributed equally from all the five identified courses.

Syllabus

Full Syllabus of all five selected Courses.

1. **Data Structures(CST201)**
2. **Operating Systems(CST206)**
3. **Database Management Systems(CST204)**
4. **Computer Networks(CST303)**
5. **Applied Cryptography(CCT307)**

Course Contents and Lecture Schedule

No	Topic	No. of Lecture Hrs
1	DATA STRUCTURES	
1.1	Mock Test on Module 1, Module 2 and Module 3	1
1.2	Mock Test on Module 4 and Module 5	1
1.3	Feedback and Remedial class	1
2	OPERATING SYSTEMS	
2.1	Mock Test on Module 1 and Module 2	1
2.2	Mock Test on Module 3, Module 4 and Module 5	1
2.3	Feedback and Remedial class	1
3	DATABASE MANAGEMENT SYSTEMS	
3.1	Mock Test on Module 1 and Module 2	1
3.2	Mock Test on Module 3, Module 4 and Module 5	1
3.3	Feedback and Remedial class	1
4	COMPUTER NETWORKS	
4.1	Mock Test on Module 1, Module 2 and Module 3	1
4.2	Mock Test on Module 4 and Module 5	1

4.3	Feedback and Remedial class	1
5	APPLIED CRYPTOGRAPHY	
5.1	Mock Test on Module 1, Module 2 and Module 3	1
5.2	Mock Test on Module 4 and Module 5	1
5.3	Feedback and Remedial class	1

Model Question Paper

QP CODE:

Reg No: _____

PAGES: 10

Name: _____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
SIXTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH &
YEAR Course Code: CCT308
Course Name: Comprehensive Course Work

Max. Marks: 50

1 Hour

Duration:

Objective type questions with multiple choices. Mark one correct answer for each question.

Each Question Carries 1 Mark

- Consider the following sequence of operations on an empty stack.push (22); push(43); pop(); push(55); push(12); s=pop();
Consider the following sequence of operations on an empty queue.
enqueue(32);enqueue(27); dequeue(); enqueue(38); enqueue(12);
q=dequeue();

The value of s+q is _____
 (A)44 (B) 54 (C) 39 (D) 70
- The following postfix expression with single digit operands is evaluated using a stack: 8 2 2 ^ / 4 3 * + 5 1 * - Note that ^ is the exponentiation operator. The top two elements of the stack after the first *is evaluated are:
 (A) 12,2 (B) 12,5 (C) 2,12 (D) 2,5

3. Construct a binary search tree by inserting 8, 6, 12, 3, 10, 9 one after another. To make the resulting tree as AVL tree which of the following is required?
- (A) One right rotation only
 - (B) One left rotation followed by two right rotations
 - (C) One left rotation and one right rotation
 - (D) The resulting tree itself is AVL
4. In a complete 4-ary tree, every internal node has exactly 4 children or no child. The number of leaves in such a tree with 6 internal nodes is:
- (A) 20
 - (B) 18
 - (C) 19
 - (D) 17
5. Select the postfix expression for the infix expression $a+b-c+d*(e/f)$.
- (A) $ab+c-d+e*f/$
 - (B) $ab+c-def/*+$
 - (C) $abc-+def/*+$
 - (D) $ab+c-def/*+$
6. Consider a hash table of size seven, with starting index zero, and a hash function $(2x + 5) \bmod 7$. Assuming the hash table is initially empty, which of the following is the contents of the table when the sequence 1, 4, 9, 6 is inserted into the table using closed hashing? Note that ‘_’ denotes an empty location in the table.
- (A) 9, _, 1, 6, _, _, 4
 - (B) 1, _, 6, 9, _, _, 4
 - (C) 4, _, 9, 6, _, _, 1
 - (D) 1, _, 9, 6, _, _, 4
7. Compute the time complexity of the following function:
- ```
void function(int n)
{
 int count = 0;
 for (int i=n/2; i<=n; i++)
 for (int j=1; j<=n; j = j + 2)
 for (int k=1; k<=n; k = k * 2) count++;
}
```
- A.  $O(n^2 \log n)$
  - B.  $O(n \log_2 n)$
  - C.  $O(n^3)$
  - D.  $O(n \log n^2)$
8. How many distinct binary search trees can be created out of distinct keys?
- (A) 7
  - (B) 36
  - (C) 140
  - (D) 132
9. Which tree traversal performed on a binary search tree, results in ascending order listing of the keys?
- A. Pre-order
  - B. In-order
  - C. Post-order
  - D. Level-order
10. You are given pointers to first and last nodes of a singly linked list, which of the following operations are dependent on the length of the linked list?
- (A) Delete the first element
  - (B) Insert a new element as a first element

- (C) Add a new element at the end of the list  
 (D) Delete the last element of the list
11. Suppose a disk has 400 cylinders, numbered from 0 to 399. At some time the disk arm is at cylinder 58, and there is a queue of disk access requests for cylinder 66, 349, 201, 110, 38, 84, 226, 70, 86. If Shortest-Seek Time First (SSTF) is being used for scheduling the disk access, the request for cylinder 86 is serviced after servicing \_\_\_\_\_ number of requests.  
 (A) 1 (B) 2 (C) 3 (D) 4
12. If frame size is 4KB then a paging system with page table entry of 2 bytes can address \_\_\_\_\_ bytes of physical memory.  
 (A)  $2^{12}$  (B)  $2^{16}$  (C)  $2^{18}$  (D)  $2^{28}$
13. Calculate the internal fragmentation if page size is 4KB and process size is 103KB.  
 (A) 3KB (B) 4KB (C) 1KB (D) 2KB
14. Which of the following scheduling policy is likely to improve interactivenss?  
 (A) FCFS (B) Round Robin  
 (C) Shortest Process Next (D) Priority Based Scgeduling
15. Consider the following program  
 Semaphore X=1, Y=0
- ```

Void A ( )
{
    While (1)
    {
        P(X);
        Print'1';
        V(Y);
    }
}

Void B ( )
{
    While (1)
    {
        P(Y);
        P(X);
        Print'0';
        V(X);
    }
}
  
```
- The possible output of the program:
 (A) Any number of 0's followed by any number of 1's.
 (B) Any number of 1's followed by any number of 0's.
 (C) 0 followed by deadlock
 (D) 1 followed by deadlock
16. In a system using single processor, a new process arrives at the rate of 12 processes per minute and each such process requires 5 seconds of service time. What is the percentage of CPU utilization?
 (A) 41.66 (B) 100.00 (C) 240.00 (D) 60.00
17. A system has two processes and three identical resources. Each process needs two resources to proceed. Then
 (A) Deadlock is possible (B) Deadlock is not possible
 (C) Starvation may be present (D) Thrashing
18. Which of the following is true with regard to Round Robin scheduling technique?
 (A) Responds poorly to short process with small time quantum.

- (B) Works like SJF for larger time quantum
 (C) Does not use a prior knowledge of burst times of processes.
 (D) Ensure that the ready queue is always of the same size.
19. Thrashing can be avoided if
 (A) the pages, belonging to working set of programs, are in main memory
 (B) the speed of CPU is increased
 (C) the speed of I/O processor is increased
 (D) none of the above
20. The circular wait condition can be prevented by
 (A) using thread
 (B) defining a linear ordering of resource types
 (C) using pipes
 (D) all of the above
21. Let E1, E2 and E3 be three entities in an E/R diagram with simple single-valued attributes. R1 and R2 are two relationships between E1 and E2, where R1 is one-to-many, R2 is manyto-many. R3 is another relationship between E2 and E3 which is many-to-many. R1, R2 and R3 do not have any attributes of their own. What is the minimum number of tables required to represent this situation in the relational model?
 (A) 3 (B) 4 (C) 5 (D) 6
22. Identify the minimal key for relational scheme R(U, V, W, X, Y, Z) with functional dependencies $F = \{U \rightarrow V, V \rightarrow W, W \rightarrow X, VX \rightarrow Z\}$
 (A) UV (B) UW (C) UX (D) UY
23. It is given that: “Every student need to register one course and each course registered by many students”, what is the cardinality of the relation say “Register” from the “Student” entity to the “Course” entity in the ER diagram to implement the given requirement. (
 (A) M:1 relationship (B) M:N relationship
 (C) 1:1 relationship (D) option (B) or(C)
24. Consider the relation branch (branch_name, assets, branch_city) `SELECT DISTINCT T.branch_name FROM branch T, branch S WHERE T.assets > L.assets AND S.branch_city = "TVM"` . Finds the names of
 (A) All branches that have greater assets than all branches located in TVM.
 (B) All branches that have greater assets than some branch located in TVM.
 (C) The branch that has the greatest asset in TVM.
 (D) Any branch that has greater asset than any branch located in TVM
25. Consider the following relation instance, where “A” is primary Key.
- | A1 | A2 | A3 | A4 |
|----|----|----|------|
| 1 | 1 | 1 | Null |
| 5 | 2 | 5 | 1 |
| 9 | 5 | 13 | 5 |
| 13 | 13 | 9 | 15 |
- Which one of the following can be a foreign key that refers to the same relation?
 (A) A2 (B) A3 (C) A4 (D) ALL
26. A relation R(ABC) is having the tuples(1,2,1),(1,2,2),(1,3,1) and (2,3,2). Which of the

- following functional dependencies holds well?
- (A) $A \rightarrow BC$ (B) $AC \rightarrow B$ (C) $AB \rightarrow C$ (D) $BC \rightarrow A$
27. Consider a relation R with attributes A, B, C, D and E and functional dependencies $A \rightarrow BC$, $BC \rightarrow E$, $E \rightarrow DA$. What is the highest normal form that the relation satisfies?
- (A) BCNF (B) 3 NF (C) 2 NF (D) 1 NF
28. For the given schedule S, find out the conflict equivalent schedule. S : $r_1(x); r_2(Z); r_3(X); r_1(Z); r_2(Y); r_3(Y); W_1(X); W_2(Z); W_3(Y); W_2(Y)$
- (A) $T_1 \rightarrow T_2 \rightarrow T_3$ (B) $T_2 \rightarrow T_1 \rightarrow T_3$
 (C) $T_3 \rightarrow T_1 \rightarrow T_2$ (D) Not conflict serializable
29. Specialization is _____ process.
- (A) top-down (B) bottom up (C) Both (A) and (B) (D) none of these
30. If $D_1, D_2, \dots, D_n$ are domains in a relational model, then the relation is a table, which is a subset of
- (A) $D_1 + D_2 + \dots + D_n$
 (B) $D_1 \times D_2 \times \dots \times D_n$
 (C) $D_1 \cup D_2 \cup \dots \cup D_n$
 (D) $D_1 - D_2 - \dots - D_n$
31. Which network security system monitors and controls incoming & outgoing network traffic based on predetermined security rules
- (A) Spyware (B) Cookie (C) Spam (D) Firewall
32. Wireless Application Layer has several layers. Which of the following is the Security Layer?
- (A) Wireless Security Layer (B) Wireless Transport layer
 (C) Wireless Transport Layer Security (D) Wireless Security Layer Transport
33. Which anti-malware tool found in newer OS is designed for protecting computers from viruses, spyware & other malware?
- (A) Norton Antivirus (B) Windows Defender
 (C) Anti-malware (D) Microsoft Security Essentials
34. When an attempt is to make a machine or network resource unavailable to its intended users, the attack is called _____
- (A) Denial-of-service attack (B) Slow read attack
 (C) Spoofed attack (D) Starvation attack
35. Which of the following is not an appropriate way to compromise web servers?
- (A) Misconfiguration in OS (B) Using network vulnerabilities
 (C) Misconfiguration in networks
 (D) Bugs in OS which allow commands to run on web servers
36. Which of the following is not a web server attack type?
- (A) DOS attack (B) Website Defacement using SQLi
 (C) Directory Traversal (D) Password guessing
37. Which one of the following is a cryptographic protocol used to secure HTTP connection?
- (A) Stream control transmission protocol (SCTP)
 (B) Transport layer security (TLS)
 (C) Explicit congestion notification (ECN)
 (D) Resource reservation protocol
38. The main motive for using steganography is that hackers or other users can hide a secret

- message behind a
(A) Special file (B) Ordinary file (C) Program file
(D) Encrypted file
39. Which among them has the strongest wireless security?
(A) WEP (B) WPA (C) WPA2 (D) WPA3
40. When a user authenticates to an AP, both go in the path of four-step authentication progression which is known as
(A) 4-way handshake (B) AP-handshaking
(C) Wireless handshaking (D) 4-way connection
41. In asymmetric key cryptography, the private key is kept by _____
(A) sender (B) receiver
(C) sender and receiver (D) all the connected devices to the network
42. Which one of the following algorithm is not used in asymmetric-key cryptography?
(A) RSA algorithm (B) Diffie- hellman algorithm
(C) Electronic code book algorithm (D) DSA algorithm
43. In cryptography, the order of the letters in a message is rearranged by _____
(A) Transpositional ciphers (B) Substitution ciphers
(C) Both transpositional ciphers and substitution ciphers
(D) Quadratic ciphers
44. Which one of the following is a cryptographic protocol used to secure HTTP connection?
(A) Stream control transmission protocol (SCTP) (B) Transport layer security (TLS)
(C) Explicit congestion notification (ECN) (D) Resource reservation protocol
45. Blowfish encrypts blocks of plaintext which have size
(A) 256 bits (B) 64 bits (C) 72 bits (D) 128 bits
46. Cryptanalysis is used _____
(A) To find some insecurity in a cryptographic scheme
(B) To increase the speed
(C) To encrypt the data
(D) To make new ciphers
47. Which of the following security services cannot be achieved using the Hash functions?
(A) Password Check (B) Data Integrity check
(C) Digital Signature (D) Data retrieval in its original form
48. In the DES algorithm the Round Input is 32 bits, which is expanded to 48 bits via _____
(A) Scaling of the existing bits
(B) Duplication of the existing bits
(C) Addition of zeros
(D) Addition of ones
49. Which one of the following modes of operation in DES is used for operating short data?
(A) Cipher Feedback Mode (CFB)
(B) Cipher Block chaining (CBC)
(C) Electronic code book (ECB)
(D) Output Feedback Modes (OFB)
50. All the below-stated processes are performed in the AES (Advanced Encryption

Standard) Algorithm. Which of the following process(s) are not performed in the final round of the AES?

- I. Substitution bytes
- II. Shift rows
- III. Mix columns
- IV. Add round key

(A)I (B)III (C)All of the above (D)None of the above

ANSWER KEY:-

Q.No	Ans.Key	Q.No	Ans.Key	Q.No	Ans. Key	Q.No	Ans. Key	Q. No	Ans. Key
1	(C)	11	(C)	21	(C)	31	(D)	41	(B)
2	(A)	12	(D)	22	(D)	32	(C)	42	(C)
3	(A)	13	(C)	23	(A)	33	(B)	43	(A)
4	(C)	14	(B)	24	(B)	34	(A)	44	(B)
5	(D)	15	(D)	25	(B)	35	(B)	45	(B)
6	(D)	16	(B)	26	(D)	36	(D)	46	(A)
7	(A)	17	(B)	27	(A)	37	(B)	47	(D)
8	(D)	18	(C)	28	(D)	38	(B)	48	(A)
9	(B)	19	(A)	29	(A)	39	(D)	49	(C)
10	(D)	20	(B)	30	(B)	40	(A)	50	(B)

CCT332	STORAGE MANAGEMENT AND SECURITY	CATEGORY	L	T	P	CREDITS
		PEC	2	1	0	3

Preamble: To enable students to understand, explore and acquire a critical understanding about comprehensive learning on storage technology, which will enable them to make more informed decisions in an increasingly complex IT environment. It builds a strong understanding of underlying storage technologies and prepares them to learn advanced concepts, technologies and products. Students will learn about the architectures, features, and benefits of intelligent storage systems; storage networking technologies such as FC-SAN, IP-SAN, NAS, object-based and unified storage; business continuity solutions such as backup and replication; the increasingly critical area of Information Security and Management.

Prerequisite: A basic understanding of Computer Architecture, Operating Systems, Networking, and databases.

Course Outcomes: After the completion of the course, the student will be able to

CO#	Course Outcomes
CO1	Explain storage architectures and key data center elements(Cognitive Knowledge Level: Understand)
CO2	Explain physical and logical components of a storage infrastructure including storage subsystems and RAID(Cognitive Knowledge Level: Understand)
CO3	Summarize storage networking technologies such as FCSAN, IP-SAN, NAS (Cognitive Knowledge Level: Understand)
CO4	Describe business continuity backup and replication solutions.(Cognitive Knowledge Level: Understand)
CO5	Explain the storage security aspects and the virtualization technologies. (Cognitive Knowledge Level: Understand)

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12
CO1	✓	✓	✓									✓
CO2	✓	✓	✓									✓
CO3	✓	✓	✓									✓
CO4	✓	✓	✓									✓
CO5	✓	✓	✓									✓

Abstract POs defined by National Board of Accreditation			
PO#	Broad PO	PO#	Broad PO
PO1	Engineering Knowledge	PO7	Environment and Sustainability
PO2	Problem Analysis	PO8	Ethics
PO3	Design/Development of solutions	PO9	Individual and teamwork
PO4	Conduct investigations of complex problems	PO10	Communication
PO5	Modern tool usage	PO11	Project Management and Finance
PO6	The Engineer and Society	PO12	Lifelong learning

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination (%)
	Test 1 (%)	Test 2 (%)	
Remember	30	30	30
Understand	50	50	50
Apply	20	20	20
Analyze			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 Hours

Continuous Internal Evaluation Pattern:

Attendance	10 marks
Continuous Assessment Tests (Average of Series Tests 1 & 2)	25 marks
Continuous Assessment Assignment	15 marks

Internal Examination Pattern:

Each of the two internal examinations has to be conducted out of 50 marks. The first series test shall be preferably conducted after completing the first half of the syllabus. The second series test shall be preferably conducted after completing the remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly completed module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly completed module), each with 7 marks. Out of the 7 questions, a student should answer any 5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which a student should answer anyone. Each question can have maximum 2 sub-divisions and carries 14 marks.

Syllabus

Module-1(Introduction)

Introduction to Storage Technology- Review data creation-amount of data being created- understand the value of data to business- challenges in data storage and data management-solutions available for data storage-core elements of a data center infrastructure- role of each element in supporting business activities.

Module-2(Storage system architecture)

Storage system architecture-Hardware and software components of the host environment-Key protocols and concepts used by each component-physical and logical components of a connectivity environment- major physical components of a disk drive and their function-logical constructs of a physical disk-Access characteristics-Performance implications-Concept of RAID and its components-Different RAID levels and their sustainability for different application environments-Compare and contrast integrated and modular storage systems-High-level architecture and working of an intelligent storage system.

Module-3(Network Storage)

Introduction to Networked Storage-Evolution of networked storage- Architecture-Components- Topologies of FC- SAN- NAS - IP- SAN- Benefits of the different networked storage options- understand the need for long- Term archiving solutions- Describe how CAS fulfill the need- Understand the appropriateness- Different networked storage options-Different application environments.

Module-4(Management of Information)

Information Availability, Monitoring & Managing Data centers- List reasons for planned or unplanned outages- Impact of downtime-Business continuity(BC)-Disaster recovery(DR)-RTO-RPO- Identify single points of failure- List solutions to mitigate failures –Architecture of backup/recovery- Different backup or recovery topologies-Replication technologies-Role in ensuring information availability and business continuity- Remote replication technologies-Role in providing disaster recovery and business continuity capabilities-Identify key areas to monitor in a data center- Industry standards for data monitoring and management-key metrics-key management tasks.

Module-5(Storage Security)

Securing storage and storage virtualization-Information security- Critical security attributes- storage security domains –List and analyzes the common threats in each domain –Virtualization technologies- Block-level and file-level virtualization technologies and processes.

Text/Reference Books

1. EMC Corporation, "Information Storage and Management: Storing, Managing and Protecting Digital Information", Wiley, India, 2nd Edition, 2012.
2. Marc Farley, "Building storage networks", Tata McGraw Hill, Osborne, 2nd Edition, 2001.
3. Robert Spalding, "Storage Networks: The complete Reference", Tata McGraw hill, Osborne, First Edition, 2003.

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. What are the key requirements needed for designing a data center for storage?

Course Outcome 2 (CO2):

1. Explain the Evolution of storage Technology and Architecture.

Course Outcome 3 (CO3):

1. Explain Network-attached storage (NAS) its future and benefits.

Course Outcome 4 (CO4):

1. What is the need of data management and monitoring in storage?

Course Outcome 5 (CO5):

1. Explain the storage security aspects and the virtualization technology.



Model Question Paper

QP CODE:

Reg No: _____

Name : _____

PAGES : 2

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
SIXTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR**

Course Code: CCT 332

Course Name: STORAGE MANAGEMENT AND SECURITY

Max.Marks:100

Duration: 3 Hours

PART A

Answer all Questions. Each question carries 3 Marks

1. Which are the challenges in data storage?
2. Which are the elements needs for a data center infrastructure?
3. Explain about key protocols used in host environment.
4. What is the importance of High-level architecture in storage?
5. Describe in detail about NAS topology.
6. Which are the different application environments in storage?
7. What is the need of ensuring information availability and business continuity?
8. Which are the key areas to monitor in a data center?
9. Explain how Information Security is achieved in storage.
10. Discuss the different Virtualization technologies.

(10x3=30 Marks)

PART B

CSE(CYBER SECURITY)

Answer any one Question from each module.

Each question carries 14 Marks

- 11) a) Describe the evolution of storage technology and architecture. (7Marks)
b) Describe the core elements of a data centre infrastructure and explain role of each element in supporting business activities. (7Marks)
OR (4Marks)
- 12) a) Explain the value of data to business. (10Marks)
b) Describe the challenges faced and the solutions in storage management.
- 13) a) Explain Storage security domains. (8 Marks)
b) Explain the major physical components of a disk drive. (6 Marks)
OR
- 14) a) Write down the Different RAID levels and their sustainability for different application environments (10 Marks)
b) Compare integrated and modular storage systems. (4 Marks)
- 15) a) What are the components of NAS? Explain NAS Implementations. (7 Marks)
b) Briefly explain the architecture and components of networked storage. (7 Marks)
OR (7 Marks)
- 16) a) Explain the topologies used in networked storage management. (7 Marks)
b) What are the benefits of different network storage devices?
- 17) a) List the reasons for planned or unplanned outages. (10 Marks)
b) Explain disaster recovery(DR)-RTO-RPO. (4 Marks)
OR (6 Marks)
- 18) a) Explain industry standards for data monitoring and management (8 Marks)
b) Explain the key metrics and key task for storage management
- 19) a) Explain Critical security attributes in storage. (8 Marks)
b) Explain the storage security domains in storage management. (6 Marks)
OR
- 20) a) What isStorage Virtualization? Explain how it can be done. (8 Marks)

b) List and analyzes the common threats in security storage management

(6 Marks)**TEACHING PLAN**

No	Contents	No of Lecture Hrs
Module-1(Introduction)(5 hrs)		
1.1	Introduction to Information Storage Management –Evolution of Storage Technology	1
1.2	Data Centre Infrastructure-Key Challenges in managing Information	1
1.3	Solutions available for data storage	1
1.4	Core elements of a data center infrastructure	1
1.5	Role of each element in supporting business activities	1
Module-2(Storage system architecture)(9 hrs)		
2.1	Hardware and software components of the host environment	1
2.2	Key protocols and concepts used by each component	1
2.3	Physical and logical components of a connectivity environment	1
2.4	Major physical components of a disk drive and their function	1
2.5	Logical constructs of a physical disk-Access characteristics-Performance implications	1
2.6	Concept of RAID and its components	1

2.7	Different RAID levels and their sustainability for different application environments	1
2.8	Compare and contrast integrated and modular storage systems-	1
2.9	High-level architecture and working of an intelligent storage system.	1
Module-3(Network Storage)(8 hrs)		
3.1	Evolution of networked storage	1
3.2	Architecture-Components	1
3.3	Topologies of FC- SAN- NAS	1
3.4	Topologies of IP- SAN	1
3.5	Benefits of the different networked storage options	1
3.6	Understand the need for long- Term archiving solutions	1
3.7	Describe how CAS fulfill the need- Understand the appropriateness	1
3.8	Different networked storage options-Different application environments.	1
Module-4(Management of Information)(8hrs)		
4.1	List reasons for planned or unplanned outages- Impact of downtime- Business continuity(BC)	1
4.2	Disaster recovery(DR)-RTO-RPO-Identify single points of failure	1
4.3	Identify single points of failure- List solutions to mitigate failures – Architecture of backup/recovery systems	1

4.4	Different backup or recovery topologies-Replication technologies	1
4.5	Role in ensuring information availability and business continuity	1
4.6	Remote replication technologies-Role in providing disaster recovery and business continuity capabilities	1
4.7	Identify key areas to monitor in a data center	1
4.8	Industry standards for data monitoring and management-key metrics-key management tasks.	1
Module-5(Storage Security)(5hrs)		
5.1	Information security- Critical security attributes	1
5.2	Storage security domains –List and analyzes the common threats in each domain	1
5.3	Virtualization technologies	1
5.4	Block-level virtualization technologies and processes	1
5.5	File-levelvirtualization technologies and processes	1

Estd.



2014

Abstract POs defined by National Board of Accreditation			
PO#	Broad PO	PO#	Broad PO
PO1	Engineering Knowledge	PO7	Environment and Sustainability
PO2	Problem Analysis	PO8	Ethics
PO3	Design/Development of solutions	PO9	Individual and team work
PO4	Conduct investigations of complex problems	PO10	Communication
PO5	Modern tool usage	PO11	Project Management and Finance
PO6	The Engineer and Society	PO12	Life long learning

Assessment Pattern

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	75	75	

Continuous Internal Evaluation Pattern:

Attendance	10 marks
Project Guide	15 marks
Project Report	10 marks

Evaluation by the Committee (will be evaluating the level of completion and demonstration of functionality/specifications, presentation, oral examination, work knowledge and involvement) : **40 marks**

Student Groups with 3 or 4 members should identify a topic of interest in consultation with a Faculty/Advisor. Review the literature and gather information pertaining to the chosen topic. State the objectives and develop a methodology to achieve the objectives. Carryout the design/fabrication or develop codes/programs to achieve the objectives by strictly following steps specified in the teaching plan. Innovative design concepts, performance, scalability, reliability considerations, aesthetics/ergonomic, user experience and security aspects taken care of in the project shall be given due weight.

The progress of the mini project is evaluated based on a minimum of two reviews. The review committee may be constituted by the Head of the Department comprising HoD or a senior faculty member, Mini Project coordinator and project guide. The internal evaluation shall be made based on the progress/outcome of the project, reports and a viva-voce examination, conducted internally by a 3-member committee. A project report is required at the end of the semester. The project has to be demonstrated for its full design specifications.

End Semester Examination Pattern:

The marks will be distributed as

Presentation: **30 marks**

Demo : **20 marks**

Viva : **25 marks.**

Total : **75 marks.**

TEACHING PLAN

Students are expected to follow the following steps.

1. Review of Literature and Identification of a problem
2. Create an abstract with a problem statement, solution approach, technology stack, team, etc. and get department approval. Register Online course/ Collect study materials.
3. Create Software Requirements Specification (SRS Document)
4. Create Software Design Document (SDD). This may include designs like,
 - a. System Architecture Design
 - b. Application Architecture Design
 - c. GUI Design (Mockups)
 - d. API Design
 - e. Database Design
 - f. Technology Stack
5. Create Test Plan, Test Scenarios and Test Cases (Test Case Document) & Traceability Matrix
6. Create a Project Plan (with Modules, Tasks, Resources, Time schedule) [May use any project management tool or excel for this] – Choose and follow agile or waterfall models.
7. Development
 - a. Set coding standards
 - b. Environment Setup
 - c. Source Code Control Setup (Like Subversion(SVN), Git)
 - d. Development
 - e. Unit Testing
 - f. Integration Testing
 - g. Testing /Quality Assurance(QA)
 - i. Functional Testing
 - ii. Load Testing
 - iii. Report Bugs
 - h. Resolve Bugs & Retest

8. Deployment (of software from local development environment to a production environment)
9. Test Run & Get Results
10. Prepare Project Report

Guidelines for the Report preparation

A bonafide report on the mini project shall be submitted within one week after the final presentation. Minimum number of pages should be 40.

- Use Times New Roman font for the entire report – Chapter/Section Title – Times New Roman 18, Bold; Heading 2 – Times New Roman 16, Bold; Heading 3 – Times New Roman 14, Bold; Body- Times New Roman 12, Normal.
- Line Spacing – Between Heading 2 – 3 lines, between lines in paragraph 1.5 lines.
- Alignments – Chapter/Section Title – Center, Heading 2 & 3 should be Left Aligned. Ensure that all body text is paragraph justified.
- Figures & Tables – Ensure that all Figures and Tables are suitably numbered and given proper names/headings. Write figure title under the figure and table title above the table.
- **Suggestive order of documentation:**
 - i. Top Cover
 - ii. Title page
 - iii. Certification page
 - iv. Acknowledgement
 - v. Abstract
 - vi. Table of Contents
 - vii. List of Figures and Tables
 - viii. Chapters
 - ix. Appendices, if any
 - x. References/Bibliography

APJ ABDUL KALAM
TECHNOLOGICAL
UNIVERSITY

SEMESTER VI

PROGRAM ELECTIVE I



CST 312	FOUNDATIONS OF MACHINE LEARNING	Category	L	T	P	Credit	Year of Introduction
		PEC	2	1	0	3	2019

Preamble:

This course enables the learners to understand the mathematical foundations of Machine Learning concepts. This course covers Linear Algebra, Probability and Distributions. Concepts in this course help the learners to identify the inherent assumptions & limitations of the current methodologies and develop new Machine Learning solutions.

Prerequisite: A sound background in higher secondary school Mathematics.

Course Outcomes: After the completion of the course the student will be able to

CO 1	Illustrate operations and applications of linear equations, matrix algebra, vector spaces, eigen values & eigenvectors (Cognitive Knowledge Level: Apply)
CO 2	Illustrate the concepts of orthogonality & diagonalization. (Cognitive Knowledge Level: Apply)
CO 3	Solve computational problems using probability and random variables. (Cognitive Knowledge Level: Apply)
CO 4	Identify an appropriate probability distribution for a given discrete or continuous random variable and use its properties. (Cognitive Knowledge Level: Apply)
CO 5	Illustrate moment generating function, law of large numbers and central limit theorems (Cognitive Knowledge Level: Apply)

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	✓	✓	✓	✓								✓
CO 2	✓	✓	✓	✓								✓
CO 3	✓	✓	✓	✓								✓
CO 4	✓	✓	✓	✓								✓

CO 5	✓	✓	✓	✓							✓

Abstract POs defined by National Board of Accreditation			
PO#	Broad PO	PO#	Broad PO
PO1	Engineering Knowledge	PO7	Environment and Sustainability
PO2	Problem Analysis	PO8	Ethics
PO3	Design/Development of solutions	PO9	Individual and team work
PO4	Conduct investigations of complex problems	PO10	Communication
PO5	Modern tool usage	PO11	Project Management and Finance
PO6	The Engineer and Society	PO12	Life long learning

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	30%	30%	30%
Understand	30%	30%	30%
Apply	40%	40%	40%
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks

Continuous Assessment Tests : 25 marks

Continuous Assessment Assignment : 15 marks

Internal Examination Pattern:

Each of the two internal examinations has to be conducted out of 50 marks

First Internal Examination shall be preferably conducted after completing the first half of the syllabus and the Second Internal Examination shall be preferably conducted after completing remaining part of the syllabus.

There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly covered module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly covered module), each with 7 marks. Out of the 7 questions in Part B, a student should answer any 5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer anyone. Each question can have maximum 2 sub-divisions and carry 14 marks.

Syllabus

Module 1 (LINEAR ALGEBRA)

Systems of Linear Equations – Matrices, Solving Systems of Linear Equations. Vector Spaces - Linear Independence, Basis and Rank, Linear Mappings.

Module 2 (LINEAR ALGEBRA)

Norms - Inner Products, Lengths and Distances, Angles and Orthogonality. Orthonormal Basis, Orthogonal Complement, Orthogonal Projections. Matrix Decompositions - Eigenvalues and Eigenvectors, Eigen decomposition and Diagonalization.

Module 3 (PROBABILITY AND DISTRIBUTIONS)

Probability Space - Sample Spaces, Probability Measures, Computing Probabilities, Conditional Probability, Baye's Rule, Independence. Random Variables - Discrete Random Variables (Bernoulli Random Variables, Binomial Distribution, Geometric and Poisson Distribution, Continuous Random Variables (Exponential Density, Gamma Density, Normal Distribution, Beta Density)

Module 4 (RANDOM VARIABLES)

Functions of a Random Variable. Joint Distributions - Independent Random Variables, Conditional Distributions, Functions of Jointly Distributed Random Variables.

Expected Values - Expected Value of a Random Variable, Expectations of Functions of Random Variables, Expectations of Linear Combinations of Random Variables, Variance and Standard Deviation, Covariance and Correlation, Conditional Expectation

Module 5 (LIMIT THEOREMS)

Moment-Generating Function. Limit Theorems(Proof not expected) - Law of Large Numbers, Convergence in Distribution and the Central Limit Theorem. Distributions derived from the Normal Distribution - Chi-square, t, and F Distributions, Sample Mean and the Sample Variance.

Text book:

1. Marc Peter Deisenroth, A. Aldo Faisal, Cheng Soon Ong, Mathematics for Machine Learning, Cambridge University Press (freely available at <https://mml-book.github.io>)
2. John A. Rice, Mathematical Statistics and Data Analysis, University of California, Berkeley, Third edition, published by Cengage.

Reference books:

1. Gilbert Strang, Linear Algebra and Its Applications, 4th Edition,
2. Axler, Sheldon, Linear Algebra Done Right, 2015 Springer
3. Stephen Boyd and Lieven Vandenberghe, Introduction to Applied Linear Algebra, 2018 published by Cambridge University Press

Sample Course Level Assessment Questions**Course Outcome 1 (CO1):**

1. Find the set S of all solutions in x of the following inhomogeneous linear systems $Ax = b$, where A and b are defined as follows:

$$A = \begin{bmatrix} 1 & -1 & 0 & 0 & 1 \\ 1 & 1 & 0 & -3 & 0 \\ 2 & -1 & 0 & 1 & -1 \\ -1 & 2 & 0 & -2 & -1 \end{bmatrix}, \quad b = \begin{bmatrix} 3 \\ 6 \\ 5 \\ -1 \end{bmatrix}$$

2. Determine the inverses of the following matrix if possible

$$A = \begin{bmatrix} 1 & 0 & 1 & 0 \\ 0 & 1 & 1 & 0 \\ 1 & 1 & 0 & 1 \\ 1 & 1 & 1 & 0 \end{bmatrix}$$

3. Are the following sets of vectors linearly independent?

$$x_1 = \begin{bmatrix} 2 \\ -1 \\ 3 \end{bmatrix}, \quad x_2 = \begin{bmatrix} 1 \\ 1 \\ -2 \end{bmatrix}, \quad x_3 = \begin{bmatrix} 3 \\ -3 \\ 8 \end{bmatrix}$$

4. A set of n linearly independent vectors in R^n forms a basis. Does the set of vectors $(2, 4, -3)$, $(0, 1, 1)$, $(0, 1, -1)$ form a basis for R^3 ? Explain your reasons.

Course Outcome 2 (CO2):

1. Determine which of the following sets are orthogonal sets.

$$\left\{ \begin{bmatrix} 3 \\ 1 \\ 1 \end{bmatrix}, \begin{bmatrix} -1 \\ 2 \\ 1 \end{bmatrix}, \begin{bmatrix} -1/2 \\ -2 \\ 7/2 \end{bmatrix} \right\} \quad \left\{ \begin{bmatrix} 1 \\ -1 \\ 1 \end{bmatrix}, \begin{bmatrix} 2 \\ 1 \\ -1 \end{bmatrix}, \begin{bmatrix} 3 \\ 0 \\ -3 \end{bmatrix} \right\} \quad \left\{ \begin{bmatrix} 3 \\ -2 \\ 1 \\ 3 \end{bmatrix}, \begin{bmatrix} -1 \\ 3 \\ -3 \\ 4 \end{bmatrix}, \begin{bmatrix} 3 \\ 8 \\ 7 \\ 0 \end{bmatrix} \right\}$$

2. Find the characteristic equation, eigenvalues, and eigenspaces corresponding to each eigenvalue of the following matrix.

$$\begin{bmatrix} 2 & 0 & 4 \\ 0 & 3 & 0 \\ 0 & 1 & 2 \end{bmatrix}$$

3. Diagonalize the following matrix, if possible

$$\begin{bmatrix} 3 & 0 & 0 & 0 \\ 0 & 2 & 0 & 0 \\ 0 & 0 & 2 & 0 \\ 1 & 0 & 0 & 3 \end{bmatrix}$$

Course Outcome 2 (CO3):

1. Let J and T be independent events, where $P(J)=0.4$ and $P(T)=0.7$.
 - i. Find $P(J \cap T)$
 - ii. Find $P(J \cup T)$
 - iii. Find $P(J \cap T')$
2. Let A and B be events such that $P(A)=0.45$, $P(B)=0.35$ and $P(A \cup B)=0.5$. Find $P(A/B)$.
3. A random variable R has the probability distribution as shown in the following table:

r	1	2	3	4	5
P(R=r)	0.2	a	b	0.25	0.15

- i. Given that $E(R)=2.85$, find a and b .
 - ii. Find $P(R>2)$.
4. A biased coin (with probability of obtaining a head equal to $p > 0$) is tossed repeatedly and independently until the first head is observed. Compute the probability that the first head appears at an even numbered toss.
 5. Two players A and B are competing at a quiz game involving a series of questions. On any individual question, the probabilities that A and B give the correct answer are p and q respectively, for all questions, with outcomes for different questions being independent. The game finishes when a player wins by answering a question correctly. Compute the probability that A wins if
 - i. A answers the first question,
 - ii. B answers the first question.
 6. A coin for which $P(heads) = p$ is tossed until two successive tails are obtained. Find the probability that the experiment is completed on the n^{th} toss.

Course Outcome- 3 (CO4):

1. An urn contains p black balls, q white balls, and r red balls; and n balls are chosen without replacement.
 - a. Find the joint distribution of the numbers of black, white, and red balls in the sample.
 - b. Find the joint distribution of the numbers of black and white balls in the sample.
 - c. Find the marginal distribution of the number of white balls in the sample.
2. Suppose that two components have independent exponentially distributed lifetimes, T_1 and T_2 , with parameters α and β , respectively. Find (a) $P(T_1 > T_2)$ and (b) $P(T_1 > 2 T_2)$.
3. Let Z_1 and Z_2 be independent random variables each having the standard normal distribution. Define the random variables X and Y by $X = Z_1 + 3Z_2$ and $Y = Z_1 + Z_2$. Argue that the joint distribution of (X, Y) is a bivariate normal distribution. What are the parameters of this distribution?

4. Given a continuous random variable x , with cumulative distribution function $F_x(x)$, show that the random variable $y = F_x(x)$ is uniformly distributed.
5. You roll a fair dice twice. Let the random variable X be the product of the outcomes of the two rolls. What is the probability mass function of X ? What are the expected values and the standard deviation of X ?
6. Let X be a continuous random variable with the density function $f(x) = 2x, 0 \leq x \leq 1$
 - a. Find $E(X)$.
 - b. Find $E(X^2)$ and $Var(X)$.

Course Outcome 5 (CO5):

1. Find the moment-generating function of a Bernoulli random variable, and use it to find the mean, variance, and third moment.
2. Use moment-generating functions to show that if X and Y are independent, then $Var(aX + bY) = a^2 Var(X) + b^2 Var(Y)$.
3. Suppose that you bet Rs 5 on each of a sequence of 50 independent fair games. Use the central limit theorem to approximate the probability that you will lose more than Rs 75.
4. Suppose that the number of insurance claims, N , filed in a year is Poisson distributed with $E(N) = 10,000$. Use the normal approximation to the Poisson to approximate $P(N > 10,200)$.

Estd.



2014

Model Question paper

QP Code :

Total Pages: 4

Reg No.: _____

Name: _____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY**SIXTH SEMESTER B.TECH DEGREE EXAMINATION (ELECTIVE), MONTH and YEAR****Course Code: CST 312****Course Name: FOUNDATIONS OF MACHINE LEARNING**

Max. Marks: 100

Duration: 3 Hours

PART A*Answer all questions, each carries 3 marks.*

- 1 Show that with the usual operation of scalar multiplication but with addition on reals given by $x \# y = 2(x + y)$ is not a vector space.
- 2 Are the following vectors linearly independent? Justify your answer.

$$x_1 = \begin{bmatrix} 2 \\ -1 \\ 3 \end{bmatrix}, \quad x_2 = \begin{bmatrix} 1 \\ 1 \\ -2 \end{bmatrix}, \quad x_3 = \begin{bmatrix} 3 \\ -3 \\ 8 \end{bmatrix}$$

- 3 Find the eigenvalues of the following matrix in terms of k. Can you find an eigenvector corresponding to each of the eigenvalues?

$$\begin{bmatrix} 1 & k \\ 2 & 1 \end{bmatrix}$$

- 4 Find a unit vector in $\mathbf{R}^2$ that is orthogonal to $(-1, 2)$.
- 5 The first three digits of a telephone number are 452. If all the sequences of the remaining four digits are equally likely, what is the probability that a randomly selected telephone number contains seven distinct digits?

- 6 Show that if two events A and B are independent, then A and B' are independent.
- 7 Prove that X and Y are independent if and only if $f_{X|Y}(x|y) = f_X(x)$ for all x and y .
- 8 If X is a discrete uniform random variable, i.e., $P(X = k) = 1/n$ for $k = 1, 2, \dots, n$, find $E(X)$ and $Var(X)$.
- 9 Compare the Poisson cdf and the normal approximation for (a) $\lambda = 10$, (b) $\lambda = 20$, and (c) $\lambda = 40$.
- 10 State law of large numbers. 10 x 3 = 30

PART B

Answer any one Question from each module. Each question carries 14 Marks

- 11 a) Find all solutions to the system of linear equations (8)

$$\begin{aligned} -4x + 5z &= -2 \\ -3x - 3y + 5z &= 3 \\ -x + 2y + 2z &= -1 \end{aligned}$$

- b) Consider the transformation $T(x, y) = (x + y, x + 2y, 2x + 3y)$. Obtain $\ker T$ and use this to calculate the nullity. Also find the transformation matrix for T . (6)

OR

- 12 a) Consider the following linear mapping (8)

$$\Phi : \mathbb{R}^3 \rightarrow \mathbb{R}^4$$

$$\Phi \left(\begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} \right) = \begin{bmatrix} 3x_1 + 2x_2 + x_3 \\ x_1 + x_2 + x_3 \\ x_1 - 3x_2 \\ 2x_1 + 3x_2 + x_3 \end{bmatrix}$$

- i. Find the transformation matrix T .
- ii. Determine $\text{rank}(T)$.

iii. Compute the kernel and image of the mapping and find their dimension

- b) Prove that all vectors orthogonal to $[2, -3, 1]^T$ forms a subspace W of $\mathbb{R}^3$. What is $\dim(W)$ and why? (6)

- 13 a) Find an orthonormal basis of $\mathbb{R}^3$ consisting of eigenvectors for the following matrix (8)

$$\begin{bmatrix} 1 & 0 & -2 \\ 0 & 5 & 0 \\ -2 & 0 & 4 \end{bmatrix}$$

- b) Find a 3×3 orthogonal matrix S and a 3×3 diagonal matrix D such that $A = SDS^T$ (6)

OR

- 14 a) Find an orthogonal basis for the subspace of $\mathbb{R}^4$ spanned by $\{w_1 = (1, 1, 3, 2), w_2 = (1, -2, 0, -1), w_3 = (0, 2, 1, 2)\}$. (8)

- b) Find the characteristic equation, eigenvalues, and eigenspaces corresponding to each eigenvalue of the following matrix (6)

$$\begin{bmatrix} 2 & 0 & 4 \\ 0 & 3 & 0 \\ 0 & 1 & 2 \end{bmatrix}$$

- 15 a) Three players play 10 independent rounds of a game, and each player has probability $1/3$ of winning each round. Find the joint distribution of the numbers of games won by each of the three players. (7)

- b) An experiment consists of throwing a fair coin four times. Find the probability mass function and the cumulative distribution function of the following random variables: (7)

- i. the number of heads before the first tail
- ii. the number of heads following the first tail
- iii. the number of heads minus the number of tails
- iv. the number of tails times the number of heads.

OR

- 16 a) A factory runs three shifts. On a given day, 1% of the items produced by the first shift are defective, 2% of the second shift's items are defective, and 5% of the third shift's items are defective. If the shifts all have the same productivity, what percentage of the items produced in a day are defective? If an item is defective, what is the probability that it was produced by the third shift? (8)
- b) Show that if A and B are two independent events, then $P(A \cup B) = P(A) + P(B) - P(A)P(B)$ (6)
- 17 a) Find the joint density of $X + Y$ and X/Y , where X and Y are independent exponential random variables with parameter λ . Show that $X + Y$ and X/Y are independent. (8)
- b) Let X be a discrete random variable that takes on values 0, 1, 2 with probabilities $1/2$, $3/8$, $1/8$, respectively. (6)
- i. Find $E(X)$ and $\text{Var}(X)$.
 - ii. Let $Y = X^2$. Find the probability mass function of Y and use it to find $E(Y)$.
- 18 a) A random square has a side length that is a uniform $[0, 1]$ random variable. Find the expected area of the square. (7)
- b) Let X be a continuous random variable with probability density function on $0 \leq x \leq 1$ defined by $f(x) = 3x^2$. Find the pdf of $Y = X^2$. (7)
- 19 a) Using the fact that the mean of the chi-squared distribution is $(n-1)$, prove that $E(S^2) = \sigma^2$. (7)
- b) i. Random samples of size 36 are taken from an infinite population whose mean is 80 and standard deviation is 18. Find the mean and standard error of the (7)

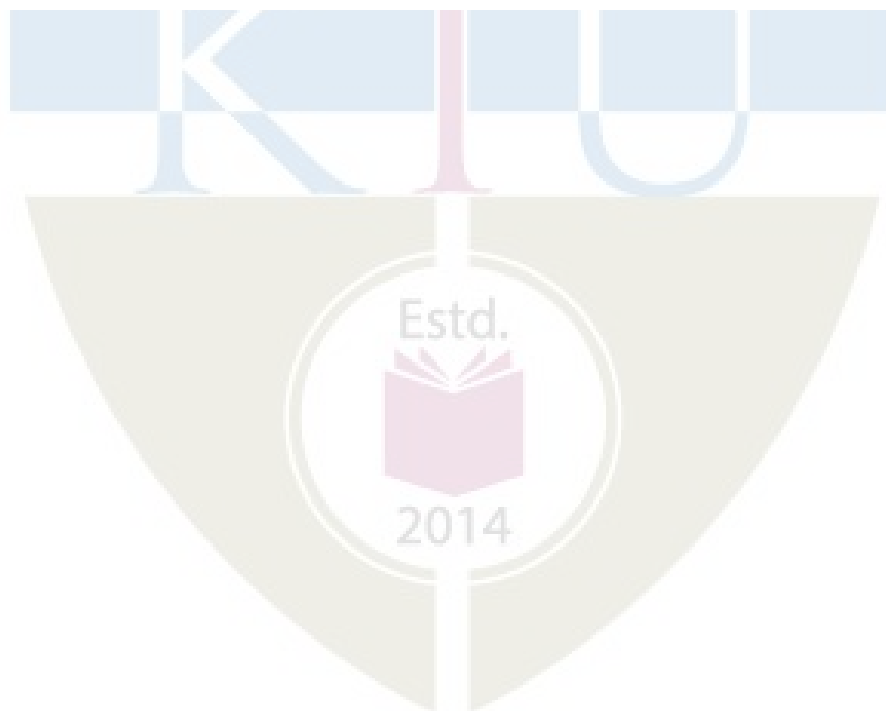
sampling distribution.

ii. Why is the Central Limit Theorem so important to statistical analysis?

OR

20 a) A six-sided die is rolled 100 times. Using the normal approximation, find the probability that the face showing a six turns up between 15 and 20 times. Find the probability that the sum of the face values of the 100 trials is less than 300. (8)

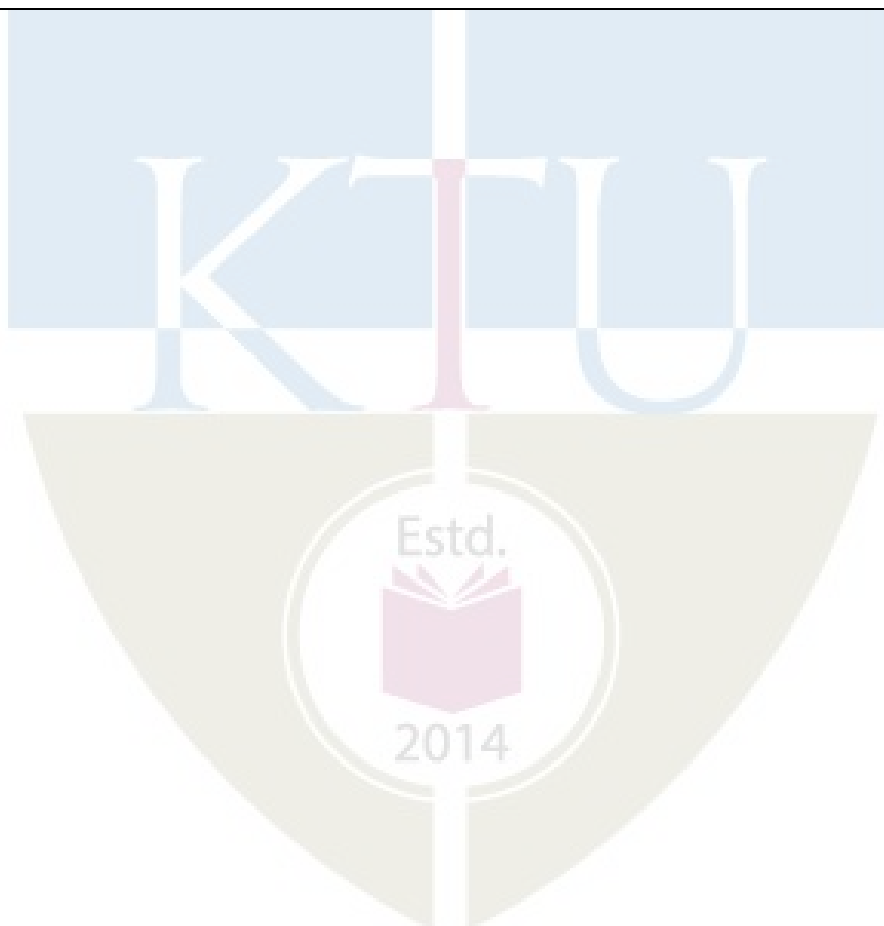
b) Determine an interval (a, b) such that $P[a \leq t \leq b] = 0.80$, and that 10% of the area is on each side of a and b , assuming that the sample is of size 21. (6)



Teaching Plan		
No	Topic	No. of Lectures (35)
1	Module-1 (LINEAR ALGEBRA) TB-1(Ch 2,3,4) (6 hours)	
1.1	Systems of Linear Equations – Matrices, Solving Systems of Linear Equations.	1 hour
1.2	Vector Spaces, sub space	1 hour
1.3	Linear Independence,	1 hour
1.4	Basis and Rank	1 hour
1.5.	Linear Mappings- Kernel, Range	1 hour
1.6.	Linear Mappings- Rank, Nullity	
2	Module-2 (LINEAR ALGEBRA) (6 hours)	
2.1.	Norms, Inner Products, Lengths and Distances, Angles and Orthogonality,	1 hour
2.2	Orthonormal Basis, Orthogonal Complement,	1 hour
2.3	Orthogonal Projections	1 hour
2.4.	Eigenvalues and Eigenvectors	1 hour
2.5.	Eigen decomposition	1 hour
2.6.	Eigen Diagonalization	1 hour
3.	Module-3 (PROBABILITY AND DISTRIBUTIONS) TB-2(Ch 1,2) (9 hours)	

3.1	Sample Spaces, Probability Measures, Computing Probabilities	1 hour
3.2	Conditional Probability,	1 hour
3.3	Baye's Rule	1 hour
3.4	Independence of events	1 hour
3.5	Discrete Random Variables -Bernoulli Random Variables, Binomial Distribution	1 hour
3.6	Discrete Random Variables -Geometric Distribution	1 hour
3.7	Discrete Random Variables -Poisson Distribution	1 hour
3.8	Continuous Random Variables - Exponential Density, Gamma Density,	1 hour
3.9	Continuous Random Variables - Normal Distribution, Beta Density	1 hour
4.	Module-4 (RANDOM VARIABLES) TB-2 (Ch 3, 4, 5, 6) (9 hours)	
4.1	Functions of a Random Variable	1 hour
4.2	Joint Distributions - Independent Random Variables	1 hour
4.3	Conditional Distributions	1 hour
4.4	Functions of Jointly Distributed Random Variables	1 hour
4.5	Expected Value of a Random Variable,	1 hour
4.6	Expectations of Functions of Random Variables,	1 hour
4.7	Expectations of Linear Combinations of Random Variables	1 hour
4.6	Variance and Standard Deviation	1 hour
4.9	Covariance and Correlation	1 hour

5	Module-5 (LIMIT THEOREMS) (6 hours)	
5.1	Conditional Expectation,	1 hour
5.2	Moment-Generating Function	1 hour
5.3	Limit Theorems(Proof not expected) - Law of Large Numbers,	1 hour
5.4	Convergence in Distribution and the Central Limit Theorem.	1 hour
5.5	Distributions derived from the Normal Distribution - Chi-square and, and F Distributions,	1 hour
5.6	Distributions derived from the Normal Distribution - Sample Mean and the Sample Variance.	1 hour



CST 322	DATA ANALYTICS	Category	L	T	P	Credits	Year of Introduction
		PEC	2	1	0	3	2019

Preamble:

This course helps the learner to understand the basic concepts of data analytics. This course covers mathematics for data analytics, predictive and descriptive analytics of data, Big data and its applications, techniques for managing big data and data analysis & visualization using R programming tool. It enables the learners to perform data analysis on a real world scenario using appropriate tools.

Prerequisite: NIL

Course Outcomes: After the completion of the course the student will be able to

CO#	Course Outcomes
CO1	Illustrate the mathematical concepts for data analytics (Cognitive Knowledge Level: Apply)
CO2	Explain the basic concepts of data analytics (Cognitive Knowledge Level: Understand)
CO3	Illustrate various predictive and descriptive analytics algorithms (Cognitive Knowledge Level: Apply)
CO4	Describe the key concepts and applications of Big Data Analytics (Cognitive Knowledge Level: Understand)
CO5	Demonstrate the usage of Map Reduce paradigm for Big Data Analytics (Cognitive Knowledge Level: Apply)
CO6	Use R programming tool to perform data analysis and visualization (Cognitive Knowledge Level: Apply)

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓								✓
CO2	✓	✓	✓									✓
CO3	✓	✓	✓	✓								✓
CO4	✓	✓	✓	✓								✓
CO5	✓	✓	✓	✓	✓							✓
CO6	✓	✓	✓	✓	✓							✓

Abstract POs Defined by National Board of Accreditation			
PO#	Broad PO	PO#	Broad PO
PO1	Engineering Knowledge	PO7	Environment and Sustainability
PO2	Problem Analysis	PO8	Ethics
PO3	Design/Development of solutions	PO9	Individual and team work
PO4	Conduct investigations of complex problems	PO10	Communication
PO5	Modern tool usage	PO11	Project Management and Finance
PO6	The Engineer and Society	PO12	Lifelong learning

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination Marks (%)
	Test 1 (%)	Test 2 (%)	
Remember	30	30	30
Understand	40	40	40
Apply	30	30	30

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3

Continuous Internal Evaluation Pattern:

Attendance	10 marks
Continuous Assessment Tests (Average of Series Tests 1& 2)	25 marks
Continuous Assessment Assignment	15 marks

Internal Examination Pattern:

Each of the two internal examinations has to be conducted out of 50 marks. The first series test shall be preferably conducted after completing the first half of the syllabus and the second series test shall be preferably conducted after completing the remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly completed module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question

from the partly completed module), each with 7 marks. Out of the 7 questions, a student should answer any 5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 full questions from each module of which students should answer any one. Each question can have a maximum 2 sub-divisions and carries 14 marks.

Syllabus

Module – 1 (Mathematics for Data Analytics)

Descriptive statistics - Measures of central tendency and dispersion, Association of two variables - Discrete variables, Ordinal and Continuous variable, Probability calculus - probability distributions, Inductive statistics - Point estimation, Interval estimation, Hypothesis Testing - Basic definitions, t-test

Module - 2 (Introduction to Data Analytics)

Introduction to Data Analysis - Analytics, Analytics Process Model, Analytical Model Requirements. Data Analytics Life Cycle overview. Basics of data collection, sampling, preprocessing and dimensionality reduction

Module - 3 (Predictive and Descriptive Analytics)

Supervised Learning - Classification, Naive Bayes, KNN, Linear Regression. Unsupervised Learning - Clustering, Hierarchical algorithms – Agglomerative algorithm, Partitional algorithms - K- Means. Association Rule Mining - Apriori algorithm

Module - 4 (Big Data Analytics)

Big Data Overview – State of the practice in analytics, Example Applications - Credit Risk Modeling, Business Process Analytics. Big Data Analytics using Map Reduce and Apache Hadoop, Developing and Executing a HadoopMapReduce Program.

Module - 5 (R programming for Data Analysis)

Overview of modern data analytic tools. Data Analysis Using R - Introduction to R - R Graphical User Interfaces, Data Import and Export, Attribute and Data Types, Descriptive Statistics, Exploratory Data Analysis - Visualization Before Analysis, Dirty Data, Visualizing a Single Variable, Examining Multiple Variables, Data Exploration Versus Presentation, Statistical Methods for Evaluation

Text Book

1. Bart Baesens," Analytics in a Big Data World: The Essential Guide to Data Science and its Business Intelligence and Analytic Trends", John Wiley & Sons, 2013.
2. David Dietrich, "EMC Education Services, Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data", John Wiley & Sons, 2015.
3. Jaiwei Han, MichelineKamber, "Data Mining Concepts and Techniques", Elsevier, 2006.
4. Christian Heumann and Michael Schomaker, "Introduction to Statistics and DataAnalysis", Springer, 2016

References

1. Margaret H. Dunham, Data Mining: Introductory and Advanced Topics. Pearson, 2012.
2. Michael Berthold, David J. Hand, Intelligent Data Analysis, Springer, 2007.

Course Level Assessment Questions**Course Outcome 1 (CO1):**

1. Explain the measures of central tendency.
2. Drive the mean and variance of normal distribution.
3. Collect sample data associated with a real world scenario, and identify central tendency and dispersion measures. Explain your inferences.

Course Outcome 2 (CO2):

1. Explain the life cycle of Data Analytics.
2. Discuss in detail the relevance of data sampling.

Course Outcome 3 (CO3):

1. The following table shows the midterm and final exam marks obtained for students in a database course.

X (Midterm exam)	Y (Final exam)
72	84
50	63

81	77
74	78
94	90
86	75
59	49
83	79
65	77
33	52
88	74
81	90

- Use the method of least squares to find an equation for the prediction of a student's final exam marks based on the student's midterm grade in the course.
 - Predict the final exam marks of a student who received an 86 on the midterm exam.
- Perform knn classification on the following dataset and predict the class for the data point X ($P1 = 3$, $P2 = 7$), assuming the value of k as 3.

P1	P2	Class
7	7	False
7	4	False
3	4	True
1	4	True

Course Outcome 4 (CO4):

- List down the characteristics of Big Data.
- Illustrate process discovery task in business analytics using the scenario of insurance claim handling process. Draw the annotated process map.

Course Outcome 5 (CO5):

1. Explain how fault tolerance is achieved in HDFS.
2. Write down the pseudocode for Map and Reduce functions to solve any one data analytic problem.

Course Outcome 6 (CO6):

1. Illustrate any three R functions used in data analytics.
2. Explain the different categories of attributes and data types in R.

Model Question Paper**QP CODE:****Reg No:** _____**Name :** _____**PAGES : 4****APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY****SIXTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR****Course Code: CST 322****Course Name: Data Analytics****Max.Marks :100****Duration: 3 Hrs****PART A****(Answer all Questions. Each question carries 3 Marks)**

1. Outline the errors that arise in hypothesis testing.
2. The number of members of a millionaires' club were as follows:

Year	2011	2012	2013	2014	2015	2016
Members	23	24	27	25	30	28

(a)What is the average growth rate of the membership?

(b)Based on the results of (a), how many members would one expect in 2018?

3. List and explain any two methods for dealing with missing values in a dataset.
4. Consider the following data (in increasing order) for the attribute age: 13, 15, 16, 16, 19, 20, 20, 21, 22, 22, 25, 25, 25, 25, 30, 33, 33, 35, 35, 35, 35, 36, 40, 45, 46, 52, 70. Sketch an example for stratified sampling using samples of size 5 and the strata “youth,” “middle-aged,” and “senior.”
5. Why is k nearest neighbor classifier called a lazy learner?
6. Find the absolute support, relative support and confidence of the rule (bread $\Rightarrow$ jam) in the following set of transactions
 T1 {bread, butter}, T2 {bread, jam, milk}
 T3 {Milk, curd}, T4 {bread, jam}
7. Explain the 3 Vs of Big Data.
8. Discuss the application of big data analytics in credit risk modeling.
9. Why is Exploratory Data Analysis important in business application ?
10. Explain how box plots be used for data summarization.

(10x3=30)

Part B**(Answer any one question from each module. Each question carries 14 Marks)**

11. (a) Illustrate the Maximum Likelihood Estimation of Bernoulli distribution. (8)
- (b) A hiking enthusiast has a new app for his smartphone which summarizes his hikes by using a GPS device. Let us look at the distance hiked (in km) and maximum altitude (in m) for the last 10 hikes: (6)

Distance	12.5	29.9	14.8	18.7	7.6	16.2	16.5	27.4	12.1	17.5
Altitude	342	1245	502	555	398	670	796	912	238	466

Calculate the arithmetic mean and median for both distance and altitude.

OR

12. (a) Explain the steps in conducting a hypothesis test. (8)

- (b) A total of 150 customers of a petrol station are asked about their satisfaction with their car and motorbike insurance. The results are summarized below: Determine and interpret Pearson's χ^2 statistic and Cramer's V. (6)

	Satisfied	Unsatisfied	Total
Car	33	25	58
Car (Diesel engine)	29	31	60
Motor bike	12	20	32
Total	74	76	150

13. (a) Explain the data analytical process model. (8)

- (b) Discuss the methods for handling noisy data. Consider the following sorted data for price (in dollars) 4, 8, 15, 21, 21, 24, 25, 28, 34. (6)
Illustrate smoothing by bin means and bin boundaries

OR

14. (a) a) What is the need for sampling in data analytics? Discuss the different sampling techniques. (8)

- (b) Use these methods to *normalize* the following group of data: (6)

200, 300, 400, 600, 1000

- (i) min-max normalization by setting $min = 0$ and $max = 1$
(ii) z-score normalization
(iii) normalization by decimal scaling .

15. (a) A database has five transactions. Let min_sup be 60% and min_conf be 80%. .

<i>TID</i>	<i>items_bought</i>
T100	{M, O, N, K, E, Y}
T200	{D, O, N, K, E, Y}
T300	{M, A, K, E}
T400	{M, U, C, K, Y}
T500	{C, O, O, K, I, E}

(a) Find all frequent itemsets using Apriori algorithm (10)

(b) Generate strong association rules from any one 3 itemset. (4)

OR

16. (a) Explain agglomerative hierarchical clustering with an example. (8)

(b) Suppose that the data mining task is to cluster points (with (x, y) representing location) into three clusters, where the points are A1(2,10), A2 (2,5), A3 (8,4), B1 (5,8), B2 (7,5), B3 (6,4), C1(1,2), C2 (4,9). The distance function is Euclidean distance. Suppose initially we assign A1, B1, and C1 as the center of each cluster, respectively. Use the k-means algorithm to show only

(a) The three cluster centers after the first round of execution.

(b) The final three clusters.

17. (a) Illustrate the working of a Map Reduce program with example. (8)

(b) Explain the data analytic architecture with a diagram. (6)

OR

18. (a) Discuss the architecture of HDFS and its features. (8)

(b) Illustrate the use of big data analytics in credit risk modeling. (6)

19. (a) List and explain the R functions used in descriptive statistics. (8)

(b) Explain hypothesis testing using ANOVA. (6)

OR

20. (a) Discuss the data visualization for multiple variables in R (8)

(b) Describe the R functions used for cleaning dirty data. (6)

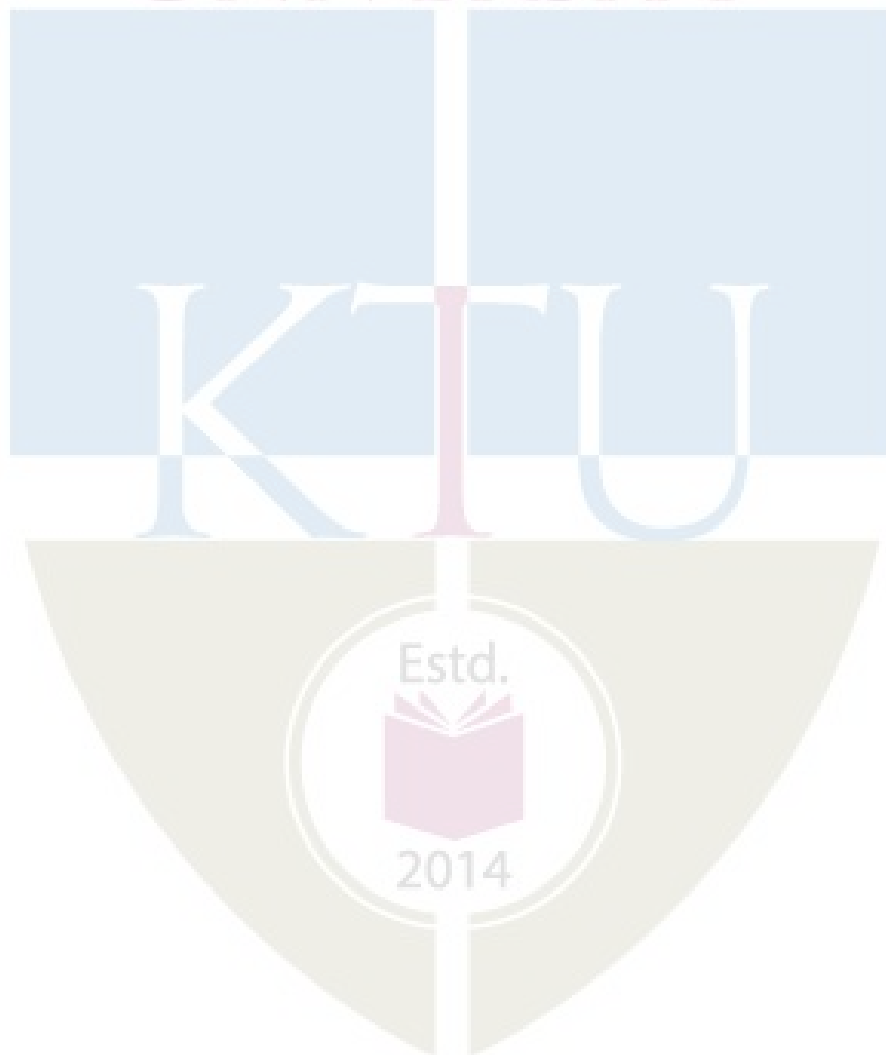
(5 x 14 = 70)

Teaching Plan

No	Contents	No of Lecture Hrs
Module – 1(Mathematics for Data Analytics) (7 hrs)		
1.1	Descriptive statistics - Measures of central tendency	1
1.2	Measures of dispersion	1
1.3	Association of two variables - Discrete Variables	1
1.4	Association of two variables - Ordinal and Continuous variable	1
1.5	Probability calculus - Probability distributions	1
1.6	Inductive statistics - Point estimation, Interval estimation	1
1.7	Hypothesis Testing - Basic definitions, t-test	1
Module – 2 (Introduction to Data Analytics) (6 hrs)		
2.1	Introduction to Data Analysis –Analytics, Analytics process model	1
2.3	Analytical model requirements	1
2.4	Data Analytics Life Cycle overview	1
2.5	Basics of data collection	1
2.6	Basics of sampling and preprocessing	1
2.7	Dimensionality reduction	1
Module - 3 (Predictive and Descriptive Analytics) (8 hrs)		
3.1	Supervised Learning, Naive Bayes classification	1
3.2	KNN algorithm	1

3.3	Linear Regression	1
3.4	Unsupervised Learning- Clustering	1
3.5	Hierarchical algorithms Agglomerative algorithm	1
3.6	Partitional algorithms -K- Means	1
3.7	Association Rule Mining	1
3.8	Apriori algorithm	1
Module - 4 (Big Data Analytics) (7 hrs)		
4.1	Big Data Overview – State of the practice in analytics.	1
4.2	Example Applications - Credit Risk Modeling	1
4.3	Business Process Analytics.	1
4.4	Big Data Analytics using Map Reduce and Apache Hadoop	1
4.5	Big Data Analytics using Map Reduce and Apache Hadoop	1
4.6	Developing and Executing a Hadoop MapReduce Program	1
4.7	Developing and Executing a Hadoop MapReduce Program	1
Module - 5 (R programming for Data Analysis) (8 hrs)		
5.1	Overview of modern data analytic tools, Introduction to R, R Graphical User Interfaces	1
5.2	Data Import and Export, Attribute and Data Types	1

5.3	Descriptive Statistics	1
5.4	Exploratory Data Analysis, Visualization Before Analysis	1
5.5	Dirty Data, Visualizing a Single Variable	1
5.6	Examining Multiple Variable	1
5.7	Data Exploration Versus Presentation	1
5.8	Statistical Methods for Evaluation	1



CCT332	STORAGE MANAGEMENT AND SECURITY	CATEGORY	L	T	P	CREDITS
		PEC	2	1	0	3

Preamble: To enable students to understand, explore and acquire a critical understanding about comprehensive learning on storage technology, which will enable them to make more informed decisions in an increasingly complex IT environment. It builds a strong understanding of underlying storage technologies and prepares them to learn advanced concepts, technologies and products. Students will learn about the architectures, features, and benefits of intelligent storage systems; storage networking technologies such as FC-SAN, IP-SAN, NAS, object-based and unified storage; business continuity solutions such as backup and replication; the increasingly critical area of Information Security and Management.

Prerequisite: A basic understanding of Computer Architecture, Operating Systems, Networking, and databases.

Course Outcomes: After the completion of the course, the student will be able to

CO#	Course Outcomes
CO1	Explain storage architectures and key data center elements(Cognitive Knowledge Level: Understand)
CO2	Explain physical and logical components of a storage infrastructure including storage subsystems and RAID(Cognitive Knowledge Level: Understand)
CO3	Summarize storage networking technologies such as FCSAN, IP-SAN, NAS (Cognitive Knowledge Level: Understand)
CO4	Describe business continuity backup and replication solutions.(Cognitive Knowledge Level: Understand)
CO5	Explain the storage security aspects and the virtualization technologies. (Cognitive Knowledge Level: Understand)

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12
CO1	✓	✓	✓									✓
CO2	✓	✓	✓									✓
CO3	✓	✓	✓									✓
CO4	✓	✓	✓									✓
CO5	✓	✓	✓									✓

Abstract POs defined by National Board of Accreditation			
PO#	Broad PO	PO#	Broad PO
PO1	Engineering Knowledge	PO7	Environment and Sustainability
PO2	Problem Analysis	PO8	Ethics
PO3	Design/Development of solutions	PO9	Individual and teamwork
PO4	Conduct investigations of complex problems	PO10	Communication
PO5	Modern tool usage	PO11	Project Management and Finance
PO6	The Engineer and Society	PO12	Lifelong learning

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination (%)
	Test 1 (%)	Test 2 (%)	
Remember	30	30	30
Understand	50	50	50
Apply	20	20	20
Analyze			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 Hours

Continuous Internal Evaluation Pattern:

Attendance	10 marks
Continuous Assessment Tests (Average of Series Tests 1 & 2)	25 marks
Continuous Assessment Assignment	15 marks

Internal Examination Pattern:

Each of the two internal examinations has to be conducted out of 50 marks. The first series test shall be preferably conducted after completing the first half of the syllabus. The second series test shall be preferably conducted after completing the remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly completed module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly completed module), each with 7 marks. Out of the 7 questions, a student should answer any 5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which a student should answer anyone. Each question can have maximum 2 sub-divisions and carries 14 marks.

Syllabus

Module-1(Introduction)

Introduction to Storage Technology- Review data creation-amount of data being created- understand the value of data to business- challenges in data storage and data management-solutions available for data storage-core elements of a data center infrastructure- role of each element in supporting business activities.

Module-2(Storage system architecture)

Storage system architecture-Hardware and software components of the host environment-Key protocols and concepts used by each component-physical and logical components of a connectivity environment- major physical components of a disk drive and their function-logical constructs of a physical disk-Access characteristics-Performance implications-Concept of RAID and its components-Different RAID levels and their sustainability for different application environments-Compare and contrast integrated and modular storage systems-High-level architecture and working of an intelligent storage system.

Module-3(Network Storage)

Introduction to Networked Storage-Evolution of networked storage- Architecture-Components- Topologies of FC- SAN- NAS - IP- SAN- Benefits of the different networked storage options- understand the need for long- Term archiving solutions- Describe how CAS fulfill the need- Understand the appropriateness- Different networked storage options-Different application environments.

Module-4(Management of Information)

Information Availability, Monitoring & Managing Data centers- List reasons for planned or unplanned outages- Impact of downtime-Business continuity(BC)-Disaster recovery(DR)-RTO-RPO- Identify single points of failure- List solutions to mitigate failures –Architecture of backup/recovery- Different backup or recovery topologies-Replication technologies-Role in ensuring information availability and business continuity- Remote replication technologies-Role in providing disaster recovery and business continuity capabilities-Identify key areas to monitor in a data center- Industry standards for data monitoring and management-key metrics-key management tasks.

Module-5(Storage Security)

Securing storage and storage virtualization-Information security- Critical security attributes- storage security domains –List and analyzes the common threats in each domain –Virtualization technologies- Block-level and file-level virtualization technologies and processes.

Text/Reference Books

1. EMC Corporation, "Information Storage and Management: Storing, Managing and Protecting Digital Information", Wiley, India, 2nd Edition, 2012.
2. Marc Farley, "Building storage networks", Tata McGraw Hill, Osborne, 2nd Edition, 2001.
3. Robert Spalding, "Storage Networks: The complete Reference", Tata McGraw hill, Osborne, First Edition, 2003.

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. What are the key requirements needed for designing a data center for storage?

Course Outcome 2 (CO2):

1. Explain the Evolution of storage Technology and Architecture.

Course Outcome 3 (CO3):

1. Explain Network-attached storage (NAS) its future and benefits.

Course Outcome 4 (CO4):

1. What is the need of data management and monitoring in storage?

Course Outcome 5 (CO5):

1. Explain the storage security aspects and the virtualization technology.



Model Question Paper

QP CODE:

Reg No: _____

Name : _____

PAGES : 2

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
SIXTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR**

Course Code: CCT 332

Course Name: STORAGE MANAGEMENT AND SECURITY

Max.Marks:100

Duration: 3 Hours

PART A

Answer all Questions. Each question carries 3 Marks

1. Which are the challenges in data storage?
2. Which are the elements needs for a data center infrastructure?
3. Explain about key protocols used in host environment.
4. What is the importance of High-level architecture in storage?
5. Describe in detail about NAS topology.
6. Which are the different application environments in storage?
7. What is the need of ensuring information availability and business continuity?
8. Which are the key areas to monitor in a data center?
9. Explain how Information Security is achieved in storage.
10. Discuss the different Virtualization technologies.

(10x3=30 Marks)

PART B

CSE(CYBER SECURITY)

Answer any one Question from each module.

Each question carries 14 Marks

- 11) a) Describe the evolution of storage technology and architecture. (7Marks)
b) Describe the core elements of a data centre infrastructure and explain role of each element in supporting business activities. (7Marks)
- OR**
- 12) a) Explain the value of data to business. (4Marks)
b) Describe the challenges faced and the solutions in storage management. (10Marks)
- OR**
- 13) a) Explain Storage security domains. (8 Marks)
b) Explain the major physical components of a disk drive. (6 Marks)
- OR**
- 14) a) Write down the Different RAID levels and their sustainability for different application environments (10 Marks)
b) Compare integrated and modular storage systems. (4 Marks)
- OR**
- 15) a) What are the components of NAS? Explain NAS Implementations. (7 Marks)
b) Briefly explain the architecture and components of networked storage. (7 Marks)
- OR**
- 16) a) Explain the topologies used in networked storage management. (7 Marks)
b) What are the benefits of different network storage devices? (7 Marks)
- OR**
- 17) a) List the reasons for planned or unplanned outages. (10 Marks)
b) Explain disaster recovery(DR)-RTO-RPO. (4 Marks)
- OR**
- 18) a) Explain industry standards for data monitoring and management (8 Marks)
b) Explain the key metrics and key task for storage management (6 Marks)
- OR**
- 19) a) Explain Critical security attributes in storage. (8 Marks)
b) Explain the storage security domains in storage management. (6 Marks)
- OR**
- 20) a) What isStorage Virtualization? Explain how it can be done. (8 Marks)

b) List and analyzes the common threats in security storage management

(6 Marks)**TEACHING PLAN**

No	Contents	No of Lecture Hrs
Module-1(Introduction)(5 hrs)		
1.1	Introduction to Information Storage Management –Evolution of Storage Technology	1
1.2	Data Centre Infrastructure-Key Challenges in managing Information	1
1.3	Solutions available for data storage	1
1.4	Core elements of a data center infrastructure	1
1.5	Role of each element in supporting business activities	1
Module-2(Storage system architecture)(9 hrs)		
2.1	Hardware and software components of the host environment	1
2.2	Key protocols and concepts used by each component	1
2.3	Physical and logical components of a connectivity environment	1
2.4	Major physical components of a disk drive and their function	1
2.5	Logical constructs of a physical disk-Access characteristics-Performance implications	1
2.6	Concept of RAID and its components	1

2.7	Different RAID levels and their sustainability for different application environments	1
2.8	Compare and contrast integrated and modular storage systems-	1
2.9	High-level architecture and working of an intelligent storage system.	1
Module-3(Network Storage)(8 hrs)		
3.1	Evolution of networked storage	1
3.2	Architecture-Components	1
3.3	Topologies of FC- SAN- NAS	1
3.4	Topologies of IP- SAN	1
3.5	Benefits of the different networked storage options	1
3.6	Understand the need for long- Term archiving solutions	1
3.7	Describe how CAS fulfill the need- Understand the appropriateness	1
3.8	Different networked storage options-Different application environments.	1
Module-4(Management of Information)(8hrs)		
4.1	List reasons for planned or unplanned outages- Impact of downtime- Business continuity(BC)	1
4.2	Disaster recovery(DR)-RTO-RPO-Identify single points of failure	1
4.3	Identify single points of failure- List solutions to mitigate failures – Architecture of backup/recovery systems	1

4.4	Different backup or recovery topologies-Replication technologies	1
4.5	Role in ensuring information availability and business continuity	1
4.6	Remote replication technologies-Role in providing disaster recovery and business continuity capabilities	1
4.7	Identify key areas to monitor in a data center	1
4.8	Industry standards for data monitoring and management-key metrics-key management tasks.	1
Module-5(Storage Security)(5hrs)		
5.1	Information security- Critical security attributes	1
5.2	Storage security domains –List and analyzes the common threats in each domain	1
5.3	Virtualization technologies	1
5.4	Block-level virtualization technologies and processes	1
5.5	File-levelvirtualization technologies and processes	1

Estd.



2014

CST 342	AUTOMATED VERIFICATION	Category	L	T	P	CREDIT	YEAR OF INTRODUCTION
		PEC	2	1	0		

Preamble: This course is intended to impart the basic theory and algorithm for an automatic verification process namely model checking. This course covers finite-state modelling of hardware/software, linear-time properties, classification of linear-time properties, Linear Temporal Logic (LTL) - a formal language for property specification, LTL model checking algorithm and model checking case studies. This course enables the learners to prove correctness of a hardware/software used in safety critical systems in domains such as avionics, health care and automotive.

Prerequisite: NIL

Course Outcomes: After the completion of the course the student will be able to

CO1	Illustrate an application for model checking. (Cognitive Knowledge Level: Understand)
CO2	Describe finite-state modelling for hardware and software. (Cognitive Knowledge Level: Understand)
CO3	Identify linear-time properties required to represent the requirements of a system. (Cognitive Knowledge Level: Apply)
CO4	Specify a given linear-time property in Linear Temporal Logic (LTL). (Cognitive Knowledge Level: Apply)
CO5	Perform LTL model checking using the tool Symbolic Analysis Laboratory (SAL). (Cognitive Knowledge Level: Apply)

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

Abstract POs defined by National Board of Accreditation			
PO#	Broad PO	PO#	Broad PO
PO1	Engineering Knowledge	PO7	Environment and Sustainability
PO2	Problem Analysis	PO8	Ethics
PO3	Design/Development of solutions	PO9	Individual and team work
PO4	Conduct investigations of complex problems	PO10	Communication
PO5	Modern tool usage	PO11	Project Management and Finance
PO6	The Engineer and Society	PO12	Life long learning

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination Marks
	Test 1 (Marks)	Test 2 (Marks)	
Remember	30	30	30
Understand	30	30	30
Apply	40	40	40
Analyze			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks

Continuous Assessment Test : 25 marks

Continuous Assessment Assignment : 15 marks (Out 15, 10 marks shall be given for a model checking project to be implemented in SAL.)

Internal Examination Pattern:

Each of the two internal examinations has to be conducted out of 50 marks. First series test shall be preferably conducted after completing the first half of the syllabus and the second series test shall be preferably conducted after completing remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly completed module), having 3 marks for each

question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly completed module), each with 7 marks. Out of the 7 questions, a student should answer any 5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which a student should answer any one. Each question can have maximum 2 sub-divisions and carries 14 marks.

Syllabus

Module - 1 (Introduction to Model Checking)

System Verification – Hardware and Software Verification, Model Checking, Characteristics of Model Checking.

Transition Systems – Transition System, Direct Predecessors and Successors, Terminal State, Deterministic Transition System.

Executions - Execution Fragment, Maximal and Initial Execution Fragment, Execution, Reachable States.

Module - 2 (Linear Time Properties)

Linear-Time (LT) Properties - Deadlock. Linear-Time Behavior - Paths and State Graph, Path Fragment, Maximal and Initial Path Fragment, Path. Traces - Trace and Trace Fragment, LT Properties - LT Property, Satisfaction Relation for LT Properties, Trace Equivalence and LT Properties. Safety Properties and Invariants - Invariants, Safety Properties, Trace Equivalence and Safety properties. Liveness Properties - Liveness Property, Safety vs. Liveness Properties. Fairness - Fairness, Unconditional, Weak and Strong Fairness, Fairness Strategies, Fairness and Safety. (Definition and examples only for all topics - no proof required).

Module - 3 (Regular Properties)

Regular Properties - Model Checking Regular Safety properties - Regular Safety property, Verifying Regular Safety Properties. Automata on Infinite Words - ω -Regular Languages and Properties, Nondeterministic Buchi Automata (NBA), Deterministic Buchi Automata (DBA),

Generalised Buchi Automata (Definitions only). Model Checking ω -Regular Properties - Persistence Properties and Product, Nested Depth-First Search (Only algorithms required).

Module - 4 (Linear Time Logic)

Linear Temporal Logic (LTL) - Syntax, Semantics, Equivalence of LTL Formulae, Weak Until, Release and Positive Normal Form, Fairness, Safety and Liveness in LTL (Definitions only). Automata Based LTL Model Checking (Algorithms and examples only).

Module - 5 (Model Checking in SAL)

Introduction - Introduction to the tool Symbolic Analysis Laboratory (SAL).

The Language of SAL - The expression language, The transition Language, The module language, SAL Contexts.

SAL Examples - Mutual Exclusion, Peterson's Protocol, Synchronous Bus Arbiter, Bounded Bakery protocol, Bakery Protocol, Traffic Signalling System.

Text Books

1. Christel Baier and Joost-Pieter Katoen, Principles of Model Checking, The MIT Press. (Modules 1 - 4)
2. Leonardo de Moura, Sam Owre and N. Shankar, The SAL Language Manual, SRI International (<http://sal.csl.sri.com/doc/language-report.pdf>, Chapters 1, 3, 4, 5, 6, 7) (Module 5)

Reference Materials

1. SAL Examples (<http://sal.csl.sri.com/examples.shtml>) (Module 5)

Sample Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Illustrate how model checking can make a system design reliable, based on a required set of properties/constraints.

Course Outcome 2 (CO2):

1. Consider a message delivery system. The sender s is trying to send a series of messages to the receiver r in such a way that the $(i+1)^{st}$ message is sent only after the i^{th} message is delivered. There is a possibility of error in sending a message and in that case, s keeps on

trying until it is able to send the message. Show a finite state transition system modeling this system.

Course Outcome 3 (CO3):

1. Consider a shared memory segment s protected using a mutex lock variable m . Two processes p_1 and p_2 are trying to access s . List the Linear Time properties of the system which will ensure safety, liveness and fairness.

Course Outcome 4 (CO4):

1. Show the LTL specifications of the safety, liveness and fairness properties listed for the assessment question given in CO3.

Course Outcome 5 (CO5):

1. Model the system mentioned in the question given in CO3 in SAL and verify that the system is correct with respect to the LTL properties shown as the answer for CO4.

Model Question paper

QP CODE:

PAGES: 3

Reg No: _____

Name : _____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SIXTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: CST342

Course Name: Automated Verification

Max.Marks:100

Duration: 3 Hours

PART A

Answer all questions. Each question carries 3 marks.

1. Define model checking. Show the schematic diagram of the model checking approach.
2. Show a transition system modeling a coffee/Tea vending machine.

3. Define invariant as a Linear Time (LT) property. Give an example
4. List any three Linear Time properties in the Mutual Exclusion problem of processes.
5. Illustrate the construction of a product automaton from two automata.
6. Differentiate between Deterministic Buchi Automaton and Non-deterministic Buchi Automaton.
7. Specify the following statements about traffic lights in Linear Temporal Logic (LTL).
 - a. Once red, the light can not become green immediately.
 - b. Once red, the light always becomes green eventually after being yellow for some time.
8. What is Positive Normal Form (PNF) in LTL? Give an example.
9. List any three applications of the tool Symbolic Analysis Laboratory (SAL).
10. What is a SAL context? Give an example.

(10x3=30)

Part B**(Answer any one question from each module. Each question carries 14 Marks)**

11. (a) Explain in detail the various phases of the model checking process. (8)
 - (b) Explain the strengths and weaknesses of model checking. (6)
- OR**
12. (a) Define and illustrate the following terms of a transition system. (14)
 - a. Execution Fragment
 - b. Maximal and Initial Execution Fragment
 - c. Execution
 - d. Reachable States

13. (a) With an example, explain the satisfaction relation for LT properties. (7)
- (b) What is trace equivalence in Transition Systems? Give an example to show that if two transition systems satisfy the trace equivalence property, then they satisfy the same set of LT properties. (7)
- OR**
14. (a) Give the transition system for the fault tolerant variant of the dining philosophers problem. (4)
- (b) With a suitable example, explain the algorithms to check whether a Transition System satisfies an invariant or not. (10)
15. (a) Explain Regular Safety Properties with a suitable example. (7)
- (b) Illustrate an algorithm for verifying Regular Safety Properties. (7)
- OR**
16. (a) Explain ω -Regular Properties. (4)
- (b) Illustrate how ω -Regular Properties are verified. (10)
17. (a) Explain the syntax of Linear Temporal Logic (LTL). (7)
- (b) Explain the semantics of LTL. (7)
- OR**
18. (a) With an example, give the difference between until and weak until in LTL. (4)
- (b) With a suitable example, explain automata based LTL model checking. (10)
19. (a) Explain Peterson's protocol. What are the LTL properties to be verified to ensure its correctness? (8)
- (b) Write a SAL script for the verification of Peterson's protocol. (6)

OR

20. (a) Show the SAL model corresponding to Bakery protocol. (8)

(b) List any three Linear Time properties of this model and show their LTL (6)

Teaching Plan

Module 1 (Introduction to Model Checking)		4 Hours
1.1	System Verification – Hardware and Software Verification, Model Checking, Model Checking	1 Hour
1.2	Transition Systems – Transition System, Direct Predecessors and Successors, Terminal State, Deterministic Transition System	1 Hour
1.3	Executions - Execution Fragment, Maximal and Initial Execution Fragment	1 Hour
1.4	Execution, Reachable States	1 Hour
Module 2 (Linear Time Properties)		8 Hours
2.1	Linear-Time (LT) Properties - Deadlock	1 Hour
2.2	Linear-Time Behavior - Paths and State Graph, Path Fragment, Maximal and Initial Path Fragment, Path	1 Hour
2.3	Traces - Trace and Trace Fragment	1 Hour
2.4	LT Property, Satisfaction Relation for LT Properties, Trace Equivalence and LT Properties	1 Hour
2.5	Invariants	1 Hour
2.6	Safety Properties, Trace Equivalence and Safety properties	1 Hour
2.7	Liveness Property, Safety vs. Liveness Properties	1 Hour
2.8	Fairness, Unconditional, Weak and Strong Fairness, Fairness Strategies, Fairness and Safety	1 Hour
Module 3 (Regular Properties)		9 Hours
3.1	Regular Properties - Model Checking Regular Safety properties - Regular Safety property	1 Hour
3.2	Verifying Regular Safety Properties	1 Hour
3.3	Automata on Infinite Words - ω -Regular Languages and Properties	2 Hour

3.4	Nondeterministic Buchi Automata (NBA), Deterministic Buchi Automata (DBA), Generalised Buchi Automata	1 Hour
3.5	Model Checking ω -Regular Properties - Persistence Properties and Product - Lecture 1	1 Hour
3.6	Persistence Properties and Product - Lecture 2	1 Hour
3.7	Nested Depth-First Search (Lecture 1)	1 Hour
3.8	Nested Depth-First Search (Lecture 2)	1 Hour
Module 4 (Linear Time Logic)		7 Hours
4.1	Linear Temporal Logic – Linear Temporal Logic (LTL) - Syntax	1 Hour
4.2	Semantics - Lecture 1	1 Hour
4.3	Equivalence of LTL Formulae, Weak Until	1 Hour
4.4	Release and Positive Normal Form	1 Hour
4.5	Fairness, Safety and Liveness in LTL	1 Hour
4.6	Automata Based LTL Model Checking (Lecture 1)	1 Hour
4.7	Automata Based LTL Model Checking (Lecture 2)	1 Hour
Module 5 (Model Checking in SAL)		7 Hours
5.1	Introduction - Introduction to the tool Symbolic Analysis Laboratory (SAL).	1 Hour
5.2	The Language of SAL - The expression language, The transition Language	1 Hour
5.3	The module language, SAL Contexts.	1 Hour
5.4	SAL Examples - Mutual Exclusion	1 Hour
5.5	Peterson's Protocol, Synchronous Bus Arbiter	1 Hour
5.6	Bounded Bakery protocol, Bakery Protocol	1 Hour
5.7	Traffic Signalling System	1 Hour

Abstract POs defined by National Board of Accreditation			
PO#	Broad PO	PO#	Broad PO
PO1	Engineering Knowledge	PO7	Environment and Sustainability
PO2	Problem Analysis	PO8	Ethics
PO3	Design/Development of solutions	PO9	Individual and team work
PO4	Conduct investigations of complex problems	PO10	Communication
PO5	Modern tool usage	PO11	Project Management and Finance
PO6	The Engineer and Society	PO12	Lifelong learning

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination Marks(%)
	Test1 (%)	Test2 (%)	
Remember	30	30	30
Understand	50	50	50
Apply	20	20	20
Analyze			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance	10 marks
Continuous Assessment Tests (Average of Series Tests 1 & 2)	25 marks
Continuous Assessment Assignment	15 marks

Internal Examination Pattern:

Each of the two internal examinations has to be conducted out of 50 marks. First Internal Examination shall be preferably conducted after completing the first half of the syllabus and the Second Internal Examination shall be preferably conducted after completing remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly covered module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly covered module), each with 7 marks. Out of the 7 questions in Part B, a student should answer any 5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which a student should answer any one. Each question can have maximum 2 sub-divisions and carries 14 marks.

Module-1 (Introduction)

Introduction to malware, OS security concepts, malware threats, evolution of malware, malware types: viruses, worms, rootkits, Trojans, bots, spyware, adware, logic bombs.

Types of malware Analysis – Static Analysis, Dynamic Analysis, Malware Analysis Techniques - Obfuscated, Deobfuscated, Malware Analysis Tools - Static Analysis Tools, Dynamic Analysis Tools. Antivirus Scanning, Fingerprint for Malware.

Module-2 (Malware Analysis)

Dynamic analysis: Live malware analysis, dead malware analysis, analyzing traces of malware-system-calls, api-calls, registries, network activities. Anti-dynamic analysis techniques anti-vm, runtime-evasion techniques, Malware Sandbox, Monitoring with Process Monitor, Packet Sniffing with Wireshark, Kernel vs. User-Mode Debugging, OllyDbg, Breakpoints, Tracing, Exception Handling, Patching.

Module-3 (Malware Detection)

Malware Detection Techniques: Signature-based techniques: malware signatures, packed malware signature, metamorphic and polymorphic malware signature. Non-signature based techniques: similarity-based techniques, machine-learning methods, invariant inferences.

Module-4 (Incident Response)

Malware Incident response: Volatile Data Collection and Examination on a Live Windows Systems - Volatile Data collection methodology from Windows systems- Preservation of Volatile data, Collecting Subject System details, Identifying users Logged into the System, Inspect Network Connections and Activity, Current and Recent Network Connections, Collecting Process Information, Correlate Open Ports with Running Processes and Programs, Identifying Services and Drivers, Determining Scheduled Tasks, Collecting Clipboard Contents, Non-Volatile Data Collection from a Live Windows System, Volatile Data collection methodology from Linux systems, Non-volatile Data collection from a live Linux system.

Module – 5(OS Forensics)

Post-Mortem Forensics - Malware Discovery and Extraction from a Windows and Linux system, Examine Windows and Linux file system, Examine application traces, Examine Windows registry, keyword searching from Windows and Linux systems, Forensic reconstruction of compromised Linux and Windows system.

Text Books

1. James M. Aquilina, Cameron H. Malin, Eoghan Casey, "Malware Forensics Field Guide for Windows Systems: Digital Forensics Field Guides", Syngress Publishing, First Edition, 2012
2. James M. Aquilina, Cameron H. Malin, Eoghan Casey, "Malware Forensics Field Guide for Linux Systems: Digital Forensics Field Guides", Syngress Publishing, Second Edition, 2014
3. Eoghan Casey, James M. Aquilina, Cameron H. Malin, "Malware Forensics Investigating and Analyzing Malicious code", Syngress Publishing, First Edition, 2008

References

1. Michael Sikorski and Andrew Honig, "Practical malware analysis The Hands-On Guide to Dissecting Malicious Software", No starch press, First Edition, 2012.
2. Michael Davis, Sean Bodmer, Aaron Lemasters, "Malware & rootkits: malware & rootkits security secrets & Solutions", McGraw Hill, Second Edition, 2010
3. Victor Marak, "Windows Malware Analysis Essentials" Packt Publishing, First Edition, 2015

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Discuss the different types of Malware Analysis.

Course Outcome 2 (CO2):

1. Explain the various Anti-dynamic malware analysis techniques?

Course Outcome 3 (CO3):

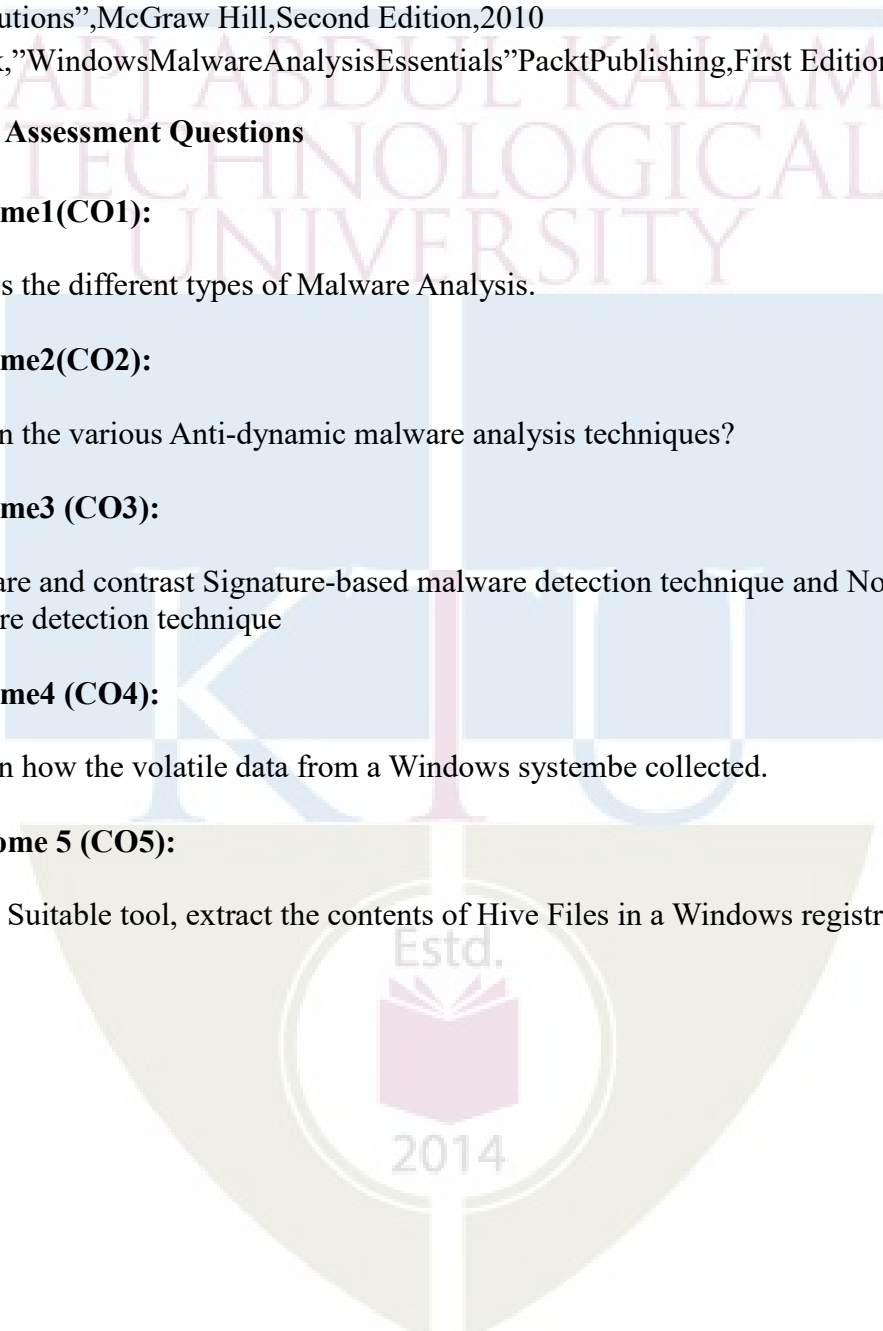
1. Compare and contrast Signature-based malware detection technique and Non-signature based malware detection technique

Course Outcome 4 (CO4):

1. Explain how the volatile data from a Windows system be collected.

Course Outcome 5 (CO5):

1. With a Suitable tool, extract the contents of Hive Files in a Windows registry.



QP CODE:

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Name : _____

PAGES : 3

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
SIXTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR**

Course Code: CCT 352

Course Name: Malware Forensics

Max.Marks:100

Duration: 3 Hours

PART A

Answer all Questions. Each question carries 3 Marks

1. Compare Static and Dynamic analysis.
2. List the different types of malware threats.
3. How to perform packetsniffing using wireshark? Explain.
4. What are the different types of Anti-dynamic analysis techniques?
5. What is the difference between polymorphic and metamorphic malware?
6. Write the different techniques used for malware detection.
7. "Performing live response and collecting information from a system is vital". Justify.
8. Explain the process of collecting Non-volatile data from a Windows system.
9. Discuss the significance of performing Post- Mortem Forensics.
10. Explain the methodology for uncovering trace evidence of malware on Linux.

(10x3=30 Marks)

PART B

Answer any one Question from each module.

Each question carries 14 Marks

11. (a) Explain viruses, worms, rootkits, Trojans, bots, spyware, adware and Logic bombs.
(b) Discuss the different tools used for Static and Dynamic Analysis.

(8 Marks)

(6 Marks)

OR

12. (a) Explain in detail the different types of Malware Analysis Techniques.
(b) What is antivirus scanning?
13. (a) Compare the live and dead malware analysis.

(8 Marks)

(6 Marks)

(8 Marks)

(b)What are the different methods of Anti-dynamic analysis techniques? **(6 Marks)**

OR

14. (a)Explain the process of analyzing traces of malware. **(8 Marks)**

(b) What is User mode debugging? **(6 Marks)**

15. (a)Discuss how Signature-based techniques are used for malware detection. **(8 Marks)**

(b) How the machine learning techniques are used for malware detection? **(6 Marks)**

OR

16. (a)Compare Similarity-based techniques and Machine-learning methods with illustrations.

(8 Marks)

(b)What are the characteristics of signature based analysis of malware? **(6 Marks)**

17. (a)Explain the process of collecting non-volatile data from a windows system. **(8 Marks)**

(b)How to gather volatile data such as subject system details, logged on users, process information, open ports, open files from a Linux system? **(6 Marks)**

OR

18. (a)Explain the different steps involved in collecting volatile data from a Linux system.

(8 Marks)

(b) With Illustrations, Correlate Open Ports with Running Processes and Programs. **(6 Marks)**

19. (a)What are the tools required for searching known malware in Linux system? **(10 Marks)**

(b) Explain Real time data and protected data with examples. **(4 Marks)**

OR

20. (a)Explain the methodology for discovering and extracting malware from Windows system.

(7 Marks)

(b) How the artifacts from a windows registry be extracted? **(7 Marks)**

TEACHING PLAN

No	Contents	No of Lecture Hrs
Module-1 (Introduction) (7hrs)		
1.1	Introduction to malware, OS security concepts	1
1.2	Malware threats, Evolution of malware	1
1.3	Malware types- viruses,worms, rootkits	1
1.4	Trojans, bots, spyware, adware,logicbombs	1
1.5	Types of malware Analysis – Static Analysis, Dynamic Analysis	1
1.6	Malware Analysis Techniques –1. Obfuscated, Deobfuscated	1

1.7	Malware Analysis Tools - Static Analysis Tools, Dynamic Analysis Tools	1
Module-2 (Malware Analysis)(9hrs)		
2.1	Dynamic analysis: Live malware analysis	1
2.2	Dead malware analysis	1
2.3	Analyzing traces of malware- system-calls, api-calls	1
2.4	Analyzing traces of malware- registries, network activities	1
2.5	Anti-dynamic analysis techniques anti-vm,	1
2.6	Runtime-evasion techniques	1
2.7	Malware Sandbox, Monitoring with Process Monitor	1
2.8	Packet Sniffing with Wireshark	1
2.9	Kernel vs. User-Mode Debugging	1
Module-3 (Malware Detection) (6hrs)		
3.1	Malware Detection Techniques: Signature-based techniques: malware signatures	1
3.2	Signature-based techniques: packed malware signature	1
3.3	Signature-based techniques: metamorphic and polymorphic malware signature	1
3.4	Malware Detection Techniques: Non-signature based techniques	1
3.5	Non-signature based techniques: similarity-based and machine learning techniques	1
3.6	Non-signature based techniques: invariant inferences	1
Module- 4 (Incident Response)(7hrs)		
4.1	Malware Incident response: Volatile Data Collection and Examination on a Live Windows Systems	1
4.2	Preservation of Volatile data, Collecting Subject System details, Identifying users Logged into the System	1

4.3	Inspect Network Connections and Activity, Current and Recent Network Connections	1
4.4	Collecting Process Information, Correlate Open Ports with Running Processes and Programs, Identifying Services and Drivers	1
4.5	Determining Scheduled Tasks, Collecting Clipboard Contents	1
4.6	Non-Volatile Data Collection from a Live Windows System	1
4.7	Volatile Data collection methodology from Linux systems	1
Module - 5 (OS Forensics)(6 hrs)		
5.1	Post-Mortem Forensics	1
5.2	Post-Mortem Forensics - Malware Discovery and Extraction from a Windows system	1
5.3	Malware Discovery and Extraction from a Linux system	1
5.4	ExamineWindowsfilesystem	1
5.5	ExamineLinuxfilesystem and application traces	1
5.6	ExamineWindowsregistry	1



CST 372	DATA AND COMPUTER COMMUNICATION	Category	L	T	P	Credits	Year of Introduction
		PEC	2	1	0	3	2019

Preamble:

The purpose of this course is to prepare learners to understand the communication entities and the associated issues in data transmission. This course covers fundamental concepts of data transmission in digital and analog form, transmission media, concepts of encoding, multiplexing, spread spectrum and switching methods. This course helps the learner to gain insight into the important aspects of data communication and computer networking systems and enables to apply in practical applications.

Prerequisite: NIL

Course Outcomes: After the completion of the course the student will be able to

CO#	Course Outcomes
CO1	Identify the characteristics of signals for analog and digital transmissions (Cognitive knowledge: Apply)
CO2	Identify the issues in data transmission (Cognitive knowledge: Apply)
CO3	Select transmission media based on characteristics and propagation modes (Cognitive knowledge: Apply)
CO4	Choose appropriate signal encoding techniques for a given scenario (Cognitive knowledge: Apply)
CO5	Illustrate multiplexing and spread spectrum technologies (Cognitive knowledge: Apply)
CO6	Use error detection, correction and switching techniques in data communication (Cognitive knowledge: Apply)

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓									✓
CO2	✓	✓	✓	✓								✓
CO3	✓		✓									✓
CO4	✓	✓	✓	✓								✓
CO5	✓	✓	✓	✓								✓
CO6	✓	✓	✓	✓								✓

Abstract POs defined by National Board of Accreditation			
PO#	Broad PO	PO#	Broad PO
PO1	Engineering Knowledge	PO7	Environment and Sustainability
PO2	Problem Analysis	PO8	Ethics
PO3	Design/Development of solutions	PO9	Individual and team work
PO4	Conduct investigations of complex problems	PO10	Communication
PO5	Modern tool usage	PO11	Project Management and Finance
PO6	The Engineer and Society	PO12	Lifelong learning

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination (%)
	Test 1 (%)	Test 2 (%)	
Remember	30	30	30
Understand	30	30	30
Apply	40	40	40

Analyze			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3

Continuous Internal Evaluation Pattern:

Attendance : **10 marks**

Continuous Assessment Test : **25 marks**

Continuous Assessment Assignment : **15 marks**

Internal Examination Pattern:

Each of the two internal examinations has to be conducted out of 50 marks. The first series test shall be preferably conducted after completing the first half of the syllabus and the second series test shall be preferably conducted after completing the remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly completed module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly completed module), each with 7 marks. Out of the 7 questions, a student should answer any 5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which a student should answer any one. Each question can have maximum 2 sub-divisions and carries 14 marks.

Syllabus

Module-1 (Data Transmission Basics)

Communication model - Simplex, Half duplex, Full duplex transmission. Periodic analog signals - Sine wave, Amplitude, Phase, Wavelength, Time and frequency domain, Bandwidth. Analog & digital data and signals. Transmission impairments - Attenuation, Delay distortion, Noise. Data rate limits - Noiseless channel, Nyquist bandwidth, Noisy channel, Shannon's capacity formula.

Module-2 (Transmission Media)

Guided transmission media - Twisted pair, Coaxial cable, Optical fiber. Unguided media - Radio waves, Terrestrial microwave, Satellite microwave, Infrared. Wireless propagation - Ground wave propagation, Sky wave propagation, Line-of-Sight (LoS) propagation.

Module-3 (Digital Transmission and Analog Transmission)

Digital data to digital signal – Non-Return-to-Zero (NRZ), Return-to-Zero (RZ), Multilevel binary, Biphasic. Analog data to digital signal - Sampling theorem, Pulse Code Modulation (PCM), Delta Modulation (DM). Digital data to analog signal - Amplitude Shift Keying (ASK), Frequency Shift Keying (FSK), Phase Shift Keying (PSK). Analog data to analog signal - Amplitude Modulation (AM), Frequency Modulation (FM), Phase Modulation (PM).

Module-4 (Multiplexing and Spread Spectrum)

Multiplexing - Frequency Division Multiplexing (FDM), Wavelength Division Multiplexing (WDM), Time Division Multiplexing (TDM), Characteristics, Synchronous TDM, Statistical TDM. Spread spectrum techniques - Direct Sequence Spread Spectrum (DSSS), Frequency Hopping Spread Spectrum (FHSS), Code Division Multiplexing, Code Division Multiple Access (CDMA).

Module-5 (Error Detection, Correction and Switching)

Digital data communication techniques - Asynchronous transmission, Synchronous transmission. Detecting and correcting errors - Types of errors, Parity check, Checksum, Cyclic Redundancy Check (CRC), Forward Error Correction (FEC), Hamming distance, Hamming code. Basic principles of switching - Circuit switching, Packet switching, Message switching.

Text Books

1. Forouzan B. A., Data Communications and Networking, 5/e, McGraw Hill, 2013.
2. William Stallings, Data and Computer Communication 9/e, Pearson Education, Inc.

References

1. Schiller J., Mobile Communications, 2/e, Pearson Education, 2009.
2. Curt M. White, Fundamentals of Networking and Communication 7/e, Cengage learning.

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. If the spectrum of a channel is between 3 MHz and 4 MHz and $\text{SNR}_{\text{dB}} = 24 \text{ dB}$, calculate the Shannon capacity.
2. Assume that a periodic signal is composed of five sine waves with frequencies 200, 400, 600, 800 and 1000 Hz. Determine the bandwidth. Draw the spectrum assuming all components have a maximum amplitude of 5 V.

Course Outcome 2 (CO2):

1. Given a receiver with an effective noise temperature of 294 K and a bandwidth of 10 MHz. Find the thermal noise level at the receiver side in dBW.
2. The loss in a cable is usually defined in decibels per kilometer (dB/km). If the signal at the beginning of a cable with -0.3 dB/km has a power of 2 mW, determine the power of the signal at 5 km.

Course Outcome 3 (CO3):

1. Explain the reflective property of a parabolic antenna.
2. Two separate frequencies are used for uplink and downlink transmission in satellite communication. Give reason.

Course Outcome 4 (CO4):

1. Encode the data sequence 101011100 using Multilevel binary and Biphasic schemes.
2. Encode the data bits 00101101110001 using 2B1Q encoding scheme. Assume negative original level.

Course Outcome 5 (CO5):

1. The frequency spectrum of input signals will move to high frequency bands by the FDM process. Justify.
2. Four channels are multiplexed using TDM. If each channel sends 100 bytes/sec and we multiplex one byte per channel, determine the frame size, duration of a frame, frame rate and bit rate of link.

Course Outcome 6 (CO6):

1. Using the divisor polynomial $x^4 + x + 1$, determine the Cyclic Redundancy Check (CRC) for the dataword 10110100. Also, perform the checking at the receiver side.
2. How many redundancy bits are required to generate the Hamming code for a 7-bit data? Assuming even parity, generate the Hamming code for the 7-bit dataword 1001101. If the fifth bit from the left of the received codeword is changed to 0, can

this be detected? Give reasons for your answer.

Model Question Paper

QP CODE: _____

PAGES: 3

Reg No: _____

Name: _____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SIXTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: CST 372

Course Name : Data and Computer Communication

Max Marks: 100

Duration: 3 Hours

PART A

(Answer All Questions. Each question carries 3 marks)

1. Define bandwidth. Find the lowest frequency, if a periodic signal has a bandwidth of 20 Hz and the highest frequency is 60 Hz. Draw the spectrum if the signal contains all frequencies of the same amplitude.
2. Assume that a TV picture is to be transmitted over a channel with 4.5 MHz bandwidth and a 35 dB Signal-to-Noise-Ratio. Find the capacity of the channel.
3. How does twisting affect the performance in a twisted pair cable?
4. Which wireless propagation method is suitable for satellite communication? Justify your answer.
5. Explain the two main distortions that can occur in a delta modulated waveform. How can it be avoided?
6. Illustrate the equivalent square wave pattern of the bit string 01001101 using Non-Return-to-Zero (NRZ) - Level and NRZ-Invert encoding schemes.
7. Apply Direct Sequence Spread Spectrum to the data 101 using the Barker sequence 10110111000. Show the encoding and decoding steps.
8. Compare synchronous and statistical time division multiplexing.
9. Find the minimum hamming distance for the following cases:
 - a) Detection of two errors

- b) Correction of two errors
- c) Detection of three errors

10. Find the parity bit for simple even parity check for the following.

(10x3=30)

- a) 1001010
- b) 0001100
- c) 1000000

Part B

(Answer any one question from each module. Each question carries 14 Marks)

11. (a) With the help of suitable figures, distinguish between time and frequency domain representations. (4)

(b) Describe the different types of transmission impairments. (10)

OR

12. (a) Calculate the bandwidth, if a periodic signal is decomposed into 4 sine waves with frequencies 50 Hz, 100 Hz, 150 Hz and 200 Hz. Draw the spectrum, assuming all components having an amplitude in the range 6-12 V and all are multiples of two in the increasing order. (6)

(b) Distinguish between Nyquist bandwidth and Shannon capacity. Consider a noiseless channel with a bandwidth of 3000 Hz transmitting a signal with (i) Two signal levels (ii) Four signal levels. Determine the maximum bit rate in both cases. (8)

13. (a) For a parabolic reflective antenna operating at 12 GHz with a diameter of 2 m, calculate the effective area and the antenna gain. (6)

(b) List any four advantages and disadvantages of twisted pair, coaxial cable and fiber optic cable. (8)

OR

14. (a) Compare the features of terrestrial microwave and satellite microwave. (6)

(b) With the help of suitable diagrams, differentiate Multi-mode and Single-mode optical fibres. How are the rays propagated in Step-index and Graded-index Multi-mode fibres? (8)

15. (a) Distinguish between data rate and signal rate. (4)
- (b) How is polar encoding done? Encode the pattern 010011001110 using the two Biphase schemes. (10)

OR

16. (a) Show the equivalent analog sine wave pattern of the bit string 010011010 using Amplitude Shift Keying, Frequency Shift Keying and Phase Shift Keying. (4)
- (b) State Sampling theorem. Explain Pulse Code Modulation with suitable figures. (10)
17. (a) Four channels are multiplexed using Time Division Multiplexing. If each channel sends 100 bytes/sec and we multiplex one byte per channel, determine the frame size, duration of a frame, frame rate and bit rate of the link. (6)
- (b) Explain the working of Frequency Hopping Spread Spectrum with an example. (8)

OR

18. (a) Explain any three techniques by which the disparity in input data rate is handled by Time Division Multiplexing. Give examples. (4)
- (b) Suppose Alice and Bob are communicating using Code Division Multiple Access. Alice uses the code [+1 +1] and Bob uses the code [+1 -1]. Alice sends a data bit 0 and Bob sends a data bit 1. Show the data in the channel and how they can detect what the other person has sent. (10)
19. (a) Explain two-dimensional parity check with examples. (4)
- (b) Describe the need for a switch in a communication system. What are the different phases in circuit switching? (10)

OR

20. (a) Explain the virtual circuit approach of packet switching with a suitable example. (6)
- (b) Find the Hamming code for the data word 1011001. Assume odd parity. (8)

Teaching Plan

No	Contents	No.of Lecture Hrs (35 hrs)
Module-1 (Data Transmission Basics) (6 hrs)		
1.1	Introduction, Communication model, Simplex, Half duplex, Full duplex transmission, Periodic analog signals, Sine wave, Amplitude, Phase, Wavelength	1
1.2	Time and frequency domain, Bandwidth	1
1.3	Analog & digital data and signals	1
1.4	Transmission impairments, Attenuation, Delay distortion, Noise	1
1.5	Data rate limits, Noiseless channel, Nyquist bandwidth	1
1.6	Noisy channel, Shannon's capacity formula	1
Module-2 (Transmission Media) (6 hrs)		
2.1	Guided transmission media, Twisted pair, Coaxial cable	1
2.2	Optical fiber	1
2.3	Unguided media, Radio waves	1
2.4	Terrestrial microwave, Satellite microwave	1
2.5	Infrared	1
2.6	Wireless Propagation, Ground wave, Sky wave, Line-of-Sight (LoS) propagation	1
Module-3 (Digital Transmission and Analog Transmission) (8 hrs)		
3.1	Digital data to digital signal, Non-Return-to-Zero (NRZ), Return-to-Zero (RZ)	1
3.2	Multilevel binary and Biphase	1
3.3	Analog data to digital signal, Sampling theorem, Pulse Code Modulation (PCM)	1

3.4	Delta Modulation (DM)	1
3.5	Digital data to analog signal, Amplitude Shift Keying (ASK)	1
3.6	Frequency Shift Keying (FSK), Phase Shift Keying (PSK)	1
3.7	Analog data to analog signal, Amplitude Modulation (AM)	1
3.8	Frequency Modulation (FM), Phase Modulation (PM)	1
Module-4 (Multiplexing and Spread Spectrum) (7 hrs)		
4.1	Multiplexing, Frequency Division Multiplexing (FDM), Wavelength Division Multiplexing (WDM)	1
4.2	Time Division Multiplexing (TDM), Characteristics, Synchronous TDM, Statistical TDM	1
4.3	Spread spectrum techniques, Direct Sequence Spread Spectrum (DSSS)	1
4.4	Frequency Hopping Spread Spectrum (FHSS)	1
4.5	Code Division Multiplexing	1
4.6	Code Division Multiple Access (CDMA) (Lecture 1)	1
4.7	CDMA (Lecture 2)	1
Module-5 (Error Detection, Correction and Switching) (8 hrs)		
5.1	Digital data communication techniques, Asynchronous & Synchronous transmission	1
5.2	Detecting and correcting errors, Types of errors, Parity check, Checksum	1
5.3	Cyclic Redundancy Check (CRC)	1
5.4	Forward Error Correction (FEC), Hamming distance	1
5.5	Hamming code	1
5.6	Basic principles of switching, Circuit switching	1
5.7	Packet switching	1
5.8	Message switching	1

APJ ABDUL KALAM
TECHNOLOGICAL
UNIVERSITY

SEMESTER VI

MINOR



CST 382	INTRODUCTION TO SOFTWARE TESTING	Category	L	T	P	Credits	Year of Introduction
		VAC	3	1	0	4	2019

Preamble:

This is a course in theoretical computer science that includes test cases for white-box, black-box, and grey-box approaches. This course describes the various techniques for test case design used to test software artifacts, including requirements, design, and code. The course includes different techniques for test case design based on graphs, programming language syntaxes and inputs. The course also covers symbolic execution using PEX tool.

Course Outcomes: After the completion of the course the student will be able to:-

CO1	List a range of different software testing techniques and be able to apply specific unit testing method to the projects using Junit. (Cognitive Knowledge Level: Understand)
CO2	Explain mutation testing method for a given piece of code to identify hidden defects that can't be detected using other testing methods. (Cognitive Knowledge Level: Understand)
CO3	Explain graph coverage criteria in terms of control flow graph and data flow graph for a given program. (Cognitive Knowledge Level: Understand)
CO4	Demonstrate the importance of black-box approaches in terms of domain and functional testing. (Cognitive Knowledge Level: Understand)
CO5	Illustrate the use of PEX tool with symbolic execution. (Cognitive Knowledge Level: Apply)

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO 9	PO10	PO11	PO12
CO1												
CO2												

CO3												
CO4												
CO5												

Abstract POs defined by National Board of Accreditation			
PO#	Broad PO	PO#	Broad PO
PO1	Engineering Knowledge	PO7	Environment and Sustainability
PO2	Problem Analysis	PO8	Ethics
PO3	Design/Development of solutions	PO9	Individual and team work
PO4	Conduct investigations of complex problems	PO10	Communication
PO5	Modern tool usage	PO11	Project Management and Finance
PO6	The Engineer and Society	PO12	Life long learning

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	Test 1 (Marks)	Test 2 (Marks)	
Remember	30	30	30
Understand	40	40	40
Apply	30	30	30
Analyze			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : **10 marks**

Continuous Assessment - Test : **25 marks**

Continuous Assessment - Assignment : **15 marks**

Internal Examination Pattern:

Each of the two internal examinations has to be conducted out of 50 marks. First series test shall be preferably conducted after completing the first half of the syllabus and the second series test shall be preferably conducted after completing remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly completed module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly completed module), each with 7 marks. Out of the 7 questions, a student should answer any 5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which a student should answer any one. Each question can have maximum 2 sub-divisions and carries 14 marks.

Syllabus

Module - 1 (Introduction to Software Testing)

Some Popular Errors – Ariane 5, Therac 25, Intel Pentium Bug. What is Software testing? Why should it be tested? Software Quality, Role of Testing. Testing Process - Level 0 thinking, Level 1 thinking, Level 2 thinking, Level 3 thinking, Level 4 thinking. Software Testing Terminologies - Verification, Validation and Testing, Faults, Error and Bug, Test cases, Coverage Criteria. Types of Testing- Unit testing, integration testing, System testing, Acceptance testing, Beta testing, Functional testing, Stress testing, Performance testing, Usability testing and Regression testing. Testing Methods - Black Box testing, White Box testing, Grey Box testing.

Module - 2 (Unit Testing)

Concept of Unit testing. Static Unit testing. Dynamic Unit testing - Control Flow testing, Data Flow testing, Domain testing, Functional Program testing. Mutation testing - Mutation and Mutants, Mutation operators, Mutation score. Junit - Framework for Unit testing. Case Study - Mutation testing using Junit and Muclipse.

Module - 3 (Unit Testing - White Box Approaches)

Overview of Graph Coverage Criteria. Structural Graph Coverage Criteria - Node/vertex coverage, Edge coverage, Edge pair coverage, Path coverage, Complete path coverage, Prime path coverage, Complete round trip coverage, Simple round trip coverage. Data Flow Criteria - du paths, du pairs. Subsumption Relationships among Graph Coverage Criteria. Graph Coverage for Source Code - Control flow graphs for code, CFG: If statement, CFG: If statement with return, CFG: Switch-case, CFG: Loops, CFG: Exceptions (try-catch). Example program – Statistics. Graph Coverage for Design Elements - Call graphs and classes, Class inheritance testing: Coverage criteria, Coverage criteria on inheritance graph, Data flow at the design level, Inter-procedural DU pairs, Coupling du-pairs example. Example - Quadratic Root. Case Study - Graph Based testing using JUnit Framework.

Module - 4 (Unit Testing - Black Box Approaches)

Domain Testing / Input Space Partitioning - Partitions of a set. Input domain modelling - Interface-based approach, Functionality-based approach. Identifying values. Multiple partitions of the inputdomain - All Combinations Coverage (ACoC), Each Choice Coverage (ECC), Pair-wise Coverage, T-wise Coverage, Base Choice Coverage, Multiple Base Choices Coverage. TriTyp example. Functional Testing - Functional Testing Concepts of Howden. Functional testing - Important Steps. Types of Functional testing - Equivalence Class Partitioning, Boundary Value Analysis, Decision Tables, Random Testing. Case Study - Black Box testing approaches using JUnit.

Module - 5 (Grey Box Testing Approaches)

Introduction to Grey Box testing - Why Grey Box testing, Gray Box Methodology, Advantages and Disadvantages. Techniques of Grey Box Testing - Matrix Testing, Regression Testing, Orthogonal Array Testing or OAT, Pattern Testing. An Introduction to PEX - Parameterized Unit Testing, The Testing Problem. Symbolic Execution – Example, Symbolic execution tree. PEX application Case Study – PEX.

Text Books

1. Paul Ammann and Jeff Offutt, Introduction to Software Testing.
2. Kshirasagar Naik and Priyadarshi Tripathy, Software Testing And Quality Assurance: Theory And Practice.

Reference Materials

1. <https://www.csc.ncsu.edu/academics/undergrad/honors/thesis/muclipsebinder.pdf> - Muclipse tutorial.
2. King, James C, “Symbolic Execution and Program Testing”, Association for Computing Machinery, July 1976.
- 3.

Sample Course Level Assessment Questions

Course Outcome 1 (CO1): Explain the following types of testing methods with examples.

- (i) Black-box testing.
- (ii) White-box testing.
- (iii) Grey-box testing.

Course Outcome 2 (CO2): Define 12 mutants for the following method *power()* using effective mutation operators. Try to use each mutation operator at least once. Approximately, how many mutants do you think there would be, if all mutants for *power()* were created?

```
public static int power (int left, int right)
```

```
{
```

```
/**/
```

```
// Raises Left to the power of Right
```

```
// precondition : Right >= 0
```

```
// postcondition: Returns Left**Right
```

```
/**/
```

```
    intrslt;
```

```
    rslt = Left;
```

```

if (Right == 0)
{
    rslt = 1;
}
else
{
    for (int i = 2; i <= Right; i++)
        rslt = rslt * Left;
}
return (rslt);
}

```

Course Outcome 3 (CO3): Draw the control flow graph and data flow graph of given piece of code.

```

public static double ReturnAverage(int value[],int AS, int MIN, int MAX){
/*

```

Function: ReturnAverage Computes the average of all those numbers in the input array in the positive range [MIN, MAX]. The maximum size of the array is AS. But, the array size could be smaller than AS in which case the end of input is represented by -999.

```

*/
int i, ti, tv, sum;
double av;
i = 0; ti = 0; tv = 0; sum = 0;
while (ti < AS && value[i] != -999) {
    ti++;
    if (value[i] >= MIN && value[i] <= MAX) {
        tv++;
        sum = sum + value[i];
    }
    i++;
}
if (tv > 0)
    av = (double)sum/tv;

```

```

else
av = (double) -999;
return (av);
}

```

Course Outcome 4 (CO4): Explain the following with examples.

1. Input domain modelling.
2. All Combinations Coverage (ACoC)
3. Each Choice Coverage (ECC)
4. Pair-wise Coverage
5. T-wise Coverage
6. Base Choice Coverage
7. Multiple Base Choices Coverage.

Course Outcome 5 (CO5): Draw the symbolic execution tree for the following program code and explain the symbolic execution of testme (α_1 , α_2).

```

1. int twice (int v) {
2.   return 2 * v;
3. }
4. void testme (int x, int y ) {
5.   z = twice ( y);
6.   if ( z == x ){
7.     if ( x > y + 10)
8.       ERROR;
9.   }
10. }
11. int main() {
12.   x = sym input();
13.   y = sym input();
14.   testme ( x , y);
15.   return(0);
16. }

```

Model Question Paper

QP CODE:

PAGES: 4

Reg No: _____

Name : _____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SIXTH SEMESTER B.TECH DEGREE EXAMINATION(MINOR), MONTH & YEAR

Course Code: CST 382

Course Name: Introduction to Software Testing

Max.Marks:100

Duration: 3 Hours

PART A

Answer all Questions. Each question carries 3 Marks

1. Explain the differences between Validation and Verification.
2. Explain the differences between Fault, Error, and Bug?
3. Define Ground string, Mutation score, and Mutants.
4. What are the functions of Test driver and Test stubs in dynamic unit testing?
5. Define Node coverage, Edge coverage and Prime path coverage in a control flow graph.
6. What are du paths and du pairs in a data flow graph?
7. Explain the two approaches in input domain modelling.
8. Explain the difference between Equivalence Class Partitioning and Boundary Value Analysis.
9. Briefly explain three techniques of Grey box testing.
10. Explain the concept of symbolic execution with the help of a toy example.

(10x3=30)

Part B

(Answer any one question from each module. Each question carries 14 Marks)

11. (a) Explain the following types of testing
(i) Black Box testing (ii) White Box testing (iii) Grey Box testing

(14)

(iv) Unit testing (v) Integration testing (vi) System testing (vii) Acceptance testing

OR

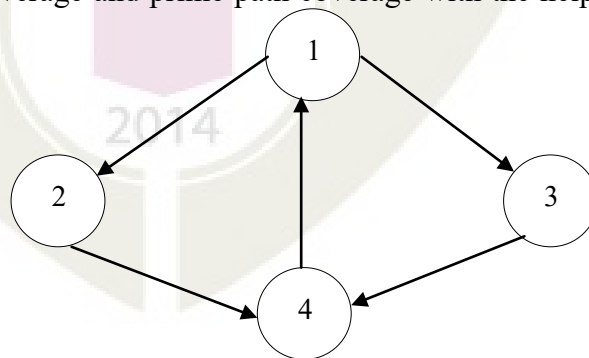
12. (a) Explain the following coverage criterias based on the code fragment given below. (i) Functional coverage (ii) Statement coverage (iii) Conditional coverage (iv) Branch coverage (8)

```
int foo (int x, int y){
    int z = 0;
    if ((x > 0) && (y > 0)){
        z = x;}
    return z;
}
```

- (b) Write positive and negative test cases for an ATM Machine? (6)
13. (a) Explain Dynamic unit test environment with a neat figure. (8)
- (b) Explain the major difference between control flow testing and data flow testing. (6)

OR

14. Explain seven types of mutation operators with neat examples. (14)
15. (a) Explain touring, side trips and detours with a neat example. (7)
- (b) Explain simple path coverage and prime path coverage with the help of CFG given below. (7)



OR

16. (a) Draw CFG fragment for

- (i) Simple *if* (ii) Simple *while* loop (iii) Simple *for* loop (7)
- (b) Explain the following concepts with examples. (7)
- (i) Call graph (ii) Inheritance graph (iii) Coupling du-pairs
17. (a) What are the four important steps in functional testing? (7)
- (b) Briefly explain input domain modelling approaches. (7)
- OR**
18. (a) Consider the triangle classification program with a specification: (6)
- The program reads floating values from the standard input. The three values A , B , and C are interpreted as representing the lengths of the sides of triangle. The program then prints a message to the standard output that states whether the triangle, if it can be formed, is scalene, isosceles, equilateral, or right angled. Determine the following for the above program:
- (i) For the boundary condition $A + B > C$ case (scalene triangle), identify test cases to verify the boundary.
 - (ii) For the boundary condition $A = C$ case (isosceles triangle), identify test cases to verify the boundary.
 - (iii) For the boundary condition $A = B = C$ case (equilateral triangle), identify test cases to verify the boundary.
- (b) Develop a decision table to generate test cases for this specification. (8)
19. (a) Explain the importance of grey box testing, its advantages and disadvantages. (9)
- (b) Explain the concept of symbolic execution tree. (5)
- OR**
20. (a) Consider the code fragment given below: - (7)

```

1. POWER: PROCEDURE(X, Y);
2. Z ← 1;
3. J ← 1;
4. LAB: IF Y ≥ J THEN

```

```

5. DO; Z ← Z * X;
6. J ← J + 1;
7. GO TO LAB; END;
8. RETURN (Z) ;
9. END;

```

a) Explain Symbolic execution of POWER (α_1 , α_2).

(b) Explain Execution tree for POWER (α_1 , α_2) in the above code fragment.

(7)

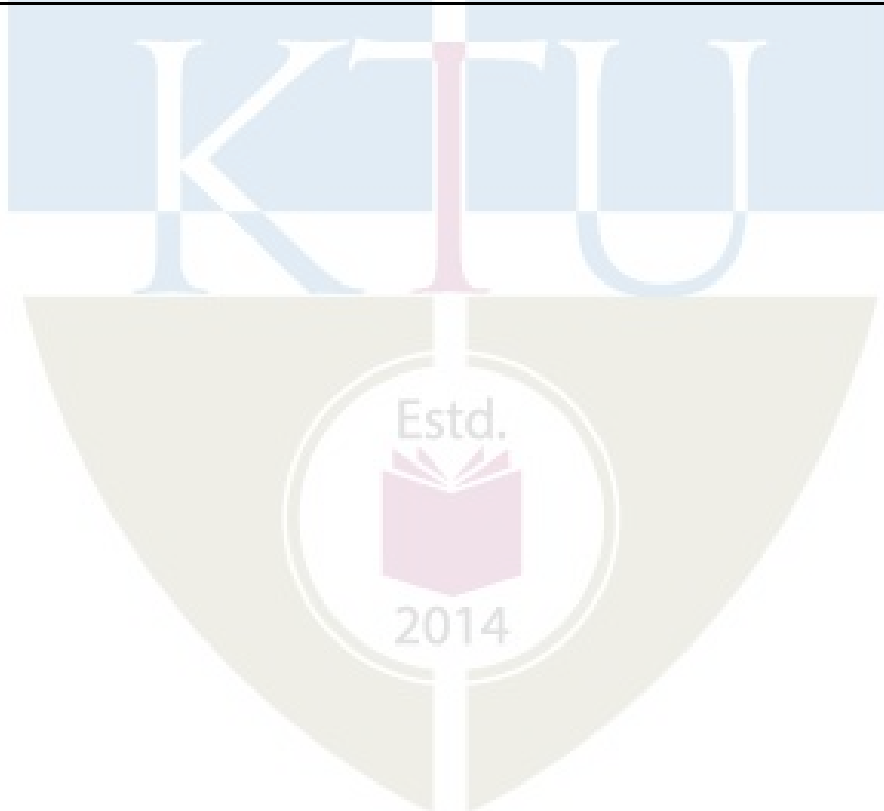
TEACHING PLAN

Index	Topics	No. of Hours (45)
Module 1 (Introduction to Software Testing) 9 Hours		
1.1	Some Popular Errors– Ariane 5, Therac 25, Intel Pentium Bug.	1 Hour
1.2	What is Software testing? Why should it be tested? Software Quality, Role of Testing.	1 Hour
1.3	Testing Process - Level 0 thinking, Level 1 thinking, Level 2 thinking, Level 3 thinking, Level 4 thinking.	1 Hour
1.4	Software Testing Terminologies- Verification, Validation and Testing, Faults, Error and Bug, Test cases, Coverage Criteria.	1 Hour
1.5	Types of Testing- Unit testing, integration testing, System testing, Acceptance testing, Beta testing	1 Hour
1.6	Functional testing, Stress testing	1 Hour
1.7	Performance testing, Usability testing and Regression testing.	1 Hour
1.8	Testing Methods - Black Box testing	1 Hour
1.9	Grey Box testing.	1 Hour
Module 2 (Unit testing) 8 Hours		

2.1	Concept of Unit testing.	1 Hour
2.2	Static Unit testing.	1 Hour
2.3	Dynamic Unit testing - Control Flow testing, Data Flow testing	1 Hour
2.4	Domain testing, Functional Program testing.	
2.5	Mutation testing - Mutation and Mutants, Mutation operators, Mutation score.	1 Hour
2.6	Junit - Framework for Unit testing.	1 Hour
2.7	Case Study - Mutation testing using Junit	1 Hour
2.8	Case Study - Mutation testing using Muclipse	1 Hour
Module 3 (Unit Testing:- White Box Approaches) 10 Hours		
3.1	Overview of Graph Coverage Criteria	1 Hour
3.2	Structural Graph Coverage Criteria - Node/vertex coverage, Edge coverage, Edge pair coverage, Path coverage	1 Hour
3.3	Complete path coverage, Prime path coverage, Complete round trip coverage, Simple round trip coverage.	1 Hour
3.4	Data Flow Criteria - du paths, du pairs	1 Hour
3.5	Subsumption Relationships among Graph Coverage Criteria.	1 Hour
3.6	Graph Coverage for Source Code - Control Flow Graphs (CFG) for code, CFG: If statement, CFG: If statement with return, CFG: Switch-case, CFG: Loops, CFG: Exceptions (try-catch). Example program - Statistics	1 Hour
3.7	Graph Coverage for Design Elements - Call graphs and classes, Class inheritance testing: Coverage criteria, Coverage criteria on inheritance graph,	1 Hour

3.8	Data flow at the design level, Inter-procedural DU pairs, Coupling du-pairs example. Example - Quadratic Root	1 Hour
3.9	Case Study - Graph Based testing using JUnit Framework. (Lecture 1)	1 Hour
3.10	Case Study - Graph Based testing using JUnit Framework. (Lecture 2)	1 Hour
Module 4 (Unit Testing:- Black Box Approaches) 9 Hours		
4.1	Domain Testing / Input Space Partitioning - Partitions of a set.	1 Hour
4.2	Input domain modelling - Interface-based approach, Functionality-based approach.	1 Hour
4.3	Identifying values.	1 Hour
4.4	Multiple partitions of the input domain - All Combinations Coverage (ACoC), Each Choice Coverage (ECC), Pair-wise Coverage, T-wise Coverage, Base Choice Coverage, Multiple Base Choices Coverage.	1 Hour
4.5	TriTyp example.	1 Hour
4.6	Functional Testing - Functional Testing Concepts of Howden. Important Steps.	1 Hour
4.7	Types of Functional testing - Equivalence Class Partitioning, Boundary Value Analysis	1 Hour
4.8	Decision Tables, Random Testing.	1 Hour
4.9	Case Study - Black Box testing approaches using JUnit.	1 Hour
Module 5 (Grey Box Testing Approaches) 9 Hours		
5.1	Introduction to Grey Box testing - Why Grey Box testing, Gray Box Methodology, Advantages and Disadvantages.	1 Hour
5.2	Techniques of Grey Box Testing - Matrix Testing, Regression Testing,	1 Hour

5.3	Orthogonal Array Testing or OAT, Pattern Testing.	1 Hour
5.4	An Introduction to Pex - Parameterized Unit Testing, The Testing Problem.	1 Hour
5.5	Symbolic Execution – Example, Symbolic execution tree.	1 Hour
5.6	PEX application.	1 hour
5.7	Case Study – PEX (Lecture 1)	1 Hour
5.8	Case Study – PEX (Lecture 2)	1 Hour
5.9	Case Study – PEX (Lecture 3)	1 Hour



CST 384	CONCEPTS IN DEEP LEARNING	Category	L	T	P	Credits	Year of Introduction
		VAC	3	1	0	4	2019

Preamble:

This course aims to introduce the learner to an overview of the concepts and algorithms involved in deep learning. Deep learning is a subfield of machine learning, a subfield of artificial intelligence. Basic concepts and application areas of machine learning, deep networks, convolutional neural network and recurrent neural network are covered here. This is a foundational program that will help students understand the capabilities, challenges, and consequences of deep learning and prepare them to participate in the development of leading-edge AI technology. They will be able to gain the knowledge needed to take a definitive step in the world of AI.

Prerequisite: Sound knowledge in Basics of linear algebra and probability theory.

CO1	Demonstrate basic concepts in machine learning.(Cognitive Knowledge Level: Understand)
CO2	Illustrate the validation process of machine learning models using hyper-parameters and validation sets. (Cognitive Knowledge Level: Understand)
CO3	Demonstrate the concept of the feed forward neural network and its training process. (Cognitive Knowledge Level: Apply)
CO4	Build CNN and Recurrent Neural Network (RNN) models for different use cases. (Cognitive Knowledge Level: Apply)
CO5	Use different neural network/deep learning models for practical applications. (Cognitive Knowledge Level: Apply)

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓								✓
CO2	✓	✓	✓	✓								✓
CO3	✓	✓	✓	✓	✓							✓
CO4	✓	✓	✓	✓	✓	✓						✓
CO5	✓	✓	✓	✓	✓	✓						✓

Abstract POs defined by National Board of Accreditation			
PO#	Broad PO	PO#	Broad PO
PO1	Engineering Knowledge	PO7	Environment and Sustainability
PO2	Problem Analysis	PO8	Ethics
PO3	Design/Development of solutions	PO9	Individual and team work
PO4	Conduct investigations of complex problems	PO10	Communication
PO5	Modern tool usage	PO11	Project Management and Finance
PO6	The Engineer and Society	PO12	Life long learning

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination Marks
	Test1 (Percentage)	Test2 (Percentage)	
Remember	30	30	30
Understand	40	40	40
Apply	30	30	30
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks

Continuous Assessment Tests : 25 marks

Continuous Assessment Assignment : 15 marks

Internal Examination Pattern:

Each of the two internal examinations has to be conducted out of 50 marks. First Internal Examination shall be preferably conducted after completing the first half of the syllabus and the Second Internal Examination shall be preferably conducted after completing remaining part of the syllabus.

There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly covered module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly covered module), each with 7 marks. Out of the 7 questions in Part B, a student should answer any 5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which a student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Syllabus

INTRODUCTION TO DEEP LEARNING

(General Instructions: Instructors are to introduce students to any one software platform and demonstrate the working of the algorithms in the syllabus using suitable use cases and public datasets to give a better understanding of the concepts discussed. Tutorial hour may be used for this purpose)

Module-1 (Introduction)

Key components - Data, models, objective functions, optimization algorithms, Learning algorithm. Supervised learning- regression, classification, tagging, web search, page ranking, recommender systems, sequence learning, Unsupervised learning, Reinforcement learning, Historical Trends in Deep Learning. Other Concepts - overfitting, underfitting, hyperparameters and validation sets, estimators, bias and variance.

Module- 2 (Optimization and Neural Networks)

Neural Networks –Perceptron, Gradient Descent solution for Perceptron, Multilayer perceptron, activation functions, architecture design, chain rule, back propagation, gradient based learning. Introduction to optimization– Gradient based optimization, linear least squares. Stochastic gradient descent, Building ML algorithms and challenges.

Module -3 (Convolutional Neural Network)

Convolutional Neural Networks – convolution operation, motivation, pooling, Structure of CNN, Convolution and Pooling as an infinitely strong prior, variants of convolution functions, structured outputs, data types, efficient convolution algorithms. Practical challenges of common deep learning architectures- early stopping, parameter sharing, dropout. Case study: AlexNet, VGG, ResNet.

Module- 4 (Recurrent Neural Network)

Recurrent neural networks – Computational graphs, RNN design, encoder – decoder sequence to sequence architectures, deep recurrent networks, recursive neural networks, modern RNNs LSTM and GRU, Practical use cases for RNNs.

Module-5 (Application Areas)

Applications – computer vision, speech recognition, natural language processing, common word embedding: continuous Bag-of-Words, Word2Vec, global vectors for word representation (GloVe). Research Areas – autoencoders, representation learning, boltzmann machines, deep belief networks.

Text Book

1. Ian Goodfellow, YoshuaBengio, Aaron Courville, Deep Learning, MIT Press 2015 ed.
2. Aston Zhang, Zachary C. Lipton, Mu Li, and Alexander J. Smola, Dive into Deep Learning, August 2019.
3. Neural Networks and Deep Learning, Aggarwal, Charu C., c Springer International Publishing AG, part of Springer Nature 2018

Reference Books

1. Neural Smithing: Supervised Learning in Feedforward Artificial Neural Networks by Russell Reed, Robert J MarksII, A Bradford Book,2014
2. Practical Convolutional Neural Networks by MohitSewak, Md. Rezaul Karim, PradeepPujari, Packt Publishing 2018
3. Hands-On Deep Learning Algorithms with Python by SudharsanRavichandran, Packt Publishing 2019
4. Deep Learning with Python by Francois Chollet, Manning Publications Co., 2018

Sample Course Level Assessment Questions

Course Outcome 1 (CO1):

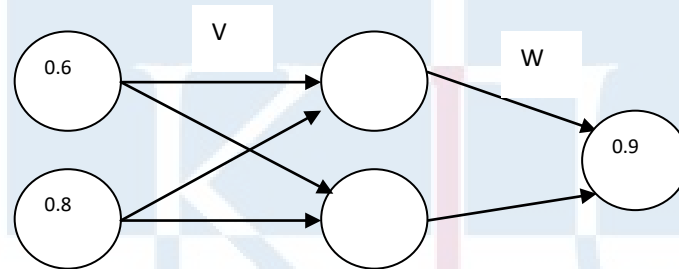
1. Compare regression and classification.
2. Define supervised learning? Distinguish between regression and classification.
3. Discuss the different learning approaches used in machine learning.

Course Outcome 2 (CO2):

1. What are hyperparameters? Why are they needed?
2. What issues are to be considered while selecting a model for applying machine learning in a given problem?

Course Outcome 3 (CO3):

1. Update the parameters V_{11} in the given MLP using back propagation with learning rate as 0.5 and activation function as sigmoid. Initial weights are given as $V_{11}=0.2$, $V_{12}=0.1$, $V_{21}=0.1$, $V_{22}=0.3$, $V_{11}=0.2$, $W_{11}=0.5$, $W_{21}=0.2$



2. Draw the architecture of a multi-layer perceptron.
3. Derive update rules for parameters in the multi-layer neural network through the gradient descent.

Course Outcome 4 (CO4):

1. Give two benefits of using convolutional layers instead of fully connected ones for visual tasks.
2. Suppose that a CNN was trained to classify images into different categories. It performed well on a validation set that was taken from the same source as the training set but not on a testing set. What could be the problem with the training of such a CNN? How will you ascertain the problem? How can those problems be solved?
3. Explain how the cell state is updated in the LSTM model from C_{t-1} to C_t
4. Show the steps involved in an LSTM to predict stock prices.

Course Outcome 5 (CO5):

1. Explain how the cell state is updated in the LSTM model from C_{t-1} to C_t
2. Show the steps involved in an LSTM to predict stock prices.
3. Illustrate the workings of the RNN with an example of a single sequence defined on a vocabulary of four words.

Course Outcome 6 (CO6):

1. Development a deep learning solution for problems in the domain i) natural language processing or ii Computer vision (Assignment)
2. Illustrate the workings of the RNN with an example of a single sequence defined on a vocabulary of four words.

Model Question Paper

QP CODE:

PAGES:4

Reg No: _____

Name: _____

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
SIXTH SEMESTER B.TECH DEGREE EXAMINATION(MINOR), MONTH & YEAR**

Course Code: CST 384

Course Name: CONCEPTS IN DEEP LEARNING

Max. Marks:100

Duration: 3 Hours

PART A

Answer all Questions. Each question carries 3 Marks

1. Distinguish between supervised learning and Reinforcement learning. Illustrate with an example.
2. Differentiate classification and regression.
3. Compare overfitting and underfitting. How it can affect model generalization.

4. Why does a single perceptron cannot simulate simple XOR function? Explain how this limitation is overcome?
5. Illustrate the strengths and weaknesses of convolutional neural networks.
6. Illustrate convolution and pooling operation with an example
7. How many parameters are there in AlexNet? Why the dataset size (1.2 million) is important for the success of AlexNet?
8. Explain your understanding of unfolding a recursive or recurrent computation into a computational graph.
9. Illustrate the use of deep learning concepts in Speech Recognition.
10. What is an autoencoder? Give one application of an autoencoder

(10x3=30
)

Part B

(Answer any one question from each module. Each question carries 14 Marks)

11. (a) “A computer program is said to learn from experience E with respect to some class of tasks T and performance measure P, if its performance at tasks in T, as measured by P, improves with experience E.” What is your understanding of the terms task, performance and experience. Explain with two example (10)
- (b) “How does bias and variance trade-off affect machine learning algorithms? (4)

OR

12. (a) Illustrate the concepts of Web search, Page Ranking, Recommender systems with suitable examples. (10)
- (b) List and discuss the different hyper parameters used in fine tuning the (4)

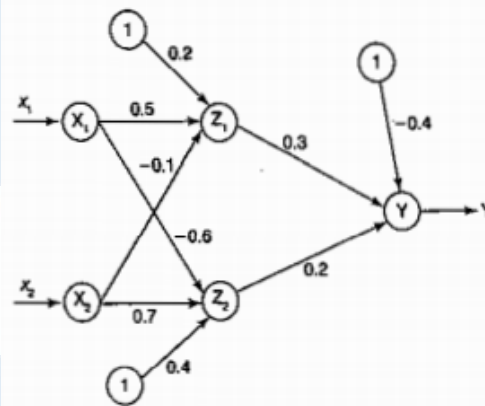
traditional machine learning models

13. (a) How multilayer neural networks learn and encode higher level features from input features. (7)

- (b) Explain gradient decent and delta rule? Why stochastic approximation to gradient descent is needed? (7)

OR

14. (a) Find the new weights for the network using backpropagation algorithm, the network is given with a input pattern $[-1,1]$ and target output as $+1$, Use learning rate of $\alpha=0.3$ and bipolar sigmoid function. (7)



- (b) Write an algorithm for backpropagation which uses stochastic gradient descent method. Comment on the effect of adding momentum to the network. (7)
15. (a) Input to CNN architecture is a color image of size $112 \times 112 \times 3$. The first convolution layer comprises of 64 kernels of size 5×5 applied with a stride of 2 and padding 0. What will be the number of parameters? (5)
- (b) Let $X = [-1, 0, 3, 5]$ $W = [0.3, 0.5, 0.2, 0.1]$ be the the input of i^{th} layer of a neural network and to apply softmax function. What should be the output of it? (4)
- (c) Draw and explain the architecture of convolutional network (5)

OR

16. (a) Explain the concept behind i) Early stopping ii) dropout iii) weight decay (9)

(b) How backpropagation is used to learn higher-order features in a convolutional Network? (5)

17. (a) Explain the working of RNN and discuss how backpropagation through time is used in recurrent networks. (8)

(b) Describe the working of a long short term memory in RNNs. (6)

OR

18. (a) What is the vanishing gradient problem and exploding gradient problem? (8)

(b) Why do RNNs have a tendency to suffer from exploding/vanishing gradient? How to overcome this challenge? (6)

19. (a) Explain any two word embedding techniques (8)

(b) Explain the merits and demerits of using Auto encoders in Computer Vision. (6)

OR

20. (a) Illustrate the use of representation learning in object classification. (7)

(b) Compare Boltzmann Machine with Deep Belief Network. (7)

Teaching Plan

CONCEPTS IN DEEP LEARNING (45 Hours)		
Module 1 : Introduction (9 hours)		
1.1	Key components - Data, models, objective functions, optimization algorithms. (TB2: Section 1.1-1.2)	1 hour

1.2	Learning algorithm (TB1: Section 5.1), Supervised learning- regression, classification (TB2: Section 1.3.1)	1 hour
1.3	tagging, web search, page ranking (TB2: Section 1.3.1)	1 hour
1.4	Recommender systems, Sequence learning, Unsupervised learning, Reinforcement learning(TB2: Section 1.3.2-1.3.4)	1 hour
1.5	Historical Trends in Deep Learning (TB1: Section 1.2).	1 hour
1.6	Concepts: over-fitting, under-fitting, hyperparameters and validation sets. (TB1: Section 5.2-5.3)	1 hour
1.7	Concepts: Estimators, bias and variance. (TB1: Section 5.4)	1 hour
1.8	Demonstrate the concepts of supervised learning algorithms using a suitable platform.	1 hour
1.9	Demonstrate the concepts of unsupervised using a suitable platform.	1 hour
Module 2 : Optimization and Neural Networks (9 hours)		
2.1	Perceptron, Stochastic Gradient descent, Gradient descent solution for perceptron (TB3: Section 1.1 - 1.2.1)	1 hour
2.2	Multilayer perceptron (TB3: Section 1.2.2), (TB1: Section 6.1,6.3)	1 hour
2.3	Activation functions- Sigmoid, tanh, Softmax, ReLU, leaky ReLU (TB3: Section 1.2.1.3 - 1.2.1.5)	1 hour
2.4	Architecture design (TB1: Section 6.4, TB3: Section 1.6)	1 hour
2.5	Chain rule, back propagation (TB3: Section 1.3)	1 hour

2.6	Gradient based learning (TB1: Section 6.2)	1 hour
2.7	Gradient based optimization (TB1: Section 4.3)	1 hour
2.8	Linear least squares using a suitable platform. (TB1: Section 4.5)	1 hour
2.9	Building ML Algorithms and Challenges (TB3: 1.4, TB1: 5.10-5.11)	1 hour
Module 3 :Convolution Neural Network (10 hours)		
3.1	Convolution operation, Motivation, pooling (TB1:Section 9.1-9.3)	1 hour
3.2	Structure of CNN (TB3: Section 8.2)	1 hour
3.3	Convolution and Pooling as an infinitely strong prior (TB1: Section 9.4)	1 hour
3.4	Variants of convolution functions – multilayer convolutional network, tensors, kernel flipping, downsampling, strides and zero padding. (TB1: Section 9.5)	1 hour
3.5	Variants of convolution functions - unshared convolutions, tiled convolution, training different networks. (TB1: Section 9.5)	1 hour
3.6	Structured outputs, data types (TB1: Section 9.6-9.7)	1 hour
3.7	Efficient convolution algorithms. (TB1: Section 9.8,9.10)	1 hour
3.8	Practical challenges of common deep learning architectures- early Stopping (TB3: 4.6)	1 hour
3.9	Practical challenges of common deep learning architectures- parameter sharing, drop-out (TB3: Section 4.9, 4.5.4)	1 hour
3.10	Case Study: AlexNet,VGG, ResNet. (TB3: Section 8.4.1-8.4.3,8.4.5)	1 hour

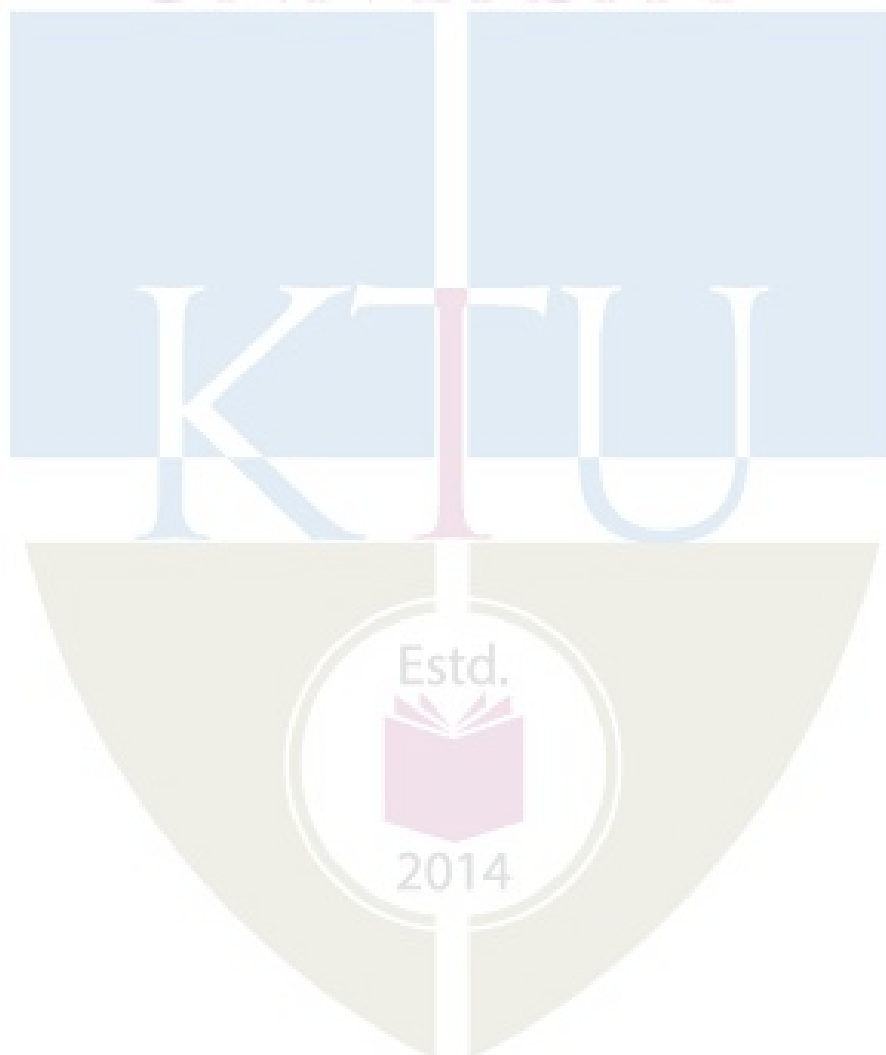
Module 4 :Recurrent Neural Network (8 hours)

4.1	Computational graphs (TB1: Section 10.1)	1 hour
4.2	RNN (TB1: Section 10.2-10.3)	1 hour
4.3	Encoder – decoder sequence to sequence architectures. (TB1: Section 10.4)	1 hour
4.4	Deep recurrent networks (TB1: Section 10.5)	1 hour
4.5	Recursive neural networks , Modern RNNs, (TB1: Section 10.6, 10.10)	1 hour
4.6	LSTM and GRU (TB1: Section 10.10, TB3: Section 7.5-7.6)	1 hour
4.7	Practical use cases for RNNs. (TB1: Section 11.1-11.4)	1 hour
4.8	Demonstrate the concepts of RNN using a suitable platform.	1 hour

Module 5 : Applications and Research (9 hours)

5.1	Computer vision. (TB1: Section 12.2)	1 hour
5.2	Speech recognition. (TB1: Section 12.3)	1 hour
5.3	Natural language processing. (TB1: Section 12.4)	1 hour
5.4	Common Word Embedding -: Continuous Bag-of-Words, Word2Vec (TB3: Section 2.6)	1 hour
5.5	Common Word Embedding -: Global Vectors for Word Representation(GloVe) (TB3: Section 2.9.1- Pennigton 2014)	1 hour
5.6	Brief introduction on current research areas- Autoencoders, Representation learning. (TB3: Section 4.10)	1 hour

5.7	Brief introduction on current research areas- representation learning. (TB3: Section 9.3)	1 hour
5.8	Brief introduction on current research areas- Boltzmann Machines, Deep belief networks. (TB1: Section 20.1, TB3 Section 6.3)	1 hour
5.9	Brief introduction on current research areas- Deep belief networks. (TB1: Section 20.3)	1 hour



CST 386	WIRELESS NETWORKS AND IoT APPLICATIONS	Category	L	T	P	Credit	Year of Introduction
		VAC	3	1	0	4	2019

Preamble:

This course equips the learners with fundamental wireless technologies for the Internet of Things(IoT) and the IoT ecosystem. It covers the underlying concepts in wireless networks, communication mechanisms, protocols, hardware, software, and the cloud platforms for IoT. The students will be able to design smart IoT applications for real world problems..

Prerequisite: Sound knowledge in Data Communication, Computer Networks and Programming in C

Course Outcomes: After the completion of the course the students will be able to

CO1	Recognize wireless technologies required for IoT ecosystem (Cognitive Knowledge Level : Understand)
CO2	Perceive the concept of IoT and M2M architecture, IoT examples, and Data Management in IoT (Cognitive Knowledge Level :Apply)
CO3	Outline the hardware components used in IoT including Sensors, Actuators and development boards (Cognitive Knowledge Level : understand)
CO4	Explain the software components of IoT (Cognitive Knowledge Level :Understand)
CO5	Demonstrate the protocols used in IoT and build IoT Programs (Cognitive Knowledge Level : Apply)
CO6	Build IoT-based smart real-time applications such as Smart Healthcare, Smart Agriculture, Smart Environment and Smart Home (Cognitive Knowledge Level : Apply)

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												

CO3												
CO4												
CO5												
CO6												

Abstract POs Defined by National Board of Accreditation			
PO#	Broad PO	PO#	Broad PO
PO1	Engineering Knowledge	PO7	Environment and Sustainability
PO2	Problem Analysis	PO8	Ethics
PO3	Design/Development of solutions	PO9	Individual and teamwork
PO4	Conduct investigations of complex problems	PO10	Communication
PO5	Modern tool usage	PO11	Project Management and Finance
PO6	The Engineer and Society	PO12	Lifelong learning

Assessment Pattern

Blooms Category	Continuous Assessment Tests		End Semester Examination Marks
	Test 1 (Percentage)	Test 2 (Percentage)	
Remember	30	30	30
Understand	50	40	40
Apply	20	30	30

Analyze			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 Hours

Continuous Internal Evaluation Pattern:

Attendance	10 marks
Continuous Assessment Tests	25 marks
Continuous Assessment Assignment	15 marks

Internal Examination Pattern:

Each of the two internal examinations has to be conducted out of 50 marks. First Internal Examination shall be preferably conducted after completing the first half of the syllabus, and the Second Internal Examination shall be preferably conducted after completing the remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly covered module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly covered module), each with 7 marks. Out of the 7 questions in Part B, a student should answer any 5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which a student should answer anyone. Each question can have a maximum 2 subdivisions and carries 14 marks.

Syllabus

Module- 1 (Introduction to IoT and wireless technologies required for IoT)

Internet of Things, Role of Things and the Internet, Wireless IoT. Wireless Networks - Network Topologies, Types of Networks. Role of Wireless Standards in IoT. Protocol Stack - OSI Model, TCP/IP Model, IEEE 802 Reference Model, Protocols for Wireless IoT. Bluetooth - Transceiver, Frequency Channels, Typical Range, Access and Spread Spectrum, Modulation and Data Rate, Error Correction and Detection, Network Topology. ITU G.9959, Zwave, IEEE 802.15.4, Zigbee Specification, Thread, WiFi, 6LowPAN, IPv6, LoRaWAN.

Module- 2 (IoT architecture, Data and Device management)

Internet of Things - IoT Architectural View, Technology Behind IoT - Server End Technology, Sources of Internet of Things, M2M Communication. IoT Application Areas. IoT Examples. IoT Data Management - Device Management Gateways. Design Principles for Web Connectivity - Web Communication Protocols for Connected Devices, Web Connectivity for Connected Devices using Gateways. Internet Connectivity Principles – Internet Connectivity, Internet based communication, IP addressing in the IoT.

Module- 3 (Data Acquiring and Enabling Technologies)

Data Acquiring and Storage for IoT Services- Organization of Data, Big data, Acquiring Methods, Management Techniques, Analytics, Storage Technologies. Cloud Computing for Data storage - IoT Cloud based Services using Xively, Nimbits, and Other Platforms. Sensor Technologies for IoT Devices - Sensor Technology, Participatory Sensing, Industrial IoT and Automotive IoT, Actuators for Various Devices, Sensor Data Communication Protocols, Wireless Sensor network Technology

Module-4 (Prototyping the Embedded Devices for IoT)

Embedded Computing Basics, Embedded Hardware Unit. Embedded Platforms for Prototyping - Arduino, Intel Galileo, Intel Edison, Raspberry Pi, BeagleBone, mBed. Prototyping and Designing the Software for IoT Applications- Introduction, Prototyping Embedded Device Software- Programming using Arduino, Programming for an Arduino Controlled Traffic Control Lights at a Road Junction, Basic Arduino Programs to Blink LED, Find the Distance using Ultrasonic Sensor, Estimate Room Temperature, Measuring Soil Moisture Level

Module 5 (Business Models and Case Studies)

Business Models and Processes using IoT. Value Creation in the Internet of Things. Cloud PaaS- Xively, Nimbits, IBM Bluemix, CISCO IoT, AWS IoT, TCS Connected AWS Platform, Case studies- Smart Home, Smart Environment, Smart healthcare, Smart agriculture

Text Books

1. Daniel Chew, “Wireless Internet of Things -A Guide to the lower layers”, IEEE Standards and Association, IEEE Press, Wiley
2. Rajkamal, “Internet of Things : Architecture and Design Principles”, McGraw Hill (India) Private Limited.

References

1. ArshadeepBahga, Vijay Madiseti, “Internet of Things: A hands-on approach”, University Press, 2015 (First edition)
2. Dieter Uckelmann, Mark Harrison, Michahelles Florian (Ed.), Architecting the internet of things, Springer, 2011
3. Dr. Ovidiu Vermesan, Dr. Peter Friess, Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems, River Publishers, 2013
4. Simon Monk, “Programming Arduino: Getting Started with Sketches”, McGraw Hill Publications

Sample Course Level Assessment Questions**Course Outcome 1 (CO1):**

1. Compare Bluetooth and Bluetooth LE power classes
2. Demonstrate Zigbee Specification Protocol Stack

Course Outcome 2 (CO2):

1. What are the major components of IOT system? Briefly explain each
2. Correlate M2M architectural Levels with IOT architectural Levels

Course Outcome 3 (CO3):

1. Describe the use of GPIO pins ?
2. What are actuators ? Mention the roles of actuators in IoT systems

Course Outcome 4(CO4):

1. Identify the role of HBase in Hadoop File System
2. Differentiate Edge computing and Distributed computing
3. Illustrate open protocols, tools and frameworks generally used in M2M

Course Outcome 5(CO5):

1. What do you mean by Arduino sketches?
2. Write an Arduino program to blink LED

Course Outcome 6(CO6):

1. How IoT technology helps TELEMEDICINE in India?
2. How soil moisture can be detected in Smart Agriculture?

Model Question Paper

QP CODE:

PAGES :2

Reg No: _____

Name: _____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SIXTH SEMESTER B.TECH DEGREE EXAMINATION(MINOR), MONTH & YEAR

Course Code: CST 386

Course Name: WIRELESS NETWORKS AND IoT APPLICATIONS

Max.Marks:100

Duration: 3 Hours

PART A

Answer All Questions. Each Question Carries 3 Marks

1. Illustrate Role of *things* and *internet* in IoT
2. What is Bluetooth? Explain the range and frequency channels of Bluetooth?
3. List any three the features of Constrained Application Protocol (COAP).
4. Compare Raspberry Pi and BeagleBoard boards.
5. Identify the role of HBase in Hadoop File System.
6. Differentiate Edge computing and Distributed computing.
7. Give an example of Raspberry Pi applications for Industrial IoT.
8. What are the on-board functional units in Intel Galileo?
9. Interpret the concept of value creation in IoT.

10. Explain the use of PaaS in IoT Smart applications with any three examples.

(10x3=30)

Part B

(Answer any one question from each module. Each question carries 14 Marks)

11. (a) Compare various Network topologies used in Wireless Networks. (8)
- (b) Describe the following wireless technologies on i) *Zigbee* ii) *WiFi*
iii) *Thread*. (6)

OR

12. (a) Explain protocol stacks used in wireless networks for IoT applications. (8)
- (b) Illustrate the Architectural design of LoRaWAN. (6)
13. (a) Define M2M. Explain M2M architecture. Correlate M2M architectural levels with IoT architectural levels. (8)
- (b) Compare SOAP and REST protocols. (6)

OR

14. (a) Summarize different Online Transactions and Processing techniques. (8)
- (b) Identify the functions of Device-Management Gateway . (6)
15. (a) Define actuators ? Describe the roles of actuators in IoT systems. (8)
- (b) Explain the usage contexts of analog sensors and digital sensors. (6)

OR

16. (a) How data collection, storage & computing services done using Nimbits? (10)
- (b) List any four features of Xively. (4)

17. (a) What do you mean by Arduino sketches? (4)
- (b) Write an Arduino program to blink LED (10)

OR

18. (a) Demonstrate an example of Raspberry Pi applications for Industrial IoT. (10)
- (b) Compare the features of Arduino-R3 and Arduino Yun boards. (4)
19. (a) Explain various tasks of a smart irrigation monitoring service. (8)
- (b) Demonstrate the tasks of Soil-Moisture monitoring service. (6)

OR

20. (a) a) Mr. Kiran Mathew has been a chronic diabetic patient for the past few years. He was under regular check up at the hospital every two weeks. All of a sudden the pandemic like COVID-19 arises in the country and the government issues a lockdown for a period of two months. Illustrate how Mr. Kiran can be monitored by the health care worker using intelligent healthcare techniques. (10)
- (b) Mention any four sensors used in smart healthcare (4)

TEACHING PLAN

No	Contents	No of Lecture Hrs(45)
Module – 1 (Introduction to IoT and wireless technologies required for IoT) (8 hrs) (TB-1, Chapter 1...)		
1.1	Internet Of Things, Role of things and internet ,Wireless IoT	1
1.2	Wireless Networks- Network Topologies-Types of Networks,Role of	1

	Wireless standards in IoT	
1.3	Protocol Stack-OSI Model- TCP/IP Model-IEEE 802 reference model	1
1.4	Protocols for Wireless IoT-Bluetooth-Transceiver, Frequency Channels-Typical Range, Access and Spread Spectrum, Modulation and Data Rate	1
1.5	Error Correction and Detection-Network Topology.	1
1.6	ITU G.9959, Zwave, IEEE 802.15.4, Zigbee Specification	1
1.7	Thread, Wifi, 6LowPAN, IPv6	1
1.8	LoRaWAN	1
Module- 2 (IOT architecture, Data and Device management) (9hrs)		
2.1	Internet of Things -IoT Architectural view	1
2.2	Technology Behind IOT-Server End Technology,Sources of Internet of Things	1
2.3	M2M Communication.	1
2.4	IoT Application Areas. IOT Examples.	1
2.5	IoT Data Management, Device Management Gateways.	1
2.6	Design Principles for Web Connectivity	1
2.7	Web communication protocols for connected devices,	1
2.8	Web connectivity for connected devices using Gateways.	1
2.9	Internet connectivity Principles – Internet Connectivity, Internet based communication, IP addressing in the IoT.	1
Module- 3 (Data Acquiring and Enabling Technologies (8 hrs)		
3.1	Data acquiring and storage for IoT devices- Organization of Data, Big data	1
3.2	Acquiring methods, management techniques, Analytics, Storage technologies.	1
3.3	Cloud computing for Data storage-IoT Cloud based services using Xively,	1

	Nimbits, and other platforms.	
3.4	Cloud computing-Nimbits	1
3.5	Sensor Technologies for IoT Devices-Sensor Technology, Participatory sensing	1
3.6	Industrial IoT and Automotive IoT	1
3.7	Actuators for various devices, Sensor data communication protocols	1
3.8	Wireless Sensor network Technology	1
Module 4(Prototyping the Embedded Devices for IoT)(9hrs)		
4.1	Introduction, Embedded Computing Basics, Embedded Hardware Unit.	1
4.2	Embedded Platforms for Prototyping-Arduino, Intel Galileo	1
4.3	Intel Edison, Raspberry Pi, BeagleBone, mBed	1
4.4	Prototyping and designing the software for IoT applications-Introduction, Prototyping embedded device software	1
4.5	Prototyping and designing the software for IoT applications-Introduction, Prototyping embedded device software	1
4.6	Programming concepts in Arduino	1
4.7	Programming for an arduino controlled traffic control lights at a road junction	1
4.8	Basic Arduino programs to blink LED, Find the distance using ultrasonic sensor	1
4.9	Estimate room temperature, Measuring soil moisture level	1
Module 5 (higher level protocols and case studies)(9 hrs)		
5.1	Business Models and Processes using IOT, Value creation in the Internet of Things.	1

5.2	Xively, Nimbits, IBM Bluemix	1
5.3	CISCO IoT, AWS IoT, TCS Connected AWS Platform	1
5.4	Case Study- Smart Environment	1
5.5	Case Study- Smart Environment	1
5.6	Case study Smart Home	1
5.7	Case study Smart Home	1
5.8	Case study Smart healthcare (Lecture I)	1
5.9	Case study Smart healthcare (Lecture II)	1
5.10	Case study -Smart agriculture (Lecture I)	1
5.11	Case study -Smart agriculture (Lecture II)	1



APJ ABDUL KALAM
TECHNOLOGICAL
UNIVERSITY

SEMESTER VI

HONOURS



Preamble: The course on Wireless and Email Security aims at understanding basics of Wireless security and different techniques to secure wireless networks. The course helps the learners to understand the various Email security protocols and different techniques to secure the Email communication. The course ensures that the learners get a better understanding of Domain Name System authentication Framework.

Prerequisite: A Sound knowledge in Computer Networks and Network Security

CO#	Course Outcomes
CO1	Summarize the basics of wireless networking.(Cognitive Knowledge Level: Understand)
CO2	Explain the different ways by which wireless networks can be secured. (Cognitive Knowledge Level: Understand)
CO3	Describe the cryptographic methods used for authentication in wireless networks (Cognitive Knowledge Level: Understand)
CO4	Extract the headers of different Email security protocols (Cognitive Knowledge Level: Understand)
CO5	Identify the methods used to secure DNS based communication in Wireless environment (Cognitive Knowledge Level: Understand)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓									✓
CO2	✓	✓	✓									✓
CO3	✓	✓	✓									✓
CO4	✓	✓	✓		✓							✓

CO5											

Abstract POs defined by National Board of Accreditation			
PO#	Broad PO	PO#	Broad PO
PO1	Engineering Knowledge	PO7	Environment and Sustainability
PO2	Problem Analysis	PO8	Ethics
PO3	Design/Development of solutions	PO9	Individual and team work
PO4	Conduct investigations of complex problems	PO10	Communication
PO5	Modern tool usage	PO11	Project Management and Finance
PO6	The Engineer and Society	PO12	Lifelong learning

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination Marks (%)
	Test 1 (%)	Test 2 (%)	
Remember	40	40	40
Understand	40	40	40
Apply	20	20	20
Analyze			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3

Continuous Internal Evaluation Pattern:

Attendance	10 marks
Continuous Assessment Tests (Average of Series Tests 1 & 2)	25 marks
Continuous Assessment Assignment	15 marks

Internal Examination Pattern:

Each of the two internal examinations has to be conducted out of 50 marks. First series test shall be preferably conducted after completing the first half of the syllabus and the second series test shall be preferably conducted after completing remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly completed module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly completed module), each with 7 marks. Out of the 7 questions, a student should answer any 5.

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which a student should answer any one. Each question can have maximum 2 sub-divisions and carries 14 marks.

Syllabus**Module-1 (Wireless Networking Basics)**

802.11 a/b/g/n, Access Points: DD-WRT, WRT54G, Mini access points, Mobile Hotspots, Enterprise Grade Access Points. SSID, BSSID, MAC Address, Beacons and Broadcasts, Associating and Authenticating, Encryption, Antennas

Module-2 (Securing Wireless Networks)

Phases of Wireless Deployment: New Deployments, Existing Wireless Networks, Wireless Refresh. Secure Design Principles for Wireless Networks: Defense in Depth, Least Privilege, Network Segmentation, Wireless Assessments, Secure the Infrastructure, Rogue AP Detection, Physical Security, Change the default configuration, CIA. Good Wireless Defenses

Module-3 (Wireless Authentication)

Introduction to WPA2 Enterprise with Digital Certificates, Public Key Infrastructure and Digital Certificates: Public Key Cryptography, Digital Certificates, Microsoft Certificate Services. Remote Authentication Dial-in User Service, WPA Enterprise Architecture.

Module-4 (Email Security)

Internet Mail Architecture: Email Components, Email Protocols. Email Formats: RFC 5322, Multipurpose Internet Mail Extensions. Email Threats and Comprehensive Email Security,

S/MIME: Operational Description, S/MIME Message Content Types, Approved Cryptographic Algorithms, S/MIME Messages, S/MIME Certificate Processing, Enhanced Security Services. Pretty Good Privacy, Analysis of Email headers

Module–5 (DNS Security)

DNSSEC, DNS Based Authentication of Named Entities: TLSA Record, Use of DANE for SMTP, Use of DNSSEC for S/MIME. Sender Policy Framework, Domainkeys Identified Mail, Domain Based Message Authentication, Reporting and Conformance.

Text Books

1. Tylor Wrightson, “Wireless Network Security A Beginner's Guide”, McGraw-Hill Education, First Edition, 2016
2. William Stallings “Cryptography and Network Security: Principles and Practice”, Pearson, 7th Global Edition, 2017

References

1. Jonathan LeBlanc & Tim Messerschmidt ,”Identity and Data Security for Web Development”, O’Reilly, First Edition, 2016
2. Bryan Sullivan, Vincent Liu “Web Application Security, A Beginners Guide” , McGraw-Hill, First Edition, 2012

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Explain the characteristics and functionalities of Access points, hotspots and Antennas.

Course Outcome 2 (CO2):

1. Explain the different ways by which Wireless networks be secured.

Course Outcome 3 (CO3):

1. Write down the different authentication mechanisms provided by Wireless Networks

Course Outcome 4 (CO4):

1. Apply suitable techniques/tools to examine a Email header and write down the artifacts extracted.

Course Outcome 5 (CO5):

1. Explain the methods used for Domain Name System (DNS) security.

QP CODE:

PAGES: ____

Reg No: _____

Name: _____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
FIFTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR
Course Code: CST 394
Course Name : WIRELESS AND EMAIL SECURITY

Max Marks: 100

Duration: 3 Hours

PART A

(Answer All Questions. Each question carries 3 marks)

1. What are the different types of antenna?
2. What do you mean by DD-WRT?
3. Explain briefly the concept of Least Privilege.
4. Differentiate routers and switches.
5. Explain the components of Public Key Infrastructure (PKI).
6. What are the benefits of using digital certificates?
7. How is email security threats classified?
8. What are the different S/MIME message content types?
9. What is a DNS Database?
10. What is Domain Keys Identified Mail (DKIM)?

(10x3=30 Marks)

Part B

(Answer any one question from each module. Each question carries 14 Marks)

11. (a) Define the following terminologies
(i) SSID, BSSID, MAC Address
(ii) Beacons and Broadcasts
(iii) Associating and Authenticating
(iv) Encryption

(8 Marks)

(b) What does 802.11a/b/g/n mean?

(6 Marks)

OR

12. (a) Describe (i) Autonomous vs. Controller Based (ii) Access Points

(6 Marks)

(b) Explain the different security principles.

(8 Marks)

13. (a) Explain the different ways of Wireless deployment.

(6 Marks)

(b) Describe (i) Pre-shared Key (PSK) (ii) Protected extensible Authentication Protocol (PeAP) (iii) extensible Authentication Protocol–Transport Layer Security (eAP-TLS).

(8 Marks)

OR

14. (a) What are the different wireless defenses? Explain any three.

(7 Marks)

(b) Explain (i) Faraday cage (ii) SSID cloaking (iii) WEP Cloaking

(7 Marks)

15. (a) Explain the different possible attacks on public key crypto-secured system

(7 Marks)

(b) Explain the significance of Digital Certificates.

(7 Marks)

OR

16. (a) What is public key cryptography? Explain.

(6 Marks)

(b) Explain Certificate Authority Server Structure?

(8 Marks)

17. (a) How confidentiality is achieved in S/MIME?

(4 Marks)

(b) With a neat diagram explain the Interrelationship of DNSSEC, SPF, DKIM, DMARC, DANE, and S/MIME for Assuring Message Authenticity and Integrity.

(10 Marks)

OR

18. (a) Describe the key components of the Internet mail architecture.

(7 Marks)

(b) Apply using any inbuilt tool of OS and Analyze the Email headers to find the artefacts present in it.

(7 Marks)

19. (a) Explain the four certification usage models of TLSA RR.

(6 Marks)

(b) Explain the Sender Policy Framework Operation.

(8 Marks)

OR

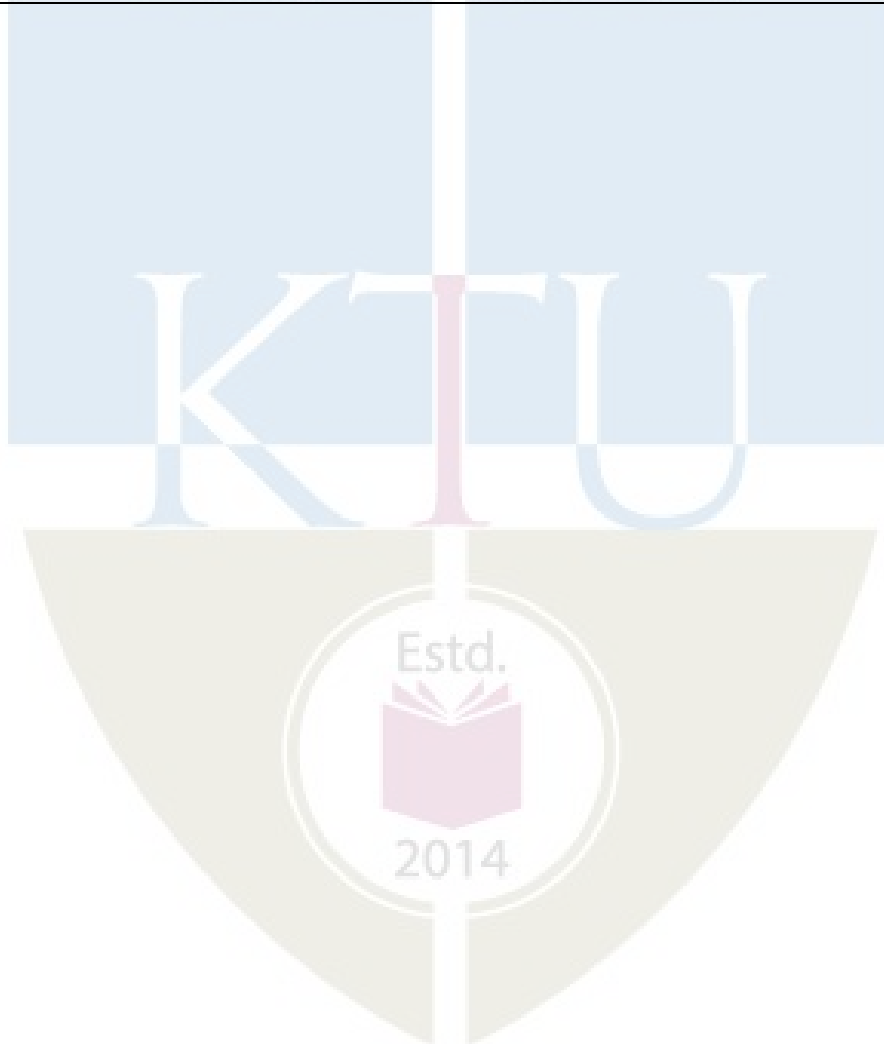
20. (a) Explain the functional flow of DMARC. **(8 Marks)**
- (b) What are the different elements of DNS? **(6 Marks)**

TEACHING PLAN

No	Contents	No.of Lecture Hrs
Module - 1 (Wireless Networking Basics) (7 hrs)		
1.1	802.11 a/b/g/n, Access Points	1
1.2	DD-WRT, WRT54G, Mini access points	1
1.3	Mobile Hotspots	1
1.4	Enterprise Grade Access Points.	1
1.5	SSID, BSSID, MAC Address	
1.6	Beacons and Broadcasts, Associating and Authenticating	1
1.7	Encryption, Antennas	1
Module - 2 (Securing Wireless Networks) (8 hrs)		
2.1	Phases of Wireless Deployment: New Deployments	1
2.2	Existing Wireless Networks, Wireless Refresh	1
2.3	Secure Design Principles for Wireless Networks: Defense in Depth, Least Privilege	1
2.4	Network Segmentation, Wireless Assessments	1
2.5	Secure the Infrastructure	1
2.6	Rogue AP Detection	1
2.7	Physical Security	1
2.8	Change the default configuration, CIA. Good Wireless Defenses	1

Module - 3 (Wireless Authentication) (9 hrs)		
3.1	Introduction to WPA2 Enterprise with Digital Certificates	1
3.2	Public Key Infrastructure and Digital Certificates-Lecture 1	1
3.3	Public Key Infrastructure and Digital Certificates-Lecture 2	1
3.4	Public Key Cryptography	1
3.5	Digital Certificates	1
3.6	Microsoft Certificate Services	1
3.7	Remote Authentication	1
3.8	Dial-in User Service	1
3.9	WPA Enterprise Architecture	1
Module – 4 (Email Security) (12 hrs)		
4.1	Internet Mail Architecture: Email Components	1
4.2	Email Protocols	1
4.3	Email Formats: RFC 5322	1
4.4	Multipurpose Internet Mail Extensions	
4.5	Email Threats and Comprehensive Email Security	1
4.6	S/MIME: Operational Description	1
4.7	S/MIME Message Content Types	1
4.8	Approved Cryptographic Algorithms	1
4.9	S/MIME Messages	1
4.10	S/MIME Certificate Processing	1
4.11	Enhanced Security Services, Pretty Good Privacy	1
4.12	Analysis of Email headers	1
Module – 5 (DNS Security) (9 hrs)		
5.1	DNSSEC	1

5.2	DNS Based Authentication of Named Entities	1
5.3	TLSA Record	1
5.4	Use of DANE for SMTP	1
5.5	Use of DNSSEC for S/MIME	1
5.6	Sender Policy Framework	1
5.7	Domain keys Identified Mail	1
5.8	Domain Based Message Authentication	1
5.9	Reporting and Conformance	1



CST 396	ADVANCED TOPICS IN MACHINE LEARNING	Category	L	T	P	Credit	Year of Introduction
		VAC	3	1	0	4	2019

Preamble:

This course enables the learners to understand the advanced concepts and algorithms in machine learning. The course covers the standard and most popular supervised learning algorithms such as linear regression, logistic regression, decision trees, Bayesian learning and the naive Bayes algorithm, basic clustering algorithms, auto encoders, sampling methods and PAC learning. This course helps the students to provide machine learning based solutions to real world problems.

Prerequisite: Basic understanding of probability theory, linear algebra, multivariate calculus and multivariate probability theory.

CO1	Illustrate the concepts of regression and classification techniques (Cognitive Knowledge Level: Apply)
CO2	Demonstrate various unsupervised learning techniques (Cognitive Knowledge Level: Apply)
CO3	Choose suitable model parameters for different machine learning techniques and to evaluate a model performance (Cognitive Knowledge Level: Apply)
CO4	Explain the framework of PAC learning, basic concepts of VC dimension and non-uniform learnability (Cognitive Knowledge Level: Understand)
CO5	Construct Bayesian models for data and apply computational techniques to draw inferences (Cognitive Knowledge Level: Apply)
CO6	Illustrate the concepts of sampling algorithms, auto encoder, generative adversarial networks (Cognitive Knowledge Level: Apply)

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓	✓	✓						✓
CO2	✓	✓	✓	✓	✓	✓						✓
CO3	✓	✓	✓	✓	✓	✓						✓
CO4	✓	✓	✓	✓								✓
CO5	✓	✓	✓	✓	✓							✓
CO6	✓	✓	✓	✓	✓	✓						✓

Abstract POs defined by National Board of Accreditation			
PO#	Broad PO	PO#	Broad PO
PO1	Engineering Knowledge	PO7	Environment and Sustainability
PO2	Problem Analysis	PO8	Ethics
PO3	Design/Development of solutions	PO9	Individual and team work
PO4	Conduct investigations of complex problems	PO10	Communication
PO5	Modern tool usage	PO11	Project Management and Finance
PO6	The Engineer and Society	PO12	Life long learning

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination Marks
	Test1 (Percentage)	Test2 (Percentage)	
Remember	30	30	30
Understand	30	30	30
Apply	40	40	40
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks

Continuous Assessment Tests : 25 marks

Continuous Assessment Assignment : 15 marks

Internal Examination Pattern:

Each of the two internal examinations has to be conducted out of 50 marks

First Internal Examination shall be preferably conducted after completing the first half of the syllabus and the Second Internal Examination shall be preferably conducted after completing remaining part of the syllabus.

There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly covered module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly covered module), each with 7 marks. Out of the 7 questions in Part B, a student should answer any 5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which a student should answer any one. Each question can have a maximum 2 sub-divisions and carry 14 marks.

Syllabus**Module -1 (Supervised Learning)**

Overview of machine learning - supervised, semi-supervised, unsupervised learning, reinforcement learning Regression algorithms: least squares linear regression, gradient descent, closed form, normal equations, regularization techniques (LASSO, RIDGE), polynomial regression. Discriminative Methods - Logistic Regression, Decision Tree Learning. Generative Methods - Naive Bayes Classifier, Gaussian Discriminant Analysis (GDA).

Module -2 (Unsupervised Learning)

Clustering - Similarity measures, Hierarchical Agglomerative Clustering, K-means partitional clustering, K-medoids clustering, Gaussian mixture models: Expectation Maximization (EM) algorithm for Gaussian mixture model.

Module -3 (Practical aspects in machine learning)

Classification Performance measures - Precision, Recall, Accuracy, F-Measure, ROC, AUC, generalisation and overfitting, cross-validation, bias-variance tradeoff, error estimation, parameter and model selection. Ensemble Methods - Bagging, Boosting, Adaboost, Random Forests.

Module -4 (Statistical Learning Theory)

Models of learnability- learning in the limit, probably approximately correct (PAC) learning. Sample complexity- quantifying the number of examples needed to PAC learn, Computational complexity of training, Sample complexity for finite hypothesis spaces, PAC results for learning conjunctions, Sample complexity for infinite hypothesis spaces, Vapnik-Chervonenkis(VC) dimension.

Module -5 (Advanced Machine Learning Topics)

Graphical models - Bayesian belief networks, Markov random fields(MRFs), Inference on chains and factor graphs, inference on clique trees. Monte Carlo methods – Basic sampling algorithms, rejection sampling, importance sampling, Markov chain Monte Carlo(MCMC), Gibbs sampling. Variational methods. Auto Encoder, Variational AutoEncoder, Generative Adversarial Networks

Textbook

1. Christopher M. Bishop. Pattern recognition and machine learning. Springer 2006.
2. Ethem Alpaydin, Introduction to Machine Learning, 2nd edition, MIT Press 2010.
3. Mohammed J. Zaki and Wagner Meira, Data Mining and Analysis: Fundamental Concepts and Algorithms, Cambridge University Press, First South Asia edition, 2016.
4. Ian Goodfellow, Yoshua Bengio and Aaron Courville. Deep Learning. MIT Press 2016.
5. Mehryar Mohri, Afshin Rostamizadeh and Ameet Talwalkar. Foundations of Machine Learning. Second edition. MIT Press 2018.
6. Tom Mitchell. Machine Learning. McGraw Hill 1997.
7. Richard O. Duda, Peter E . Hart, David G. Stork. Pattern classification, Second Edition. Wiley.
8. Jiawei Han, Micheline Kamber, Jian Pei. Data Mining Concepts and Techniques, Third Edition. Morgan Kaufmann.
9. David Foster. Generative Deep Learning - Teaching Machines to Paint, Write, Compose, and Play. O'Reilly Media, Inc., June 2019.

Reference Books

1. Kevin P. Murphy. Machine Learning: A Probabilistic Perspective. MIT Press 2012
2. Carl Edward Rasmussen and Christopher K. I. Williams. Gaussian Processes for Machine Learning. MIT Press 2005.

Sample Course Level Assessment Questions

Course Outcome1 (CO1):

1. Consider a naive Bayes classifier with 3 boolean input variables, X_1 , X_2 and X_3 , and one boolean output, Y . How many parameters must be estimated to train such a naive Bayes classifier? How many parameters would have to be estimated to learn the above classifier if we do not make the naive Bayes conditional independence assumption?
2. Describe the ID3 algorithm. Is the order of attributes identical in all branches of the decision tree?
3. Explain the difference between (batch) gradient descent and stochastic gradient descent. Give an example of when you might prefer one over the other.
4. Suppose that you are asked to perform linear regression to learn the function that outputs y , given the D -dimensional input x . You are given N independent data points, and that all the D attributes are linearly independent. Assuming that D is around 100, would you prefer the closed form solution or gradient descent to estimate the regressor?
5. Suppose you have a three class problem where class label $y \in 0, 1, 2$ and each training example X has 3 binary attributes $X_1, X_2, X_3 \in 0, 1$. How many parameters (probability distribution) do you need to know to classify an example using the Naive Bayes classifier?

Course Outcome 2(CO2):

1. Which similarity measure could be used to compare feature vectors of two images? Justify your answer.
2. Illustrate the strength and weakness of k-means algorithm.
3. Suppose you want to cluster the eight points shown below using k-means

	A_1	A_2
x_1	2	10
x_2	2	5
x_3	8	4
x_4	5	8
x_5	7	5
x_6	6	4
x_7	1	2
x_8	4	9

Assume that $k = 3$ and that initially the points are assigned to clusters as follows:

$C_1 = \{x_1, x_2, x_3\}$, $C_2 = \{x_4, x_5, x_6\}$, $C_3 = \{x_7, x_8\}$. Apply the k -means algorithm until convergence, using the Manhattan distance.

4. Cluster the following eight points representing locations into three clusters: $A_1(2, 10)$, $A_2(2, 5)$, $A_3(8, 4)$, $A_4(5, 8)$, $A_5(7, 5)$, $A_6(6, 4)$, $A_7(1, 2)$, $A_8(4, 9)$.

Initial cluster centers are: $A_1(2, 10)$, $A_4(5, 8)$ and $A_7(1, 2)$.

The distance function between two points $a = (x_1, y_1)$ and $b = (x_2, y_2)$ is defined as $D(a, b) = |x_2 - x_1| + |y_2 - y_1|$

Use k -Means Algorithm to find the three cluster centers after the second iteration.

Course Outcome 3(CO3):

1. What is ensemble learning? Can ensemble learning using linear classifiers learn classification of linearly non-separable sets?
2. Describe boosting. What is the relation between boosting and ensemble learning?
3. Classifier A attains 100% accuracy on the training set and 70% accuracy on the test set. Classifier B attains 70% accuracy on the training set and 75% accuracy on the test set. Which one is a better classifier. Justify your answer.
4. What are ROC space and ROC curve in machine learning? In ROC space, which points correspond to perfect prediction, always positive prediction and always negative prediction? Why?
5. Suppose there are three classifiers A, B and C. The (FPR, TPR) measures of the three classifiers are as follows – A (0, 1), B (1, 1), C (1, 0.5). Which can be considered as a perfect classifier? Justify your answer.

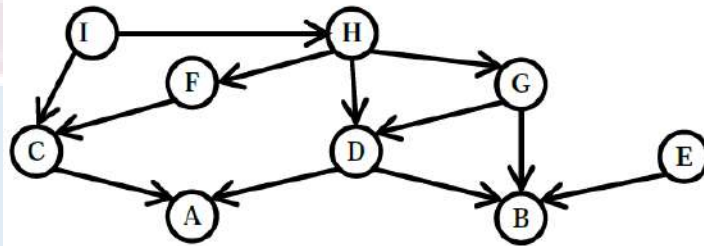
Course Outcome 4(CO4): .

1. A monotone conjunction is a conjunction of the variables such that no variable is negated. Show that the concept class of monotone conjunction is probably approximately correct (PAC)-learnable.
2. Consider a Boolean classification problem with n binary variables and a hypothesis space H , where each hypothesis is a decision tree of depth 2, using only two variables. How many training examples, m suffice to assure that with probability at least 0.99, any consistent learner using H will output a hypothesis with true error at most 0.05
3. Show that the concept class C containing the set of all boolean functions on n variable is not PAC-learnable.

4. What is the Vapnik-Chervonenkis(VC)-dimension of a circle centered at the origin.
5. A hypothesis space that has a high VC dimension is good, bad, or neither? Explain in terms of both (a) richness or expressive power of the hypotheses, and (b) sample complexity.

Course Outcome 5(CO5):

1. Write down the factored conditional probability expression that corresponds to the graphical Bayesian Network shown below.



2. How do we learn the conditional probability tables(CPT) in Bayesian networks if information about some variables is missing? How are these variables called?

Course Outcome 6 (CO6):

1. Derive an algorithm using the inverse transform method to generate a random sample from the exponential distribution.
2. Explain the pros and cons of importance sampling versus rejection sampling.
3. Sketch the core idea of the Monte Carlo method. What is a sample? What is a direct sampling method? Why can't it be used directly to do any inference? What is rejection sampling? What is its major disadvantage?
4. Generative Adversarial Networks(GANs) include a generator and a discriminator. Sketch a basic GAN using those elements, a source of real images, and a source of randomness.
5. The word “adversarial” in the acronym for GANs suggests a two-player game. What are the two players, and what are their respective goals?

Model Question Paper

QP CODE:

Reg No: _____

Name: _____

PAGES : 5

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SIXTH SEMESTER B.TECH DEGREE EXAMINATION (HONORS), MONTH & YEAR

Course Code: CST 396

Course Name: Advanced Topics in Machine Learning

Max.Marks:100

Duration: 3 Hours

PART A

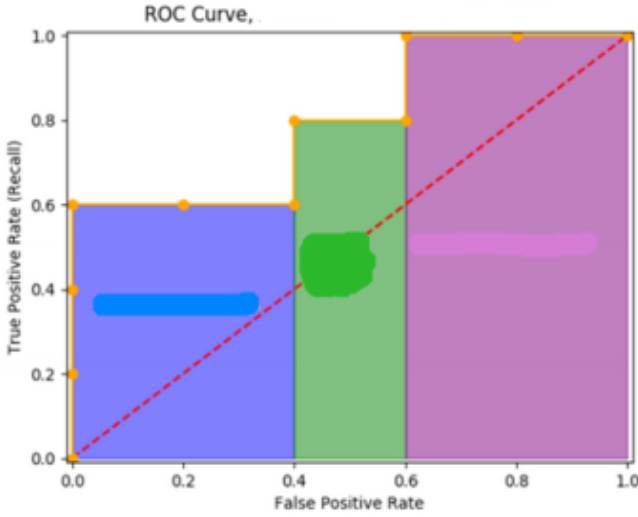
Answer All Questions. Each Question Carries 3 Marks

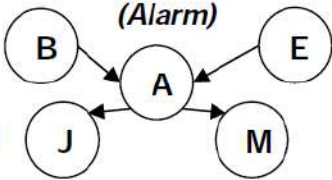
1.	Suppose you have a dataset with $m = 1000000$ examples and $n = 200000$ features for each example. You want to use multivariate linear regression to fit the parameters to our data. Should you prefer gradient descent or the normal equation? Justify your answer.	
2.	Define Information gain? How is that different from Gain ratio? Give the advantage of using Gain ratio measure?	
3.	What is cluster analysis? Identify two applications where cluster analysis can be applied to multimedia data?	
4.	Given two objects represented by the tuples (22, 1, 42, 10) and (20, 0, 36, 8): (i) Compute the Euclidean distance between the two objects. (ii) Compute the Manhattan distance between the two objects.	
5.	Suppose there are three classifiers A,B and C. The (FPR, TPR) measures of the three classifiers are as follows – A (0, 1), B (1, 1) , C (1,0.5). Which can be considered as a perfect classifier? Justify your answer.	
6.	How Bias-Variance Tradeoff affects machine learning algorithms?	
7.	For a particular learning task, if the requirement of error parameter ϵ changes from 0.1 to 0.01. How many more samples will be required for probably approximately correct(PAC) learning?	

8.	Suppose we have a hypothesis set that labels all points inside an interval $[a, b]$ as class 1. Find its Vapnik-Chervonenkis(VC)- dimension?												
9.	Given a density function $f(x)$, the rejection sampling is a method that can generate data points from the density function f . List the three steps to generate a random sample from f using rejection sampling.												
10.	How does the variational auto-encoder(VAE) architecture allow it to generate new data points, compared to auto-encoder, which cannot generate new data points?		(10x3=30)										
	Part B (Answer any one question from each module. Each question carries 14 Marks)												
11.	(a)	Consider the hypothesis for the linear regression $h_{\theta}(x) = \theta_0 + \theta_1 x$, and the cost function $J(\theta_0, \theta_1) = 1/2m \sum_{i=1}^m (h_{\theta}(x^{(i)}) - y^{(i)})^2$ where m is the number of training examples. Given the following set of training examples. <table border="1"><tr><td>x</td><td>y</td></tr><tr><td>3</td><td>2</td></tr><tr><td>1</td><td>2</td></tr><tr><td>0</td><td>1</td></tr><tr><td>4</td><td>3</td></tr></table> Answer the following questions : 1) Find the value of $h_{\theta}(2)$ if $\theta_0 = 0$ and $\theta_1 = 1.5$ 2) Find the value of $J(0,1)$ 3) Suppose the value of $J(\theta_0, \theta_1) = 0$. What can be inferred from this.	x	y	3	2	1	2	0	1	4	3	(5)
x	y												
3	2												
1	2												
0	1												
4	3												
	(b)	Write a gradient descent algorithm for multivariate regression? Compare the gradient and analytical solution to the multivariate regression?	(9)										
	OR												
12.	(a)	Consider the collection of training samples (S) in the Figure given below. Drug is the target attribute which describes the Drug suggested for each patient. Find the value of the following . i) Gain(S, Sex) ii) Gain (S, Cholesterol)	(9)										

		<table><tr><th>Patient ID</th><th>Age</th><th>Sex</th><th>BP</th><th>Cholesterol</th><th>Drug</th></tr><tr><td>p1</td><td>Young</td><td>F</td><td>High</td><td>Normal</td><td>Drug A</td></tr><tr><td>p2</td><td>Young</td><td>F</td><td>High</td><td>High</td><td>Drug A</td></tr><tr><td>p3</td><td>Middle-age</td><td>F</td><td>Hiigh</td><td>Normal</td><td>Drug B</td></tr><tr><td>p4</td><td>Senior</td><td>F</td><td>Normal</td><td>Normal</td><td>Drug B</td></tr><tr><td>p5</td><td>Senior</td><td>M</td><td>Low</td><td>Normal</td><td>Drug B</td></tr><tr><td>p6</td><td>Senior</td><td>M</td><td>Low</td><td>High</td><td>Drug A</td></tr><tr><td>p7</td><td>Middle-age</td><td>M</td><td>Low</td><td>High</td><td>Drug B</td></tr><tr><td>p8</td><td>Young</td><td>F</td><td>Normal</td><td>Normal</td><td>Drug A</td></tr><tr><td>p9</td><td>Young</td><td>M</td><td>Low</td><td>Normal</td><td>Drug B</td></tr><tr><td>p10</td><td>Senior</td><td>M</td><td>Normal</td><td>Normal</td><td>Drug B</td></tr><tr><td>p11</td><td>Young</td><td>M</td><td>Normal</td><td>High</td><td>Drug B</td></tr><tr><td>p12</td><td>Middle-age</td><td>F</td><td>Normal</td><td>High</td><td>Drug B</td></tr><tr><td>p13</td><td>Middle-age</td><td>M</td><td>High</td><td>Normal</td><td>Drug B</td></tr><tr><td>p14</td><td>Senior</td><td>F</td><td>Normal</td><td>High</td><td>Drug A</td></tr></table>	Patient ID	Age	Sex	BP	Cholesterol	Drug	p1	Young	F	High	Normal	Drug A	p2	Young	F	High	High	Drug A	p3	Middle-age	F	Hiigh	Normal	Drug B	p4	Senior	F	Normal	Normal	Drug B	p5	Senior	M	Low	Normal	Drug B	p6	Senior	M	Low	High	Drug A	p7	Middle-age	M	Low	High	Drug B	p8	Young	F	Normal	Normal	Drug A	p9	Young	M	Low	Normal	Drug B	p10	Senior	M	Normal	Normal	Drug B	p11	Young	M	Normal	High	Drug B	p12	Middle-age	F	Normal	High	Drug B	p13	Middle-age	M	High	Normal	Drug B	p14	Senior	F	Normal	High	Drug A	
Patient ID	Age	Sex	BP	Cholesterol	Drug																																																																																								
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	(b)	Explain how LASSO regression helps to reduce the overfitting problem?	(5)																																																																																										
13.	(a)	Suppose that we have the following data: <table><tr><td><i>a</i></td><td><i>b</i></td><td><i>c</i></td><td><i>d</i></td><td><i>e</i></td><td><i>f</i></td><td><i>g</i></td><td><i>h</i></td><td><i>i</i></td><td><i>j</i></td></tr><tr><td>(2,0)</td><td>(1,2)</td><td>(2,2)</td><td>(3,2)</td><td>(2,3)</td><td>(3,3)</td><td>(2,4)</td><td>(3,4)</td><td>(4,4)</td><td>(3,5)</td></tr></table> Identify the cluster by applying the k-means algorithm, with k = 2. Try using initial cluster centers as far apart as possible.	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>	<i>f</i>	<i>g</i>	<i>h</i>	<i>i</i>	<i>j</i>	(2,0)	(1,2)	(2,2)	(3,2)	(2,3)	(3,3)	(2,4)	(3,4)	(4,4)	(3,5)	(9)																																																																						
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(2,0)	(1,2)	(2,2)	(3,2)	(2,3)	(3,3)	(2,4)	(3,4)	(4,4)	(3,5)																																																																																				
	(b)	Describe EM algorithm for Gaussian mixtures.	(5)																																																																																										
OR																																																																																													
14.	(a)	Illustrate the strength and weakness of k-means in comparison with the k-medoids algorithm.	(4)																																																																																										
	(b)	Suppose that we have the following data . Use single linkage Agglomerative clustering to identify the clusters. Draw the Dendrogram. Use Euclidean distance measure	(10)																																																																																										

		<table><tr><td></td><td>X</td><td>Y</td></tr><tr><td>P1</td><td>0.4</td><td>0.53</td></tr><tr><td>P2</td><td>0.22</td><td>0.38</td></tr><tr><td>P3</td><td>0.35</td><td>0.32</td></tr><tr><td>P4</td><td>0.26</td><td>0.19</td></tr><tr><td>P5</td><td>0.08</td><td>0.41</td></tr><tr><td>P6</td><td>0.45</td><td>0.30</td></tr></table>		X	Y	P1	0.4	0.53	P2	0.22	0.38	P3	0.35	0.32	P4	0.26	0.19	P5	0.08	0.41	P6	0.45	0.30	
	X	Y																						
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P6	0.45	0.30																						
15.	(a)	Define Precision, Recall, Accuracy and F-measure?	(4)																					
	(b)	What does it mean for a classifier to have a high precision but low recall?	(3)																					
	(c)	Fill in the missing values in the accompanying three class confusion matrix. Given that model accuracy is 72% and classification error for class 2 is 20%. Find also the precision and recall for class1 <table><tr><td colspan="2" rowspan="2"></td><td colspan="3">Predicted</td></tr><tr><td>Class 1</td><td>Class 2</td><td>Class 3</td></tr><tr><td rowspan="3">Actual</td><td>Class 1</td><td>14</td><td>2</td><td>5</td></tr><tr><td>Class 2</td><td>?(X)</td><td>40</td><td>2</td></tr><tr><td>Class 3</td><td>1</td><td>?(Y)</td><td>18</td></tr></table>			Predicted			Class 1	Class 2	Class 3	Actual	Class 1	14	2	5	Class 2	?(X)	40	2	Class 3	1	?(Y)	18	(7)
		Predicted																						
		Class 1	Class 2	Class 3																				
Actual	Class 1	14	2	5																				
	Class 2	?(X)	40	2																				
	Class 3	1	?(Y)	18																				
OR																								

16.	(a)	What are ROC space and ROC curve in machine learning? In ROC space, which points correspond to perfect prediction, always positive prediction and always negative prediction? Why?	(4)
	(b)	Given the following ROC Curve? Find the AUC? 	(3)
	(c)	How does random forest classifier work? Why is a random forest better than a decision tree?	(7)
17.	(a)	Show that the concept class C_n of the conjunction of boolean literals up to n variables is probably approximately correct(PAC)-learnable.	(8)
	(b)	Explain the concept of Vapnik-Chervonenkis (VC) dimension using shattering. How the number of training examples required to train the model is related to the VC dimension and what is its relation with training and test errors.	(6)
OR			
18.	(a)	Consider a Boolean classification problem with n binary variables and a hypothesis space H , where each hypothesis is a decision tree of depth 1. How many training examples, m suffice to assure that with probability at least 0.99, any consistent learner using H will output a hypothesis with true error at most 0.05?	(7)
	(b)	Prove that $VC(H) \leq \log_2 H $, where H is a hypothesis space. ($ H $ denotes the	(7)

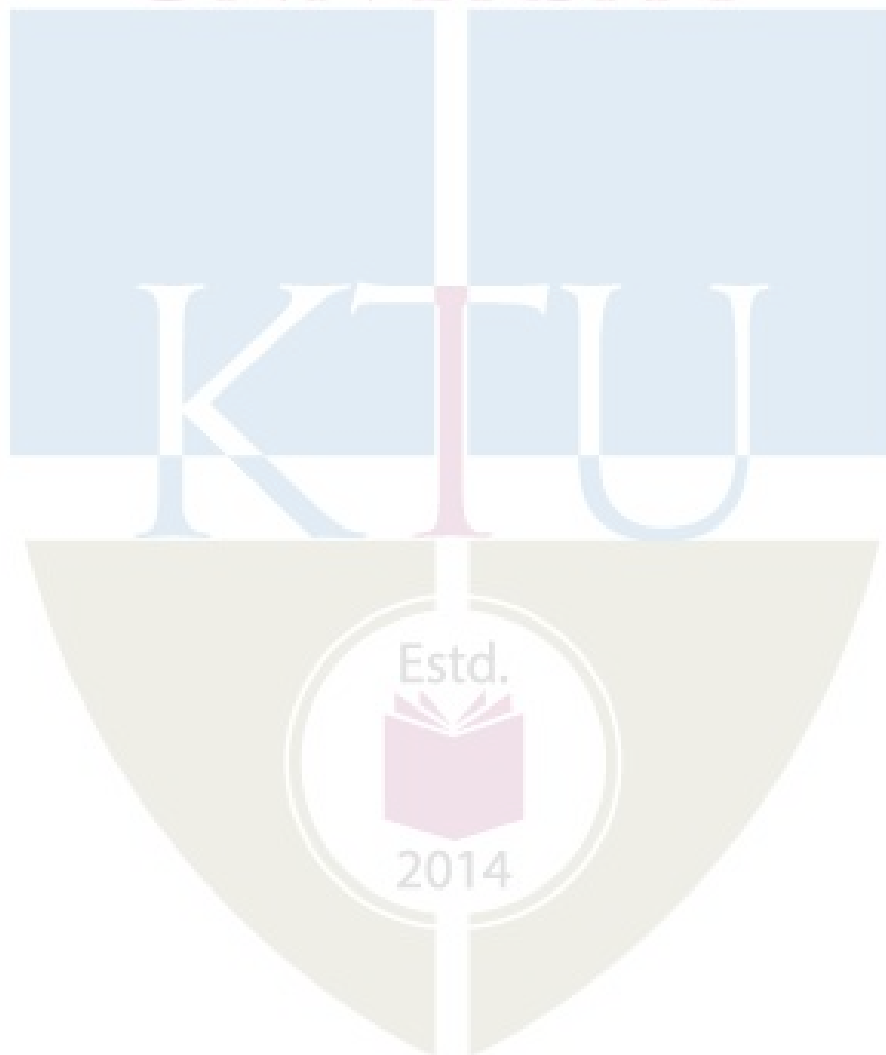
		cardinality of the hypothesis space)																																
19.	(a)	Shown below is the Bayesian network corresponding to the Burglar Alarm problem, $P(J \mid A) P(M \mid A) P(A \mid B, E) P(B) P(E)$. The probability tables show the probability that variable is True, e.g., $P(M)$ means $P(M = t)$. Find $P(J = t \wedge M = f \wedge A = f \wedge B = f \wedge E = t)$. (Burglary) (Alarm) (Earthquake) (John calls) (Mary calls)  <table><tr><th>$P(E)$</th></tr><tr><td>.002</td></tr></table><table><tr><th>A</th><th>$P(M)$</th></tr><tr><td>t</td><td>.70</td></tr><tr><td>f</td><td>.01</td></tr></table><table><tr><th>B</th><th>E</th><th>$P(A)$</th></tr><tr><td>t</td><td>t</td><td>.95</td></tr><tr><td>t</td><td>f</td><td>.94</td></tr><tr><td>f</td><td>t</td><td>.29</td></tr><tr><td>f</td><td>f</td><td>.001</td></tr></table><table><tr><th>$P(B)$</th></tr><tr><td>.001</td></tr></table><table><tr><th>A</th><th>$P(J)$</th></tr><tr><td>t</td><td>.90</td></tr><tr><td>f</td><td>.05</td></tr></table>	$P(E)$	.002	A	$P(M)$	t	.70	f	.01	B	E	$P(A)$	t	t	.95	t	f	.94	f	t	.29	f	f	.001	$P(B)$	.001	A	$P(J)$	t	.90	f	.05	(7)
$P(E)$																																		
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.001																																		
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t	.90																																	
f	.05																																	
	(b)	Derive an algorithm using the inverse transform method to generate a random sample from the distribution with density $f_X(x) = 3x^2, 0 < x < 1$.	(7)																															
OR																																		
20.	(a)	Draw the Bayesian Network that corresponds to this conditional probability: $P(A \mid B,C,E) P(B \mid D,E) P(C \mid F,H) P(D \mid G) P(E \mid G,H) P(F \mid H) P(G) P(H)$	(6)																															
	(b)	What is effective sample size (ESS)? Why is a large ESS necessary but not sufficient for good MCMC mixing?	(3)																															
	(c)	Describe the overall Gibbs sampling algorithm briefly	(5)																															

Teaching Plan

Module 1 : (Supervised Learning)(10 hours)		
1.1	Supervised, semi-supervised, unsupervised learning, reinforcement learning (TB 2: Ch 1)	1 hour
1.2	Least squares linear regression (TB 2: Section 2.6)	1 hour
1.3	Gradient descent, closed form, normal equations (TB 2: Section 5.8)	1 hour
1.4	Regularization techniques (LASSO, RIDGE) (TB 4: Section 7.1)	1 hour
1.5	Polynomial regression (TB 2: Section 2.6)	1 hour
1.6	Logistic Regression (TB 6: Section 3.3)	1 hour
1.7	Decision Tree Learning (ID3) (TB 8: Section 8.2)	1 hour
1.8	Decision Tree Learning (C4.5) (TB 8: Section 8.2)	1 hour
1.9	Naive Bayes Classifier (TB 8: Section 8.3)	1 hour
1.10	Gaussian Discriminant Analysis (GDA) (TB 7: Section 5.2,5.3)	1 hour
Module 2 : (Unsupervised Learning)(8 hours)		
2.1	Similarity measures (TB 8: Section 2.4)	1 hour
2.2	Hierarchical Agglomerative Clustering (TB 3: Chapter 14)	1 hour
2.3	Hierarchical Agglomerative Clustering (TB 3: Chapter 14)	
2.4	K-means partitional clustering (TB 3: Chapter 13)	1 hour
2.5	K-medoids partitional clustering	
2.6	Gaussian mixture models (TB 3: Chapter 13)	1 hour
2.7	Expectation Maximization (EM) algorithm for Gaussian mixture model Lecture-1 (TB 3: Chapter 13)	1 hour
2.8	Expectation Maximization (EM) algorithm for Gaussian mixture model Lecture-2 (TB 3: Chapter 13)	1 hour
Module 3 : (Practical aspects in machine learning) (6 hours)		

3.1	Precision, Recall, Accuracy, F-Measure, ROC, AUC (TB8.5/TB 3: Chapter 22.1)	1 hour
3.2	Generalisation and overfitting, cross-validation (TB 2: Section 2.7,4.8)	1 hour
3.3	Bias-variance tradeoff (TB 2: Chapter 22.3)	1 hour
3.4	Error estimation, parameter and model selection (TB 3: Chapter 8.5)	1 hour
3.5	Bagging, Boosting (TB 8: Chapter 8.6)	1 hour
3.6	Adaboost, Random Forests (TB 8: Chapter 8.6)	1 hour
Module 4 : (Statistical Learning Theory) (TB 5 – Chapter 2, 3.3)(7 hours)		
4.1	Learning in the limit, probably approximately correct (PAC) learning	1 hour
4.2	Quantifying the number of examples needed to PAC learn	1 hour
4.3	Computational complexity of training	1 hour
4.4	Sample complexity for finite hypothesis spaces	1 hour
4.5	PAC results for learning conjunctions	1 hour
4.6	Sample complexity for infinite hypothesis spaces	1 hour
4.7	Vapnik-Chervonenkis(VC) dimension	1 hour
Module 5 : (Advanced Machine Learning Topics) (13 hours)		
5.1	Bayesian belief networks (TB 1 – Chapter 8)	1 hour
5.2	Markov random fields (TB 1 – Chapter 8)	1 hour
5.3	Inference on chains and factor graphs (TB 1 – Chapter 8)	1 hour
5.4	Inference on clique trees (TB 1 – Chapter 8)	1 hour
5.5	Basic sampling algorithms (TB 1 – Chapter 11)	1 hour
5.6	Rejection sampling (TB 1 – Chapter 11)	1 hour
5.7	Importance sampling (TB 1 – Chapter 11)	1 hour
5.8	Markov chain Monte Carlo(MCMC) (TB 1 – Chapter 11)	1 hour
5.9	Gibbs sampling (TB 1 – Chapter 11)	1 hour

5.10	Variational method (TB 1 – Chapter 10)	1 hour
5.11	Auto Encoder (TB 4 – Chapter 14)	1 hour
5.12	Variational AutoEncoder (TB 9 – Chapter 3)	1 hour
5.13	Generative Adversarial Networks (TB 9 – Chapter 4)	1 hour



AIT398	IMAGE AND VIDEO PROCESSING	Category	L	T	P	Credit	Year of Introduction
		VAC	3	1	0	4	2020

Preamble: This course enables the learners to understand how digital images are stored and processed. The learners are exposed to different spatial and frequency domain methods for image enhancement, image restoration techniques, morphological operations that could be performed on digital images and also various image and video compression techniques. The course also gives an introduction to the basics of video processing and video segmentation.

Prerequisite: Advanced Computer Graphics, Advanced Concepts in Computer Vision

Course Outcomes: After the completion of the course the student will be able to

CO1	Summarize the steps of digital image processing and pixel relationships. (Cognitive Knowledge Level: Understand)
CO2	Apply spatial and frequency domain methods for image enhancement. (Cognitive Knowledge Level: Apply)
CO3	Apply restoration techniques and morphological operations on digital images. (Cognitive Knowledge Level: Apply)
CO4	Compare different methods for digital image and video compression. (Cognitive Knowledge Level: Apply)
CO5	Understand the basics of video processing and video segmentation. (Cognitive Knowledge Level: Understand)

Mapping of course outcomes with program outcomes

	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

Abstract POs defined by National Board of Accreditation			
PO#	Broad PO	PO#	Broad PO
PO1	Engineering Knowledge	PO7	Environment and Sustainability
PO2	Problem Analysis	PO8	Ethics
PO3	Design/Development of solutions	PO9	Individual and team work
PO4	Conduct investigations of complex problems	PO10	Communication
PO5	Modern tool usage	PO11	Project Management and Finance
PO6	The Engineer and Society	PO12	Life long learning

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination Marks (%)
	Test 1 (%)	Test 2 (%)	
Remember	30	30	30
Understand	30	30	30
Apply	40	40	40
Analyze			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hrs

Continuous Internal Evaluation Pattern:

Attendance	10 marks
Continuous Assessment Tests(Average of Internal Tests 1 & 2)	25 marks
Continuous Assessment Assignment	15 marks

Internal Examination Pattern

Each of the two internal examinations has to be conducted out of 50 marks. First series test shall be preferably conducted after completing the first half of the syllabus and the second series test shall be preferably conducted after completing the remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly completed module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A.

Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly completed module), each with 7 marks. Out of the 7 questions, a student should answer any 5.

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 full questions from each module of which student should answer any one. Each question can have a maximum of 2 subdivisions and carries 14 marks.

SYLLABUS

Module – 1

Fundamentals of Image processing: Basic steps of Image processing system, sampling and quantization of an Image, basic relationship between pixels and connectivity.

Image Enhancement: Spatial Domain methods - Gray level transformations, Histogram Processing, Fundamentals of Spatial Filtering, Smoothing Spatial filters, Sharpening Spatial filters.

Module -2

Image Transforms: Unitary transforms, 2D Discrete Fourier Transform, Discrete Cosine Transform (DCT), Discrete Wavelet transforms.

Frequency Domain methods: Basics of filtering in frequency domain, image smoothing, image sharpening, homomorphic filtering.

Module - 3

Image Restoration: Image degradation/Restoration model, Noise models, Restoration in presence of noise only - spatial filtering, Periodic Noise reduction by frequency domain filtering.

Morphological Operations: Erosion, Dilation, Opening, Closing, Hit-or-miss transformation, Boundary extraction.

Module - 4

Image compression fundamentals – Coding Redundancy, spatial and temporal redundancy.

Compression models : Lossy and Lossless, Huffman coding, Arithmetic coding, LZW coding, run length coding, Bit Plane coding, JPEG standards.

Module - 5

Video processing: Basics of Video Processing: Analog video, Digital Video.

Video segmentation: Introduction to video segmentation, Change detection.

Video Compression: Introduction to video compression, video compression based on motion compensation, Search for motion vectors, H.261 standard, Transform coding, predictive coding-MPEG.

Text Books

1. Gonzalez and Woods , “Digital Image Processing”, 3rd edition , Pearson, 2009.
2. Li, Ze-Nian, Mark S. Drew, and Jiangchuan Liu. “Fundamentals of multimedia”, Pearson Prentice Hall, 2004.
3. Bovik, Alan C. “Handbook of image and video processing”, Academic press, 2010.

Reference Books

1. David A. Forsyth & Jean Ponce, Computer vision – A Modern Approach, Prentice Hall, 2002.
2. Richard Szeliski, Computer Vision: Algorithms and Applications, Springer.
3. Maheshkumar H Kolekar, “Intelligent Video Surveillance Systems: An Algorithmic Approach”, CRC Press.
4. Francesco Camastra, Alessandro Vinciarelli, “Machine Learning for Audio, Image and Video Analysis: Theory and Applications”, Springer 2015.
5. M. Tekalp ,”Digital video Processing”, Prentice Hall International
6. Relf, Christopher G.,”Image acquisition and processing with LabVIEW”, CRC press
- 7 Chris Solomon, Toby Breckon ,”Fundamentals of Digital Image Processing A Practical Approach with Examples in Matlab”, John Wiley & Sons,
8. Yao wang, Joem Ostarmann and Ya – quin Zhang, ”Video processing and communication “,1st edition , PHI

Course Level Assessment Questions

Course Outcome1 (CO1):

1. Illustrate how the image is digitized by sampling and quantization.
2. Let $V = \{1,2\}$ and compute the length of the shortest 4-, 8-, and m path between p and q.
If a particular path does not exist between these two points explain why.

3	1	2	1q
2	2	0	2
1	2	1	1
p 1	0	1	2

Course Outcome 2(CO2):

1. Determine whether the given matrix is unitary or not:

$$A = \frac{1}{\sqrt{2}} \begin{bmatrix} 1 & 1 \\ -1 & 1 \end{bmatrix}.$$

2. Explain any five properties of 2D Fourier Transform.

Course Outcome 3(CO3):

1. Discuss how restoration is done in digital images.
2. Explain with examples the different morphological operations applied to images.

Course Outcome 4(CO4): .

1. With suitable examples, clearly bring out the need for compression in images and videos.
2. Discuss any one method for finding motion vectors.

Course Outcome 5(CO5):

1. Explain any one technique used for segmenting a video.
2. Compare and contrast analog video and digital video in multimedia.

Model Question Paper

QP CODE:

Reg No: _____

Name: _____

PAGES : 3

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
SIXTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: AIT 398

Course Name: Image and Video Processing

Max. Marks : 100

Duration: 3 Hours

PART A

Answer All Questions. Each Question Carries 3 Marks

1. Explain bit plane slicing and contrast stretching.
2. Discuss about pixel relationships.
3. Find the 4 order forward and inverse DFT for the following image segment:

1	1	1	1
1	1	1	1
1	1	1	1
1	1	1	1

4. Define DCT. Write the properties of DCT.
5. Discuss hit or miss transformation with appropriate examples.

6. Explain about the morphological operation dilation.
7. Explain the significance of image compression.
8. Distinguish between lossy and lossless compression.
9. Discuss the significance of change detection.
10. Explain how transform coding is used in compression algorithms.

(10x3=30
)

Part B

(Answer any one question from each module. Each question carries 14 Marks)

11. (a) Perform histogram specification of the following 3 bit gray scale image whose gray level distribution is given as follows. (9)

Input image

Gray level	0	1	2	3	4	5	6	7
No. of Pixels	8	10	10	2	12	16	4	2

Target image

Gray Level	0	1	2	3	4	5	6	7
No. of Pixels	0	0	0	0	20	20	16	8

- (b) Design Laplacian filter for image enhancement in spatial domain. (5)

OR

12. (a) What is histogram equalization? Explain the procedure for histogram equalization. (7)
- (b) Explain the gray level transformation functions: a) image negatives and b) log transformation c) power law transformation. (7)
13. (a) Compute the 2D DFT of the 4 X 4 grayscale image given below. (4)

- (b) Explain about smoothing and sharpening frequency domain filters. (10)

OR

14. (a) Explain Butterworth filters for image smoothening and image sharpening. (4)

- (b) Explain the steps followed in frequency domain filtering? (5)

15. (a) Apply opening and closing operation on the image sample A given below with structuring element B (10)

$$A = \begin{pmatrix} 1 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 1 \end{pmatrix} \text{ and } B = \begin{bmatrix} 1 & 1 & 1 \end{bmatrix}$$

- (b) Explain Morphological operations a) opening b) closing with suitable examples. (4)

OR

16. (a) Discuss about different noise models. (7)

- (b) Explain how periodic noise reduction can be done using frequency domain filtering. (7)

17. (a) Comment on JPEG compression standard. (8)

- (b) Discuss on run-length encoding with the help of an example. (6)

OR

18. (a) Explain LZW coding with the help of a suitable example. (8)

- (b) Illustrate the concept of arithmetic coding. (6)

19. (a) Compare and contrast MPEG video coding and H.261 standard. (7)

(b) Explain video segmentation with an example. (7)

OR

20. (a) Illustrate how motion compensation is used in video compression. (7)

(b) With the help of a neat block diagram explain predictive coding methods. (7)

Teaching Plan

No	Contents	No. of Lecture Hours (44 hrs)
Module – 1 (7 hours)		
1.1	Fundamentals of Image processing: Basic steps of Image processing system, Sampling and quantization of an Image.	1 hour
1.2	Basic relationship between pixels and connectivity.	1 hour
1.3	Image Enhancement: Gray level transformations	1 hour
1.4	Histogram, Histogram Equalization	1 hour
1.5	Histogram specification	1 hour
1.6	Fundamentals of Spatial Filtering	1 hour
1.7	Smoothing Spatial filters	1 hour
1.8	Sharpening Spatial filters	1 hour
Module-2 (8 hours)		
2.1	Image Transforms: Unitary transforms.	1 hour
2.2	2D Discrete Fourier Transform	1 hour

2.3	Discrete Cosine Transform (DCT)	1 hour
2.4	Discrete Wavelet transforms	1 hour
2.5	Basics of filtering in frequency domain	1 hour
2.6	Image smoothing	1 hour
2.7	Image sharpening	1 hour
2.8	Homomorphic filtering.	1 hour
Module-3 (9 hours)		
3.1	Image Restoration: Image degradation/Restoration model	1 hour
3.2	Noise models	1 hour
3.3	Restoration basics	1 hour
3.4	Restoration in presence of noise only - spatial filtering	1 hour
3.5	Periodic Noise reduction by frequency domain filtering.	1 hour
3.6	Morphological Operations: basics	1 hour
3.7	Erosion, Dilation, Opening, Closing	1 hour
3.8	Hit-or-miss transformation	1 hour
3.9	Boundary extraction.	1 hour
Module-4 (10 hours)		
4.1	Image compression fundamentals - Coding Redundancy	1 hour
4.2	Spatial and temporal redundancy.	1 hour
4.3	Compression models : Lossy and Lossless	1 hour
4.4	Huffman coding	1 hour

4.6	Arithmetic coding	1 hour
4.7	LZW coding	1 hour
4.8	Run length coding	1 hour
4.9	Bit Plane coding,	1 hour
4.10	JPEG standards	1 hour
Module-5 (10 hours)		
5.1	Basics of Video Processing: Analog video, Digital Video.	1 hour
5.2	Video segmentation: Introduction to video segmentation	1 hour
5.3	Change detection.	1 hour
5.4	Introduction to video compression	1 hour
5.5	Video compression based on motion compensation	1 hour
5.6	Search for motion vectors	1 hour
5.7	Transform coding	1 hour
5.8	Predictive coding	1 hour
5.9	MPEG standards	1 hour
5.10	H.261 standard	1 hour

APJ ABDUL KALAM
TECHNOLOGICAL
UNIVERSITY

COMMON COURSES

(S5 & S6)

Estd.



2014

MCN 301	DISASTER MANAGEMENT	Category	L	T	P	CREDIT	YEAR OF INTRODUCTION
		Non - Credit	2	0	0	Nil	2019

Preamble: The objective of this course is to introduce the fundamental concepts of hazards and disaster management.

Prerequisite: Nil

Course Outcomes: After the completion of the course the student will be able to

CO1	Define and use various terminologies in use in disaster management parlance and organise each of these terms in relation to the disaster management cycle (Cognitive knowledge level: Understand).
CO2	Distinguish between different hazard types and vulnerability types and do vulnerability assessment (Cognitive knowledge level: Understand).
CO3	Identify the components and describe the process of risk assessment, and apply appropriate methodologies to assess risk (Cognitive knowledge level: Understand).
CO4	Explain the core elements and phases of Disaster Risk Management and develop possible measures to reduce disaster risks across sector and community (Cognitive knowledge level: Apply)
CO5	Identify factors that determine the nature of disaster response and discuss the various disaster response actions (Cognitive knowledge level: Understand).
CO6	Explain the various legislations and best practices for disaster management and risk reduction at national and international level (Cognitive knowledge level: Understand).

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		2				2				2		2
CO2	2	3	2		2	2	3			3		2
CO3	2	3	2	2	2	2	3			3		2
CO4	3	3	3		2	2	3					2
CO5	3	3			2	2	3					2
CO6	3					2	3	3				2

Abstract POs defined by National Board of Accreditation			
PO#	Broad PO	PO#	Broad PO
PO1	Engineering Knowledge	PO7	Environment and Sustainability
PO2	Problem Analysis	PO8	Ethics
PO3	Design/Development of solutions	PO9	Individual and team work
PO4	Conduct investigations of complex problems	PO10	Communication
PO5	Modern tool usage	PO11	Project Management and Finance
PO6	The Engineer and Society	PO12	Life long learning

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination Marks
	Test 1 (Marks)	Test 2 (Marks)	
Remember	10	10	20
Understand	25	25	50
Apply	15	15	30
Analyze			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks

Continuous Assessment - Test : 25 marks

Continuous Assessment - Assignment : 15 marks

Internal Examination Pattern:

Each of the two internal examinations has to be conducted out of 50 marks. First series test shall be preferably conducted after completing the first half of the syllabus and the second series test shall be preferably conducted after completing remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly completed module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A.

Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly completed module), each with 7 marks. Out of the 7 questions, a student should answer any 5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which a student should answer any one. Each question can have maximum 2 sub-divisions and carries 14 marks.

SYLLABUS

MCN 301 Disaster Management

Module 1

Systems of earth

Lithosphere- composition, rocks, soils; Atmosphere-layers, ozone layer, greenhouse effect, weather, cyclones, atmospheric circulations, Indian Monsoon; hydrosphere- Oceans, inland water bodies; biosphere

Definition and meaning of key terms in Disaster Risk Reduction and Management- disaster, hazard, exposure, vulnerability, risk, risk assessment, risk mapping, capacity, resilience, disaster risk reduction, disaster risk management, early warning systems, disaster preparedness, disaster prevention, disaster mitigation, disaster response, damage assessment, crisis counselling, needs assessment.

Module 2

Hazard types and hazard mapping; Vulnerability types and their assessment- physical, social, economic and environmental vulnerability.

Disaster risk assessment –approaches, procedures

Module 3

Disaster risk management -Core elements and phases of Disaster Risk Management

Measures for Disaster Risk Reduction – prevention, mitigation, and preparedness.

Disaster response- objectives, requirements; response planning; types of responses.

Relief; international relief organizations.

Module 4

Participatory stakeholder engagement; Disaster communication- importance, methods, barriers; Crisis counselling

Capacity Building: Concept – Structural and Non-structural Measures, Capacity Assessment; Strengthening Capacity for Reducing Risk

Module 5

Common disaster types in India; Legislations in India on disaster management; National disaster management policy; Institutional arrangements for disaster management in India.

The Sendai Framework for Disaster Risk Reduction- targets, priorities for action, guiding principles

Reference Text Book

1. R. Subramanian, Disaster Management, Vikas Publishing House, 2018
2. M. M. Sulphery, Disaster Management, PHI Learning, 2016
3. UNDP, Disaster Risk Management Training Manual, 2016
4. United Nations Office for Disaster Risk Reduction, Sendai Framework for Disaster Risk Reduction 2015-2030, 2015

Sample Course Level Assessment Questions

Course Outcome 1 (CO1):

1. What is the mechanism by which stratospheric ozone protects earth from harmful UV rays?
2. What are disasters? What are their causes?
3. Explain the different types of cyclones and the mechanism of their formation
4. Explain with examples, the difference between hazard and risk in the context of disaster management
5. Explain the following terms in the context of disaster management (a) exposure (b) resilience (c) disaster risk management (d) early warning systems, (e) damage assessment (f) crisis counselling (g) needs assessment

Course Outcome 2 (CO2):

1. What is hazard mapping? What are its objectives?
2. What is participatory hazard mapping? How is it conducted? What are its advantages?
3. Explain the applications of hazard maps
4. Explain the types of vulnerabilities and the approaches to assess them

Course Outcome 3 (CO3):

1. Explain briefly the concept of 'disaster risk'

2. List the strategies for disaster risk management ‘before’, ‘during’ and ‘after’ a disaster
3. What is disaster preparedness? Explain the components of a comprehensive disaster preparedness strategy

Course Outcome 4 (CO4):

1. What is disaster prevention? Distinguish it from disaster mitigation giving examples
2. What are the steps to effective disaster communication? What are the barriers to communication?
3. Explain capacity building in the context of disaster management

Course Outcome 5 (CO5):

1. Briefly explain the levels of stakeholder participation in the context of disaster risk reduction
2. Explain the importance of communication in disaster management
3. Explain the benefits and costs of stakeholder participation in disaster management
4. How are stakeholders in disaster management identified?

Course Outcome 6 (CO6):

1. Explain the salient features of the National Policy on Disaster Management in India
2. Explain the guiding principles and priorities of action according to the Sendai Framework for Disaster Risk Reduction
3. What are Tsunamis? How are they caused?
4. Explain the earthquake zonation of India

Model Question paper

QP CODE:

PAGES:3

Reg No:_____

Name :_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FIFTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: MCN 301

Course Name: Disaster Management

Max.Marks:100

Duration: 3 Hours

PART A

Answer all Questions. Each question carries 3 Marks

1. What is the mechanism by which stratospheric ozone protects earth from harmful UV rays?
2. What are disasters? What are their causes?
3. What is hazard mapping? What are its objectives?
4. Explain briefly the concept of 'disaster risk'
5. List the strategies for disaster risk management 'before', 'during' and 'after' a disaster
6. What is disaster prevention? Distinguish it from disaster mitigation giving examples
7. Briefly explain the levels of stakeholder participation in the context of disaster risk reduction
8. Explain the importance of communication in disaster management
9. What are Tsunamis? How are they caused?
10. Explain the earthquake zonation of India

Part B

Answer any one Question from each module. Each question carries 14 Marks

11. a. Explain the different types of cyclones and the mechanism of their formation [10]
b. Explain with examples, the difference between hazard and risk in the context of disaster management [4]

OR

12. Explain the following terms in the context of disaster management [14]
(a) exposure (b) resilience (c) disaster risk management (d) early warning systems, (e) damage assessment (f) crisis counselling (g) needs assessment

13. a. What is participatory hazard mapping? How is it conducted? What are its advantages? [8]
b. Explain the applications of hazard maps [6]

OR

14. Explain the types of vulnerabilities and the approaches to assess them [14]
15. a. Explain the core elements of disaster risk management [8]
b. Explain the factors that decide the nature of disaster response [6]

OR

16. a. What is disaster preparedness? Explain the components of a comprehensive disaster preparedness strategy [6]
b. Explain the different disaster response actions [8]
17. a. Explain the benefits and costs of stakeholder participation in disaster management [10]
b. How are stakeholders in disaster management identified? [4]

OR

18. a. What are the steps to effective disaster communication? What are the barriers to communication? [7]
b. Explain capacity building in the context of disaster management [7]

19. Explain the salient features of the National Policy on Disaster Management in India

[14]

OR

20. Explain the guiding principles and priorities of action according to the Sendai Framework for Disaster Risk Reduction

[14]

Teaching Plan

	Module 1	5 Hours
1.1	Introduction about various Systems of earth, Lithosphere-composition, rocks, Soils; Atmosphere-layers, ozone layer, greenhouse effect, weather	1 Hour
1.2	Cyclones, atmospheric circulations, Indian Monsoon; hydrosphere-Oceans, inland water bodies; biosphere	1 Hour
1.3	Definition and meaning of key terms in Disaster Risk Reduction and Management- disaster, hazard,	1 Hour
1.4	Exposure, vulnerability, risk, risk assessment, risk mapping, capacity, resilience, disaster risk reduction, Disaster risk management, early warning systems	1 Hour
1.5	Disaster preparedness, disaster prevention, disaster, Mitigation, disaster response, damage assessment, crisis counselling, needs assessment.	1 Hour
	Module 2	5 Hours
2.1	Various Hazard types, Hazard mapping; Different types of Vulnerability types and their assessment	1 Hour
2.2	Vulnerability assessment and types, Physical and social vulnerability	1 Hour
2.3	Economic and environmental vulnerability, Core elements of disaster risk assessment	1 Hour
2.4	Components of a comprehensive disaster preparedness strategy approaches, procedures	1 Hour
2.5	Different disaster response actions	1 Hour
	Module 3	5 Hours
3.1	Introduction to Disaster risk management, Core elements of Disaster Risk Management	1 Hour
3.2	Phases of Disaster Risk Management, Measures for Disaster Risk Reduction	1 Hour
3.3	Measures for Disaster prevention, mitigation, and preparedness.	1 Hour

3.4	Disaster response- objectives, requirements. Disaster response planning; types of responses.	1 Hour
3.5	Introduction- Disaster Relief, Relief; international relief organizations.	1 Hour
	Module 4	5 Hours
4.1	Participatory stakeholder engagement	1 Hour
4.2	Importance of disaster communication.	1 Hour
4.3	Disaster communication- methods, barriers. Crisis counselling	1 Hour
4.4	Introduction to Capacity Building. Concept – Structural Measures, Non-structural Measures.	1 Hour
4.5	Introduction to Capacity Assessment, Capacity Assessment; Strengthening, Capacity for Reducing Risk	1 Hour
	Module 5	5 Hours
5.1	Introduction-Common disaster types in India.	1 Hour
5.2	Common disaster legislations in India on disaster management	1 Hour
5.3	National disaster management policy, Institutional arrangements for disaster management in India.	1 Hour
5.4	The Sendai Framework for Disaster Risk Reduction and targets	1 Hour
5.5	The Sendai Framework for Disaster Risk Reduction-priorities for action, guiding principles	1 Hour

HUT 300	Industrial Economics & Foreign Trade	Category	L	T	P	CREDIT
		HSMC	3	0	0	3

Preamble: To equip the students to take industrial decisions and to create awareness of economic environment.

Prerequisite: Nil

Course Outcomes: After the completion of the course the student will be able to

CO1	Explain the problem of scarcity of resources and consumer behaviour, and to evaluate the impact of government policies on the general economic welfare. (Cognitive knowledge level: Understand)
CO2	Take appropriate decisions regarding volume of output and to evaluate the social cost of production. (Cognitive knowledge level: Apply)
CO3	Determine the functional requirement of a firm under various competitive conditions. (Cognitive knowledge level: Analyse)
CO4	Examine the overall performance of the economy, and the regulation of economic fluctuations and its impact on various sections in the society. (Cognitive knowledge level: Analyse)
CO5	Determine the impact of changes in global economic policies on the business opportunities of a firm. (Cognitive knowledge level: Analyse)

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2										3	
CO2	2	2			2	2	3				3	
CO3	2	2	1								3	
CO4	2	2	1			1					3	
CO5	2	2	1								3	

Abstract POs defined by National Board of Accreditation			
PO#	Broad PO	PO#	Broad PO
PO1	Engineering Knowledge	PO7	Environment and Sustainability
PO2	Problem Analysis	PO8	Ethics
PO3	Design/Development of solutions	PO9	Individual and team work
PO4	Conduct investigations of complex problems	PO10	Communication
PO5	Modern tool usage	PO11	Project Management and Finance
PO6	The Engineer and Society	PO12	Lifelong learning

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination Marks
	Test 1 (Marks)	Test 2 (Marks)	
Remember	15	15	30
Understand	20	20	40
Apply	15	15	30

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance	: 10 marks
Continuous Assessment - Test (2 numbers)	: 25 marks
Continuous Assessment - Assignment	: 15 marks

Internal Examination Pattern:

Each of the two internal examinations has to be conducted out of 50 marks. First series test shall be preferably conducted after completing the first half of the syllabus and the second series test shall be preferably conducted after completing remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly completed module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly completed module), each with 7 marks. Out of the 7 questions, a student should answer any 5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B.

Part A	: 30 marks
Part B	: 70 marks

Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which a student should answer any one. Each question can have maximum 3 sub-divisions and carries 14 marks.

SYLLABUS

HUT 300 Industrial Economics & Foreign Trade

Module 1 (Basic Concepts and Demand and Supply Analysis)

Scarcity and choice - Basic economic problems- PPC – Firms and its objectives – types of firms – Utility – Law of diminishing marginal utility – Demand and its determinants – law of demand – elasticity of demand – measurement of elasticity and its applications – Supply, law of supply and determinants of supply – Equilibrium – Changes in demand and supply and its effects – Consumer surplus and producer surplus (Concepts) – Taxation and deadweight loss.

Module 2 (Production and cost)

Production function – law of variable proportion – economies of scale – internal and external economies – Isoquants, isocost line and producer's equilibrium – Expansion path – Technical progress and its implications – Cobb-Douglas production function - Cost concepts – Social cost: private cost and external cost – Explicit and implicit cost – sunk cost - Short run cost curves - long run cost curves – Revenue (concepts) – Shutdown point – Break-even point.

Module 3 (Market Structure)

Perfect and imperfect competition – monopoly, regulation of monopoly, monopolistic competition (features and equilibrium of a firm) – oligopoly – Kinked demand curve – Collusive oligopoly (meaning) – Non-price competition – Product pricing – Cost plus pricing – Target return pricing – Penetration pricing – Predatory pricing – Going rate pricing – Price skimming.

Module 4 (Macroeconomic concepts)

Circular flow of economic activities – Stock and flow – Final goods and intermediate goods - Gross Domestic Product - National Income – Three sectors of an economy- Methods of measuring national income – Inflation- causes and effects – Measures to control inflation- Monetary and fiscal policies – Business financing- Bonds and shares -Money market and Capital market – Stock market – Demat account and Trading account - SENSEX and NIFTY.

Module 5 (International Trade)

Advantages and disadvantages of international trade - Absolute and Comparative advantage theory - Heckscher - Ohlin theory - Balance of payments – Components – Balance of Payments

deficit and devaluation – Trade policy – Free trade versus protection – Tariff and non-tariff barriers.

Reference Materials

1. Gregory N Mankiw, 'Principles of Micro Economics', Cengage Publications
2. Gregory N Mankiw, 'Principles of Macro Economics', Cengage Publications
3. Dwivedi D N, 'Macro Economics', Tata McGraw Hill, New Delhi.
4. Mithani D M, 'Managerial Economics', Himalaya Publishing House, Mumbai.
5. Francis Cherunilam, 'International Economics', McGraw Hill, New Delhi.

Sample Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Why does the problem of choice arise?
2. What are the central problems?
3. How do we solve the basic economic problems?
4. What is the relation between price and demand?
5. Explain deadweight loss due to the imposition of a tax.

Course Outcome 2 (CO2):

1. What is shutdown point?
2. What do you mean by producer equilibrium?
3. Explain break-even point;
4. Suppose a chemical factory is functioning in a residential area. What are the external costs?

Course Outcome 3 (CO3):

1. Explain the equilibrium of a firm under monopolistic competition.
2. Why is a monopolist called price maker?
3. What are the methods of non-price competition under oligopoly?

4. What is collusive oligopoly?

Course Outcome 4 (CO4):

1. What is the significance of national income estimation?
2. How is GDP estimated?
3. What are the measures to control inflation?
4. How does inflation affect fixed income group and wage earners?

Course Outcome 5 (CO5):

1. What is devaluation?
2. Suppose a foreign country imposes a tariff on Indian goods. How does it affect India's exports?
3. What is free trade?
4. What are the arguments in favour of protection?

Model Question paper

QP CODE:

PAGES:3

Reg No:_____

Name :_____

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY FIFTH /SIXTH SEMESTER
B.TECH DEGREE EXAMINATION, MONTH & YEAR**

Course Code: HUT 300

Course Name: Industrial Economics & Foreign Trade

Max.Marks:100

Duration: 3 Hours

PART A

Answer all Questions. Each question carries 3 Marks

1. Why does an economic problem arise?
2. What should be the percentage change in price of a product if the sale is to be increased by 50 percent and its price elasticity of demand is 2?
3. In the production function $Q = 2L^{1/2}K^{1/2}$ if $L=36$ how many units of capital are needed to produce 60 units of output?
4. Suppose in the short run $AVC < P < AC$. Will this firm produce or shut down? Give reason.
5. What is predatory pricing?
6. What do you mean by non- price competition under oligopoly?
7. What are the important economic activities under primary sector?
8. Distinguish between a bond and share?
9. What are the major components of balance of payments?

10. What is devaluation?

(10 x 3 = 30 marks)

PART B

(Answer one full question from each module, each question carries 14 marks)

MODULE I

11. a) Prepare a utility schedule showing units of consumption, total utility and marginal utility, and explain the law of diminishing marginal utility. Point out any three limitations of the law.
- b) How is elasticity of demand measured according to the percentage method? How is the measurement of elasticity of demand useful for the government?

Or

12. a) Explain the concepts consumer surplus and producer surplus.
- b) Suppose the government imposes a tax on a commodity where the tax burden is met by the consumers. Draw a diagram and explain dead weight loss. Mark consumer surplus, producer surplus, tax revenue and dead weight loss in the diagram.

MODULE II

13. a) What are the advantages of large-scale production?
- b) Explain Producer equilibrium with the help of isoquants and isocost line. What is expansion path?

Or

14. a) Explain break-even analysis with the help of a diagram.
- b) Suppose the monthly fixed cost of a firm is Rs. 40000 and its monthly total variable cost is Rs. 60000.
- If the monthly sales is Rs. 120000 estimate contribution and break-even sales.
 - If the firm wants to get a monthly profit of Rs.40000, what should be the sales?
- c) The total cost function of a firm is given as $TC=100+50Q - 11Q^2+Q^3$. Find marginal cost when output equals 5 units.

MODULE III

15. a) What are the features of monopolistic competition?
b) Explain the equilibrium of a firm earning supernormal profit under monopolistic competition.

Or

16. a) Make comparison between perfect competition and monopoly.
b) Explain price rigidity under oligopoly with the help of a kinked demand curve.

MODULE IV

17. a) How is national income estimated under product method and expenditure method?
b) Estimate GDPmp, GNPmp and National income

Private consumption expenditure	= 2000 (in 000 cores)
Government Consumption	= 500
NFIA	= -(300)
Investment	= 800
Net=exports	=700
Depreciation	= 400
Net-indirect tax	= 300

Or

18. a) What are the monetary and fiscal policy measures to control inflation?
b) What is SENSEX?

MODULE V

19. a) What are the advantages of disadvantages of foreign trade?
b) Explain the comparative cost advantage.

Or

20. a) What are the arguments in favour protection?
b) Examine the tariff and non-tariff barriers to international trade.

(5 × 14 = 70 marks)

Teaching Plan

Module 1 (Basic concepts and Demand and Supply Analysis)		7 Hours
1.1	Scarcity and choice – Basic economic problems - PPC	1 Hour
1.2	Firms and its objectives – types of firms	1 Hour
1.3	Utility – Law of diminishing marginal utility – Demand – law of demand	1 Hour
1.4	Measurement of elasticity and its applications	1 Hour
1.5	Supply, law of supply and determinants of supply	1 Hour
1.6	Equilibrium – changes in demand and supply and its effects	1 Hour
1.7	Consumer surplus and producer surplus (Concepts) – Taxation and deadweight loss.	1 Hour
Module 2 (Production and cost)		7 Hours
2.1	Productions function – law of variable proportion	1 Hour
2.2	Economies of scale – internal and external economies	1 Hour
2.3	producers equilibrium – Expansion path	1 Hour
2.4	Technical progress and its implications – cob Douglas Production function	1 Hour
2.5	Cost concepts – social cost: private cost and external cost – Explicit and implicit cost – sunk cost	1 Hour
2.6	Short run cost curves & Long run cost curves	1 Hour
2.7	Revenue (concepts) – shutdown point – Break-even point.	1 Hour
Module 3 (Market Structure)		6 hours
3.1	Equilibrium of a firm, MC – MR approach and TC – TR approach	1 Hour
3.2	Perfect competition & Imperfect competition	1 Hour
3.3	Monopoly – Regulation of monopoly – Monopolistic competition	1 Hour
3.4	Oligopoly – kinked demand curve	1 Hour
3.5	Collusive oligopoly (meaning) – Non price competition	1 Hour
3.6	Cost plus pricing – Target return pricing – Penetration, Predatory pricing – Going rate pricing – price skimming	1 Hour

Module 4 (Macroeconomic concepts)		7 Hours
4.1	Circular flow of economic activities	1 Hour
4.2	Stock and flow – Final goods and intermediate goods – Gross Domestic Product - National income – Three sectors of an economy	1 Hour
4.3	Methods of measuring national income	1 Hour
4.4	Inflation – Demand pull and cost push – Causes and effects	1 Hour
4.5	Measures to control inflation – Monetary and fiscal policies	1 Hour
4.6	Business financing – Bonds and shares – Money market and capital market	1 Hour
4.7	Stock market – Demat account and Trading account – SENSEX and NIFTY	1 Hour
Module 5 (International Trade)		8 Hours
5.1	Advantages and disadvantages of international trade	1 Hour
5.2	Absolute and comparative advantage theory	2 Hour
5.3	Heckscher – Ohlin theory	1 Hour
5.4	Balance of payments - components	1 Hour
5.5	Balance of payments deficit and devaluation	1 Hour
5.6	Trade policy – Free trade versus protection	1 Hour
5.7	Tariff and non tariff barriers.	1 Hour

HUT 310	Management for Engineers	Category	L	T	P	Credit
		HMC	3	0	0	3

Preamble: This course is intended to help the students to learn the basic concepts and functions of management and its role in the performance of an organization and to understand various decision-making approaches available for managers to achieve excellence. Learners shall have a broad view of different functional areas of management like operations, human resource, finance and marketing.

Prerequisite: Nil

Course Outcomes After the completion of the course the student will be able to

CO1	Explain the characteristics of management in the contemporary context (Cognitive Knowledge level: Understand).
CO2	Describe the functions of management (Cognitive Knowledge level: Understand).
CO3	Demonstrate ability in decision making process and productivity analysis (Cognitive Knowledge level: Understand).
CO4	Illustrate project management technique and develop a project schedule (Cognitive Knowledge level: Apply).
CO5	Summarize the functional areas of management (Cognitive Knowledge level: Understand).
CO6	Comprehend the concept of entrepreneurship and create business plans (Cognitive Knowledge level: Understand).

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2				1	2	2	2		2	1	1
CO2	2				1	1		2	1	2	1	1
CO3	2	2	2	2	1							
CO4	2	2	2	2	1						2	1
CO5	2					1	1		1	2	1	
CO6		2	2	2	1	1	1	1	1	1	1	1

Abstract POs defined by National Board of Accreditation			
PO1	Engineering Knowledge	PO7	Environment and Sustainability
PO2	Problem Analysis	PO8	Ethics
PO3	Design/Development of solutions	PO9	Individual and team work
PO4	Conduct investigations of complex problems	PO10	Communication
PO5	Modern tool usage	PO11	Project Management and Finance
PO6	The Engineer and Society	PO12	Life long learning

Assessment Pattern

Bloom's Category	Test 1 (Marks in percentage)	Test 2 (Marks in percentage)	End Semester Examination (Marks in percentage)
Remember	15	15	30
Understand	15	15	30
Apply	20	20	40
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 Hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks

Continuous Assessment - Test : 25 marks

Continuous Assessment - Assignment : 15 marks

Internal Examination Pattern:

Each of the two internal examinations has to be conducted out of 50 marks. First series test shall be preferably conducted after completing the first half of the syllabus and the second series test shall be preferably conducted after completing remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly completed module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly completed module), each with 7 marks. Out of the 7 questions, a student should answer any 5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which a student should answer any one. Each question can have maximum 2 sub-divisions and carries 14 marks.

SYLLABUS

HUT 310 Management for Engineers (35 hrs)

Module 1 (Introduction to management Theory- 7 Hours)

Introduction to management theory, Management Defined, Characteristic of Management, Management as an art-profession, System approaches to Management, Task and Responsibilities of a professional Manager, Levels of Manager and Skill required.

Module 2 (management and organization- 5 hours)

Management Process, Planning types , Mission, Goals, Strategy, Programmes, Procedures, Organising, Principles of Organisation, Delegation, Span of Control, Organisation Structures, Directing, Leadership, Motivation, Controlling..

Module 3 (productivity and decision making- 7 hours)

Concept of productivity and its measurement; Competitiveness; Decision making process; decision making under certainty, risk and uncertainty; Decision trees; Models of decision making.

. Module 4 (project management- 8 hours)

Project Management, Network construction, Arrow diagram, Redundancy. CPM and PERT Networks, Scheduling computations, PERT time estimates, Probability of completion of project, Introduction to crashing.

Module 5 (functional areas of management- 8 hours)

Introduction to functional areas of management, Operations management, Human resources management, Marketing management, Financial management, Entrepreneurship, Business plans, Corporate social responsibility, Patents and Intellectual property rights.

References:

1. H. Koontz, and H. Weihrich, Essentials of Management: An International Perspective. 8th ed., McGraw-Hill, 2009.
2. P C Tripathi and P N Reddy, Principles of management, TMH, 4th edition, 2008.
3. P. Kotler, K. L. Keller, A. Koshy, and M. Jha, Marketing Management: A South Asian Perspective. 14th ed., Pearson, 2012.
4. M. Y. Khan, and P. K. Jain, Financial Management, Tata-McGraw Hill, 2008.
5. R. D. Hisrich, and M. P. Peters, Entrepreneurship: Strategy, Developing, and Managing a New Enterprise, 4th ed., McGraw-Hill Education, 1997.
6. D. J. Sumanth, Productivity Engineering and Management, McGraw-Hill Education, 1985.
7. K.Ashwathappa, 'Human Resources and Personnel Management', TMH, 3rd edition, 2005.
8. R. B. Chase, Ravi Shankar and F. R. Jacobs, Operations and Supply Chain Management, 14th ed. McGraw Hill Education (India), 2015.

Sample Course Level Assessment Questions

Course Outcome1 (CO1): Explain the systems approach to management?

Course Outcome 2 (CO2): Explain the following terms with a suitable example Goal, Objective, and Strategy.

Course Outcome 3 (CO3): Mr. Shyam is the author of what promises to be a successful novel. He has the option to either publish the novel himself or through a publisher. The publisher is offering Mr. Shyam Rs. 20,000 for signing the contract. If the novel is successful, it will sell 200,000 copies. Else, it will sell 10,000 copies only. The publisher pays a Re. 1 royalty per copy. A market survey indicates that there is a 70% chance that the novel will be successful. If Mr. Shyam undertakes publishing, he will incur an initial cost of Rs. 90,000 for printing and marketing., but each copy sold will net him Rs. 2. Based on the given information and the

decision analysis method, determine whether Mr. Shyam should accept the publisher's offer or publish the novel himself.

Course Outcome 4 (CO4): Explain the concepts of crashing and dummy activity in project management.

Course Outcome 5 (CO5): Derive the expression for the Economic order quantity (EOQ)?

Course Outcome 6 (CO6): Briefly explain the theories of Entrepreneurial motivation.?

Model Question Paper

QP CODE:

PAGES: 4

Reg No: _____

Name: _____

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
FOURTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR**

Course Code: HUT 310

Course name: Management for Engineers

Max Marks: 100

Duration: 3 Hours

PART-A (Answer All Questions. Each question carries 3 marks)

1. “Management is getting things done through other.” Elaborate.
2. Comment on the true nature of management. Is it a science or an art?
3. Planning is looking ahead and controlling is looking back. Comment with suitable examples
4. Explain the process of communication?
5. Explain the hierarchy of objectives?
6. Explain the types of decisions?
7. Describe the Economic man model?
8. Explain the concepts of crashing and dummy activity in project management.
9. Differentiate the quantitative and qualitative methods in forecasting.
10. What are the key metrics for sustainability measurement? What makes the measurement and reporting of sustainability challenging?

PART-B (Answer any one question from each module)

11. a) Explain the systems approach to management. (10)
b) Describe the roles of a manager (4)

OR

12. a) Explain the 14 principles of administrative management? **(10)**

b) Explain the different managerial skills **(4)**

13. a) What are planning premises, explain the classification of planning premises. **(10)**

b) Distinguish between strategy and policy. How can policies be made effective. **(4)**

OR

14 a) Explain three motivational theories. **(9)**

b) Describe the managerial grid. **(5)**

15. a) Modern forest management uses controlled fires to reduce fire hazards and to stimulate new forest growth. Management has the option to postpone or plan a burning. In a specific forest tract, if burning is postponed, a general administrative cost of Rs. 300 is incurred. If a controlled burning is planned, there is a 50% chance that good weather will prevail and burning will cost Rs. 3200. The results of the burning may be either successful with probability 0.6 or marginal with probability 0.4. Successful execution will result in an estimated benefit of Rs. 6000, and marginal execution will provide only Rs. 3000 in benefits. If the weather is poor, burning will be cancelled incurring a cost of Rs. 1200 and no benefit. i) Develop a decision tree for the problem. (ii) Analyse the decision tree and determine the optimal course of action. **(8)**

b) Student tuition at ABC University is \$100 per semester credit hour. The Education department supplements the university revenue by matching student tuition, dollars per dollars. Average class size for typical three credit course is 50 students. Labour costs are \$4000 per class, material costs are \$20 per student, and overhead cost are \$25,000 per class. (a) Determine the total factor productivity. (b) If instructors deliver lecture 14 hours per week and the semester lasts for 16 weeks, what is the labour productivity? **(6)**

OR

16. a) An ice-cream retailer buys ice cream at a cost of Rs. 13 per cup and sells it for Rs. 20 per cup; any remaining unsold at the end of the day, can be disposed at a salvage price of Rs. 2.5 per cup. Past sales have ranged between 13 and 17 cups per day; there is no reason to believe that

sales volume will take on any other magnitude in future. Find the expected monetary value and EOL, if the sales history has the following probabilities:

(9)

Market Size	13	14	15	16	17
Probability	0.10	0.15	0.15	0.25	0.35

b) At Modern Lumber Company, Kishore the president and a producer of an apple crates sold to growers, has been able, with his current equipment, to produce 240 crates per 100 logs. He currently purchases 100 logs per day, and each log required 3 labour hours to process. He believes that he can hire a professional buyer who can buy a better quality log at the same cost. If this is the case, he increases his production to 260 crates per 100 logs. His labour hours will increase by 8 hours per day. What will be the impact on productivity (measured in crates per labour-hour) if the buyer is hired? What is the growth in productivity in this case?

(5)

17. a) A project has the following list of activities and time estimates:

Activity	Time (Days)	Immediate Predecessors
A	1	-
B	4	A
C	3	A
D	7	A
E	6	B
F	2	C, D
G	7	E, F
H	9	D
I	4	G, H

(a) Draw the network. (b) Show the early start and early finish times. (c) Show the critical path.

(10)

b) An opinion survey involves designing and printing questionnaires, hiring and training personnel, selecting participants, mailing questionnaires and analysing data. Develop the precedence relationships and construct the project network. **(4)**

OR

18. a) The following table shows the precedence requirements, normal and crash times, and normal and crash costs for a construction project:

Activity	Immediate Predecessors	Required Time (Weeks)		Cost (Rs.)	
		Normal	Crash	Normal	Crash
A	-	4	2	10,000	11,000
B	A	3	2	6,000	9,000
C	A	2	1	4,000	6,000
D	B	5	3	14,000	18,000
E	B, C	1	1	9,000	9,000
F	C	3	2	7,000	8,000
G	E, F	4	2	13,000	25,000
H	D, E	4	1	11,000	18,000
I	H, G	6	5	20,000	29,000

Draw the network. (b) Determine the critical path. (c) Determine the optimal duration and the associated cost. **(10)**

b) Differentiate between CPM and PERT. **(4)**

19. a) What is meant by market segmentation and explain the process of market segmentation **(8)**

b) The Honda Co. in India has a division that manufactures two-wheel motorcycles. Its budgeted sales for Model G in 2019 are 80,00,000 units. Honda's target ending inventory is 10,00, 000 units and its beginning inventory is 12, 00, 000 units. The company's budgeted selling price to its distributors and dealers is Rs. 40, 000 per motorcycle. Honda procures all its wheels from an

outside supplier. No defective wheels are accepted. Honda's needs for extra wheels for replacement parts are ordered by a separate division of the company. The company's target ending inventory is 3,00,000 wheels and its beginning inventory is 2,00,000 wheels. The budgeted purchase price is Rs. 1,600 per wheel.

(a) Compute the budgeted revenue in rupees.

(b) Compute the number of motorcycles to be produced.

Compute the budgeted purchases of wheels in units and in rupees.? **(6)**

OR

20. a) a) "Human Resource Management policies and principles contribute to effectiveness, continuity and stability of the organization". Discuss. (b) What is a budget? Explain how sales budget and production budgets are prepared? **(10)**

b) Distinguish between the following: (a) Assets and Liabilities (b) Production concept and Marketing concept (c) Needs and Wants (d) Design functions and Operational control functions in operations **(4)**

Teaching Plan

Sl.No	TOPIC	SESSION
	Module I	
1.1	Introduction to management	1
1.2	Levels of managers and skill required	2
1.3	Classical management theories	3
1.4	neo-classical management theories	4
1.5	modern management theories	5
1.6	System approaches to Management,	6
1.7	Task and Responsibilities of a professional Manager	7
	Module 2	
2.1	Management process – planning	8
2.2	Mission – objectives – goals – strategy – policies – programmes – procedures	9
2.3	Organizing, principles of organizing, organization structures	10
2.4	Directing, Leadership	11
2.5	Motivation, Controlling	12
	Module III	
3.1	Concept of productivity and its measurement Competitiveness	13
3.2	Decision making process;	14
3.3	Models in decision making	15
3.4	Decision making under certainty and risk	16
3.5	Decision making under uncertainty	17
3.6	Decision trees	18
3.7	Models of decision making.	19
	Module IV	
4.1	Project Management	20

Sl.No	TOPIC	SESSION
	Module I	
4.2	Network construction	21
4.3	Arrow diagram, Redundancy	22
4.4	CPM and PERT Networks	23
4.5	Scheduling computations	24
4.6	PERT time estimates	25
4.7	Probability of completion of project	26
4.8	Introduction to crashing	
	Module V	
5.1	Introduction to functional areas of management,	28
5.2	Operations management	29
5.3	Human resources management ,	30
5.4	Marketing management	31
5.5	Financial management	32
5.6	Entrepreneurship,	33
5.7	Business plans	34
5.8	Corporate social responsibility, Patents and Intellectual property rights	35

APJ ABDUL KALAM
TECHNOLOGICAL
UNIVERSITY

SEMESTER VII



SCHEME : 2019

PROGRAMME: CSE (CYBER SECURITY)

CCT 401	ETHICAL HACKING	CATEGORY	L	T	P	Credits	Year of Introduction
		PCC	2	1	0	3	2019

Preamble:

The course enables students to learn ethical hacking and security challenges in computer networking. It addresses the data security issues, types of attacks including malwares, viruses, sniffer and denial of service. Students will also learn how to protect the network system using firewalls and filters, about the legal, professional and ethical issues.

Prerequisite: Knowledge in Cryptography, System and Network Security, Computer Networks.

Course Outcomes: After the completion of the course the student will be able to

CO#	Course Outcomes
CO1	Explain the basic concepts of Ethical hacking. (Cognitive Knowledge Level: Understand)
CO2	Utilize the tools to conduct competitive intelligence and social engineering. (Cognitive Knowledge Level: Apply)
CO3	Examine the different types of cyber and network attack vectors and players. (Cognitive Knowledge Level: Apply)
CO4	Use different security techniques to protect system and user data. (Cognitive Knowledge Level: Apply)
CO5	Infer the basic concepts of logging and safeguard controls/measures. (Cognitive Knowledge Level: Understand)

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓			✓						✓
CO2	✓	✓	✓		✓							✓
CO3	✓	✓	✓		✓							✓
CO4	✓	✓	✓		✓							✓
CO5	✓	✓	✓			✓						✓

Abstract POs defined by National Board of Accreditation			
PO#	Broad PO	PO#	Broad PO
PO1	Engineering Knowledge	PO7	Environment and Sustainability
PO2	Problem Analysis	PO8	Ethics
PO3	Design/Development of solutions	PO9	Individual and team work
PO4	Conduct investigations of complex problems	PO10	Communication
PO5	Modern tool usage	PO11	Project Management and Finance
PO6	The Engineer and Society	PO12	Lifelong learning

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination Marks (%)
	Test1 (%)	Test2 (%)	
Remember	30	30	30
Understand	30	30	30
Apply	40	40	40
Analyze			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance	: 10 marks
Continuous Assessment Tests	: 25 marks
Continuous Assessment Assignment	: 15 marks

Internal Examination Pattern:

Each of the two internal examinations has to be conducted out of 50 marks. First Internal Examination shall be preferably conducted after completing the first half of the syllabus and the Second Internal Examination shall be preferably conducted after completing the remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly covered module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly covered module), each with 7 marks. Out of the 7 questions in Part B, a student should answer any 5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which a student should answer any one. Each question can have a maximum 2 subdivisions and carries 14 marks.

Syllabus**Module 1(Introduction to Ethical Hacking)**

Elements of Information Security, Authenticity and Non-Repudiation, Security Challenges, Effects of Hacking, Hacker – Types of Hacker, Ethical Hacker ,Role of Security and Penetration Tester, Penetration Testing Methodologies :- OSSTMM, NIST, OWASP, Categories of Penetration Test, Types of Penetration Tests, Vulnerability Assessment.

Module 2(Foot Printing and Social Engineering)

Tools for Foot Printing, Conducting Competitive Intelligence, Google Hacking, Scanning, Enumeration, Trojans & Backdoors, Virus & Worms, Proxy & Packet Filtering, Denial of Service, Sniffer, Social Engineering–shoulder surfing, Dumpster Diving, Piggybacking.

Module 3(Network attacks)

Vulnerability Data Resources – Exploit Databases – Network Sniffing – Types of Sniffing – MITM Attacks – ARP Attacks – Denial of Service Attacks - Hijacking Session with MITM Attack -DNS Spoofing – ARP Spoofing Attack Manipulating the DNS Records – DHCP Spoofing -Remote

Exploitation – Attacking Network Remote Services – Overview of Brute Force Attacks – Traditional Brute Force – Attacking SMTP – Attacking SQL Servers – Testing for Weak Authentication.

Module 4(Network Protection System & Hacking Web servers)

Routers, Firewall & Honey pots, IDS & IPS, Web Filtering, Vulnerability, Penetration Testing, Session Hijacking, Web Server, SQL Injection, Cross Site Scripting, Exploit Writing, Buffer Overflow, Reverse Engineering, Email Hacking, Incident Handling & Response, Bluetooth Hacking, Mobiles Phone Hacking.

Module 5(Event Logging)

Covering tracks and hiding-Event Logging, Hiding evidence by altering event log. Defenses against log and accounting file attacks, Hiding evidence on the network. System hacking: Password Cracking, Escalating Privileges, and Hiding Files

Textbooks

1. Michael T Simpson, Kent Back man, James Corley, “Hands on ethical hacking and network defense”, Cengage Learning, 2nd edition, 2010.
2. Ed Skoudis and Tom Liston, “Counter Hack Reloaded: A step-by-step guide to computer attacks and effective defenses”, Prentice Hall Series in Computer Networking and security, 2nd edition, 2006.
3. Rafay Baloch, “Ethical Hacking and Penetration Testing Guide”, CRC Press, 2014.

References

1. Kimberly Graves, “Certified Ethical Hacker: A Study Guide”, Wiley Publishing, Inc., 2010.
2. Stuart Mc Clure, Joel Scambray, “Hacking Exposed 7 :Network Security Secrets & Solutions”, McGraw-Hill publishing, edition 7, 2012

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Explain the different stages in Ethical hacking.
2. The role of penetration testers in the current scenario is inevitable. Justify.

Course Outcome 2 (CO2):

1. Use a suitable tool to perform any of the social engineering attack. What are its inferences?

Course Outcome 3 (CO3):

1. Describe how session hijacking is performed by using MITM attack.
2. Use a suitable tool to perform brute force attack.

Course Outcome 4 (CO4):

1. Explain how vulnerability is assessed using penetration testing.
2. Cross site scripting can be prevented. Explain.

Course Outcome 5 (CO5):

1. Explain the different safeguard measures used to hide evidence.
2. Password cracking a boon or bane. Explain both contexts.

MODEL QUESTION PAPER**QP CODE: Reg No:** _____**Name :** _____**PAGES : 3****APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY****SIXTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR****Course Code: CCT 401****Course Name: Ethical Hacking****Max.Marks:100****Duration: 3 Hours****PART A****Answer all Questions. Each question carries 3 Marks**

1. What are the different stages involved in hacking?
2. Define the basic elements of information security.
3. What is foot printing? How is it done?
4. How Distributed DoS is different from DoS?
5. Explain network sniffing.
6. How is Brute-force attack performed?
7. What is SQL injection? How can you find whether the website is affected by SQL injection?
8. What is cross-site scripting and what are its different variations?

9. List out the challenges in password cracking.
10. Define Event logging.

(10*3=30 Marks)

PART B

Answer any One Question from each module. Each question carries 14 Marks

- 11(a) Write down the security challenges in information security. **(6 marks)**
- (b) Describe the different types of penetration testing. **(8 marks)**

OR

- 12(a) Explain the role of a penetration tester in ethical hacking. **(8 marks)**
- (b) Describe how vulnerability assessment is done. **(6 marks)**

- 13(a) Explain any one method to showcase dumpster diving social engineering attack. **(8marks)**
- (b) What are the results obtained by the usage of foot printing tools? **(6 marks)**

OR

- 14(a) Explain how social enumeration is performed. **(6marks)**
- (b) Illustrate the working of network sniffers. **(8 marks)**

- 15(a) How DNS records can be manipulated using ARP spoofing? **(6 marks)**
- (b) Explain network sniffing and its different types? **(8marks)**

OR

- 16(a) Describe DHCP Spoofing. **(6marks)**
- (b) How SQL Servers are vulnerable attacked? **(8marks)**

- 17(a) Compare and contrast Session Hijacking & SQL Injection. **(8marks)**
- (b) Explain how Reverse Engineering is done. **(6marks)**

OR

- 18(a) Differentiate Bluetooth Hacking & Mobile Phone Hacking. **(6marks)**
- (b) Explain the concept of Incident Handling & Response. **(8 marks)**

- 19(a) How can we hide evidence by altering event logs? **(6marks)**
- (b) What are the defense methods taken against log and accounting file attacks? **(8marks)**

OR

- 20(a) Explain how Password cracking method is used for system hacking? Explain any one tool used for cracking usernames and passwords. **(8marks)**
- (b) Evidence on network can be hidden. Justify? **(6 marks)**

TEACHING PLAN

Sl.No	Contents	No. of Lecture Hrs (37)
Module 1(Introduction to Ethical Hacking) (8 hrs)		
1.1	Elements of Information Security, Authenticity and Non-Repudiation	1
1.2	Security Challenges, Effects of Hacking	1
1.3	Hacker – Types of Hacker, Ethical Hacker- Explanation	1
1.4	Role of Security and Penetration Tester	1
1.5	Penetration Testing Methodologies:–OSSTMM, NIST	1
1.6	OWASP	1
1.7	Categories of Penetration Test, Types of Penetration Tests	1
1.8	Vulnerability Assessment	1
Module 2(Foot Printing and Social Engineering) (6 hrs)		
2.1	Tools for Foot Printing, Conducting Competitive Intelligence	1
2.2	Google Hacking, Scanning, Enumeration	1
2.3	Trojans & Backdoors, Virus & Worms	1
2.4	Proxy & Packet Filtering	1
2.5	Denial of Service, Sniffer	1
2.6	Social Engineering – shoulder surfing, Dumpster Diving, Piggybacking	1
Module 3(Network attacks) (9 hrs)		
3.1	Vulnerability Data Resources – Exploit Databases	1
3.2	Network Sniffing – Types of Sniffing	1
3.3	MITM Attacks – ARP Attacks, Denial of Service Attacks	1
3.4	Hijacking Session with MITM Attack	1
3.5	DNS Spoofing – ARP Spoofing Attack	1
3.6	Manipulating the DNS Records – DHCP Spoofing	1
3.7	Remote Exploitation – Attacking Network Remote Services	1
3.8	Overview of Brute Force Attacks – Traditional Brute Force	1
3.9	Attacking SMTP – Attacking SQL Servers, Testing for Weak Authentication	1
Module 4(Network Protection System & Hacking Web servers) (8 hrs)		
4.1	Routers, Firewall & Honeypots	1
4.2	IDS & IPS, Web Filtering, Vulnerability	1

4.3	Penetration Testing, Session Hijacking, Web Server	1
4.4	SQL Injection	1
4.5	Cross-Site-Scripting, Exploit Writing, Buffer-Overflow	1
4.6	Reverse Engineering, Email Hacking	1
4.7	Incident Handling & Response, Bluetooth Hacking	1
4.8	Mobiles Phone Hacking	1

Module 5(Event Logging) (6 hrs)

5.1	Covering tracks and hiding-Event-Logging	1
5.2	Hiding evidence by altering event log	1
5.3	Defenses against log and accounting file attacks	1
5.4	Hiding evidence on the network.	1
5.5	System hacking: Password Cracking,	1
5.6	Escalating Privileges, and Hiding Files	1



CCL 411	ETHICAL HACKING LAB	CATEGORY	L	T	P	CREDITS	Year of Introduction
		PCC	0	0	3	2	2019

Preamble: The aim of the course is to give practical exposure on various methods used in Ethical Hacking and to trace out vulnerabilities.

Prerequisite: Topics covered under the course Ethical Hacking.

Course Outcomes: After the completion of the course the student will be able to

CO1	Use the tools available in Kali Linux to perform Reconnaissance (Cognitive Knowledge Level: Apply)
CO2	Use the tools available online or in Kali Linux to perform Configuration and deployment testing (Cognitive Knowledge Level: Apply)
CO3	Compute Infrastructure and Application Admin Interface (Cognitive Knowledge Level: Apply)
CO4	Use the tools available online or in Kali Linux to perform identity management testing (Cognitive Knowledge Level :Apply)
CO5	Use the tools available online or in Kali Linux to perform authorization and authentication testing (Cognitive Knowledge Level: Apply)
CO6	Use the tools available online or in Kali Linux to perform input validation and client side testing (Cognitive Knowledge Level : Apply)

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

CO6												

Abstract POs defined by National Board of Accreditation			
PO#	Broad PO	PO#	Broad PO
PO1	Engineering Knowledge	PO7	Environment and Sustainability
PO2	Problem Analysis	PO8	Ethics
PO3	Design/Development of solutions	PO9	Individual and teamwork
PO4	Conduct investigations of complex problems	PO10	Communication
PO5	Modern tool usage	PO11	Project Management and Finance
PO6	The Engineer and Society	PO12	Lifelong learning

Assessment Pattern

Bloom's Category	Continuous Assessment Test (Internal Exam)(%)	End Semester Examination (%)
Remember	20	20
Understand	20	20
Apply	60	60
Analyse		
Evaluate		
Create		

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	75	75	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 15 marks

Continuous Evaluation in Lab	: 30 marks
Continuous Assessment Test	: 15 marks
Viva-voce	: 15marks

Internal Examination Pattern:

The marks will be distributed as Algorithm 30 marks, Program 20 marks, Output 20 marks and Viva 30 marks. Total 100 marks which will be converted out of 75 while calculating Internal Evaluation marks.

End Semester Examination Pattern:

The marks will be distributed as Algorithm 30 marks, Program 20 marks, Output 20 marks and Viva 30 marks. Total 100 marks will be converted out of 75 for End Semester Examination.

Operating System to Use in Lab : Kali Linux/Windows 7/8/10

Software to Use in Lab : Penetration Testing Softwares/Tools- Open Source

Fair Lab Record:

All Students attending the Lab should have a Fair Record. The fair record should be produced in the University Lab Examination. Every experiment conducted in the lab should be noted in the fair record. For every experiment in the fair record the right hand page should contain Experiment Heading, Experiment Number, Date of Experiment, Aim of Experiment, Data Structure used and the operations performed on them, Details of Experiment including algorithm and Result of Experiment. The left hand page should contain a print out of the code used for the experiment and sample output obtained for a set of input.

Syllabus

1. Application Penetration Testing for Network Foot printing (Reconnaissance) and Vulnerability Assessment
2. Test for Configuration and deployment
Checking for known server vulnerabilities using scanning ' ZAP' or wpscan , NVD database
Sensitive files using spidering or crawling
Using robots. txt file finding unreferenced directories
3. Enumerate Infrastructure and Application Admin Interface

Using Google dorks, Hydra tool and ZAP, Finding sub domain info, The harvester tool, Recon-ng, DDnsrecon, Dig

4. Identity Management Testing
 - Test Role Definitions
 - Test User Registration Process
 - Testing for Account Enumeration and Guessable User Account
 - Testing for Weak or Unenforced Username Policy
5. Authentication and Authorization Testing
 - Testing for Default Credentials
 - Testing for Weak Lock out Mechanism
 - Testing for Browser Cache Weaknesses
 - Testing for Weak Password Policy
 - Testing for Weak Password Change or Reset Functionalities
6. Input Validation Testing
 - Testing for SQL Injection
7. Client-side Testing
 - Testing for Cross Site Scripting
 - Testing for JavaScript Execution
 - Testing for HTML Injection

PRACTICE QUESTIONS

List of Exercises/ Experiments

1. Using any reconnaissance tool perform active reconnaissance
2. Check for known server vulnerabilities using scanning 'ZAP' or wpscan or NVD database.
3. Use the following tools to Enumerate Infrastructure and Application Admin Interface
Google dorks, Hydra tool and ZAP, Finding sub domain info, The harvester tool, Recon-ng, Dnsrecon, Dig
4. Perform Identity Management Testing
5. Perform Authentication and Authorization Testing
6. Perform Input Validation Testing
7. Perform Client side testing

CCQ 413	SEMINAR	CATEGORY	L	T	P	Credits	Year of Introduction
		PWS	0	0	3	2	2019

Preamble: The course ‘Seminar’ is intended to enable a B.Tech graduate to read, understand, present and prepare report about an academic document. The learner shall search in the literature including peer reviewed journals, conference, books, project reports etc., and identify an appropriate paper/thesis/report in her/his area of interest, in consultation with her/his seminar guide. This course can help the learner to experience how a presentation can be made about a selected academic document and also empower her/him to prepare a technical report.

Course Objectives:

- To do literature survey in a selected area of study.
- To understand an academic document from the literature and to give a presentation about it.
- To prepare a technical report.

Course Outcomes: After the successful completion of the course the students will be able to

CO#	Course Outcomes
CO1	Identify academic documents from the literature which are related to her/his areas of interest (Cognitive knowledge level: Apply).
CO2	Read and apprehend an academic document from the literature which is related to her/ his areas of interest (Cognitive knowledge level: Analyze)
CO3	Prepare a presentation about an academic document (Cognitive knowledge level: Create)
CO4	Give a presentation about an academic document (Cognitive knowledge level: Apply).
CO5	Prepare a technical report (Cognitive knowledge level: Create)

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	1		2	1					3

CO2	3	3	2	3		2	1					3
CO3	3	2			3			1		2		3
CO4	3				2			1		3		3
CO5	3	3	3	3	2	2		2		3		3

Abstract POs defined by National Board of Accreditation			
PO#	Broad PO	PO#	Broad PO
PO1	Engineering Knowledge	PO7	Environment and Sustainability
PO2	Problem Analysis	PO8	Ethics
PO3	Design/Development of solutions	PO9	Individual and team work
PO4	Conduct investigations of complex problems	PO10	Communication
PO5	Modern tool usage	PO11	Project Management and Finance
PO6	The Engineer and Society	PO12	Lifelong learning

General Guidelines

- The Department shall form an Internal Evaluation Committee (IEC) for the seminar with academic coordinator for that program as the Chairperson/Chairman and seminar coordinator & seminar guide as members. During the seminar presentation of a student, all members of IEC shall be present.
- Formation of IEC and guide allotment shall be completed within a week after the University examination (or last working day) of the previous semester.
- Guide shall provide required input to their students regarding the selection of topic/ paper.
- Choosing a seminar topic: The topic for a UG seminar should be current and broad based rather than a very specific research work. It's advisable to choose a topic for the Seminar to be closely linked to the final year project area. Every member of the project team could choose or

be assigned Seminar topics that covers various aspects linked to the Project area.

- A topic/paper relevant to the discipline shall be selected by the student during the semester break.
- Topic/Paper shall be finalized in the first week of the semester and shall be submitted to the IEC.
- The IEC shall approve the selected topic/paper by the second week of the semester.
- Accurate references from genuine peer reviewed published material to be given in the report and to be verified.

Evaluation pattern

Total marks: 100, only CIE, minimum required to pass 50

Seminar Guide: 20 marks (Background Knowledge – 10 (The guide shall give deserving marks for a candidate based on the candidate's background knowledge about the topic selected), Relevance of the paper/topic selected – 10).

Seminar Coordinator: 20 marks (Seminar Diary – 10 (Each student shall maintain a seminar diary and the guide shall monitor the progress of the seminar work on a weekly basis and shall approve the entries in the seminar diary during the weekly meeting with the student), Attendance – 10).

Presentation: 40 marks to be awarded by the IEC (Clarity of presentation – 10, Interactions – 10 (to be based on the candidate's ability to answer questions during the interactive session of her/his presentation), Overall participation – 10 (to be given based on her/his involvement during interactive sessions of presentations by other students), Quality of the slides – 10).

Report: 20 marks to be awarded by the IEC (check for technical content, overall quality, templates followed, adequacy of references etc.)

CCD 415	PROJECT PHASE I	CATEGORY	L	T	P	Credits	Year of Introduction
		PWS	0	0	6	2	2019

Preamble: The course 'Project Work' is mainly intended to evoke the innovation and invention skills in a student. The course will provide an opportunity to synthesize and apply the knowledge and analytical skills learned, to be developed as a prototype or simulation. The project extends to 2 semesters and will be evaluated in the 7th and 8th semester separately, based on the achieved objectives. One third of the project credits shall be completed in 7th semester and two third in 8th semester. It is recommended that the projects may be finalized in the thrust areas of the respective engineering stream or as interdisciplinary projects. Importance should be given to address societal problems and developing indigenous technologies.

Course Objectives:

- To apply engineering knowledge in practical problem solving.
- To foster innovation in design of products, processes or systems.
- To develop creative thinking in finding viable solutions to engineering problems.

Course Outcomes: After the successful completion of the course the students will be able to

CO#	Course Outcomes
CO1	Model and solve real world problems by applying knowledge across domains (Cognitive knowledge level: Apply).
CO2	Develop products, processes or technologies for sustainable and socially relevant applications (Cognitive knowledge level: Apply).
CO3	Function effectively as an individual and as a leader in diverse teams and to comprehend and execute designated tasks (Cognitive knowledge level: Apply).
CO4	Plan and execute tasks utilizing available resources within timelines, following ethical and professional norms (Cognitive knowledge level: Apply).
CO5	Identify technology/research gaps and propose innovative/creative solutions (Cognitive knowledge level: Analyze).
CO6	Organize and communicate technical and scientific findings effectively in written and oral forms (Cognitive knowledge level: Apply).

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	1	2	2	2	1	1	1	1	2
CO2	2	2	2		1	3	3	1	1		1	1
CO3									3	2	2	1
CO4					2			3	2	2	3	2
CO5	2	3	3	1	2							1
CO6					2			2	2	3	1	1

Abstract POs defined by National Board of Accreditation

PO#	Broad PO	PO#	Broad PO
PO1	Engineering Knowledge	PO7	Environment and Sustainability
PO2	Problem Analysis	PO8	Ethics
PO3	Design/Development of solutions	PO9	Individual and team work
PO4	Conduct investigations of complex problems	PO10	Communication
PO5	Modern tool usage	PO11	Project Management and Finance
PO6	The Engineer and Society	PO12	Lifelong learning

PROJECT PHASE I

Phase 1 Target

- Literature study/survey of published literature on the assigned topic
- Formulation of objectives
- Formulation of hypothesis/ design/ methodology
- Formulation of work plan and task allocation.
- Block level design documentation
- Seeking project funds from various agencies
- Preliminary Analysis/Modeling/Simulation/Experiment/Design/Feasibility study
- Preparation of Phase 1 report

Evaluation Guidelines & Rubrics

Total: 100 marks (Minimum required to pass: 50 marks).

- Project progress evaluation by guide: 30 Marks.
- Interim evaluation by the Evaluation Committee: 20 Marks.
- Final Evaluation by the Evaluation Committee: 30 Marks.
- Project Phase - I Report (By Evaluation Committee): 20Marks.

(The evaluation committee comprises HoD or a senior faculty member, Project coordinator and project supervisor).

Evaluation by the Guide

The guide/supervisor shall monitor the progress being carried out by the project groups on a regular basis. In case it is found that progress is unsatisfactory it shall be reported to the Department Evaluation Committee for necessary action. The presence of each student in the group and their involvement in all stages of execution of the project shall be ensured by the guide. Project evaluation by the guide: 30 Marks. This mark shall be awarded to the students in his/her group by considering the following aspects:

Topic Selection: innovativeness, social relevance etc. (2)

Problem definition: Identification of the social, environmental and ethical issues of the project problem. (2)

Purpose and need of the project: Detailed and extensive explanation of the purpose and need of the project. (3)

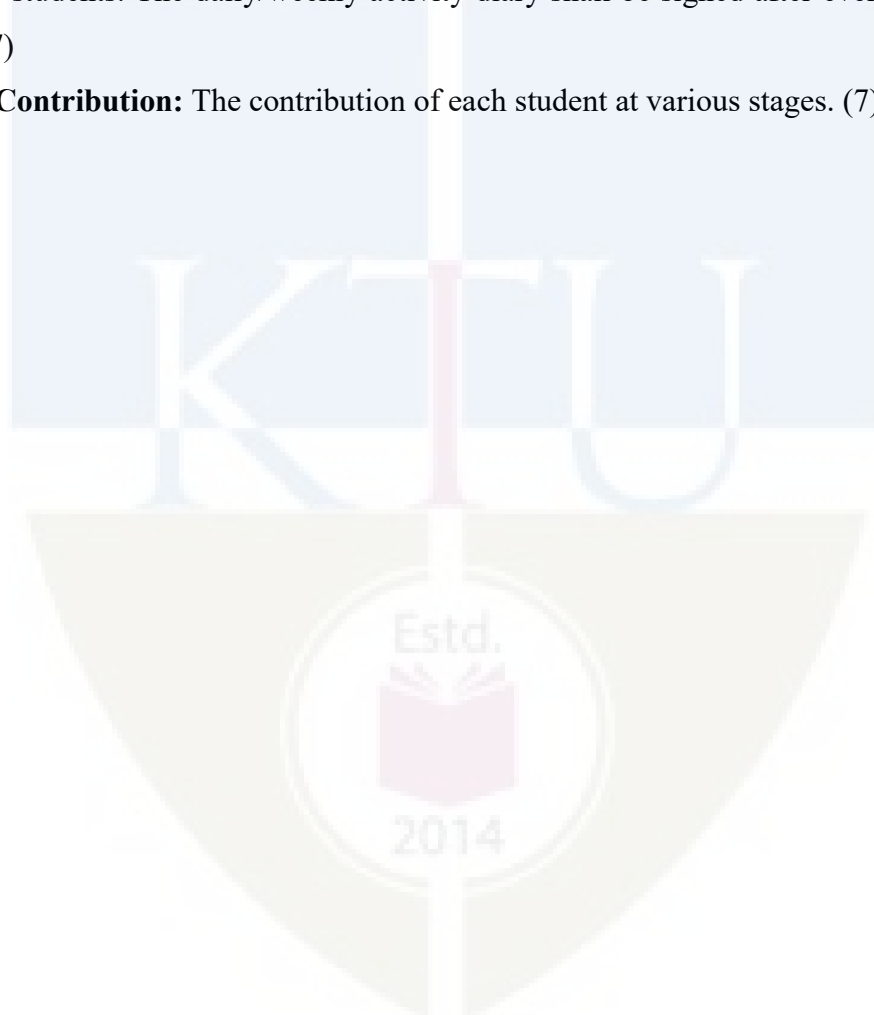
Project Objectives: All objectives of the proposed work are well defined; Steps to be followed to solve the defined problem are clearly specified. (2)

Project Scheduling & Distribution of Work among Team members: Detailed and extensive Scheduling with timelines provided for each phase of project. Work breakdown structure well defined. (3)

Literature survey: Outstanding investigation in all aspects. (4)

Student's Diary/ Daily Log: The main purpose of writing daily diary is to cultivate the habit of documenting and to encourage the students to search for details. It develops the students' thought process and reasoning abilities. The students should record in the daily/weekly activity diary the day to day account of the observations, impressions, information gathered and suggestions given, if any. It should contain the sketches & drawings related to the observations made by the students. The daily/weekly activity diary shall be signed after every day/week by the guide. (7)

Individual Contribution: The contribution of each student at various stages. (7)



EVALUATION RUBRICS for PROJECT Phase

EVALUATION RUBRICS for PROJECT Phase

EVALUATION RUBRICS for PROJECT Phase I: Final Evaluation

B TECH CSE (CYBER SECURITY)

Sl. No.	Parameters	Marks	Poor	Fair	Very Good	Outstanding
1-c	Formulation of Design and/or Methodology and Progress. (Group assessment) [CO1]	5	None of the team members show any evidence of knowledge about the design and the methodology adopted till now/ to be adopted in the later stages. The team has not progressed from the previous stage of evaluation.	The students have some knowledge on the design procedure to be adopted, and the methodologies. However, the team has not made much progress in the design, and yet to catch up with the project plan.	The students are comfortable with design methods adopted, and they have made some progress as per the plan. Their methodologies are understood to a large extent.	Shows clear evidence of having a well- defined design methodology and adherence to it. Excellent knowledge in design procedure and its adaptation. Adherence to project plan is commendable.
			(0 – 1 Marks)	(2 – 3 Marks)	(4 Marks)	(5 Marks)
1-d	Individual and Teamwork Leadership (Individual assessment) [CO3]	10	The student does not show any interest in the project activities, and is a passive member.	The student show some interest and participates in some of the activities. However, the activities are mostly easy and superficial in nature.	The student shows very good interest in project, and takes up tasks and attempts to complete them. Shows excellent responsibility and team skills. Supports the other members well.	The student takes a leadership position and supports the other team members and leads the project. Shows clear evidence of leadership.
			(0 – 3 Marks)	(4 – 6 Marks)	(7 - 9 Marks)	(10 Marks)
1-e	Preliminary Analysis/ Modeling / Simulation/ Experiment / Design/ Feasibility study [CO1]	10	The team has not done any preliminary work with respect to the analysis/modeling/ simulation/experiment/ design/feasibility study/ algorithm development.	The team has started doing some preliminary work with respect to the project. The students however are not prepared enough for the work and they need to improve a lot.	There is some evidence to show that the team has done good amount of preliminary investigation and design/ analysis/ modeling etc. They can improve further.	Strong evidence for excellent progress in the project. The team has completed the required preliminary work already and are poised to finish the phase I in an excellent manner. They have shown results to prove their progress.
			(0 – 3 Marks)	(4 – 6 Marks)	(7 - 9 Marks)	(10 Marks)

1-f	Documentation and presentation. (Individual & group assessment). [CO6]	5	The team did not document the work at all. The project journal/diary is not presented. The presentation was shallow in content and dull in appearance. The individual student has no idea on the presentation of his/her part.	Some documentation is done, but not extensive. Interaction with the guide is minimal. Presentation include some points of interest, but overall quality needs to be improved. Individual performance to be improved.	Most of the project details were documented well enough. There is scope for improvement. The presentation is satisfactory. Individual performance is good.	The project stages are extensively documented in the report. Professional documentation tools like LaTeX were used to document the progress of the project along with the project journal. The documentation structure is well-planned and can easily grow into the project report. The presentation is done professionally and with great clarity. The individual's performance is excellent.
			(0 – 1 Marks)	(2 – 3 Marks)	(4 Marks)	(5 Marks)
Total		30	Phase - I Final Evaluation Marks: 30			

EVALUATION RUBRICS for PROJECT Phase I: Report Evaluation						
Sl. No.	Parameters	Marks	Poor	Fair	Very Good	Outstanding
1-g	Report [CO6]	20	The prepared report is shallow and not as per standard format. It does not follow proper organization. Contains mostly Unacknowledged content. Lack of effort in preparation is evident.	Project report follows the standard format to some extent. However, its organization is not very good. Language needs to be improved. All references are not cited properly in the report.	Project report shows evidence of systematic documentation. Report is following the standard format and there are only a few issues. Organization of the report is good. Most of references are cited properly.	The report is exceptionally good. Neatly organized. All references cited properly. Diagrams/Figures, Tables and equations are properly numbered, and listed and clearly shown. Language is excellent and follows standard styles.
			(0 - 7 Marks)	(8 - 12 Marks)	(13 - 19 Marks)	(20 Marks)
Phase - I Project Report Marks: 20						

APJ ABDUL KALAM
TECHNOLOGICAL
UNIVERSITY

SEMESTER VII

PROGRAM ELECTIVE II



CST413	MACHINE LEARNING	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		PEC	2	1	0	3	2019

Preamble: This course enables the learners to understand the advanced concepts and algorithms in machine learning. The course covers the standard and most popular supervised learning algorithms such as linear regression, logistic regression, decision trees, Bayesian learning and the Naive Bayes algorithm, basic clustering algorithms and classifier performance measures. This course helps the students to provide machine learning based solutions to real world problems.

Prerequisite: Basic understanding of probability theory, linear algebra and Python Programming

Course Outcomes: After the completion of the course the student will be able to

CO1	Illustrate Machine Learning concepts and basic parameter estimation methods. (Cognitive Knowledge Level: Apply)
CO2	Demonstrate supervised learning concepts (regression, linear classification). (Cognitive Knowledge Level: Apply)
CO3	Illustrate the concepts of Multilayer neural network and Support Vector Machine (Cognitive Knowledge Level: Apply)
CO4	Describe unsupervised learning concepts and dimensionality reduction techniques. (Cognitive Knowledge Level: Apply)
CO5	Solve real life problems using appropriate machine learning models and evaluate the performance measures (Cognitive Knowledge Level: Apply)

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

Abstract POs defined by National Board of Accreditation			
PO#	Broad PO	PO#	Broad PO
PO1	Engineering Knowledge	PO7	Environment and Sustainability
PO2	Problem Analysis	PO8	Ethics
PO3	Design/Development of solutions	PO9	Individual and team work
PO4	Conduct investigations of complex problems	PO10	Communication
PO5	Modern tool usage	PO11	Project Management and Finance
PO6	The Engineer and Society	PO12	Life long learning

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination Marks (%)
	Test 1 (%)	Test 2 (%)	
Remember	30	30	30
Understand	30	30	30
Apply	40	40	40
Analyze			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3

Continuous Internal Evaluation Pattern:

Attendance	10 marks
Continuous Assessment Tests(Average of Internal Tests 1 & 2)	25 marks
Continuous Assessment Assignment	15 marks

Internal Examination Pattern

Each of the two internal examinations has to be conducted out of 50 marks. First series test shall be preferably conducted after completing the first half of the syllabus and the second series test shall be preferably conducted after completing remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly completed module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly completed module), each with 7 marks. Out of the 7 questions, a student should answer any 5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 full questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carries 14 marks.

Syllabus**Module-1 (Overview of machine learning)**

Machine learning paradigms-supervised, semi-supervised, unsupervised, reinforcement learning. Basics of parameter estimation - maximum likelihood estimation(MLE) and maximum a posteriori estimation(MAP). Introduction to Bayesian formulation.

Module-2 (Supervised Learning)

Regression - Linear regression with one variable, Linear regression with multiple variables, solution using gradient descent algorithm and matrix method, basic idea of overfitting in regression. Linear Methods for Classification- Logistic regression, Naive Bayes, Decision tree algorithm ID3.

Module-3 (Neural Networks (NN) and Support Vector Machines (SVM))

Perceptron, Neural Network - Multilayer feed forward network, Activation functions (Sigmoid, ReLU, Tanh), Backpropagation algorithm.

SVM - Introduction, Maximum Margin Classification, Mathematics behind Maximum Margin Classification, Maximum Margin linear separators, soft margin SVM classifier, non-linear SVM, Kernels for learning non-linear functions, polynomial kernel, Radial Basis Function(RBF).

Module-4 (Unsupervised Learning)

Clustering - Similarity measures, Hierarchical Agglomerative Clustering, K-means partitioned clustering, Expectation maximization (EM) for soft clustering. Dimensionality reduction – Principal Component Analysis.

Module-5 (Classification Assessment)

Classification Performance measures - Precision, Recall, Accuracy, F-Measure, Receiver Operating Characteristic Curve(ROC), Area Under Curve(AUC). Bootstrapping, Cross Validation, Ensemble methods, Bias-Variance decomposition. Case Study: Develop a classifier for face detection.

Text Book

1. Ethem Alpaydin, Introduction to Machine Learning, 2nd edition, MIT Press 2010.
2. Mohammed J. Zaki and Wagner Meira, Data Mining and Analysis: Fundamental Concepts and Algorithms, Cambridge University Press, First South Asia edition, 2016.
3. Jake VanderPlas, Python Data Science Handbook, O'Reilly Media, 2016
4. Tom Mitchell, Machine Learning, McGraw-Hill, 1997.

Reference Books

1. Christopher Bishop. Neural Networks for Pattern Recognition, Oxford University Press, 1995.
2. Kevin P. Murphy. Machine Learning: A Probabilistic Perspective, MIT Press 2012.
3. Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements Of Statistical Learning, Second edition Springer 2007.
4. P. Langley, Elements of Machine Learning, Morgan Kaufmann, 1995.
5. Richert and Coelho, Building Machine Learning Systems with Python.
6. Davy Cielen, Arno DB Meysman and Mohamed Ali. Introducing Data Science: Big Data, Machine Learning, and More, Using Python Tools, Dreamtech Press 2016.

Course Level Assessment Questions

Course Outcome1 (CO1):

1. A coin is tossed 100 times and lands heads 62 times. What is the maximum likelihood estimate for θ , the probability of heads.
2. Suppose data $x_1, \dots, x_n$ are independent and identically distributed drawn from an exponential distribution $\exp(\lambda)$. Find the maximum likelihood for λ .
3. Suppose $x_1, \dots, x_n$ are independent and identically distributed(iid) samples from a distribution with density

Find the maximum estimate(MLE) for θ .

$$f_X(x|\theta) = \begin{cases} \frac{\theta x^{\theta-1}}{3^\theta}, & 0 \leq x \leq 3 \\ 0, & \text{otherwise} \end{cases} \quad \text{likelihood}$$

4. Find the maximum likelihood estimator (MLE) and maximum a posteriori (MAP) estimator for the mean of a univariate normal distribution. Assume that we have N samples, $x_1, \dots, x_N$ independently drawn from a normal distribution with known variance σ^2 and unknown mean μ and the prior distribution for the mean is itself a normal distribution with mean ν and variance β^2 . What happens to the MLE and MAP estimators as the number of samples goes to infinity.

Course Outcome 2(CO2):

1. Suppose that you are asked to perform linear regression to learn the function that outputs y , given the D -dimensional input x . You are given N independent data points, and that all the D attributes are linearly independent. Assuming that D is around 100, would you prefer the closed form solution or gradient descent to estimate the regressor?
2. Suppose you have a three class problem where class label $y \in 0, 1, 2$ and each training example X has 3 binary attributes $X_1, X_2, X_3 \in 0, 1$. How many parameters (probability distribution) do you need to know to classify an example using the Naive Bayes classifier?

Course Outcome 3(CO3):

1. What are support vectors and list any three properties of the support vector classifier solution?
2. Why do you use kernels to model a projection from attributes into a feature space, instead of simply projecting the dataset directly?

- Describe how Support Vector Machines can be extended to make use of kernels. Illustrate with reference to the Gaussian kernel $K(x, y) = e^{-z}$, where $z = (x-y)^2$.
- Briefly explain one way in which using tanh instead of logistic activations makes optimization easier.
- ReLU activation functions are most used in neural networks instead of the tanh activation function. Draw both activation functions and give a) an advantage of the ReLU function compared to the tanh function. b) a disadvantage of the ReLU function compared to the tanh function.

Course Outcome 4(CO4): .

- Which similarity measure could be used to compare feature vectors of two images? Justify your answer.
- Illustrate the strength and weakness of k-means algorithm.
- Suppose you want to cluster the eight points shown below using **k**-means

	A_1	A_2
x_1	2	10
x_2	2	5
x_3	8	4
x_4	5	8
x_5	7	5
x_6	6	4
x_7	1	2
x_8	4	9

Assume that $k = 3$ and that initially the points are assigned to clusters as follows:

$C_1 = \{x_1, x_2, x_3\}$, $C_2 = \{x_4, x_5, x_6\}$, $C_3 = \{x_7, x_8\}$. Apply the **k**-means algorithm until convergence, using the Manhattan distance.

- Cluster the following eight points representing locations into three clusters: $A_1(2, 10)$, $A_2(2, 5)$, $A_3(8, 4)$, $A_4(5, 8)$, $A_5(7, 5)$, $A_6(6, 4)$, $A_7(1, 2)$, $A_8(4, 9)$.

Initial cluster centers are: $A_1(2, 10)$, $A_4(5, 8)$ and $A_7(1, 2)$.

The distance function between two points $a = (x_1, y_1)$ and $b = (x_2, y_2)$ is defined as $D(a, b) = |x_2 - x_1| + |y_2 - y_1|$

Use **k**-Means Algorithm to find the three cluster centers after the second iteration.

Course Outcome 5(CO5):

1. What is ensemble learning? Can ensemble learning using linear classifiers learn classification of linearly non-separable sets?
2. Describe boosting. What is the relation between boosting and ensemble learning?
3. Classifier A attains 100% accuracy on the training set and 70% accuracy on the test set. Classifier B attains 70% accuracy on the training set and 75% accuracy on the test set. Which one is a better classifier. Justify your answer.
4. What are ROC space and ROC curve in machine learning? In ROC space, which points correspond to perfect prediction, always positive prediction and always negative prediction? Why?
5. Suppose there are three classifiers A,B and C. The (FPR, TPR) measures of the three classifiers are as follows – A (0, 1), B (1, 1) , C (1,0.5). Which can be considered as a perfect classifier? Justify your answer.

Model Question Paper

QP CODE:

Reg No: _____

Name: _____

PAGES : 4

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SEVENTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: CST413

Course Name: Machine Learning

Max. Marks : 100

Duration: 3 Hours

PART A

Answer All Questions. Each Question Carries 3 Marks

1. Define supervised learning? Name special cases of supervised learning depending on whether the inputs/outputs are categorical, or continuous.

2. Differentiate between Maximum Likelihood estimation (MLE) and Maximum a Posteriori (MAP) estimation?
3. What is overfitting and why is it a problem?
4. Specify the basic principle of gradient descent algorithm.
5. Suppose that you have a linear support vector machine(SVM) binary classifier. Consider a point that is currently classified correctly, and is far away from the decision boundary. If you remove the point from the training set, and re-train the classifier, will the decision boundary change or stay the same? Justify your answer.
6. Mention the primary motivation for using the kernel trick in machine learning algorithms?
7. Expectation maximization (EM) is designed to find a maximum likelihood setting of the parameters of a model when some of the data is missing. Does the algorithm converge? If so, do you obtain a locally or globally optimal set of parameters?
8. Illustrate the strength and weakness of k-means algorithm.
9. Classifier A attains 100% accuracy on the training set and 70% accuracy on the test set. Classifier B attains 70% accuracy on the training set and 75% accuracy on the test set. Which one is a better classifier. Justify your answer.
10. How does bias and variance trade-off affect machine learning algorithms?

(10x3=30)

Part B**(Answer any one question from each module. Each question carries 14 Marks)**

11. (a) Suppose that X is a discrete random variable with the following probability mass function: where $0 \leq \theta \leq 1$ is a parameter. The following 10 independent observations (7)

X	0	1	2	3
$P(X)$	$2\theta/3$	$\theta/3$	$2(1 - \theta)/3$	$(1 - \theta)/3$

were taken from such a distribution: (3, 0, 2, 1, 3, 2, 1, 0, 2, 1). What is the maximum likelihood estimate of θ .

- (b) Suppose you have a three class problem where class label $y \in \{0, 1, 2\}$ (7)
- and each training example X has 3 binary attributes $X_1, X_2, X_3 \in \{0, 1\}$.
- How many parameters (probability distribution) do you need to know

to classify an example using the Naive Bayes classifier?

OR

12. (a) Consider the geometric distribution, which has p.m.f $P(X = k) = (1 - \theta)^{k-1}\theta$. (7)
Assume that n i.i.d data are drawn from that distribution.

- Write an expression for the log-likelihood of the data as a function of the parameter θ .
- Find the maximum likelihood estimate for θ ?
- Let θ has a beta prior distribution. What is the posterior distribution of θ ?

- (b) Find the maximum a posteriori (MAP) estimator for the mean of a univariate normal distribution. Assume that we have N samples, $x_1, \dots, x_N$ independently drawn from a normal distribution with known variance σ^2 and unknown mean μ and the prior distribution for the mean is itself a normal distribution with mean ν and variance β^2 . (7)

13. (a) Consider the hypothesis for the linear regression $h_\theta(x) = \theta_0 + \theta_1 x$, and the cost function $J(\theta_0, \theta_1) = 1/2m \sum_i^m (h_\theta(x^{(i)}) - y^{(i)})^2$ where m is the number of training examples. Given the following set of training examples. (7)

x	y
3	2
1	2
0	1
4	3

Answer the following questions :

- Find the value of $h_\theta(2)$ if $\theta_0 = 0$ and $\theta_1 = 1.5$
- Find the value of $J(0,1)$
- Suppose the value of $J(\theta_0, \theta_1) = 0$. What can be inferred from this.

- (b) Assume we have a classification problem involving 3 classes: professors, students, and staff members. There are 750 students, 150 staff members and 100 professors. All professors have blond hair, 50 staff members have blond hair, and 250 students have blond hair. Compute the information gain of the test "hair color = blond" that returns true or false. (3)

- (c) Explain the significance of regularization. How do Ridge differs from Lasso regularization? (4)

OR

14. (a) The following dataset can be used to train a classifier that determines whether a given person is likely to own a car or not. There are three features: education level (primary, secondary, or university); residence (city or country); gender (female, male). (7)

education	residence	gender	has car?
sec	country	female	yes
univ	country	female	yes
prim	city	male	no
univ	city	male	no
sec	city	female	no
sec	country	male	yes
prim	country	female	yes
univ	country	male	yes
sec	city	male	yes
prim	city	female	no
univ	city	female	no
prim	country	male	yes

Use ID3 Algorithm and find the best attribute at the root level of the tree

- (b) Consider a linear regression problem $y = w_1x + w_0$, with a training set having m examples $(x_1, y_1), \dots, (x_m, y_m)$. Suppose that we wish to minimize the mean 5th degree error (loss function) given by $1/m \sum_1^m (y_i - w_1x_i - w_0)^5$. (7)
1. Calculate the gradient with respect to the parameter w_1 .
 2. Write down pseudo-code for on-line gradient descent on w_1 .
 3. Give one reason in favor of on-line gradient descent compared to batch-gradient descent, and one reason in favor of batch over on-line.

15. (a) Consider a support vector machine whose input space is 2-D, and the inner products are computed by means of the kernel $K(\mathbf{x}, \mathbf{y}) = (\mathbf{x} \cdot \mathbf{y} + 1)^2 - 1$, where $\mathbf{x} \cdot \mathbf{y}$ denotes the ordinary inner product. Show that the mapping to feature space that is implicitly defined by this kernel is the mapping to 5-D given by

$$\mathbf{x} = \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} \rightarrow \phi(\mathbf{x}) = \begin{bmatrix} x_1^2 \\ x_2^2 \\ \sqrt{2} x_1 x_2 \\ \sqrt{2} x_1 \\ \sqrt{2} x_2 \end{bmatrix}$$

- (b) Consider a neuron with four inputs, and weight of edge connecting the inputs are 1, 2, 3 and 4. Let the bias of the node is zero and inputs are 2, 3, 1, 4. If the activation function is linear $f(x)=2x$, compute the output of the neuron. (3)
- (c) Compare ReLU with Sigmoid function (3)

OR

16. (a) State the mathematical formulation to express Soft Margin as a constraint optimization problem. (10)
- (b) What is the basic idea of back propagation algorithm (4)
17. (a) Suppose that we have the following data (one variable). Use single linkage Agglomerative clustering to identify the clusters. (8)
Data: (2, 5, 9, 15, 16, 18, 25, 33, 33, 45).
- (b) Given two objects represented by the tuples (22, 1, 42, 10) and (20, 0, 36, 8): (6)
(i) Compute the Euclidean distance between the two objects.
(ii) Compute the Manhattan distance between the two objects.
(iii) Compute the Minkowski distance between the two objects, using $p = 3$

OR

18. (a) Suppose that we have the following data: (8)
(2, 0), (1, 2), (2, 2), (3, 2), (2, 3), (3, 3), (2, 4), (3, 4), (4, 4), (3, 5)
Identify the cluster by applying the k-means algorithm, with $k = 2$. Try using initial cluster centers as far apart as possible

(b) Describe EM algorithm for Gaussian Mixtures (8)

19. (a) Suppose the dataset had 9700 cancer-free images from 10000 images from cancer patients. Find precision, recall and accuracy ? Is it a good classifier? Justify. (7)

Actual Class\Predicted class	cancer = yes	cancer = no	Total
cancer = yes	90	210	300
cancer = no	140	9560	9700
Total	230	9770	10000

(b) What is Principal Component Analysis (PCA)? Which eigen value indicates the direction of largest variance? (7)

OR

20. (a) Assume you have a model with a high bias and a low variance. What are the characteristics of such a model? (6)

(b) What are ROC space and ROC curve in machine learning? In ROC space, which points correspond to perfect prediction, always positive prediction and always negative prediction? Why? (8)

Teaching Plan

No	Contents	No. of Lecture Hours (37 hrs)
Module -1 (Overview of machine learning) (7 hours)		
1.1	Supervised, semi-supervised, unsupervised learning, reinforcement learning (Text Book (TB) 1: Chapter 1)	1 hour
1.2	Maximum likelihood estimation(MLE) (TB 1: Section 4.2)	1 hour
1.3	Maximum likelihood estimation (MLE)- example (TB 1: Section 4.2)	1 hour
1.4	Maximum a posteriori estimation(MAP) (TB 4: Section 6.2)	1 hour
1.5	Maximum a posteriori estimation(MAP)-example (TB 4: Section 6.2)	1 hour
1.6	Bayesian formulation (TB 1: Section 14.1, 14.2)	1 hour
1.7	Bayesian formulation -example (TB 1: Section 14.1, 14.2)	1 hour
Module-2 (Supervised Learning) (7 hours)		
2.1	Linear regression with one variable (TB 1: Section 2.6)	1 hour
2.2	Multiple variables, Solution using gradient descent algorithm and matrix method (No derivation required) (TB 1: Section 5.8)	1 hour
2.3	Overfitting in regression, Lasso and Ridge regularization	1 hour
2.4	Logistic regression	1 hour
2.5	Naive Bayes (TB 2: Section 18.2)	1 hour
2.6	Decision trees (TB 2: Chapter 19)	1 hour
2.7	Decision trees- ID3 algorithm (TB 2: Chapter 19)	1 hour
Module-3 (Neural Networks and Support Vector Machines) (9 hours)		
3.1	Perceptron, Perceptron Learning	1 hour
3.2	Multilayer Feed forward Network, Activation Functions (Sigmoid, ReLU, Tanh)	1 hour
3.3	Back Propagation Algorithm	1 hour
3.4	Illustrative Example for Back Propagation	1 hour
3.5	Introduction, Maximum Margin Hyperplane,	1 hour
3.6	Mathematics behind Maximum Margin Classification	1 hour
3.7	Formulation of maximum margin hyperplane and solution	1 hour

3.8	Soft margin SVM, Solution of Soft margin SVM	1 hour
3.9	Non-linear SVM , Kernels for learning non-linear functions, Examples - Linear, RBF, Polynomial	1 hour
Module-4 (Unsupervised Learning) (7 hours)		
4.1	Similarity measures- Minkowski distance measures(Manhattan, Euclidean), Cosine Similarity	1 hour
4.2	Clustering - Hierarchical Clustering (TB 2: Chapter 14)	1 hour
4.3	K-means partitional clustering (TB 2: Chapter 13)	1 hour
4.4	Expectation maximization (EM) for soft clustering (TB 2: Chapter 13)	1 hour
4.5	Expectation maximization (EM) for soft clustering (TB 2: Chapter 13)	1 hour
4.6	Dimensionality reduction – Principal Component Analysis (TB 1: Section 6.3)	1 hour
4.7	Dimensionality reduction – Principal Component Analysis (TB 1: Section 6.3)	1 hour
Module-5 (Classification Assessment) (7 hours)		
5.1	Performance measures - Precision, Recall, Accuracy, F-Measure, ROC, AUC. (TB 2: Chapter 22.1)	1 hour
5.2	Boot strapping, Cross validation	1 hour
5.3	Ensemble methods- bagging, boosting	1 hour
5.4	Bias-Variance decomposition (TB 2: Chapter 22.3)	1 hour
5.5	Bias-Variance decomposition (TB 2: Chapter 22.3)	1 hour
5.6	Face detection (TB 3: Chapter 5 Section Application: A Face Detection Pipeline)	1 hour
5.7	Face detection (TB 3: Chapter 5 Section Application: A Face Detection Pipeline)	1 hour

CCT 423	INTRUSION DETECTION AND PREVENTION SYSTEM	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		PEC	2	1	0		

Preamble: This course provides the learners a clear understanding of the fundamental concepts of Intrusion detection and prevention systems and the different control strategies used to implement IDPS. The course also covers the different types of IDPS systems used to protect the network traffic and host based systems. Students will get a clear understanding of the usage of different Intrusion detection systems so that protection against attacks can be minimized.

Course Outcomes: After the completion of the course, the student will be able to

CO#	Course Outcomes
CO1	Comprehend the different terminologies and types related to Intrusion detection and prevention systems. (Cognitive Knowledge Level: Understand)
CO2	Familiarize the different control strategies and detection systems, (Cognitive Knowledge Level: Understand)
CO3	Explore the different technologies and detection capabilities related to Network IDPS (Cognitive Knowledge Level: Understand)
CO4	Identify the capabilities, security attacks against wireless IDPS. (Cognitive Knowledge Level: Apply)
CO5	Explore the different technologies and detection capabilities and approaches related to host IDPS (Cognitive Knowledge Level: Apply)

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12
CO1	✓	✓	✓									✓
CO2	✓	✓	✓									✓
CO3	✓	✓	✓									✓
CO4	✓	✓	✓		✓							✓

CO5												

Abstract POs defined by National Board of Accreditation			
PO#	Broad PO	PO#	Broad PO
PO1	Engineering Knowledge	PO7	Environment and Sustainability
PO2	Problem Analysis	PO8	Ethics
PO3	Design/Development of solutions	PO9	Individual and teamwork
PO4	Conduct investigations of complex problems	PO10	Communication
PO5	Modern tool usage	PO11	Project Management and Finance
PO6	The Engineer and Society	PO12	Lifelong learning

Assessment Pattern Bloom's Category	Test 1 (Marks in percentage)	Test 2 (Marks in percentage)	End Semester Examination (Marks in percentage)
Remember	40	40	40
Understand	50	50	50
Apply	10	10	10
Analyze			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3

Continuous Internal Evaluation Pattern:

Attendance : 10 marks

Continuous Assessment Test : 25 marks

Continuous Assessment Assignment : 15 marks

Internal Examination Pattern: Each of the two internal examinations has to be conducted out of 50 marks. The first series test shall be preferably conducted after completing the first half of the syllabus. The second series test shall be preferably conducted after completing the remaining part of

the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly completed module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly completed module), each with 7 marks. Out of the 7 questions, a student should answer any 5.

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which a student should answer anyone. Each question can have a maximum 2 subdivisions and carries 14 marks.

Syllabus

Module 1(Introduction)

Introduction-Intrusion Detection and Prevention Systems, IDPS terminology, Network attacks-Probes, Privilege Escalation Attacks, Denial of Service (DoS) and Distributed Denial of Service (DDoS) Attacks, Worms Attacks, Routing Attacks ,Why use an IDPS, Types of IDPS, IDPS Detection methods-Signature-Based IDPS, Statistical Anomaly-Based IDPS, Stateful Protocol Analysis IDPS, Log File Monitors, IDPS Response Options Selecting IDPS Approaches and Products, Strengths and Limitations of IDPSs

Module 2(IDPS Control Strategies)

IDPS Control Strategies-Centralized Control Strategy, Fully Distributed Control Strategy, Partially Distributed Control Strategy, IDPS Deployment-Deploying Network-Based IDPSs, Deploying Host-Based IDPSs, Measuring the Effectiveness of IDPSs, Intrusion Detection systems-How the IDS Watches Your Network -Packet Sniffing, Log Parsing, System Call Monitoring, Filesystem Watching, What the IDS Does When It Finds an Attack Attempt, Passive Response, Active Response, Analyzing Your IDS Design and Investment, False Positives versus False Negatives.

Module 3(IDPS Technologies)

IDPS Technologies-components and architecture, Network architectures, security capabilities, prevention capabilities, Network based IDPS, Networking overview, components and architecture, Security Capabilities, Information Gathering Capabilities, Logging Capabilities, Detection Capabilities, Types of Events Detected, Detection Accuracy , Tuning and Customization, Technology Limitations, Prevention Capabilities, Implementation, Wireless IDPS, WLAN Standards, WLAN Components, Threats against WLANs, Components and Architecture, Sensor Locations, Information Gathering Capabilities, Types of Events Detected, Prevention Capabilities

Module 4(Host Based IDPS)

Host-Based IDPS-Components and Architecture, Typical Components, Network Architectures,

Agent Locations, Host Architectures, Security Capabilities, Logging Capabilities, Detection Capabilities, Types of Events Detected, Technology Limitations, Prevention Capabilities, Other Capabilities, Implementation, The Need for Multiple IDPS Technologies, Direct IDPS Integration, Indirect IDPS Integration, Network Forensic Analysis Tool (NFAT) Software, Anti-Malware Technologies, Firewalls and Routers, Honeypots

Module 5(IDPS Detection Approaches)

IDPS Detection Approaches-Misuse detection-pattern matching, Rule based techniques,state based techniques, Anomaly Detection-Advanced Statistical Models, Rule based Techniques, Biological Models, Learning Models, Specification-based Detection, Hybrid Detection, Architecture and Implementation-Centralized, Distributed-Intelligent Agents,Mobile Agents, Cooperative Intrusion Detection, Examples of Commercial and Open Source IDSs- Bro Intrusion Detection System, Prelude Intrusion Detection System, Snort Intrusion Detection System, Ethereal Application - Network Protocol Analyzer, Multi Router Traffic Grapher (MRTG), Tamandua Network Intrusion Detection System, Other Commercial IDSs

Textbooks

1. Michael E. Whitman and Herbert J. Mattord “Principles of Information Security”, Course Technology, Cengage Learning, Fourth Edition 2012
2. Brian Caswell, Mike Poor “Snort 2.1: Intrusion Detection”, Jay Beale's Open Source Security 2nd Edition,2004

References

1. Karen Scarfone Peter Mell, “Guide to Intrusion Detection and Prevention Systems (IDPS)”, National Institute of Standards and Technology, 2007

Sample Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Explain the importance of using Intrusion Detection and Prevention Systems.

Course Outcome 2 (CO2):

1. Illustrate how the effectiveness of IDPS be measured?

Course Outcome 3 (CO3):

1. Describe the detection capabilities of a network based IDPS.

Course Outcome 4 (CO4):

1. Explain with examples the different types of events detected while using WLAN IDPS.

Course Outcome 5 (CO5):

1. Describe the prevention capability of host based IDPS

2. Illustrate the working of Snort Intrusion Detection System and Tamandua Network Intrusion detection System

Model Question Paper

QP CODE:

Reg No: _____

Name : _____

PAGES : 3

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SEVENTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: CCT 423

Course Name: INTRUSION DETECTION AND PREVENTION SYSTEM

Max.Marks:100

Duration: 3 Hours

PART A

Answer all Questions. Each question carries 3 Marks

1. Describe any five terminologies related to IDPS.
2. Discuss the strength and limitations of using IDPS.
3. Differentiate between false positives and false negatives.
4. How to deploy a network based IDPS in an organization's network perimeter?
5. Differentiate between network based and host based IDPS.
6. What are the different types of events detected while deploying a Network IDPS?
7. Differentiate between direct and indirect IDPS integration.
8. Discuss the different ways in which firewalls and routers complement IDPSs.
9. Briefly describe about the intelligent and mobile agents.
10. Write note on Biological model of Intrusion detection system.

(10*3=30 Marks)

PART B

Answer any one Question from each module. Each question carries 14 Marks

11. a) With neat figures, explain the different types of Intrusion detection and prevention systems. (8)

b) Explain the different steps to be followed while selecting an IDPS. (6)

OR

12. a) Explain in detail the different Intrusion detection methods. (8)

b) Explain
i) Probes
ii) Routing attacks
iii) Worm attacks (6)

13. a) Discuss about the different IDPS control strategies with neat figures. (8)

b) How important is Log parsing and System call monitoring in Network IDPS. (6)

OR

14. a) What is packet sniffing. How the design of IDPS is analyzed? (8)

b) What does the Intrusion detection system do when it finds an attack attempt? (6)

15. a) Explain the network architecture of Network IDPS. (8)

b) Describe the prevention capability of Network Intrusion Detection System. (6)

OR

16. a) Explain about the WLAN standards and the different components IEEE 802.11 WLAN. (8)

b) Discuss about the information gathering and logging capabilities of WLAN (6)

17. a) Illustrate the use of Network Forensic Analysis Tool (NFAT) Software. (8)

b) What is the need of employing multiple Intrusion detection and prevention systems? (6)

OR

18. a) With a neat figure, explain the components and architecture of Host-Based IDPS Agent Deployment. (8)

b) Briefly explain the different types of events detected while using host based IDPS. (6)

19. a) Discuss the different IDS detection approaches. (8)

b) Briefly describe the working of Multi Router Traffic Grapher. (6)

OR

20. a) Illustrate the use of any three Intrusion detection systems. (8)

b) Explain about any three models of anomaly detection approach. (6)

TEACHING PLAN

Sl.No.	Contents	No of Lecture Hrs (36)
Module 1(Introduction) (7 Hrs)		
1.1	Introduction-Intrusion Detection and Prevention Systems, IDPS terminology	1 hour
1.2	Network attacks- Probes, Privilege Escalation Attacks	1 hour
1.3	Denial of Service (DoS) and Distributed Denial of Service (DDoS) Attacks, Worms Attacks	1 hour
1.4	Routing Attacks ,Why use an IDPS, Types of IDPS	1 hour
1.5	IDPS Detection methods-Signature-Based IDPS, Statistical Anomaly-Based IDPS, Stateful Protocol Analysis IDPS	1 hour
1.6	Log File Monitors, IDPS Response Options	1 hour
1.7	Selecting IDPS Approaches and Products, Strengths and Limitations of IDPSs	1 hour
Module 2(IDPS Control Strategies) (6 hrs)		
2.1	IDPS Control Strategies-Centralized Control Strategy, Fully Distributed Control Strategy, Partially Distributed Control Strategy	1 hour
2.2	IDPS Deployment-Deploying Network-Based IDPSs, Deploying Host-Based IDPSs,	1 hour
2.3	Measuring the Effectiveness of IDPSs	1 hour
2.4	Intrusion Detection systems-How the IDS Watches Your Network	1 hour
2.5	Packet Sniffing, Log Parsing, System Call Monitoring, Filesystem	1 hour

2.6	Watching, What the IDS Does When It Finds an Attack Attempt, Passive Response, Active Response,	1 hour
Module 3(IDPS Technologies) (10 hrs)		
3.1	IDPS Technologies-components and architecture	1 hour
3.2	Network architectures, security capabilities, prevention capabilities	1 hour
3.3	Network based IDPS, Networking overview, components and architecture,	1 hour
3.4	Security Capabilities, Information Gathering Capabilities, Logging Capabilities, Detection Capabilities	1 hour
3.5	Types of Events Detected, Detection Accuracy , Tuning and Customization	1 hour
3.6	Technology Limitations, Prevention Capabilities, Implementation	1 hour
3.7	Wireless IDPS, WLAN Standards	1 hour
3.8	WLAN Components, Threats against WLANs	1 hour
3.9	Components and Architecture, Sensor Locations	1 hour
3.10	Information Gathering Capabilities, Types of Events Detected, Prevention Capabilities	1 hour
Module 4(Host Based IDPS) (7 hrs)		
4.1	Host-Based IDPS-Components and Architecture, Typical Components	1 hour
4.2	Network Architectures, Agent Locations, Host Architectures, Security Capabilities	1 hour
4.3	Logging Capabilities, Detection Capabilities, Types of Events Detected,	1 hour
4.4	Technology Limitations, Prevention Capabilities, Other Capabilities, Implementation	1 hour
4.5	The Need for Multiple IDPS Technologies, Direct IDPS Integration, Indirect IDPS Integration	1 hour
4.6	Network Forensic Analysis Tool (NFAT) Software, Anti-Malware	1 hour

	Technologies	
4.7	Firewalls and Routers, Honeypots	1 hour
Module 5(IDPS Detection Approaches) (6 hrs)		
5.1	IDPS Detection Approaches-Misuse detection-pattern matching, Rule based techniques, state based techniques	1 hour
5.2	Anomaly Detection-Advanced Statistical Models, Rule based Techniques, Biological Models, Learning Models	1 hour
5.3	Specification-based Detection, Hybrid Detection, Architecture and Implementation-Centralized	1 hour
5.4	Architecture and Implementation- Distributed-Intelligent agents, Mobile agents, cooperative Intrusion detection	1 hour
5.5	Examples of Commercial and Open Source IDSs-Bro Intrusion Detection System, Prelude Intrusion Detection System, Snort Intrusion Detection System	1 hour
5.6	Ethereal Application - Network Protocol Analyzer, Multi Router Traffic Grapher (MRTG),Tamandua Network Intrusion Detection System, Other Commercial IDSs	1 hour

CCT 433	CLOUD COMPUTING & SECURITY	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		PEC	2	1	0	3	2019

Preamble: This course provides the ground-up coverage on the high level concepts of cloud landscape, architectural principles, techniques, design patterns and real-world best practices applied to Cloud service providers and consumers and delivering secure Cloud based services. The course also describes the Cloud security architecture and explore the guiding security design principles, design patterns, industry standards, applied technologies and addressing regulatory compliance requirements critical to design, implement, deliver and manage secure cloud based services.

Prerequisites: Operating Systems and Computer Networks

Course Outcomes: After the completion of the course, the student will be able to

CO#	Course Outcomes
CO1	Summarize core cloud computing concepts and fundamental principles, including standard delivery models and service designs. (Cognitive knowledge level: Understand)
CO2	Apprehend the foundational security practices that are required to secure modern cloud computing infrastructures. (Cognitive knowledge level: Understand)
CO3	Explain the standard cloud security network designs and architecture models (Cognitive knowledge level: Understand)
CO4	Explain the cloud services that meet essential Cloud infrastructure characteristics (Cognitive knowledge level: Understand)
CO5	Identify the industry security standards, regulatory mandates, audit policies and compliance requirements for Cloud based infrastructures (Cognitive knowledge level: Apply)

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12
CO1	✓	✓	✓									✓
CO2	✓	✓	✓									✓
CO3	✓	✓	✓									✓
CO4	✓	✓	✓									✓
CO5	✓	✓	✓									✓

Abstract POs defined by National Board of Accreditation

PO#	Broad PO	PO#	Broad PO
PO1	Engineering Knowledge	PO7	Environment and Sustainability
PO2	Problem Analysis	PO8	Ethics
PO3	Design/Development of solutions	PO9	Individual and teamwork
PO4	Conduct investigations of complex problems	PO10	Communication
PO5	Modern tool usage	PO11	Project Management and Finance
PO6	The Engineer and Society	PO12	Lifelong learning

Assessment Pattern Bloom's Category	Test 1 (Marks in percentage)	Test 2 (Marks in percentage)	End Semester Examination (Marks in percentage)
Remember	40	40	40
Understand	50	50	50

Apply	10	10	10
Analyze			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 Hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks

Continuous Assessment Test : 25 marks

Continuous Assessment Assignment : 15 marks

Internal Examination Pattern: Each of the two internal examinations has to be conducted out of 50 marks. The first series test shall be preferably conducted after completing the first half of the syllabus. The second series test shall be preferably conducted after completing the remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly completed module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly completed module), each with 7 marks. Out of the 7 questions, a student should answer any 5.

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which a student should answer anyone. Each question can have a maximum 2 subdivisions and carries 14 marks.

Syllabus

Module 1 (Introduction to Cloud Computing)

Traditional computing: Limitations, Overview of Computing Paradigms: Grid Computing, Cluster Computing, Distributed Computing, Utility Computing, Cloud Computing, NIST reference Model,

Basic terminology and concepts, Cloud characteristics, benefits and challenges, Cloud delivery (service) models: Infrastructure-as-a-Service (IaaS), Platform-as-a-Service (PaaS), Software-as-a-Service (SaaS), XaaS (Anything-as-a-service), Cloud deployment models: Public cloud, Community cloud, Private cloud, Hybrid cloud, Open Cloud Services.

Module 2(Fundamental Cloud Security)

Basic Terms and Concepts in Security, Threat Agents, Cloud Security Threats, Identity Management and Access Control, Cloud Security Working Groups, Elements of Cloud Security Model, Cloud Security Reference Model, Examining Cloud Security against Traditional Computing.

Module 3(Cloud Mechanisms)

Data Center Technology, Virtualization Technology, Web Technology, Multitenant Technology, Scaling, Foundation of Cloud Scaling, Scaling Strategies in Cloud, Auto Scaling in Cloud, Cloud Bursting, Types of Scaling, Capacity Planning, Capacity Planning at Different Service Levels, Load Balancer, Two Levels of Balancing, Goals of Load Balancing, Categories of Load Balancing, Exploring Dynamic Load Balancing.

Module 4(Cloud Management)

Cloud Computing and Business Continuity Planning/Disaster Recovery, Cloud Audit and Compliance: Internal Policy Compliance, Regulatory/External Compliance, Cloud Security Alliance.

Module 5(Cloud Security Strategies)

Standards for Security: SAML OAuth, OpenID, SSL/TLS, Encrypting Data and Key Management, Creating a Cloud Security Strategy, The Future of Security in Cloud Computing

Textbooks

1. Bhowmik, S., “Cloud computing”, Cambridge University Press, 2017.
2. Thomas, E., Zaigham, M., Ricardo, P “Cloud Computing Concepts, Technology & Architecture, Prentice Hall, 2013.

References

1. Ronald L. Krutz, Russell Dean Vines, "Cloud Security: A Comprehensive Guide to Secure Cloud Computing", Wiley Publishing, 2010.

2. Tim Mather, SubraKumaraswamy, and ShahedLatif, " Cloud Security and Privacy", O'Reilly Media, Inc., 2009

Sample Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Explain different cloud delivery models.
2. Compare public clouds and private clouds.
3. List the essential characteristics of cloud computing.

Course Outcome 2 (CO2):

1. Discuss briefly the fundamental characteristics of cloud security design principles.

Course Outcome 3 (CO3):

1. Summarize various access control issues in the cloud.
2. Outline any two acts for preserving privacy principles of the cloud.

Course Outcome 4 (CO4):

1. Explain load balancing in google cloud.
2. Describe different types of virtualization technologies.

Course Outcome 5 (CO5):

1. What are the industry security standards and regulatory mandates requirements for setting up cloud based infrastructures?

MODEL QUESTION PAPER

QP CODE:

Reg No: _____

Name : _____

PAGES : 3

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SEVENTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: CCT 433

Course Name: Cloud Computing and Security

Max.Marks:100

Duration: 3 Hours

PART A**Answer all Questions. Each question carries 3 Marks**

1. What is multi-tenant technology?
2. Why is it harder to establish security in the cloud?
3. "A hybrid cloud is a combination of two or more other cloud deployment models".
Justify the statement with an example.
4. What is grid computing?
5. Differentiate Threat and vulnerabilities.
6. What are the advantages of load balancing?
7. What does cloud computing's auto-scaling functionality entail? Based on three pillars, how has it been accomplished?
8. What is auditing in cloud computing?
9. Compare public clouds and private clouds.
10. What is the significance of OpenID?

(10*3=30 Marks)**PART B****Answer any one Question from each module. Each question carries 14 Marks**

11. a) Compare and contrast various computing models. (10)
- b) With an example explain utility computing. (4)

OR

12. a) Explain NIST Cloud Reference model (10)
- b) What is distributed computing? (4)

13. a) Explain the common threats and vulnerabilities that occur in cloud-based environments with suitable examples. (8)

- b) Explain Identity Management and Access Control in the cloud. (6)

OR

14. a) Explain Cloud Security Reference Model. (8)
- b) Examine the Challenges in accomplishing Cloud Security against Traditional

- Computing. (6)
15. a) Define Scaling. Differentiate between vertical and horizontal scaling. (10)
b) Why is availability important in a cloud based system? (4)

OR

16. a) Auto-scaling implementation requires a mixture of both reactive and proactive scaling approaches. Justify this statement. (7)
b) Explain Dynamic Load Balancing. (7)
17. a) Describe Cloud Security Alliance. (7)
b) Discuss the challenges in implementing Internal policy compliance in cloud (7)

OR

18. a) Explain Business Continuity Planning in Cloud Computing. (10)
b) How is disaster recovery accomplished in cloud? (4)
19. a) Explain the various standards for cloud security. (8)
b) How regulatory mandate requirements are set for cloud infrastructure? (6)

OR

20. a) Describe Encrypting Data and Key Management in Cloud. (10)
b) Which is the best cloud security strategy? (4)

TEACHING PLAN

Sl.No.	Contents	No of Lecture Hrs (35)
Module 1: Introduction to Cloud Computing (8 Hours)		
1.1	Traditional computing: Limitations	1 hour
1.2	Overview of Computing Paradigms: Grid Computing, Cluster Computing.	1 hour

1.3	Distributed Computing, Utility Computing, Cloud Computing.	1 hour
1.4	NIST reference Model, Basic terminology and concepts,	1 hour
1.5	Cloud characteristics, benefits and challenges	1 hour
1.6	Cloud delivery (service) models: Infrastructure-as-a-Service (IaaS), Platform-as-a-Service (PaaS), Software-as-a-Service (SaaS), XaaS (Anything-as-a service),	1 hour
1.7	Cloud deployment models: Public cloud, Community cloud, Private cloud, Hybrid cloud.	1 hour
1.8	Open Cloud Services	1 hour
Module 2: Fundamental Cloud Security (7 Hours)		
2.1	Basic Terms and Concepts in Security	1 hour
2.2	Threat Agents	1 hour
2.3	Cloud Security Threats.	1 hour
2.4	Identity Management and access Control	1 hour
2.5	Cloud Security Working Groups, Elements of Cloud Security Model.	1 hour
2.6	Cloud Security Reference Model.	1 hour
2.7	Examining Cloud Security against Traditional Computing.	1 hour
Module 3: Cloud Mechanisms (8 Hours)		
3.1	Scaling, Foundation of Cloud Scaling, Scaling Strategies in Cloud.	1 hour
3.2	Auto Scaling in Cloud, Cloud Bursting.	1 hour
3.3	Types of Scaling	1 hour
3.4	Capacity Planning	1 hour

3.5	Capacity Planning at Different Service Levels.	1 hour
3.6	Load Balancer, Two Levels of Balancing, Goals of Load Balancing	1 hour
3.7	Categories of Load Balancing	1 hour
3.8	Exploring Dynamic Load Balancing	1 hour
Module 4: Cloud Management (6 Hours)		
4.1	Cloud Computing and Business Continuity Planning	1 hour
4.2	Disaster Recovery	1 hour
4.3	Cloud Audit and Compliance	1 hour
4.4	Internal Policy Compliance	1 hour
4.5	Regulatory/External Compliance	1 hour
4.6	Cloud Security Alliance	1 hour
Module 5: Cloud Security Strategies (6 Hours)		
5.1	Standards for Security: SAML	1 hour
5.2	OAuth	1 hour
5.3	OpenID, SSL/TLS	1 hour
5.4	Encrypting Data and Key Management,	1 hour
5.5	Creating a Cloud Security Strategy	1 hour
5.6	The Future of Security in Cloud Computing.	1 hour

CCT443	MODEL BASED SOFTWARE DEVELOPMENT	CATEGORY	L	T	P	Credits	Year of Introduction
		PEC	2	1	0	3	2019

Preamble: The objective of the course is to familiarize learners about the concepts and advantages of using model based software development. This course covers the methodologies in developing the model of a software, perform analysis on the model and automatic generation of code from the model. The OSATE framework and its plugins using the Architecture Analysis and Design Language(AADL) language is used in the course to demonstrate the end-to-end concept of MBSD which helps the learners to get a hands on experience.

Prerequisite: Software Engineering.

Course Outcomes: After the completion of the course the student will be able to

CO#	Course Outcomes
CO1	Explain the relevance of model based software development in the software development process. (Cognitive Knowledge level: Understand)
CO2	Explain Model Driven Architecture with Computation Independent Model (CIM), Platform Independent Model(PIM), Platform Specific Model (PSM). (Cognitive Knowledge level: Apply)
CO3	Illustrate software modeling with Architecture Analysis and Design Language (AADL). (Cognitive Knowledge level: Apply)
CO4	Explain error annex using error modelling concepts and illustrate error modelling in AADL. (Cognitive Knowledge level: Understand)
CO5	Illustrate the process of code generation from an AADL model. (Cognitive Knowledge level: Understand)

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												

C02	✓	✓	✓	✓								✓
C03	✓	✓	✓	✓								✓
C04	✓	✓	✓									✓
C05	✓	✓	✓									✓

Abstract POs defined by National Board of Accreditation

PO#	Broad PO	PO#	Broad PO
PO1	Engineering Knowledge	PO7	Environment and Sustainability
PO2	Problem Analysis	PO8	Ethics
PO3	Design/Development of solutions	PO9	Individual and team work
PO4	Conduct investigations of complex problems	PO10	Communication
PO5	Modern tool usage	PO11	Project Management and Finance
PO6	The Engineer and Society	PO12	Lifelong learning

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	Test1 (%)	Test2 (%)	Marks (%)
Remember	30	30	30
Understand	50	50	50
Apply	20	20	20

Analyze			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks

Continuous Assessment Tests : 25 marks

Continuous Assessment Assignment : 15 marks

Internal Examination Pattern:

Each of the two internal examinations has to be conducted out of 50 marks. First Internal Examination shall be preferably conducted after completing the first half of the syllabus and the Second Internal Examination shall be preferably conducted after completing the remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly covered module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly covered module), each with 7 marks. Out of the 7 questions in Part B, a student should answer any 5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which a student should answer any one. Each question can have a maximum 2 subdivisions and carries 14 marks.

Syllabus

Module - 1 (Introduction to Model Based Software Development)

Software faults, Introduction to Model checking, Introduction to Automated Testing, Model Based Software Development (MBSD) – Need, MBSD Approach, Learning MBSD from the perspective of Architecture Analysis and Design Language (AADL).

Module - 2 (More on MBSD)

MBSD based software development – Requirements, Analysis, Design and Implementation. Model-Driven Architecture - Definitions and Assumptions, Overview of MBSD methodology, The modeling levels-Computation Independent Model (CIM), Platform Independent Model (PIM), Platform Specific Model (PSM). Introduction to AADL, Basic Comparison of AADL with other modeling languages - Comparison with UML.

Module -3 (Modeling using AADL)

Modeling: Developing a Simple Model - Define the components - Explain with example (powerboat autopilot system), Develop a top-level model - Use example Powerboat Autopilot (PBA) system.

AADL: Components - Software, Hardware, Composite, Runtime semantics, Language syntax, AADL declarations, AADL classifiers, AADL system models and specifications Case Study: Powerboat Autopilot System.

Module - 4 (Model Analysis)

Safety Analysis -Fault tree analysis, Minimal cutsets. Error Modeling in AADL-Error Model Libraries and Subclause Annotations, Error Types and Common Type Ontology, Error Sources and Their Impact, Component Error Behavior, Compositional Abstraction of Error Behavior, Use of Properties in Architecture Fault Models, Error modeling example.

Module - 5 (Code Generation)

Need for code generation, Categorization, Code Generation Techniques, Code Generation in AADL Model – Ocarina.

Text Books

1. Marco, Brambilla, Jordi Cabot, Manuel Wimmer, Model-Driven Software Engineering in Practice, 2/e, Synthesis Lectures on Software Engineering, 2017.
2. Christel Baier and Joost-Pieter Katoen, Principles of model checking, The MIT Press.
3. Thomas Stahl and Markus Volter, Model-Driven Software Development, Wiley, 2006.
4. David P. Gluch, Peter H. Feiler, Model-Based Engineering with AADL: An Introduction to the SAE Architecture Analysis & Design Language, Addison-Wesley, 2015.

References:

1. Automated software testing : <http://www2.latech.edu>
2. Peter H. Feiler, David P. Gluch, John J. Hudak. The Architecture Analysis & Design Language(AADL): An Introduction.

3. de Niz, Dionisio, Diagrams and Languages for Model-Based Software Engineering of Embedded Systems: UML and AADL
4. FAA System Safety Handbook, Chapter 8: Safety Analysis/Hazard Analysis Tasks
5. Enno Ruijters, Marielle Stoelinga, Fault tree analysis: A survey of the state-of-the-art in modeling, analysis and tools.
6. Larson, Brian & Hatcliff, John & Fowler, Kim & Delange, Julien. (2013). Illustrating the AADL error modeling annex (v.2) using a simple safety-critical medical device. ACM SIGAda Ada Letters. 33. 65-84. 10.1145/2527269.2527271.
7. Delange, Julien & Feiler, Peter & Hudak, John & Gluch, Dave. (2016). Architecture Fault Modeling and Analysis with the Error Model Annex, Version 2. 10.13140/RG.2.1.4224.7927.

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Justify the need of model based software development?
2. Explain the advantages of model based software development?

Course Outcome 2 (CO2):

1. Explain infrastructure of model driven architecture.
2. Describe about MDA modeling levels.

Course Outcome 3 (CO3):

1. Illustrate the basic components of an AADL Model.
2. Assume we have a system to regulate the fuel valve of a boiler by monitoring the steam flow and steam pressure. Identify the basic components of this system and design its AADL model..

Course Outcome 4 (CO4):

1. Suppose we have an isotherm system which ensures the temperature is within a specified temperature range with following components:
 - i) temperature sensor - detects air temperature.
 - ii) heat source - supply hot air to maintain temperature.
 - iii) operator interface - specify target temperature range(lower desired temperature, upper desired temperature.)
 - iv) thermostat - takes as input an air temperature value from a temperature sensor and controls a heat source to produce an air temperature within a target range.

Model the error flows, error propagations, component error behaviour and error properties for the value error in the isolette system.

Course Outcome 5 (CO5):

1. Illustrate code generation from an AADL model

MODEL QUESTION PAPER

QP CODE:

Reg No: _____

Name : _____

PAGES : 3

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SEVENTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: CCT 443

Course Name: Model Based Software Development

Max.Marks:100

Duration: 3 Hours

PART A

Answer all Questions. Each question carries 3 Marks

1. List any three advantages of automated software testing.
2. Specify the steps and their purpose in the model checking process.
3. Compare Analysis And Design Language (AADL) with Unified modeling language (UML).
4. Describe the design phase in the model based software development process.
5. Represent interface component with an out data port and an out event port in AADL.
a) textual b) graphical
6. Give the textual top level model of a powerboat autopilot system in AADL.
7. What is an error type? Mention any two pre-declared timing and value errors in AADL.
8. Define : (i) Fault Tree Analysis (ii) Minimal cutsets
9. Explain templates and filtering code generation technique.
10. How does automated code generation help to deal with faults in a software system?

(10*3=30 Marks)

PART B

Answer any One Question from each module. Each question carries 14 Marks

11. (a) Explain model based software development approach. (12)
(b) Why is model based software development important? (2)

OR

12. (a) What are software faults? Mention any three software faults and its consequences. (5)

(b) Explain two approaches for ensuring software reliability?

(i) Model Checking (ii) Automated Testing (9)

13. (a) Illustrate model based software development process. (8)

(b) Explain infrastructure of model driven architecture. (6)

OR

14. (a) What is AADL? Compare AADL and UML. (6)

(b) Explain in detail about MDA modeling levels. (8)

15. (a) Illustrate the components of an AADL model. (12)

(b) What is the AADL language syntax? (2)

OR

16. (a) Explain the following: i) AADL classifiers ii) AADL declarations (2)

(b) Design an AADL model which controls the speed of a vehicle. Also describe the basic components of the designed model. (10)

17. (a) Illustrate how value error can be modelled using AADL in the isolette system. (10)

(b) With a diagram explain error propagation, termination and transformation in AADL models. (4)

OR

18. (a) Illustrate error state machines in AADL using proper textual representations. (8)

(b) Suppose we have a train door controller system with following components

i) door_controller - ensures safe opening of the door.

ii) train_controller - sends train speed and transit status to the door_controller.

iii) alarm - triggered when an emergency occurs in other components.

Model the error flows, error propagations, component error behaviour and error properties for the value error in the component door_controller. (6)

19. (a) Explain templates and meta model type code generation? (4)

(b) Illustrate how the code can be generated from an AADL model. (10)

OR

20. (a) Describe any four code generation techniques. (10)

(b) Explain the advantages of automatic code generation. (4)

TEACHING PLAN

Sl.No	Contents	No.of Lecture Hrs (35)
Module 1 (Introduction) (7 Hours)		
1.1	Software faults	1

1.2	Introduction to Model Checking	1
1.3	Introduction to Automated Testing (Lecture 1)	1
1.4	Introduction to Automated Testing (Lecture 2)	1
1.5	Need for MBSD, MBSD Approach	1
1.6	Architecture centric model driven software development	1
1.7	AADL and architecture-centric model-based software systems	1

Module 2 (Model Based Software Development) (7 Hours)

2.1	Model based software development process	1
2.2	Overview of MBSD methodology	1
2.3	Model Driven Architecture	1
2.4	MDA Definitions and Assumptions	1
2.5	The modeling levels	1
2.6	Introduction to AADL	1
2.7	Comparison of AADL with other modeling languages	1

Module 3 (Modeling using AADL) (7 Hours)

3.1	Modeling in detail: AADL components	1
3.2	Modeling in detail: Developing a simple model	1
3.3	Modeling in detail: Define top level model with an example	1
3.4	AADL in detail: Explain AADL components, Language syntax	1
3.5	AADL declarations and classifiers	1
3.6	AADL system models and specifications	1
3.7	Case study: Power boat auto pilot system	1

Module 4 (Model Analysis)(7 Hours)

4.1	Introduction to safety analysis	1
4.2	Fault tree analysis, minimal cutsets	1
4.3	Error modeling with AADL - Error Model Libraries and Subclause Annotations	1
4.4	Error modeling with AADL - Error Types and Common Type Ontology	1
4.5	Error modeling with AADL - Error Sources and Their Impact, Component Error Behavior	1
4.6	Error modelling with AADL - Compositional Abstraction of Error Behavior, Use of Properties in Architecture Fault Models	1
4.7	Illustrate isolette error model	1

Module 5 (Code Generation) (7 Hours)

5.1	Code generation and its advantages	1
5.2	Categorization	1

5.3	Code generation techniques - Templates + filtering, Template + metamodel, Frame processors	1
5.4	Code generation techniques - API-based generators, In-line generation, Code attributes	1
5.5	Code generation techniques - Code weaving Commonalities and Differences Between the Different Code generation Approaches	1
5.6	Code generation in AADL - Ocarina	1
5.7	Illustration of code generation using AADL model	1



CST463	WEB PROGRAMMING	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		PEC	2	1	0	3	2019

Preamble: This course helps the learners to understand the web programming concepts. It includes the essential frontend and backend technologies needed for the development of web applications. The learners will have an opportunity to gain necessary web development skills such as HTML, CSS, JavaScript, PHP, MySQL integration, JSON and Laravel framework.

Prerequisite: Knowledge of Programming is required.

Course Outcomes: After the completion of the course the student will be able to

CO1	Use HyperText Markup Language (HTML) for authoring web pages and understand the fundamentals of WWW. (Cognitive Knowledge Level: Understand)
CO2	Construct and visually format responsive, interactive web pages using CSS and JavaScript (JS) (Cognitive Knowledge Level: Apply)
CO3	Construct websites using advanced sever side programming tool PHP (Cognitive Knowledge Level: Apply)
CO4	Develop dynamic web applications using PHP and perform MySQL database operations. (Cognitive Knowledge Level: Apply)
CO5	Explain the importance of object exchange formats using JSON and the MVC based web application development frameworks (Laravel) (Cognitive Knowledge Level: Understand)

Mapping of course outcomes with program outcomes

	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												

CO5												

Abstract POs defined by National Board of Accreditation			
PO#	Broad PO	PO#	Broad PO
PO1	Engineering Knowledge	PO7	Environment and Sustainability
PO2	Problem Analysis	PO8	Ethics
PO3	Design/Development of solutions	PO9	Individual and team work
PO4	Conduct investigations of complex problems	PO10	Communication
PO5	Modern tool usage	PO11	Project Management and Finance
PO6	The Engineer and Society	PO12	Life long learning

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination Marks (%)
	Test 1 (%)	Test 2 (%)	
Remember	20	20	20
Understand	40	40	40
Apply	40	40	40
Analyze			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3

Continuous Internal Evaluation Pattern:

Attendance	10 marks
Continuous Assessment Tests (Average of Internal Tests 1 & 2)	25 marks
Continuous Assessment Assignment	15 marks

Internal Examination Pattern

Each of the two internal examinations has to be conducted out of 50 marks.

First series test shall be preferably conducted after completing the first half of the syllabus and the second series test shall be preferably conducted after completing the remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly completed module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly completed module), each with 7 marks. Out of the 7 questions, a student should answer any 5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 full questions from each module of which student should answer any one. Each question can have a maximum of 2 subdivisions and carries 14 marks.

Syllabus**Module – 1 (WWW, HTML)**

Introduction to the Internet & WWW: Evolution of Internet & World Wide Web- Web Basics, URI's & URL-MIME.

Introduction to HTML5: Structuring & editing an HTML5 document, Fundamentals of HTML - Headings-Hyper Links- Images - Special Characters & Horizontal Rules-Lists- Tables -Forms - Internal Linking- Meta Elements-HTML5 Form input types -Input and Data List Elements and autocomplete attribute- Page Structure Elements -Multimedia-HTML5 Audio & video elements..

Module -2 (CSS, JavaScript)

Introduction to Stylesheets : Introduction to CSS-Basic syntax and structure-Inline Styles, Embedded Style Sheets, Conflict Resolution, Linking External Style Sheets-Exploring CSS Selectors-Properties, values, Positioning Elements: Absolute Positioning, Relative Positioning -

Backgrounds-List Styles-Element Dimensions- Table Layouts-Box Model and Text Flow-div and span -Basics of Responsive CSS, Media port & Media Queries.

Introduction to JavaScript : Introduction to Scripting- Programming fundamentals of JavaScript -Obtaining User Input with prompt Dialogs-Arithmetic-Decision Making -Control Statements - Functions -Arrays -Objects -Document Object Model (DOM) -Form processing

Module- 3 (PHP Basics)

PHP Language Structure: Introduction- Building blocks of PHP-Variables, Data Types -simple PHP program-Converting between Data Types- Operators and Expressions -Flow Control functions - Control statements- Working with Functions- Initialising and Manipulating Arrays-- Objects- String Comparisons-String processing with Regular Expression

Module -4 (PHP- MySQL, JSON)

Advanced PHP: Form processing and Business Logic-Cookies- Sessions & MySQL Integration- Connecting to MySQL with PHP- Performing CREATE, DELETE, INSERT, SELECT and UPDATE operations on MySQL table -Working with MySQL data-Reading from Database-Dynamic Content.

Module- 5 (JSON, Laravel)

JSON Data Interchange Format: Syntax, Data Types, Object, JSON Schema, Manipulating JSON data with PHP

Web Development Frameworks: Laravel Overview-Features of Laravel-Setting up a Laravel Development Environment-Application structure of Laravel-Routing -Middleware-Controllers-Route Model Binding-Views-Redirections-Request and Responses.

Text Books

- 1 Paul J. Deitel, Harvey M. Deitel, Abbey Deitel, Internet & World Wide Web How to Program 5th Edition [**Module 1,2,3,4**]
2. Lindsay Bassett, Introduction to JavaScript Object Notation: A To-the-Point Guide to JSON 1st Edition, O'Reilly [**Module 5**]
3. Julie C. Meloni, Pearson -PHP, MySQL & JavaScript All in One, Sams Teach Yourself,5th Ed [**Module 4**]
4. Matt Stauffer," LARAVEL up and Running, A framework for building modern PHP apps"1st Edition, O'REILLY [**Module 5**]

Reference Books

1. Robert W Sebesta, Programming the World Wide Web, 7/e, Pearson Education Inc, 8th Edition
2. Larry Ullman, Pearson- PHP 6 and MySQL 5 for Dynamic Web Sites: Visual QuickPro Guide
3. Eric van der Vlist, Danny Ayers, Erik Bruchez, Joe Fawcett, Alessandro Vernet", Wrox- Professional Web 2.0 Programming, Wiley-India edition
4. Web Technologies Black Book 2018 (As per Mumbai University Syllabus) HTML, CSS3, JavaScript, iQuery, AJAX, PHP, XML, MVC and Laravel DT Editorial Services (ISBN: 9789386052490)

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Construct a valid HTML document for your personal Profile registration page for a Job Site www.123Jobs.com. Add relevant HTML elements in a table, to accept a minimum of 10 different fields which includes your name, address, phone, email address, your picture, your college; your branch, fields for your personal history (Minimum 3 fields), favourite theory and practical subjects (Checkbox), Username, Password(password)
2. What is MIME? Give the expansion of MIME. List four examples for MIME types. State the reason why MIME type specification is necessary in a request-response transaction between a browser and server.
3. What is codec? Recognize the role of controls attribute in <video> & <audio> tag in HTML. Use the COVID vaccination promotional video 'MySafety.mp4' in a web page with suitable HTML code, 'autoplay' option enabled and displayed in a standard dimension 750 X500.

Course Outcome 2 (CO2):

1. Organize a sample web page for the event 'Raagam2021' at your campus and use embedded Style sheets to apply a minimum 5 styles. State the Style Specification format of embedded style sheets.
2. Write CSS style rules to implement the following in a web page:
 - a. to display the content of hyperlinks with yellow background color and in italics
 - b. to display the contents of unordered lists in bold and in Arial font
 - c. to display a background image titled "birds.jpg" with no tiling.
3. Write the code for an HTML document with embedded JavaScript scripts, which initially displays a paragraph with text "Welcome" and a button titled "Click". When the button is clicked, the message "Hello from JavaScript" in bold should replace the paragraph text

Course Outcome 3 (CO3):

1. Write a PHP program to store the name and roll no of 10 students in an Associative Array and Use foreach loop to process the array and Perform asort, rsort and ksort in the array. Illustrate with suitable output data
2. Design an HTML page which enters a given number, write a PHP program to display a message indicating, whether the number is odd or even, when clicking on the submit button.
3. Write a PHP program to compute the sum of the positive integers up to 100 using do while.

Course Outcome 4 (CO4):

1. Write a PHP form handling program to verify the user authentication credentials of a web page using MySQL connection and store the userid value as a Session variable if the userid is valid.
2. Create a valid HTML document for yourself, including your name, address, and email address. Also add your college; your major and the course. Perform form handling in PHP and process the output using POST method.
3. Write an embedded PHP script which displays the factorial of all numbers from 1 to 10 in a table in the web page. The factorial should be calculated and returned from a function. The table headings should be "Number" and "Factorial"

Course Outcome 5 (CO5):

1. What is Route Model Binding in Laravel? Which types of route model binding are supported in Laravel?
2. Explain how laravel performs route handling using routes calling controller methods?
3. List the data types used in JSON? Explain the use of parse () and stringify() functions in JSON with examples.

Model Question Paper

QP CODE:

Reg No: _____

Name: _____

PAGES : 4

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SEVENTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: CST463

Course Name: Web Programming

Max. Marks : 100

Duration: 3 Hours

PART A

Answer All Questions. Each Question Carries 3 Marks

1. Define WWW. List any two examples of web server & web browser. Differentiate between URL and a domain?
2. Write the syntax of the URL? Rewrite the default URL of your university website by adding a subdomain named 'Research' and a web page named 'FAQ.html'. Also link this URL through the logo of 'kturesearch.png' placed in a web page. The FAQ page should be opened in a new window.
3. Illustrate the implementation of a JavaScript function greeting () using external .js file, to display a welcome message, when you click on a Button in an HTML page.
4. What are different ways of adjusting spacing in a text with suitable example.
5. Discuss the various CSS style sheet levels with suitable examples. How are conflicts resolved when multiple style rules apply to a single web page element?
6. Describe how input from an HTML form is retrieved in a PHP program, with an example
7. Write a PHP program to check whether a number is prime number or not.
8. Discuss the various steps for establishing PHP-MySQL connection with a MySQL

database ?

9. Describe the schema of a document implemented in JSON with suitable examples
10. Explain the role of Resource controllers in Laravel.

(10x3=30)

Part B

(Answer any one question from each module. Each question carries 14 Marks)

11. (a) Design a webpage that displays the following table.

(6)

Food Item	Recommended Intake			
	age<15		age>15	
	gm	Kcal	gm	Kcal
Cerials	1000	2000	750	1760
NonCerials	450	800	350	600

- (b) What is the difference between radio buttons and checkboxes when implemented using HTML? Write HTML code to implement a form which has the following elements:
- A textbox which can accept a maximum of 25 characters
 - Three radio buttons with valid Label, Names and values
 - Three check boxes buttons with valid Label, Names and values
 - A selection list containing four items, two which are always visible
 - A submit button clicking on which will prompt the browser to send the form data to the server “http://www..mysite.com/reg.php” using “POST” method and reset button to clear its contents. You can use any text of your choice to label the form elements.

(8)

OR

12. (a) Write the equivalent HTML code to implement the following in a web page:
- An image titled “birds.jpg” with a height of 100 pixels and width of 200 pixels. If the image cannot be accessed, a message “No image available” should be displayed
 - A hyperlink to the URL “www.mysite.com/birds.jpg”. The hyperlink should have the label “Click Here”.

(6)

- (b) Create a static HTML document for your portfolio, which includes the following contents: your name, address, Mobile Number and email address. Also add the details about your college, university, your major and the batch

(8)

of study. Include a picture of yourself and at least one other image (friend/pet/role model) to the document with a short description about that. Add three paragraphs about your personal history, with links to your social media profile. Also create an ordered list for describing your Skill Set & an unordered list showing your Strengths & Weaknesses.

13. (a) Illustrate the usage of JavaScript DOM in event handling and explain any three methods with example. (8)
- (b) Write CSS and the corresponding HTML code for the following: (6)
- i. Set the background color for the hover and active link states to "green"
 - ii. Set the list style for unordered lists to "square".
 - iii. Set "Flower.png" as the background image of the page and set 3% margin for the pages
 - iv. Set dashed border for left and right and double border for top & bottom of a table with 2 rows.

OR

14. (a) List the order of precedence of style levels. Organize a sample web page for providing 'KTU BTech Honours Regulation 19' for KTU and use embedded Style sheet to apply minimum 5 styles for list, tables and pages. (6)
- (b) Illustrate the different ways of Array declaration in JavaScript. Describe the function of the following JavaScript Array object methods with examples. (8)
- (i) join (ii) slice
15. (a) Explain any six string handling functions used in PHP with example. (6)
- (b) How does a PHP array differ from an array in C? List the different ways to create an array in PHP with an example. Explain any 4 functions that deals with PHP array. (8)

OR

16. (a) During the process of fetching a web page from a web server to a client browser, at what point does an embedded PHP script get executed. What are the two modes that the PHP processor operates in? Explain (6)
- (b) Why is PHP considered to be dynamically typed? Distinguish between (8)

implode and explode function in PHP with suitable examples.

17. (a) Write equivalent PHP statements corresponding to the following: (8)
- i. Declare an associative array named “ages” to store the key-value pairs (“Alice”, 30), (“Bob”, 30), (“Harry”, 35), (“Mary”, 32).
 - ii. Modify the value associated with the key “Mary” to 28.
 - iii. Sort the array according to values maintaining the key-value relationships and print the sorted key-value pairs.
 - iv. The entry identified by the key “Bob”
- (b) What are the uses of cookies in web pages? Describe syntax for setting cookies in PHP. How can you access and delete the cookie using setcookie() function? (6)

OR

18. (a) Write a PHP form handling program to perform the user registration of any website with a minimum of 5 different fields and insert the data into a MySQL table after establishing necessary connections with the DB, (8)
- (b) Design the HTML page which enters a given number and embed the PHP code to display a message indicating, whether the number is odd or even, when clicking on the ‘CHECK NUMBER’ button. (6)
19. (a) With a neat diagram, explain about Laravel MVC Framework. (6)
- (b) Discuss in detail about Laravel’s Routing mechanisms. (8)

OR

20. (a) Enumerate the data types in JSON. Illustrate the document definition of a ‘Student document’ using JSON Schema. (8)
- (b) Discuss the following in Laravel Views (6)
- i. Creating & Rendering Views
 - ii. Passing Data to Views
 - iii. Sharing Data with All Views

Teaching Plan

No	Contents	No of Lecture Hrs (35 hrs)
Module 1 (7 hours)		
Introduction to Internet and WWW		
1.1	Evolution of Internet & World Wide Web- Web Basics URI's & URL -MIME [Book 1 - Chapter 1]	1
Introduction to HTML5		
1.2	Structuring & editing an HTML5 document- Fundamentals of HTML, Headings- Images [Book 1 - Chapter 2]	1
1.3	Hyper Links, Internal Linking- Lists [Book 1 - Chapter 2]	1
1.4	Special Characters & Horizontal Rules- meta Elements- div and span [Book 1 - Chapter 2]	1
1.5	Tables- Forms [Book 1 - Chapter 2]	1
1.6	HTML5 Form input types, input and data list Elements and autocomplete attributes-Page Structure Elements [Book 1 - Chapter 3]	1
1.7	Multimedia-HTML5 Audio & video elements [Book 1 - Chapter 9]	1
Module 2 (10 hours)		
Introduction to Cascading Style Sheets(CSS)		
2.1	Introduction to CSS3-Basic syntax and structure-Inline Styles [Book 1 - Chapter 4]	1
2.2	Embedded Style Sheets-Linking External Style Sheets [Book 1 - Chapter 4]	1
2.3	Exploring CSS Selectors-Properties-values [Book 1 - Chapter 4]	1
2.4	Positioning Elements: Absolute Positioning- Relative Positioning -Backgrounds- List Styles- Table Layouts [Book 1 - Chapter 4]	1

2.5	Box Model and Text Flow, Basics of Responsive CSS-Media port & Media Queries [Book 1 - Chapter 4]	1
Introduction to JavaScript		
2.6	Introduction to Scripting- Programming fundamentals of JavaScript -Obtaining User Input with prompt Dialogs [Book 1 - Chapter 6]	1
2.7	Arithmetic-Decision Making [Book 1 - Chapter 6]	1
2.8	Control Statements [Book 1 - Chapter 7]- Functions [Book 1 - Chapter 9]	1
2.9	Arrays [Book 1 - Chapter 10] - Objects [Book 1 - Chapter 11]	1
2.10	Document Object Model (DOM)- Form processing [Book 1 - Chapter 12,13]	1
Module 3 (6 hours)		
Introduction to PHP		
3.1	Building blocks of PHP-Variables, Data Types simple PHP program [Book 3- Chapters 4]	1
3.2	Converting between Data Types, Operators and Expressions -Flow Control functions [Book 1- Chapters 19]	1
3.3	Control Statements -Working with Functions [Book 3- Chapters 6]	1
3.4	Initialising and Manipulating Arrays- Objects [Book 1- Chapters 19]	1
3.5	Working with Strings-String processing with Regular expression, Pattern Matching [Book 1- Chapters 19]	1
3.6	Form processing and Business Logic [Book 1- Chapters 19]	1
Module 4 (6 hours)		
PHP -MYSQL		
4.1	Cookies- Sessions [Book 1- Chapters 19]	1
4.2	PHP& MySQL Integration-Connecting to MySQL with PHP . [Book 4- Chapters 18]	1

4.3	Working with MySQL data [Book 4- Chapters 18]	1
4.4	Performing CREATE, DELETE, INSERT operations on MySQL table from PHP Program. [Book 4- Chapters 16]	1
4.5	Performing SELECT and UPDATE operations on MySQL table from PHP Program. [Book 4- Chapters 16]	1
4.6	Building Dynamic Content in PHP application [Book1- Chapter19]	1
Module 5 (6 hours)		
	JSON	
5.1	JSON Data Interchange Format -Syntax, Data Types, Object [Book 2 - Chapters 1-2]	1
5.2	JSON Schema, Manipulating JSON data with PHP [Book 2 - Chapter 3,4]	1
	LARAVEL	
5.3	Laravel Overview- Design Pattern- Laravel Features [Book 4- Chapters 1] Setting up a Laravel Development Environment-Application structure of Laravel [Book 4- Chapters 2]	1
5.4	Laravel Basics Routing -middleware - Controllers [Book 4- Chapters 3]	1
5.5	Route Model Binding-Views-Redirections [Book 4- Chapters 3]	1
5.6	Blade Templating -echoing data, control structures [Book 4- Chapters 4]	1

CST473	NATURAL LANGUAGE PROCESSING	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		PEC	2	1	0	3	2019

Preamble: This course enables the learners to understand the concepts of Natural Language Processing. The course covers basic pre-processing steps, language models, text classification using machine learning algorithms, information and relation extraction methods, Information Retrieval, Question Answer Systems and Machine Translation models. This course enables the students to apply techniques and methods to solve challenging real-world problems in NLP.

Prerequisite: Nil.

Course Outcomes: After the completion of the course the student will be able to

CO1	Summarize basic concepts and learning methods for NLP (Cognitive Knowledge Level: Understand)
CO2	Demonstrate the relevance of pre-processing methods on text data(Cognitive Knowledge Level: Apply)
CO3	Compare different language modelling techniques(Cognitive Knowledge Level: Apply)
CO4	Make use of NLP techniques in Text Classification and Information Retrieval(Cognitive Knowledge Level: Apply)
CO5	Explain Information Extraction, Relation Detection, QA Systems and Machine Translation(Cognitive Knowledge Level: Understand)

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

Abstract POs defined by National Board of Accreditation			
PO#	Broad PO	PO#	Broad PO
PO1	Engineering Knowledge	PO7	Environment and Sustainability
PO2	Problem Analysis	PO8	Ethics
PO3	Design/Development of solutions	PO9	Individual and team work
PO4	Conduct investigations of complex problems	PO10	Communication
PO5	Modern tool usage	PO11	Project Management and Finance
PO6	The Engineer and Society	PO12	Life long learning

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination Marks (%)
	Test 1 (%)	Test 2 (%)	
Remember	30	30	30
Understand	40	40	40
Apply	30	30	30
Analyze			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3

Continuous Internal Evaluation Pattern:

Attendance	10 marks
Continuous Assessment Tests (Average of Internal Tests 1 & 2)	25 marks
Continuous Assessment Assignment	15 marks

Internal Examination Pattern

Each of the two internal examinations has to be conducted out of 50 marks. First series test shall be preferably conducted after completing the first half of the syllabus and the second series test shall be preferably conducted after completing remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly completed module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly completed module), each with 7 marks. Out of the 7 questions, a student should answer any 5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 full questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carries 14 marks.

Syllabus**Module – 1 (Introduction to NLP)**

NLP Tasks and Applications, Language-Building Blocks, Challenges of NLP, Machine Learning for NLP – Naïve Bayes Classifier, Logistic Regression, Support Vector Machines, Approaches to NLP-- Heuristics-Based NLP, Machine Learning-based NLP.

Module – 2 (Pre-processing and Representation Models)

NLP System Pipeline--Steps--Data Acquisition, Text Extraction and Clean-up, Pre-processing, Feature Engineering, Modelling, Evaluation, Post-Modelling Phases

Text Representation--Vector Space Models--Basic Vectorization Approaches--One-Hot Encoding, Bag of Words, Bag of N-Grams TF-IDF; Distributed Representations-- Word Embeddings, Doc2Vec.

Module - 3 (Classification and Information Extraction)

Text Classification--Text classification applications – Pipeline for building text classification systems, Naïve Bayes for Sentiment Classification – Naïve Bayes Classifier Training – Optimizing for Sentiment Analysis, Logistic Regression, Support Vector Machine for Text Classification

Information Extraction(IE)—IE Applications – The General Pipeline for IE - Named Entity Recognition(NER), Ambiguity in Named Entity Recognition – NER as Sequence Labeling – Evaluation of NER.

Module - 4 (Relation Detection and Information Retrieval)

Relation Detection and Classification – Supervised Learning Approaches to Relation Analysis – Lightly Supervised Approaches to Relation Analysis – Evaluation of Relation Analysis systems
Information Retrieval – Term weighting and document scoring – Inverted Index – Evaluation of Information Retrieval Systems.

Module - 5 (QA Systems and Machine Translation)

Question-Answering Systems – Factoid Question Answering – Question Processing – Passage Retrieval – Answer Processing – Evaluation of Factoid Answers

Machine Translation – Why Machine Translation is Hard – Classical Machine Translation – Direct Translation – Transfer – Statistical Machine Translation- The Phrase based Translation model – Alignment in MT – Training Alignment Models – Symmetrizing Alignments for Phrase-based MT – Decoding for Phrase-based Statistical MT

Text Books

1. Daniel Jurafsky, James H. Martin , “Speech and Language Processing”(2nd and 3rd editions), Pearson Prentice Hall
2. Sowmya Vajjala, Bodhisattwa Majumder, Anuj Gupta, Harshit Surana,” Practical Natural Language Processing: A Comprehensive Guide to Building Real-World NLP Systems “ June 2020 Publisher(s): O'Reilly Media, Inc. ISBN: 9781492054054.

Reference Books

1. James Allen, “Natural Language Understanding”, Second Edn , Pearson.
2. Christopher Manning and Hinrich Schutze, Statistical Natural Language Processing, MIT Press.

Course Level Assessment Questions

Course Outcome1 (CO1):

1. Explain the fundamental tasks that make up an NLP system.
2. Why is NLP considered a challenging problem domain?
3. The following table shows data about the profile of customers and whether they purchase computers or not. Given this data, use Naïve Bayes Classifier to classify the customer *X* (*age* = *youth*, *income* = *medium*, *student* = *yes*, *credit rating* = *fair*)

RID	age	income	student	credit_rating	Class: buys_computer
1	youth	high	no	fair	no
2	youth	high	no	excellent	no
3	middle_aged	high	no	fair	yes
4	senior	medium	no	fair	yes
5	senior	low	yes	fair	yes
6	senior	low	yes	excellent	no
7	middle_aged	low	yes	excellent	yes
8	youth	medium	no	fair	no
9	youth	low	yes	fair	yes
10	senior	medium	yes	fair	yes
11	youth	medium	yes	excellent	yes
12	middle_aged	medium	no	excellent	yes
13	middle_aged	high	yes	fair	yes
14	senior	medium	no	excellent	no

4. Illustrate how linearly inseparable data can be made linearly separable by suitable mapping using kernel functions.

Course Outcome 2(CO2):

1. Mention two issues associated with sentence segmentation.
2. Show how is lemmatization done using Python Library.
3. Given a dataset of tweets, prepare the data for sentiment analysis by doing the following operations: conversion to lower casing, removal of punctuations, removal of stop-words, stemming, lemmatization, removal of emojis and removal of URLs. (Assignment Question)

Course Outcome 3(CO3):

1. Compare Bag-of-Words model and Bag-of-n-gram model.
2. Illustrate how TF-IDF model is used to represent text. Mention the advantage of TF-IDF over other models.
3. A corpus of data is given below :

D1 Dog bites man.
 D2 Man bites dog.
 D3 Dog eats meat.
 D4 Man eats food.

Use one hot-encoding and Bag-of-words models to represent “dog bites man”.

Using the toy corpus given above, represent the sentence “Dog and Man eat meat” with TF-IDF model. Use python code for implementation. (Assignment Question)

Course Outcome 4(CO4): .

1. Given the following data about documents and contents, use tf-idf document scoring method to retrieve the document for the query “best game”

Doc 1	The game was so exciting. The players excelled in every department of the game.
Doc 2	It was an excellent game.
Doc 3	The game was not good. The moves were boring

2. A corpus of data is available from a social media platform that represents review of books. How can Naïve Bayes Classifier be used for sentiment analysis of the reviews? What changes can be made to this classifier to make it tuned for sentiment analysis.
3. Use python library to implement sentiment analysis of review of a book, given a toy corpus data set given below. (Assignment Question)

Document	Category
just plain boring	Negative
entirely predictable and lacks energy	Negative
no surprises and very few laughs	Negative
very powerful book	Positive
the best book of the summer	Positive

Course Outcome 5(CO5):

1. Explain lightly supervised approaches to relational analysis.
2. Explain a statistical algorithm for word alignment in Machine Translation.

Model Question Paper

QP CODE:

Reg No: _____

Name: _____

PAGES : 4

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SEVENTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: CST473

Course Name: Natural Language Processing

Max. Marks : 100

Duration: 3 Hours

PART A

Answer All Questions. Each Question Carries 3 Marks

1. Differentiate information extraction and information retrieval.
2. State Bayes' Theorem.
3. List three preprocessing steps that are necessary for an HTML file.
4. Differentiate CBOW and Skipgram models
5. Explain the role of support vectors in SVM Classification.
6. Explain challenges in Name Entity Recognition.
7. How is a Relational Analysis System evaluated?
8. Explain the need for an inverted index in an information retrieval system. Are there any more efficient data structures that serve the same purpose.
9. How do you extract answers to DEFINITION questions?
10. What are the components that make up a noisy channel model of statistical Machine Translation?

(10x3=30)

Part B**(Answer any one question from each module. Each question carries 14 Marks)**

11. (a) How is classification done by SVM on linearly separable data? (8)
- (b) What is a kernel function? What is the need for a kernel function? Can a kernel function be replaced by an ordinary mapping function? (4)
- (c) Explain Heuristic-based NLP. (2)

OR

12. (a) Illustrate the steps involved in classification in Naïve Bayes Classifier. (8)
- (b) Explain the fundamental tasks that make up an NLP system. (6)
13. (a) Supposing that a set of social media posts' dataset is available to do sentiment analysis. What pre-processing steps need to be done in order to use the data for generating a language model? Illustrate. (8)
- (b) Illustrate Bag-of-ngrams model with an example. (6)

OR

14. (a) Explain the concept of word embeddings as a model for text representation. (6)
- (b) Compare word embeddings model with vectorization approaches. (4)
- (c) Explain the concept of feature engineering in NLP Systems. (4)
15. (a) 1. Given the following data about movie review and its classification, classify "predictable with no fun" to one of the classes using Naïve Bayes Classifier. (10)

Document	Category
just plain boring	Negative
entirely predictable and lacks energy	Negative
no surprises and very few laughs	Negative
very powerful	Positive
the most fun film of the summer	Positive

- (b) Explain challenges in Name Entity Recognition. (4)

OR

16. (a) Explain Logistic Regression for Text Classification. (6)
- (b) Explain Name Entity Recognition using Sequence Labeling. (8)
17. (a) Explain supervised approach to relation analysis. What are its limitations? (10)
- (b) How is term selection done for indexing? (4)

OR

18. (a) Given the following data about documents and contents, use tf-idf document scoring method to retrieve the document for the query “sweet love”. (10)

Doc 1	Sweet sweet nurse! Love
Doc 2	Sweet sorrow
Doc 3	How sweet is love?
Doc 4	Nurse!

- (b) Explain the approaches to evaluate a relation analysis system. (4)
19. (a) Explain the phases of a factoid question-answering system. (8)
- (b) Give an algorithm for word alignment in Machine Translation. (6)

OR

20. (a) How is decoding done in a Phrase-based Statistical Machine Translation System? (10)
- (b) Explain the concept of Mean Reciprocal Rank. (4)

Teaching Plan

No	Contents	No of Lecture Hrs: 35
Module 1 : Introduction to NLP (7 hours)		
1.1	Introduction to NLP – Tasks and Applications	1
1.2	Language – Building Blocks, Challenges of NLP	1
1.3	Approaches to NLP - Heuristics-Based NLP, Machine Learning for NLP	1
1.4	Machine Learning for NLP – Naïve Bayes Classifier	1
1.5	Logistic Regression	1
1.6	Support Vector Machines – Linearly Separable Data	1
1.7	Support Vector Machines – Linearly Inseparable Data	1
Module 2 : Pre-processing and Representation Models(7 hours)		
2.1	NLP System Pipeline – Stages – Overview, Data Acquisition	1
2.2	NLP System Pipeline – Text Extraction and Cleanup	1
2.3	NLP System Pipeline – Preprocessing - Sentence segmentation, Word tokenization, Stemming and lemmatization	1
2.4	Feature Engineering, Model Building, Evaluation – Metrics, Post-modeling phase	1
2.5	Text Representation – Vector Space Model, Vectorization Approaches – One hot encoding, Bag of words	1
2.6	Bag of n-grams, TF-IDF	1
2.7	Word Embeddings – Word2Vec- CBOW, SkipGram models	1
Module 3: Classification and Information Extraction(7 hours)		
3.1	Text Classification--Text classification applications – Pipeline for building text classification systems	1
3.2	Sentiment Analysis using Naïve Bayes Classifier	1
3.3	Case Studies for Text Classification using Logistic Regression and	1

	Support Vector Machines	
3.4	Information Extraction (IE) and Applications, IE Tasks and the IE Pipeline	1
3.5	Named Entity Recognition (NER) – Ambiguity in NER	1
3.6	NER as Sequence Labeling	1
3.7	Evaluation of NER, Practical NER Systems	1
Module 4 : Relation Detection and Information Retrieval(5 hours)		
4.1	Relation Detection and Classification – Supervised Learning Approaches to Relation Analysis	1
4.2	Relation Detection and Classification – Lightly Supervised Approaches to Relation Analysis	1
4.3	Relation Detection and Classification -Evaluation of Relation Analysis systems	1
4.4	Information Retrieval – Term weighting and document scoring	1
4.5	Inverted Index, Evaluation of Information-Retrieval Systems	1
Module 5 : QA Systems and Machine Translation (9 hours)		
5.1	Question-Answering Systems – Factoid Question Answering, Question Processing	1
5.2	Passage Retrieval	1
5.3	Answer Processing, Evaluation of Factoid Answers	1
5.4	Machine Translation – Why Machine Translation is Hard	1
5.5	Classical Machine Translation	1
5.6	Statistical Machine Translation	1
5.7	The Phrase based Translation model	1
5.8	Alignment in Machine Translation	1
5.9	Decoding for Phrase-based Statistical MT	1

APJ ABDUL KALAM
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SEMESTER VII

OPEN ELECTIVE



CST415	INTRODUCTION TO MOBILE COMPUTING	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		OEC	2	1	0	3	2019

Preamble: The purpose of this course is to prepare learners to understand the functionalities and design considerations of mobile computing. The course content is designed to cover the mobile computing architecture, features of different communication systems and major elements of mobile security and next generation computer systems. This course enables the learners to acquire advanced concepts on mobile and ad-hoc networks.

Prerequisite: A good knowledge of data communication and computer networks.

Course Outcomes: After the completion of the course the student will be able to

CO#	Course Outcomes
CO1	Describe the mobile computing applications, services, design considerations and architectures(Cognitive knowledge: Understand)
CO2	Identify the technology trends for cellular wireless networks(Cognitive knowledge:Understand)
CO3	Summarize the Short Messaging Service and General Packet Radio Service (Cognitive knowledge: Understand)
CO4	Outline the LAN technologies used in mobile communication (Cognitive knowledge: Understand)
CO5	Describe the security protocols and apply suitable security algorithm to secure the communication (Cognitive knowledge: Apply)
CO6	Explain the fundamental concepts of next generation mobile networks(Cognitive knowledge: Understand)

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												
CO6												

Abstract POs defined by National Board of Accreditation			
PO#	Broad PO	PO#	Broad PO
PO1	Engineering Knowledge	PO7	Environment and Sustainability
PO2	Problem Analysis	PO8	Ethics
PO3	Design/Development of solutions	PO9	Individual and team work
PO4	Conduct investigations of complex problems	PO10	Communication
PO5	Modern tool usage	PO11	Project Management and Finance
PO6	The Engineer and Society	PO12	Life long learning

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination (%)
	Test 1 (%)	Test 2 (%)	
Remember	30	30	30
Understand	50	50	50
Apply	20	20	20
Analyse			
Evaluate			

Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3

Continuous Internal Evaluation Pattern:

Attendance : 10 marks

Continuous Assessment Test : 25 marks

Continuous Assessment Assignment : 15 marks

Internal Examination Pattern:

Each of the two internal examinations shall be conducted for 50 marks. First series test shall be conducted preferably after completing the first half of the syllabus and the second series test shall be conducted preferably after completing the remaining part of the syllabus. There shall be two parts for the question paper: Part A and Part B. Part A shall contain five questions (preferably, two questions each from the fully completed modules and one question from the partly covered module), having three marks for each question adding up to 15 marks for part A. A student is expected to answer all questions from Part A. Part B shall contain seven questions (preferably, three questions each from the fully completed modules and one question from the partially completed module), each having seven marks. Out of the seven questions, a student is expected to answer any five.

End Semester Examination Pattern:

There shall be two parts; Part A and Part B. Part A shall contain 10 questions with 2 questions from each module, having 3 marks for each question. A student is expected to answer all questions from Part A. Part B shall contain 2 questions from each module, out of which a student is expected to answer any one. Each question shall have a maximum of two sub-divisions and shall carry 14 marks.

Syllabus

Module-1 (Mobile Computing Architecture)

Introduction to mobile computing – Functions, Devices, Middleware and gateways, Applications and services, Limitations. Mobile computing architecture – Internet: The ubiquitous network, Three-tier architecture, Design considerations for mobile computing.

Module-2 (Communication Systems)

Mobile computing through telephony - Evolution of telephony, Multiple access procedures - Frequency Division Multiple Access (FDMA), Time Division Multiple Access (TDMA), Code Division Multiple Access (CDMA), Space Division Multiple Access (SDMA). Satellite communication systems – Basics, Applications, Geostationary Earth Orbit (GEO), Low Earth Orbit (LEO), Medium Earth Orbit (MEO), Satellite phones. Mobile computing through telephone – Interactive Voice Response (IVR) architecture, Overview of voice software, Developing an IVR application. Global System for Mobile Communication (GSM) - Introduction, Architecture, Entities, Call routing, Mobility management, Frequency allocation, Authentication and security.

Module-3 (Short Messaging Service and General Packet Radio Service)

Short Message Service (SMS) – Strengths, Architecture, Value added services, Accessing the SMS bearer. General Packet Radio Service (GPRS) – Architecture, Network operations, Data services, Applications, Limitations, Billing and charging.

Module-4 (Wireless Local Area Networks)

Wireless Local Area Network (WLAN) - Advantages, Evolution, Applications, Architecture, Mobility, Security, Deploying WLAN. Wireless Local Loop (WLL) – Architecture. High Performance Radio Local Area Network (HIPERLAN). WiFi Vs 3G.

Module-5 (Mobile Security and Next Generation Networks)

Security issues in mobile computing - Information security, Security techniques and algorithms, Security protocols. Next generation networks – The Converged Scenario, Narrowband to broadband, Orthogonal Frequency Division Multiplexing (OFDM), Multi Protocol Label Switching (MPLS), Wireless Asynchronous Transfer Mode (WATM), Multimedia broadcast services.

Text Books

1. Asoke K. Talukder, Hasan Ahmad, Roopa R Yavagal, Mobile Computing Technology- Application and Service Creation, 2nd Edition, McGraw Hill Education.
2. Schiller J., Mobile Communications, 2/e, Pearson Education, 2009.

Reference Books

1. Andrew S. Tanenbaum, Computer Networks, 6/e, PHI.
2. Theodore S. Rappaport, Wireless Communications Principles and Practice, 2/e, PHI, New Delhi, 2004.
3. Curt M. White, Fundamentals of Networking and Communication 7/e, Cengage learning.

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Describe the design considerations in mobile computing.
2. Give five examples of mobile computing applications.

Course Outcome 2 (CO2):

1. Draw a call flow diagram for a theatre ticket booking system.
2. Illustrate the GSM architecture with figure.

Course Outcome 3 (CO3):

1. Illustrate the billing and charging services in GPRS.
2. Describe the SMS architecture.

Course Outcome 4 (CO4):

1. Compare IEEE 802.11, HIPERLAN with respect to their ad-hoc capabilities.
2. Discuss the security mechanism used in WLAN.

Course Outcome 5 (CO5):

1. With the help of a suitable example, show the working of Diffie-Hellman key exchange algorithm.
2. Bob chooses 7 and 11 as two prime numbers and chooses e as 13. Find an appropriate value for d and decrypt the plaintext 5 send by Alice to Bob.
3. Describe the security issues in mobile computing.

Course Outcome 6 (CO6):

1. Describe WATM and Multimedia broadcast services.
2. Describe the significance of Orthogonal Frequency Division Multiplexing (OFDM) in next generation networks.

Model Question Paper

QP CODE:

PAGES: 3

Reg No: _____

Name: _____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SEVENTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: CST415

Course Name : INTRODUCTION TO MOBILE COMPUTING

Max Marks: 100

Duration: 3 Hours

PART-A

(Answer All Questions. Each question carries 3 marks)

1. Explain the different types of middleware and gateways required in mobile computing.
2. List any six limitations of mobile computing.
3. Compare and contrast the satellite systems – GEO, LEO and MEO.
4. How is frequency allocation done in GSM?
5. What are the various strengths of SMS?
6. How is billing and charging done in GPRS?
7. What are the different types of Wireless LANs?
8. Describe the architecture of a Wireless Local Loop.
9. Explain the key features of TLS protocol.
10. How are attacks classified?

(10x3=30)

Part B

(Answer any one question from each module. Each question carries 14 Marks)

11. (a) Describe any four mobile computing functions. (4)
(b) Explain the three-tier architecture of mobile computing with figure. (10)

OR

12. (a) Describe the significance and functions of core, edge and access network. (6)
- (b) Explain the terms (i) Client Context Manager (ii) Policy Manager (iii) Security Manager (iv) Adaptability Manager (8)
13. (a) Why is multiple access important? With the help of suitable examples, explain the various multiple access techniques. (7)
- (b) Describe the different algorithms used for security and authentication in GSM. (7)
- OR**
14. (a) Show how call routing is done in GSM. Give an example. (7)
- (b) Explain the process of handover. How does handover differ from roaming? (7)
15. (a) With the help of neat sketches, explain the difference between Short Message Mobile Terminated (SM MT) and Short Message Mobile Originated (SM MO) messages. (6)
- (b) Explain the network operations in GPRS. (8)
- OR**
16. (a) How does operator-centric pull differ from operator-independent push and pull? (7)
- (b) Describe the data services and applications of GPRS. (7)
17. (a) Compare the HIPERLAN and OSI layered architecture. (4)
- (b) Explain the 802.11 architecture. (10)
- OR**
18. (a) Compare 3G and WiFi. (7)
- (b) Explain the HIPERLAN communication models with suitable diagrams. (7)
19. (a) Given $p = 7$, $q = 17$ and $e = 5$. Find the value of d and also encrypt the message $P = 65$ using RSA. (7)
- (b) Explain the role of MPLS in service provisioning. (7)
- OR**
20. (a) With the help of a suitable example, show the working of Diffie-Hellman key exchange algorithm. (7)
- (b) Explain the features of any three multimedia broadcast services. (7)

TEACHING PLAN

No	Contents	No. of Lecture Hrs (35 hrs)
Module-1 (Mobile Computing Architecture) (6 hrs)		
1.1	Introduction to mobile computing – Functions, Devices, Middleware and gateways	1
1.2	Applications, services, limitations, Internet: The ubiquitous network	1
1.3	Three-tier architecture (Lecture 1)	1
1.4	Three-tier architecture (Lecture 2)	1
1.5	Design considerations for mobile computing (Lecture 1)	1
1.6	Design considerations for mobile computing (Lecture 2)	1
Module-2 (Communication Systems) (7hrs)		
2.1	Evolution of telephony, Multiple access procedures – FDMA, TDMA, CDMA, SDMA	1
2.2	Satellite communication systems – GEO, MEO, LEO, Satellite phones	1
2.3	Interactive Voice Response (IVR) architecture, Overview of voice software, Developing an IVR application (Call flow diagram)	1
2.4	Introduction to GSM, Architecture	1
2.5	GSM entities, Call routing	1
2.6	Mobility management	1
2.7	Frequency allocation, Authentication and security	1
Module-3 (Short Messaging Service and General Packet Radio Service) (8hrs)		
3.1	SMS Strengths, Architecture, Short Message Mobile Terminated (SM MT) and Short Message Mobile Originated (SM MO) messages	1
3.2	SMS Architecture - Operator-centric pull, operator-	1

	independent push/pull, Value added services	
3.3	Accessing the SMS bearer (Lecture 1)	1
3.4	Accessing the SMS bearer (Lecture 2)	1
3.5	GPRS architecture	1
3.6	Network operations	1
3.7	Data services, Applications	1
3.8	Limitations, Billing and charging	1
Module-4 (Wireless Local Area Networks) (7 hrs)		
4.1	WLAN Advantages, Evolution, Applications	1
4.2	WLAN Architecture (Lecture 1)	1
4.3	WLAN Architecture (Lecture 2)	1
4.4	Mobility, Security	1
4.5	Deploying WLAN	1
4.6	WLL Architecture, HIPERLAN	1
4.7	WiFi Vs 3G	1
Module-5 (Mobile Security and Next Generation Networks) (7hrs)		
5.1	Information security – Attacks, Components	1
5.2	Security techniques and algorithms – Stream Vs Block cipher, Symmetric Vs Asymmetric cryptography	1
5.3	Security techniques and algorithms – RSA, Diffie Hellman Key exchange	1
5.4	Security protocols – Secure Socket Layer, Transport Layer Security, Wireless Transport Layer Security	1
5.5	The Converged Scenario, Narrowband to broadband	1
5.6	Orthogonal Frequency Division Multiplexing (OFDM) and Multi Protocol Label Switching (MPLS)	1
5.7	Wireless Asynchronous Transfer Mode (WATM) and Multimedia broadcast services	1

CST425	INTRODUCTION TO DEEP LEARNING	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		OEC	2	1	0	3	2019

Preamble: This course aims to introduce the learner to an overview of the concepts and algorithms involved in deep learning. Basic concepts and application areas of machine learning, deep networks, convolutional neural network and recurrent neural network are covered in this course. This is a foundational program that will help students understand the capabilities, challenges, and consequences of deep learning and prepare them to participate in the development of leading-edge AI technology. They will be able to gain the knowledge needed to take a definitive step in the world of AI.

Prerequisite: Basics of linear algebra and probability.

Course Outcomes: After the completion of the course the student will be able to

CO1	Demonstrate basic concepts in machine learning.(Cognitive Knowledge Level: Understand)
CO2	Illustrate the validation process of machine learning models using hyper-parameters and validation sets. (Cognitive Knowledge Level: Understand)
CO3	Demonstrate the concept of the feed forward neural network and its training process. (Cognitive Knowledge Level: Apply)
CO4	Build CNN and Recurrent Neural Network (RNN) models for different use cases. (Cognitive Knowledge Level: Apply)
CO5	Use different neural network/deep learning models for practical applications. (Cognitive Knowledge Level: Apply)

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

Abstract POs defined by National Board of Accreditation			
PO#	Broad PO	PO#	Broad PO
PO1	Engineering Knowledge	PO7	Environment and Sustainability
PO2	Problem Analysis	PO8	Ethics
PO3	Design/Development of solutions	PO9	Individual and team work
PO4	Conduct investigations of complex problems	PO10	Communication
PO5	Modern tool usage	PO11	Project Management and Finance
PO6	The Engineer and Society	PO12	Lifelong learning

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination Marks (%)
	Test 1 (%)	Test 2 (%)	
Remember	30	30	30
Understand	30	30	30
Apply	40	40	40
Analyze			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks

Continuous Assessment Tests : 25 marks

Continuous Assessment Assignment : 15 marks

Internal Examination Pattern:

Each of the two internal examinations has to be conducted out of 50 marks

First Internal Examination shall be preferably conducted after completing the first half of the syllabus and the Second Internal Examination shall be preferably conducted after completing remaining part of the syllabus.

There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly covered module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly covered module), each with 7 marks. Out of the 7 questions in Part B, a student should answer any 5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which a student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Syllabus**Module-1 (Introduction)**

Key components - Data, models, objective functions, optimization algorithms, Learning algorithms. Supervised learning- regression, classification, tagging, web search, page ranking, recommender systems, sequence learning, Unsupervised learning, Reinforcement learning, Historical Trends in Deep Learning. Other Concepts - overfitting, underfitting , hyperparameters and validation sets, estimators, bias and variance.

Module- 2 (Optimization and Neural Networks)

Neural Networks –Perceptron, Gradient Descent solution for Perceptron, Multilayer perceptron, activation functions, architecture design, chain rule, back propagation, gradient based learning. Introduction to optimization– Gradient based optimization, linear least squares. Stochastic gradient descent, Building ML algorithms and challenges.

Module -3 (Convolutional Neural Network)

Convolutional Neural Networks – convolution operation, motivation, pooling, Convolution and Pooling as an infinitely strong prior, variants of convolution functions, structured outputs, data types, efficient convolution algorithms.

Module- 4 (Recurrent Neural Network)

Recurrent neural networks – Computational graphs, RNN design, encoder – decoder sequence to sequence architectures, deep recurrent networks, recursive neural networks, modern RNNs LSTM and GRU, Practical use cases for RNNs.

Module-5 (Application Areas)

Applications – computer vision, speech recognition, natural language processing. Research Areas – Autoencoders, Representation learning, Boltzmann Machines, Deep belief networks.

Text Book

1. Ian Goodfellow, Yoshua Bengio, Aaron Courville, Deep Learning, MIT Press 2015 ed.
2. Aston Zhang, Zachary C. Lipton, Mu Li, and Alexander J. Smola, Dive into Deep Learning, August 2019.
3. Neural Networks and Deep Learning: A Textbook by Charu C. Aggarwal. Springer.1st edition, 2018.

Reference Books

1. Neural Smithing: Supervised Learning in Feed forward Artificial Neural Networks by Russell Reed, Robert J MarksII, 1st edition, 1999, MIT Press.
2. Practical Convolutional Neural Networks by Mohit Sewak, Md. Rezaul Karim, Pradeep Pujari, 1st edition, 2018, Packt Publishing Ltd.
3. Hands-On Deep Learning Algorithms with Python by Sudharsan Ravichandran, 1st edition, 2019, Packt Publishing Ltd.
4. Deep Learning with Python by Francois Chollet, 2nd edition, 2018, Manning Publications Co.

Sample Course Level Assessment Questions**Course Outcome1(CO1):**

1. Compare regression and classification.
2. Define supervised learning? Distinguish between regression and classification.
3. Discuss the different learning approaches used in machine learning.
4. You train an initial model that achieves a 90% accuracy on the training dataset. What kind of problems your model is experiencing, and suggest a possible solution.
5. How does splitting a dataset into train, validation and test sets help identify overfitting?
6. Consider solving a classification task. You first train your network on 20 samples. Training converges, but the training loss is very high. You then decide to train this network on 10,000 examples. Is your approach to fixing the problem correct? If yes, explain the most likely results of training with 10,000 examples. If not, give a solution to this problem.

7. Describe one advantage of using mini-batch gradient descent instead of full-batch gradient descent.
8. Sketch the typical learning curves for the training and validation sets, for a setting where overfitting occurs at some point. Assume that the training set and the validation set are of the same size

Course Outcome 2(CO2):

1. What are hyperparameters? Why are they needed?
2. What issues are to be considered while selecting a model for applying machine learning in a given problem?
3. Update the parameters V_{11} in the given MLP using back propagation with learning rate as 0.5 and activation function as sigmoid. Initial weights are given as $V_{11}=0.2$, $V_{12}=0.1$, $V_{21}=0.1$, $V_{22}=0.3$, $V_{11}=0.2$, $W_{11}=0.5$, $W_{21}=0.2$
4. Draw the architecture of a multi-layer perceptron.
5. Derive update rules for parameters in the multi-layer neural network through the gradient descent.
6. Why is it important to place non-linearities between the layers of neural networks?
7. You design a fully connected neural network architecture where all activations are sigmoids. You initialize the weights with large positive numbers. Is this a good idea? Explain your answer.
8. You are doing full batch gradient descent using the entire training set (not stochastic gradient descent). Is it necessary to shuffle the training data? Explain your answer.
9. Consider training a fully-connected neural network with 5 hidden layers, each with 10 hidden units. The input is 20-dimensional and the output is a scalar. What is the total number of trainable parameters in your network?
10. Consider building a 10-class neural network classifier. Given a cat image, you want to classify which of the 10 cat breeds it belongs to. What loss function do you use? Introduce the appropriate notation and write down the formula of the loss function.
11. Why is the sigmoid activation function susceptible to the vanishing gradient problem?

Course Outcome 3 (CO3):

1. Give two benefits of using convolutional layers instead of fully connected ones for visual tasks.
2. Suppose that a CNN was trained to classify images into different categories. It performed well on a validation set that was taken from the same source as the training set but not on a testing set. What could be the problem with the training of such a CNN? How will you ascertain the problem? How can those problems be solved?
3. You are given a dataset of 10 x 10 grayscale images. Your goal is to build a 5-class classifier. You have to adopt one of the following two options: a) the input is flattened into a 100-dimensional vector, followed by a fully-connected layer with 5

- neurons, b) the input is directly given to a convolutional layer with five 10×10 filters. Explain which one you would choose and why.
4. Weight sharing allows CNNs to deal with image data without using too many parameters. Does weight sharing increase the bias or the variance of a model?
 5. Why do the layers in a deep architecture need to be non-linear?
 6. A convolutional neural network has 4 consecutive layers as follows:
 3×3 conv (stride 2) - 2×2 Pool - 3×3 conv (stride 2) - 2×2 Pool
 How large is the set of image pixels which activate a neuron in the 4th non-image layer of this network?
 7. Consider a convolution layer. The input consists of 6 feature maps of size 20×20 . The output consists of 8 feature maps, and the filters are of size 5×5 . The convolution is done with a stride of 2 and zero padding, so the output feature maps are of size 10×10 . Determine the number of weights in this convolution layer

Course Outcome 4(CO4):

1. Explain how the cell state is updated in the LSTM model from C_{t-1} to C_t
2. Show the steps involved in an LSTM to predict stock prices.
3. Illustrate the workings of the RNN with an example of a single sequence defined on a vocabulary of four words.
4. If we have a recurrent neural network (RNN), we can view it as a different type of network by "unrolling it through time". Briefly explain what that means.
5. Briefly explain how "unrolling through time" is related to "weight sharing" in convolutional networks.
6. Explain how the cell state is updated in the LSTM model from C_{t-1} to C_t
7. Show the steps involved in an LSTM to predict stock prices. Give one advantage of using an RNN rather than a convolutional network.

Course Outcome 5 (CO5):

1. Development a deep learning solution for problems in the domain i) natural language processing or ii Computer vision (Assignment)
2. Is an autoencoder for supervised learning or for unsupervised learning? Explain briefly.
3. Sketch the architecture of an autoencoder network.
4. Describe how to train an autoencoder network.
5. Write down the formula for the energy function (E) of a Restricted Boltzmann Machine (RBM).

Model Question Paper

QP CODE:

Reg No: _____

Name: _____

PAGES : 4

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

EIGHTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: CST425

Course Name: Introduction To Deep Learning

Max. Marks : 100

Duration: 3 Hours

PART A

Answer All Questions. Each Question Carries 3 Marks

1. Distinguish between supervised learning and Reinforcement learning. Illustrate with an example.
2. Differentiate classification and regression.
3. Compare overfitting and underfitting. How it can affect model generalization.
4. Why does a single perceptron cannot simulate simple XOR function? Explain how this limitation is overcome?
5. Illustrate the strengths and weaknesses of convolutional neural networks.
6. Illustrate convolution and pooling operation with an example
7. How many parameters are there in AlexNet? Why the dataset size (1.2 million) is important for the success of AlexNet?
8. Explain your understanding of unfolding a recursive or recurrent computation into a computational graph.
9. Illustrate the use of deep learning concepts in Speech Recognition.
10. What is an autoencoder? Give one application of an autoencoder

(10x3=30)

Part B

(Answer any one question from each module. Each question carries 14 Marks)

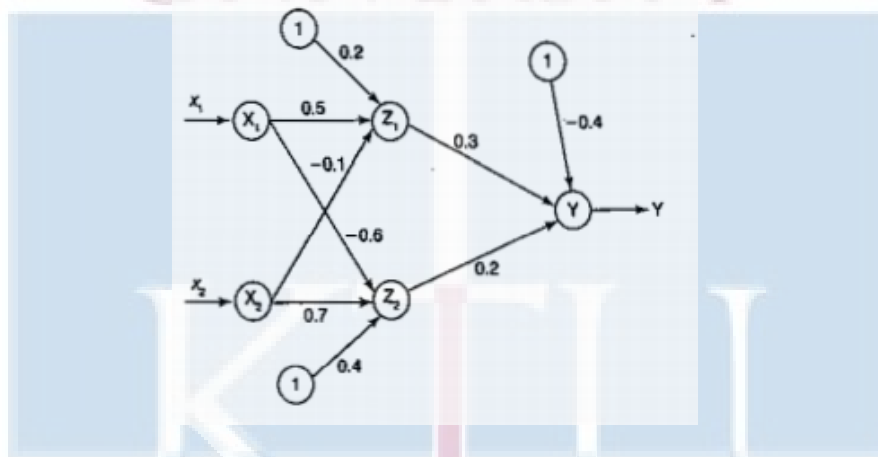
11. (a) "A computer program is said to learn from experience E with respect to some class of tasks T and performance measure P, if its performance at tasks in T, as measured by P, improves with experience E." What is your understanding of the terms task, performance and experience. Explain with two examples. **(10)**
- (b) "How does bias and variance trade-off affect machine learning algorithms?" **(4)**

OR

12. (a) Illustrate the concepts of Web search, Page Ranking, Recommender systems with suitable examples. (10)
- (b) List and discuss the different hyper parameters used in fine tuning the traditional machine learning models (4)
13. (a) How multilayer neural networks learn and encode higher level features from input features. (7)
- (b) Explain gradient decent and delta rule? Why stochastic approximation to gradient descent is needed? (7)

OR

14. (a) Find the new weights for the network using backpropagation algorithm, the network is given with a input pattern $[-1, 1]$ and target output as $+1$, Use learning rate of $\alpha=0.3$ and bipolar sigmoid function. (7)



- (b) Write an algorithm for backpropagation which uses stochastic gradient descent method. Comment on the effect of adding momentum to the network. (7)
15. (a) Input to CNN architecture is a color image of size $112 \times 112 \times 3$. The first convolution layer comprises of 64 kernels of size 5×5 applied with a stride of 2 and padding 0. What will be the number of parameters? (5)
- (b) Let $X = [-1, 0, 3, 5]$ $W = [0.3, 0.5, 0.2, 1]$ be the the input of i^{th} layer of a neural network and to apply softmax function. What should be the output of it? (4)
- (c) Draw and explain the architecture of convolutional network (5)

OR

16. (a) Explain the concept behind i) Early stopping ii) dropout iii) weight decay (9)
- (b) How backpropagation is used to learn higher-order features in a convolutional Network? (5)
17. (a) Explain the working of RNN and discuss how backpropagation through time is used in recurrent networks. (8)

- (b) Describe the working of a long short term memory in RNNs. (6)

OR

18. (a) What is the vanishing gradient problem and exploding gradient problem? (8)

- (b) Why do RNNs have a tendency to suffer from exploding/vanishing gradient?
How to overcome this challenge? (6)

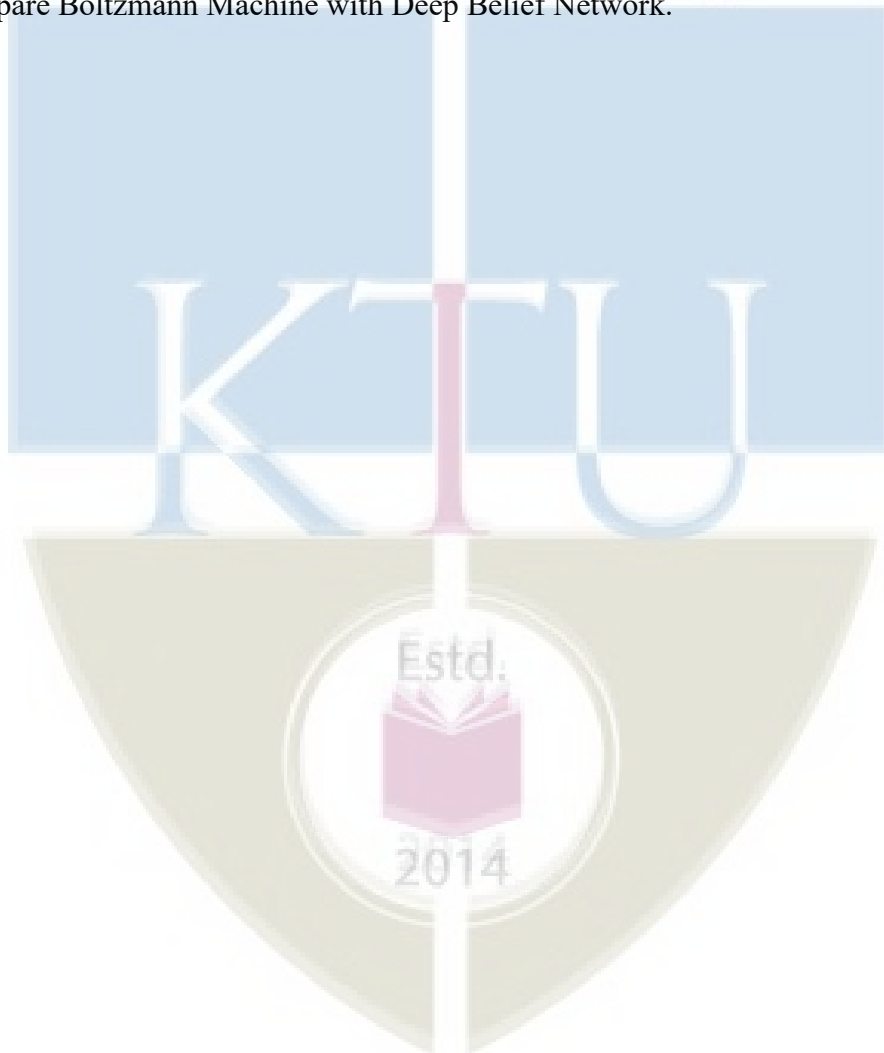
19. (a) Explain any two word embedding techniques (8)

- (b) Explain the merits and demerits of using Auto encoders in Computer Vision. (6)

OR

20. (a) Illustrate the use of representation learning in object classification. (7)

- (b) Compare Boltzmann Machine with Deep Belief Network. (7)



Teaching Plan

No	Contents	No. of Lecture Hours (37 hrs)
Module 1 : Introduction (8 hours)		
1.1	Key components - Data, models, objective functions, optimization algorithms. (TB2: Section 1.1-1.2)	1
1.2	Learning algorithm (TB1: Section 5.1), Supervised learning- regression, classification, tagging, web search, page ranking (TB2: Section 1.3.1)	1
1.3	Recommender systems, Sequence learning, Unsupervised learning, Reinforcement learning(TB2: Section 1.3.2-1.3.4)	1
1.4	Historical Trends in Deep Learning (TB1: Section 1.2).	1
1.5	Concepts: overfit, underfit, hyperparameters and validation sets. (TB1: Section 5.2-5.3)	1
1.6	Concepts: Estimators, bias and variance. (TB1: Section 5.4)	1
1.7	Demonstrate the concepts of supervised learning algorithms using a suitable platform.	1
1.8	Demonstrate the concepts of unsupervised using a suitable platform.	1
Module 2 : Optimization and Neural Networks (9 hours)		
2.1	Perceptron, Stochastic Gradient descent, Gradient descent solution for perceptron (TB3: Section 1.1 - 1.2.1)	1
2.2	Multilayer perceptron (TB3: Section 1.2.2), (TB1: Section 6.1,6.3)	1
2.3	Activation functions- Sigmoid, tanh, Softmax, ReLU, leaky ReLU (TB3: Section 1.2.1.3 - 1.2.1.5)	1
2.4	Architecture design (TB1: Section 6.4, TB3: Section 1.6)	1
2.5	Chain rule, back propagation (TB3: Section 1.3)	1
2.6	Gradient based learning (TB1: Section 6.2)	1
2.7	Gradient based optimization (TB1: Section 4.3)	1
2.8	Linear least squares using a suitable platform. (TB1: Section 4.5)	1
2.9	Building ML Algorithms and Challenges (TB3: 1.4, TB1: 5.10-5.11)	1
Module 3 :Convolution Neural Network (8 hours)		
3.1	Convolution operation (TB1:Section 9.1)	1
3.2	Motivation, pooling (TB1:Section 9.2-9.3)	1

3.3	Convolution and Pooling as an infinitely strong prior (TB1: Section 9.4)	1
3.4	Variants of convolution functions – multilayer convolutional network, tensors, kernel flipping, downsampling, strides and zero padding. (TB1: Section 9.5)	1
3.5	Variants of convolution functions - unshared convolutions, tiled convolution, training different networks. (TB1: Section 9.5)	1
3.6	Structured outputs, data types (TB1: Section 9.6-9.7)	1
3.7	Efficient convolution algorithms. (TB1: Section 9.8,9.10)	1
3.8	Case Study: AlexNet, VGG, ResNet. (TB3: Section 8.4.1, 8.4.3, 8.4.5)	1
Module 4 :Recurrent Neural Network (7 hours)		
4.1	Computational graphs (TB1: Section 10.1)	1
4.2	RNN (TB1: Section 10.2-10.3)	1
4.3	Encoder – decoder sequence to sequence architectures. (TB1: Section 10.4)	1
4.4	Deep recurrent networks (TB1: Section 10.5)	1
4.5	Recursive neural networks , Modern RNNs, LSTM and GRU (TB1: Section 10.6, 10.10)	1
4.6	Practical use cases for RNNs. (TB1: Section 11.1-11.4)	1
4.7	Demonstrate the concepts of RNN using a suitable platform.	1
Module 5 : Applications and Research (5 hours)		
5.1	Computer vision. (TB1: Section 12.2)	1
5.2	Speech recognition. (TB1: Section 12.3)	1
5.3	Natural language processing. (TB1: Section 12.4)	1
5.4	Brief introduction on current research areas- Autoencoders, Representation learning. (TB1: Section 14.1-14.2, TB3: 9.3)	1
5.5	Brief introduction on current research areas- Boltzmann Machines, Deep belief networks. (TB1: Section 20.1, 20.3)	1

CST435	COMPUTER GRAPHICS	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		OEC	2	1	0		

Preamble: This course helps the learners to make awareness about strong theoretical concept in computer graphics. It covers the three-dimensional environment representation in a computer, transformation of 2D/3D objects and basic mathematical techniques and algorithms used to build applications. This course enables the learners to develop the ability to create image processing frameworks for different domains and develop algorithms for emerging display technologies.

Prerequisite: A sound knowledge of Mathematics and concepts of any programming language.

Course Outcomes: After the completion of the course the student will be able to

CO#	CO
CO1	Describe the working principles of graphics devices(Cognitive Knowledge level: Understand)
CO2	Illustrate line drawing, circle drawing and polygon filling algorithms(Cognitive Knowledge level: Apply)
CO3	Demonstrate geometric representations and transformations on 2D & 3D objects (Cognitive Knowledge level: Apply)
CO4	Demonstrate the working of line and polygon clipping algorithms(Cognitive Knowledge level: Apply)
CO5	Summarize visible surface detection methods and illustrate projection algorithms. (Cognitive Knowledge level: Apply)

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

Abstract POs defined by National Board of Accreditation			
PO#	Broad PO	PO#	Broad PO
PO1	Engineering Knowledge	PO7	Environment and Sustainability
PO2	Problem Analysis	PO8	Ethics
PO3	Design/Development of solutions	PO9	Individual and team work
PO4	Conduct investigations of complex problems	PO10	Communication
PO5	Modern tool usage	PO11	Project Management and Finance
PO6	The Engineer and Society	PO12	Life long learning

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination Marks (%)
	Test 1 (%)	Test 2 (%)	
Remember	30	30	30
Understand	30	30	30
Apply	40	40	40
Analyze			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3

Continuous Internal Evaluation Pattern:

Attendance	10 marks
Continuous Assessment Tests (Average of Series Tests 1 & 2)	25 marks
Continuous Assessment Assignment	15 marks

Internal Examination Pattern:

Each of the two internal examinations has to be conducted out of 50 marks. The first series test shall be preferably conducted after completing the first half of the syllabus and the second series test shall be preferably conducted after completing the remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly completed module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly completed module), each with 7 marks. Out of the 7 questions, a student should answer any 5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 full questions from each module of which student should answer any one full question. Each question can have maximum 2 sub-divisions and carries 14 marks.

Syllabus

Module – 1(Basics of Computer graphics)

Basics of Computer Graphics and its applications. Video Display devices- Refresh Cathode Ray Tubes(CRT), Random Scan Displays and systems, Raster scan displays and systems, Color CRT displays, Flat panel display and its categories.

Module – 2 (Line drawing, Circle drawing and Filled Area Primitives)

Line drawing algorithms- DDA, Bresenham's algorithm. Circle drawing algorithms- Midpoint Circle generation algorithm, Bresenham's algorithm. Filled Area Primitives- Scan line polygon filling, Boundary filling and flood filling.

Module - 3 (Geometric transformations)

Two dimensional transformations-Translation, Rotation, Scaling, Reflection and Shearing, Composite transformations, Matrix representations and homogeneous coordinates. Basic 3D transformations.

Module - 4 (Clipping)

Window to viewport transformation. Cohen Sutherland and Midpoint subdivision line clipping algorithms, Sutherland Hodgeman and Weiler Atherton Polygon clipping algorithms.

Module - 5 (Three dimensional graphics)

Three dimensional viewing pipeline. Projections- Parallel and Perspective projections. Visible surface detection algorithms- Back face detection, Depth buffer algorithm, Scan line algorithm, A buffer algorithm

Text Book

1. Zhigang Xiang and Roy Plastock, Computer Graphics (Schaum's outline Series), McGraw Hill, 2019.
2. Donald Hearn and M. Pauline Baker, Computer Graphics, PHI, 2e, 1996

References

1. William M. Newman and Robert F. Sproull, Principles of Interactive Computer Graphics. McGraw Hill, 2001
2. David F. Rogers , Procedural Elements for Computer Graphics, Tata McGraw Hill, 2001.
3. Donald Hearn, M. Pauline Baker and Warren Carithers, Computer Graphics with OpenGL, PHI, 4e, 2013

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Compare the working principle of raster scan systems and random scan systems.
2. How much time is spent scanning across each row of pixels during screen refresh on a raster system with resolution of 1280*1024 and a refresh rate of 60 frames per second?

Course Outcome 2 (CO2):

1. Rasterize the line using Bresenham's line drawing algorithm with end points (2,3) and (5,8) accepted from the user and implement it using any appropriate programming language. (Assignment)
2. Illustrate how the 4-connected boundary filling approach differs from 8-connected boundary filling and implement it using any appropriate programming language. (Assignment)

Course Outcome 3 (CO3):

1. Rotate a triangle ABC 45 degree counter clockwise about the pivot point (10,3) , where the position vector of the coordinates is given as A(4,1), B(5,2) and C(4,3).
2. Implement the above transformation using any appropriate programming language with user inputs. (Assignment)
3. Illustrate the steps required for a general 3D rotation if the rotation axis is not parallel to any one of the principal axis. The rotation axis is defined by the points P1(x1,y1,z1) and P2(x2,y2,z2). Give its composite matrix representation.

Course Outcome 4 (CO4):

1. Given a clipping window A(20,20), B(60,20), C(60,40) and D(20,40). Using Cohen Sutherland algorithm, find the visible portion of the line segment joining the points P(40,80) and Q(120,30).

2. Implement Cohen Sutherland clipping algorithm using any appropriate programming language with user inputs. (Assignment)

Course Outcome 5 (CO5):

1. Explain scan line algorithm for detecting visible surfaces in an object.
2. Derive the matrix for performing perspective projection and parallel projection.

Model Question Paper

QP CODE:

Reg No: _____

Name: _____

PAGES : 3

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SEVENTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: CST435

Course Name: Computer Graphics

Max. Marks : 100

Duration: 3 Hours

PART A

Answer All Questions. Each Question Carries 3 Marks

1. Describe Flat Panel display and its categories.
2. Consider a raster system with a resolution of 1024×1024 . Compute the size of the raster needed to store 4 bits per pixel? How much storage is needed if 8 bits per pixel are to be stored?
3. Justify the usage of integer arithmetic in Bresenham's line drawing algorithm.
4. How 8-way symmetry of circle can be used for developing circle drawing algorithms?
5. Show that two successive reflections about either of the coordinate axes is equivalent to a single rotation about the coordinate origin.
6. Determine a sequence of basic transformations that is equivalent to x-direction shearing.
7. Find the window to viewport normalization transformation with window lower left corner at (1,1) and upper right corner at (2,6).

8. How does Cohen Sutherland algorithm determine whether a line is visible, invisible or a candidate for clipping based on the region codes assigned to the end points of the line?
9. Define the terms (i) Centre of projection (ii) Principal vanishing point
10. Differentiate between the object space and image space method for the hidden surface removal of an image. (10x3=30)

Part B

(Answer any one question from each module. Each question carries 14 Marks)

11. (a) Explain the working principle of beam penetration method and shadow mask method with suitable illustrations. (8)
(b) Draw the architecture of raster scan display systems and explain its working principle. (6)

OR

12. (a) Explain the working principle of a Refresh CRT monitor with suitable diagrams. (8)
(b) Describe random graphics system with suitable illustrations. (6)
13. (a) Differentiate between boundary fill and flood fill algorithms. (5)
(b) Derive the initial decision parameter of Bresenham's line drawing algorithm and rasterize a line with endpoints (2,2) and (10,10). (9)

OR

14. (a) Write Midpoint circle drawing algorithm and identify the points in the circle with radius as 20 and center at (50,30) using the algorithm. (8)
(b) Illustrate the working principle of scan line polygon filling algorithm. (6)
15. (a) Reflect a triangle ABC about the line $3x-4y+8=0$, where the coordinates of the triangle are given as A(4,1), B(5,2) and C(4,3). (8)
(b) A diamond shaped polygon is located at P(-1,0), Q(0,-2), R(1,0) and S(0,2). Find the transformation matrix which would rotate the triangle by 90 degree counter clockwise about the point Q. Using the transformation matrix, find the coordinates of the rotated polygon. (6)

OR

16. (a) Describe the steps required for a general 3D rotation if the rotation axis is not parallel to any one of the principal axis. The rotation axis is defined by the points $P1(x1,y1,z1)$ and $P2(x2,y2,z2)$. Give its composite matrix representation. (8)
- (b) Consider a triangle at $(2,2)$, $(10,2)$, $(2,10)$. Perform the following 2D transformations in succession and find the resultant vertices. (6)
- i) Scale with respect to $(2,2)$ by scaling factors $(2,2)$ along x and y directions.
 - ii) Rotate by 90 degree counter clockwise direction.
 - iii) Reflection based on $y=x$
17. (a) Illustrate Weiler – Atherton polygon clipping algorithm. (6)
- (b) Explain Cohen-Sutherland line clipping algorithm. Use the algorithm to clip line with end points $P1(70, 20)$ and $P2(100,10)$ against a window with lower left hand corner $(50,10)$ and upper right hand corner $(80,40)$. (8)

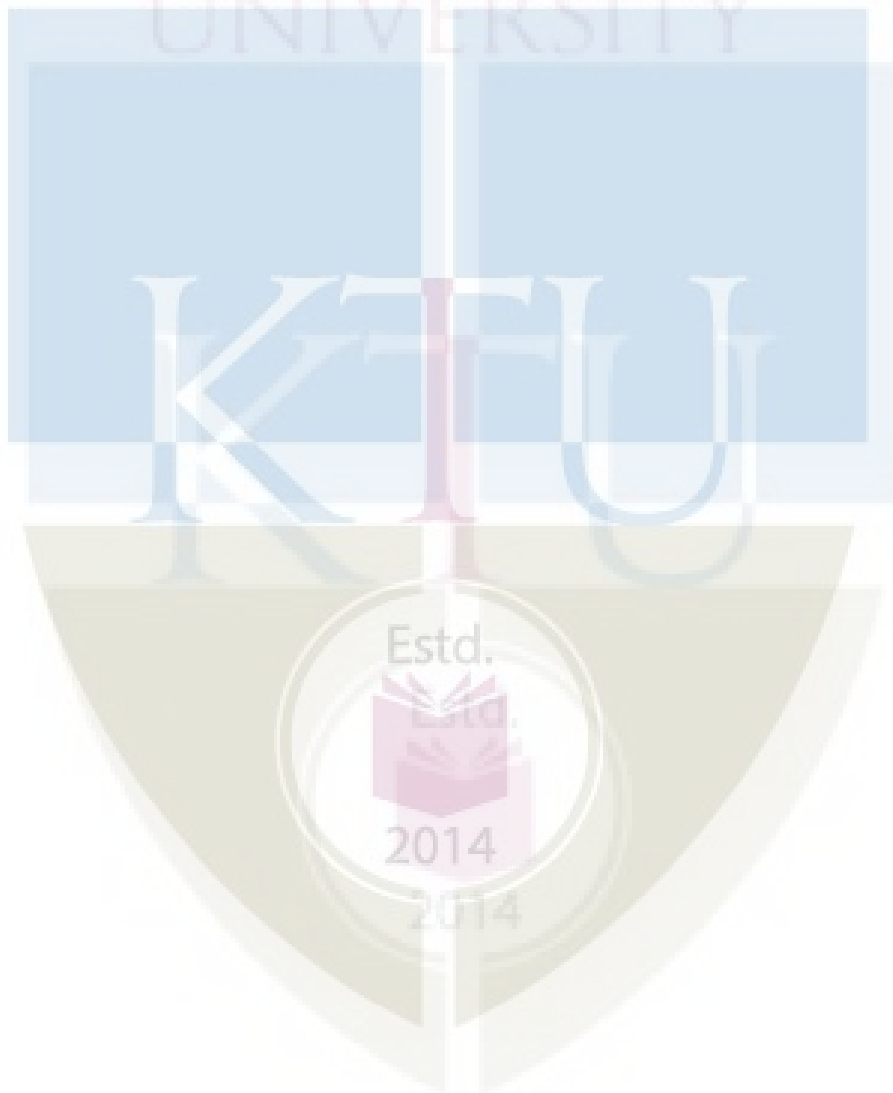
OR

18. (a) Describe Sutherland Hodgeman polygon clipping algorithm and list out its limitations. (7)
- (b) Explain the steps involved in clipping a line using Mid point Subdivision algorithm. (7)
19. (a) Explain how visible surfaces can be detected using depth buffer algorithm. (7)
- (b) Define parallel projection. Describe orthographic and oblique parallel projection. (7)
- OR
20. (a) Illustrate the scan line method used in visible surface detection. (7)
- (b) Derive the matrix needed for performing perspective projections. (7)

TEACHING PLAN

No	Contents	No of Lecture Hrs (35 hrs)
Module – 1 (Basics of Computer Graphics) (6 hrs)		
1.1	Basics of Computer Graphics and applications	1
1.2	Refresh Cathode Ray Tubes	1
1.3	Random Scan Displays and systems	1
1.4	Raster scan displays and systems	1
1.5	Color CRT displays	1
1.6	Flat panel display and its categories.	1
Module - 2 (Line drawing, Circle drawing and Filled Area Primitives) (7 hrs)		
2.1	DDA Line drawing Algorithm	1
2.2	Bresenham's line drawing algorithm	1
2.3	Midpoint Circle generation algorithm	1
2.4	Bresenham's Circle generation algorithm	1
2.5	Illustration of line drawing and circle drawing algorithms	1
2.6	Scan line polygon filling	1
2.7	Boundary filling and flood filling	1
Module - 3 (Geometric transformations) (8 hrs)		
3.1	Basic 2D transformations-Translation and Rotation	1
3.2	Basic 2D transformations- Scaling	1
3.3	Reflection and Shearing	1
3.4	Illustration of 2D Transformations	1
3.5	Composite transformations	1
3.6	Matrix representations and homogeneous coordinates	1
3.7	Basic 3D transformations	1
3.8	Illustration of basic 3D transformations	1
Module - 4 (2D Clipping) (6 hrs)		
4.1	Window to viewport transformation	1
4.2	Cohen Sutherland Line clipping algorithm	1
4.3	Midpoint subdivision Line clipping algorithm	1
4.4	Sutherland Hodgeman Polygon clipping algorithm	1
4.5	Weiler Atherton Polygon clipping algorithm	1
4.6	Practice problems on Clipping algorithms	1
Module - 5 (Three dimensional graphics)(8 hrs)		
5.1	Three dimensional viewing pipeline, Projections-Parallel projections	1

5.2	Projections- Perspective projections	1
5.3	Visible surface detection algorithms- Back face detection.	1
5.4	Depth buffer algorithm	1
5.5	Depth buffer algorithm	1
5.6	Scan line visible surface detection algorithm	1
5.7	Scan line visible surface detection algorithm	1
5.8	A buffer algorithm	1



CST445	PYTHON FOR ENGINEERS	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		OEC	2	1	0	3	2019

Preamble: The objective of the course is to provide learners an insight into Python programming in a scientific computation context and develop programming skills to solve engineering problems. It covers programming environment, important instructions, data representations, intermediate level features, Object Oriented Programming and file data processing of Python. This course lays the foundation to scientific computing, develop web applications, Machine Learning, and Artificial Intelligence-based applications and tools, Data Science and Data Visualization applications.

Prerequisite: NIL

Note : *Students who have successfully completed CST 283 - Python for Machine Learning (Minor) are not eligible to opt this course.*

Course Outcomes: After the completion of the course the student will be able to

CO1	Write, test and debug Python programs (Cognitive Knowledge level: Apply)
CO2	Illustrate uses of conditional (if, if-else, if-elif-else and switch-case) and iterative (while and for) statements in Python programs (Cognitive Knowledge level: Apply)
CO3	Develop programs by utilizing the modules Lists, Tuples, Sets and Dictionaries in Python (Cognitive Knowledge level: Apply)
CO4	Implement Object Oriented programs with exception handling (Cognitive Knowledge level: Apply)
CO5	Analyze, Interpret, and Visualize data according to the target application (Cognitive Knowledge level: Apply)
CO6	Develop programs in Python to process data stored in files by utilizing the modules Numpy, Matplotlib, and Pandas (Cognitive Knowledge level: Apply)

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												
CO6												

Abstract POs defined by National Board of Accreditation

#PO	Broad PO	#PO	Broad PO
PO1	Engineering Knowledge	PO7	Environment and Sustainability
PO2	Problem Analysis	PO8	Ethics
PO3	Design/Development of solutions	PO9	Individual and team work
PO4	Conduct investigations of complex problems	PO10	Communication
PO5	Modern tool usage	PO11	Project Management and Finance
PO6	The Engineer and Society	PO12	Life long learning

Assessment Pattern

Bloom's Category	Test 1 (<i>Marks in percentage</i>)	Test 2 (<i>Marks in percentage</i>)	End Semester Examination Marks
Remember	20	20	20
Understand	30	30	30
Apply	50	50	50
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test : 25 marks
Continuous Assessment Assignment : 15 marks

Internal Examination Pattern:

Each of the two internal examinations has to be conducted out of 50 marks. The first series test shall be preferably conducted after completing the first half of the syllabus and the second series test shall be preferably conducted after completing the remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly completed module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly completed module), each with 7 marks. Out of the 7 questions, a student should answer any 5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which a student should answer any one. Each question can have a maximum of 2 sub-divisions and carries 14 marks.

Syllabus**Module 1 (Basics of Python)**

Getting Started with Python Programming - Running code in the interactive shell, Editing, Saving, and Running a script. Using editors - IDLE, Jupyter. Basic coding skills - Working with data types, Numeric data types and Character sets, Keywords, Variables and Assignment statement, Operators, Expressions, Working with numeric data, Type conversions, Comments in the program, Input Processing, and Output, Formatting output. How Python works. Detecting and correcting syntax errors. Using built in functions and modules in math module. Control statements - Selection structure - if-else, if-elif-else. Iteration structure - for, while. Testing the control statements. Lazy evaluation.

Module 2 (Functions and Python Data Structures)

Functions - Hiding redundancy and complexity, Arguments and return values, Variable scopes and parameter passing, Named arguments, Main function, Working with recursion, Lambda functions. Strings - String function. Lists - Basic list Operations and functions, List of lists, Slicing, Searching and sorting list, List comprehension. Work with tuples. Sets. Dictionaries - Dictionary functions, dictionary literals, adding and removing keys, accessing and replacing values, traversing dictionaries, reverse lookup.

Module 3 (Object Oriented Programming)

Design with classes - Objects and Classes, Methods, Instance Variables, Constructor, Accessors and Mutators. Structuring classes with Inheritance and Polymorphism. Abstract Classes. Exceptions - Handle a single exception, Handle multiple exceptions.

Module 4 (Visualization and File handling)

Plotting - An Interactive Session with PyPlot, Basic Plotting, Logarithmic Plots, More Advanced Graphical Output, Plots with multiple axes, Mathematics and Greek symbols, The Structure of matplotlib, Contour and Vector Field Plots. File Processing - The os and sys modules, Introduction to file I/O, Reading and writing text files, Working with CSV files.

Module 5 (Scientific Computing)

Numerical Routines. SciPy and NumPy - Basics, Creating arrays, Arithmetic, Slicing, Matrix Operations, Special Functions, Random Numbers, Linear Algebra, Solving Nonlinear Equations, Numerical Integration, Solving ODEs. Data Manipulation and Analysis – Pandas : Reading Data from Files Using Pandas, Data Structures: Series and DataFrame, Extracting Information from a DataFrame, Grouping and Aggregation.

Text Books:

1. Kenneth A Lambert., Fundamentals of Python : First Programs, 2/e, Cengage Publishing, 2016
2. David J. Pine, Introduction to Python for Science and Engineering, CRC Press, 2021

Reference Books:

1. Wes McKinney, Python for Data Analysis, 2/e, Shroff / O'Reilly Publishers, 2017
2. Allen B. Downey, Think Python: How to Think Like a Computer Scientist, 2/e, Schroff, 2016
3. Michael Urban and Joel Murach, Python Programming, Shroff/Murach, 2016
4. David M.Baezly, Python Essential Reference. Addison-Wesley Professional; 4/e, 2009.
5. Charles Severance. Python for Informatics: Exploring Information,
6. <http://swcarpentry.github.io/python-novice-gapminder/>

Sample Course Level Assessment Questions**Course Outcome1(CO1):**

1. What is type conversion? How is it done in Python?

Course Outcome 2(CO2):

1. Given is a list of words, *wordlist*, and a string, *name*. Write a Python function which takes *wordlist* and *name* as input and returns a tuple. The first element of the output tuple is the number of words in the *wordlist* which have *name* as a substring in it. The second element of the tuple is a list showing the index at which the *name* occurs in each of the words of the *wordlist* and a 0 if it doesn't occur.

Course Outcome 3(CO3):

1. Write a Python program to implement the addition, subtraction, and multiplication of complex numbers using classes. Use constructors to create objects. The input to the program consist of real and imaginary parts of the complex numbers.

Course Outcome 4(CO4):

1. Plot the function $y = 3x^2$ for $-1 \leq x \leq 3$ as a continuous line. Include enough points so that the curve you plot appears smooth. Label the axes x and y

Course Outcome 5(CO5):

1. Given a file “auto.csv” of automobile data with the fields *index*, *company*, *body-style*, *wheel-base*, *length*, *engine-type*, *num-of-cylinders*, *horsepower*, *average-mileage*, and *price*, write python code to
 - i. Clean and Update the CSV file
 - ii. Print total cars of all companies
 - iii. Find the average mileage of all companies
 - iv. Find the highest priced car of all companies.

Model Question Paper

QP CODE:

PAGES:

Reg No: _____

Name: _____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
SEVENTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR
Course Code: CST445

Course name : PYTHON FOR ENGINEERS

Max Marks: 100**Duration: 3 Hours****PART-A**

(Answer All Questions. Each question carries 3 marks)

1. Explain the basic data types available in Python, with examples.
2. Write a Python program to reverse a number and also find the sum of digits of the number. Prompt the user for input.
3. Compare tuples, lists, and dictionaries.
4. Explain the concept of scope and lifetime of variables in Python programming language, with a suitable example.
5. What is polymorphism? Give an example in the context of OOP in Python.
6. How is exception handling accomplished in Python programs?
7. Describe the characteristics of the CSV format.

8. Plot the function $y = 3x^2$ for $-1 \leq x \leq 3$ as a continuous line. Include enough points so that the curve you plot appears smooth. Label the axes x and y
9. Describe random number generation using Python
10. How can a generalized eigen value problem can be solved using Python?

PART-B

(Answer any one full question from each module)

Module -1

11. (a) Compare and contrast interpreted languages and compiled languages. How does it affect the quality of program development and execution of the program? (6)
- (b) What are the possible errors in a Python program. Write a Python program to print the value of $2^{2n} + n + 5$ for n provided by the user. (8)

OR

12. (a) Describe Arithmetic operators, Assignment operators, Comparison operators, Logical operators, and Bitwise operators in detail with examples. (6)
- (b) Input 4 integers (+ve and -ve). Write a Python code to find the sum of negative numbers, positive numbers, and print them. Also, find the averages of these two groups of numbers and print (8)

Module -2

13. (a) Write a Python code to create a function called *list_of_frequency* that takes a string and prints the letters in non-increasing order of the frequency of their occurrences. Use dictionaries. (5)
- (b) Write a Python program to read a list of numbers and sort the list in a non-decreasing order without using any built in functions. Separate function should be written to sort the list wherein the name of the list is passed as the parameter. (9)

OR

14. (a) Illustrate the following Set methods with an example. (8)
i. *intersection()* ii. *Union()* iii. *Issubset()* iv. *Difference()* v. *update()* vi. *discard()*
- (b) Write a Python program to check the validity of a password given by the user. (6)

The Password should satisfy the following criteria:

1. Contains at least one letter between a and z
2. Contains at least one number between 0 and 9
3. Contains at least one letter between A and Z

4. Contains at least one special character from \$, #, @
5. Minimum length of password: 6

Module -3

15. (a) How can a class be instantiated in Python? Write a Python program to express the instances as return values to define a class RECTANGLE with parameters *height*, *width*, *corner_x*, and *corner_y* and member functions to find center, area, and perimeter of an instance. (5)
- (b) Explain inheritance in Python. Give examples for each type of inheritance. (9)

OR

16. (a) Write a Python class named Circle constructed by a radius and two methods which will compute the area and the perimeter of a given circle (6)
- (b) Define a class in Python to store the details of a ship (name, source, destination) with the following methods: (8)
 - i) *get_details()* - to assign values to class attributes
 - ii) *print_details()* - to display the attribute valuesCreate an object of the class and invoke the methods

Module -4

17. (a) Plot the functions $\sin x$ and $\cos x$ vs x on the same plot with x going from $-\pi$ to π . Make sure the limits of the x -axis do not extend beyond the limits of the data. Plot $\sin x$ in the color orange and $\cos x$ in the color green and include a legend to label the two curves. Place the legend within the plot, but such that it does not cover either of the sine or cosine traces. Draw thin gray lines behind the curves, one horizontal at $y = 0$ and the other vertical at $x = 0$. (10)
- (b) Explain semi-log plots and log-log plots along with the functions used in creating such plots. (4)

OR

18. (a) Explain how *matplotlib* can be used to create dimensional contour plots and vector field plots. (6)
- (b) Given a file “*auto.csv*” of automobile data with the fields *index*, *company*, *body-style*, *wheel-base*, *length*, *engine-type*, *num-of-cylinders*, *horsepower*, *average-mileage*, and *price*, write Python codes using Pandas to (8)
 - 1) Clean and Update the CSV file
 - 2) Print total cars of all companies
 - 3) Find the average mileage of all companies
 - 4) Find the highest priced car of all companies.

Module -5

19. (a) Write python program to solve the following system of equations (4)

$$x_1 - 2x_2 + 9x_3 + 13x_4 = 1$$

$$-5x_1 + x_2 + 6x_3 - 7x_4 = -3$$

$$4x_1 + 8x_2 - 4x_3 - 2x_4 = -2$$

$$8x_1 + 5x_2 - 7x_3 + x_4 = 5$$

- (b) Given the sales information of a company as CSV file with the following fields *month_number, facecream, facewash, toothpaste, bathings soap, shampoo, moisturizer, total_units, total_profit*. Write Python codes to visualize the data as follows (10)

- 1) Toothpaste sales data of each month and show it using a scatter plot
- 2) Face cream and face wash product sales data and show it using the bar chart

Calculate total sale data for last year for each product and show it using a Pie chart.

OR

20. (a) Write Python program to write the data given below to a CSV file. (9)

SN	Name	Country	Contribution	Year
1	Linus Torvalds	Finland	Linux Kernel	1991
2	Tim Berners-Lee	England	World Wide Web	1990
3	Guido van Rossum	Netherlands	Python	1991

- (b) Explain how integration is performed with SciPy. Illustrate the same with the two sample integrals using SciPy function. (5)

Teaching Plan

Sl No	Contents	Number of Hours (35 Hrs)
Module 1: Basics of Python (8 hours)		
1.1	Getting Started with Python Programming: Running code in the interactive shell Editing, Saving, and Running a script	1 hour
1.2	Using editors: IDLE, Jupyter	1 hour
1.3	Basic coding skills: Working with data types, Numeric data types and Character sets, Keywords, Variables and Assignment statement, Operators, Expressions,	1 hour
1.4	Working with numeric data, Type conversions, Comments in the program, Input Processing, and Output. Formatting output	1 hour
1.5	How Python works. Detecting and correcting syntax errors. Using built in functions and modules in math module.	1 hour
1.6	Control statements : Selection structure, if-else, if-elif-else	1 hour
1.7	Iteration structure - for, while	1 hour
1.8	Testing the control statements, Lazy evaluation.	1 hour
Module 2: Functions and Python Data Structures (8 hours)		
2.1	Functions: Hiding redundancy and complexity, Arguments and return values	1 hour
2.2	Variable scopes and parameter passing	1 hour
2.3	Named arguments, Main function,	1 hour
2.4	Working with recursion, Lambda functions	1 hour
2.5	Strings - String function	1 hour
2.6	Lists - Basic list Operations and functions, List of lists, Slicing, Searching and sorting list, List comprehension.	1 hour
2.7	Work with tuples. Sets.	1 hour
2.8	Dictionaries - Dictionary functions, dictionary literals, adding and removing keys, Accessing and replacing values, traversing dictionaries, reverse lookup	1 hour
Module 3: Object Oriented Programming (6 hours)		
3.1	Design with classes : Objects and Classes, Methods, Instance Variables	1 hour
3.2	Constructor, Accessors, and Mutators	1 hour
3.3	Structuring classes with Inheritance	1 hour
3.4	Polymorphism	1 hour
3.5	Abstract Classes	1 hour
3.6	Exceptions: Handle a single exception, Handle multiple exception	1 hour
Module 4: Visualization and File handling (6 hours)		

4.1	Plotting - An Interactive Session with PyPlot, Basic Plotting,	1 hour
4.2	Logarithmic Plots, More Advanced Graphical Output	1 hour
4.3	Plots with multiple axes, Mathematics and Greek symbols	1 hour
4.4	The Structure of matplotlib, Contour and Vector Field Plots	1 hour
4.5	File Processing -The <i>os</i> and <i>sys</i> modules, Introduction to file I/O, Reading and writing text files	1 hour
4.6	Working with CSV files	1 hour
Module 5: Scientific Computing (7 hours)		
5.1	Numerical Routines: SciPy and NumPy - Basics, Creating arrays, Arithmetic, Slicing	1 hour
5.2	Matrix Operations, Special Functions, Random Numbers	1 hour
5.3	Linear Algebra, Solving Nonlinear Equations	1 hour
5.4	Numerical Integration, Solving ODEs	1 hour
5.5	Data Manipulation and Analysis: Pandas - Reading Data from Files Using Pandas	1 hour
5.6	Data Structures - Series and DataFrame	1 hour
5.7	Extracting Information from a DataFrame, Grouping and Aggregation	1 hour

CST455	OBJECT ORIENTED CONCEPTS	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		OEC	2	1	0	3	2019

Preamble: The purpose of this course is to enable learners to solve problems by breaking it down to object level while designing software and to implement it using Java. This course covers Object Oriented Principles, Object Oriented Programming in Java, Exception handling, Event handling, multithreaded programming and working with window-based graphics. This course provides learners the basics to develop Mobile applications, Enterprise Applications, Scientific Applications and Web based Applications.

Prerequisite: A sound background in any of the programming languages like C, C++, Python etc is mandatory. Students who completed the minor stream course CST 281 Object Oriented Programming are not allowed to choose this Open Elective Course.

Course Outcomes: After the completion of the course the student will be able to

CO1	Develop Java programs using the object-oriented concepts - classes, objects, constructors, data hiding, inheritance and polymorphism (Cognitive Knowledge Level: Apply)
CO2	Utilise data types, operators, control statements, built in packages & interfaces, Input/Output Streams and Files in Java to develop programs (Cognitive Knowledge Level: Apply)
CO3	Illustrate how robust programs can be written in Java using exception handling mechanism (Cognitive Knowledge Level: Apply)
CO4	Develop application programs in Java using multithreading (Cognitive Knowledge Level: Apply)
CO5	Develop Graphical User Interface based application programs by utilising event handling features and Swing in Java (Cognitive Knowledge Level: Apply)

Mapping of course outcomes with program outcomes

	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

Abstract POs defined by National Board of Accreditation			
PO#	Broad PO	PO#	Broad PO
PO1	Engineering Knowledge	PO7	Environment and Sustainability
PO2	Problem Analysis	PO8	Ethics
PO3	Design/Development of solutions	PO9	Individual and team work
PO4	Conduct investigations of complex problems	PO10	Communication
PO5	Modern tool usage	PO11	Project Management and Finance
PO6	The Engineer and Society	PO12	Life long learning

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination Marks (%)
	Test 1 (%)	Test 2 (%)	
Remember	20	20	20
Understand	40	40	40
Apply	40	40	40
Analyze			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3

Continuous Internal Evaluation Pattern:

Attendance	10 marks
Continuous Assessment Tests(Average of Internal Tests1&2)	25 marks
Continuous Assessment Assignment	15 marks

Internal Examination Pattern

Each of the two internal examinations has to be conducted out of 50 marks. First series test shall be preferably conducted after completing the first half of the syllabus and the second series test shall be preferably conducted after completing remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly completed module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question

from the partly completed module), each with 7 marks. Out of the 7 questions, a student should answer any 5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 full questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carries 14 marks.

Syllabus

Module – 1 (Object Orientation and Java basics)

Object Orientation Principles – Object and Class, Data abstraction and Encapsulation, Inheritance, Polymorphism, Dynamic binding, Message communication, Benefits of using Object orientation.

Introduction to Java - Java programming Environment and Runtime Environment, Development Platforms -Standard, Enterprise. Java Virtual Machine (JVM), Java compiler, Bytecode, Java applet, Java Buzzwords, Java program structure, Comments, Garbage Collection, Lexical Issues.

Primitive Data types - Integers, Floating Point Types, Characters, Boolean. Literals, Type Conversion and Casting, Variables, Arrays, Strings, Vector class.

Module – 2 (Core Java Fundamentals)

Operators - Arithmetic Operators, Bitwise Operators, Relational Operators, Boolean Logical Operators, Assignment Operator, Conditional (Ternary) Operator, Operator Precedence.

Control Statements - Selection Statements, Iteration Statements and Jump Statements.

Object Oriented Programming in Java - Class Fundamentals, Declaring Objects, Object Reference, Introduction to Methods, Constructors, *this* Keyword, Method Overloading, Using Objects as Parameters, Returning Objects, Recursion, Access Control, Static Members, Command-Line Arguments, Variable Length Arguments.

Module - 3 (More features of Java)

Inheritance - Super Class, Sub Class, The Keyword *super*, protected Members, Calling Order of Constructors, Method Overriding, the Object class, Abstract Classes and Methods, Using *final* with Inheritance.

Packages and Interfaces - Defining Package, CLASSPATH, Access Protection, Importing Packages, Interfaces.

Exception Handling - Checked Exceptions, Unchecked Exceptions, *try* Block and *catch* Clause, Multiple *catch* Clauses, Nested *try* Statements, *throw*, *throws* and *finally*.

Module - 4 (Advanced features of Java)

Input/Output - I/O Basics, Reading Console Input, Writing Console Output, PrintWriter Class, Reading and Writing Files.

Java Library - String Handling – String Constructors, String Length, Special String Operations - Character Extraction, String Comparison, Searching Strings, Modifying Strings, Using *valueOf()*, Comparison of String Buffer and String.

Module - 5 (GUI Programming, Event Handling and Multithreaded Programming)

Multithreaded Programming - The Java Thread Model, The Main Thread, Creating Thread, Creating Multiple Threads, Suspending, Resuming and Stopping Threads.

Event Handling - Event Handling Mechanisms, Delegation Event Model, Event Classes, Sources of Events, Event Listener Interfaces, Using the Delegation Model.

Swing Fundamentals - Swing Key Features, Model View Controller (MVC), Swing Controls, Components and Containers, Exploring Swing - JFrame, JLabel, JButton, JTextField.

Text Books

1. Herbert Schildt, Java: The Complete Reference, 8/e, Tata McGraw Hill, 2011.
2. Balagurusamy E., Programming JAVA a Primer, 5/e, McGraw Hill, 2014.

Reference Books

1. Paul Deitel, Harvey Deitel, Java How to Program, Early Objects 11/e, Pearson, 2018.
2. Y. Daniel Liang, Introduction to Java Programming, 7/e, Pearson, 2013.
3. Nageswararao R., Core Java: An Integrated Approach, Dreamtech Press, 2008.
4. Flanagan D., Java in A Nutshell, 5/e, O'Reilly, 2005.
5. Sierra K., Head First Java, 2/e, O'Reilly, 2005.

Course Level Assessment Questions

Course Outcome1 (CO1):

1. Three types of employees work in an organization: Regular, Contract and Hourly. Regular employees are permanent workers of the organization. Their salary is computed as the sum of basic pay, DA (50% of basic pay) and HRA. Contract employees work for the organization only for the contract period and earn a fixed salary. Hourly employees work for a fixed number of hours each day. Their salary is computed based on the total number of hours worked.

Using object oriented principles, write a Java program to prepare pay roll of the organization.

2. Write a java program to create an abstract class named Shape that contains two integers and an empty method named printArea(). Provide three classes named Rectangle, Square, Triangle and Circle with proper class hierarchy. Each one of the classes contain only the method printArea() that prints the area of the given shape.

Course Outcome 2(CO2):

1. Write a Java program that reads a file and displays the file on the screen, with a line number before each line.
2. Write a Java program to prepare the rank list of computer science students based on their performance in the first Semester B.Tech. Degree examination at APJ Abdul Kalam Technological University. The output should be stored in a file.

Course Outcome 3(CO3):

1. Write a program to demonstrate the use of *throws* clause to handle an exception occurred within a method.
2. Write a program to demonstrate how exception handling is supported in Java.

Course Outcome 4(CO4):

1. Write a program to compute the sum of elements in an array using two threads in a parallel way. The first thread sums up the first half of the array and the second thread sums up the second half of the array. Finally, the main thread adds these partial sums and prints the result.
2. Write a java program that implements a multi-thread application that has three threads. First thread generates random integer every 1 second and if the value is even, second thread computes the square of the number and prints. If the value is odd, the third thread will print the value of cube of the number.

Course Outcome 5(CO5):

1. Write a GUI based program to convert temperature from degree Celsius to Fahrenheit.
2. Write a java program that simulates a traffic light. The program lets the user select one of three lights: red, yellow, or green with buttons. On selecting a button, an appropriate message with “stop” or “ready” or “go” should appear above the buttons in a selected color. Initially there is no message shown.

Model Question Paper

QP CODE:

Reg No: _____

Name: _____

PAGES :4

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SEVENTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: CST455

Course Name: Object Oriented Concepts

Max.Marks:100

Duration: 3 Hours

PART A

Answer All Questions. Each Question Carries 3 Marks

1. Java is considered to be secure and portable. Justify this statement.
2. Describe the concept of dynamic binding.
3. Explain the different arithmetic operators in Java.
4. What does the following Java function compute? Justify your answer.

```
int greater(int a, int b)
{
    while(a!=b)
    {
```

```
    if(a>b)
a=a-b;
    else
b=b-a;
}
return a;
}
```

5. Explain the use of CLASSPATH with an example.
6. What are the different types of exceptions?
7. Explain file handling features available in Java.
8. Write a simple program to read an integer value from console and print it.
9. Explain the concept of *main thread* in multi-threading.
10. Explain any two Event classes in Java. (10x3=30)

Part B

(Answer any one question from each module. Each question carries 14 Marks)

11. (a) Describe in detail polymorphism, abstraction and inheritance with suitable examples. (9)
(b) What is Java Virtual Machine? (5)
- OR
12. (a) Explain the salient features of Java language. How does Java Enterprise Edition (J2EE) differ from Java Standard Edition (Java SE)? (9)
(b) Explain the declaration and use of multi-dimensional array variables in Java, with example. (5)
13. (a) Explain iteration control statements in Java. Give examples. (8)

- (b) Write a recursive program to compute the factorial of a number. (6)

OR

14. (a) Using a suitable Java program, explain the concept of methods and constructors. (6)
- (b) Write a Java program that prompts the user for an integer and then prints out all the prime numbers up to that number. (8)
15. (a) In a table format, show the effect of access specifiers within and outside packages in Java. (6)
- (b) Describe exception handling using **try** block and **catch** clause in Java with the help of a suitable Java program. (8)

OR

16. (a) What is an interface in Java? Explain with a suitable example. (6)
- (b) Write a program that perform integer divisions. The user enters two input data (any data type) through console into variables Num1 and Num2. If Num1 or Num2 were not an integer, the program would throw a Number Format Exception. If Num2 were Zero, the program would throw an Arithmetic Exception. Display the appropriate exception or result. (8)
17. (a) Write a Java program that displays the number of characters, lines and words in a text file. (8)
- (b) Explain any three String constructors with the help of sample code for each. (6)

OR

18. (a) Write a program to demonstrate the usage of the *PrintWriter* class. (7)
- (b) Write a Java program for sorting a given list of names in ascending order. (7)
19. (a) Explain Delegation Event model for event handling in Java. (7)
- (b) Write a program to compute the sum of elements in an array using two (7)

threads in a parallel way. The first thread sums up the first half of the array and the second thread sums up the second half of the array. Finally, the main thread adds these partial sums and prints the result. Use Runnable interface for the creation of a thread.

OR

20. (a) What are the differences between a process and a thread? (4)
- (b) Write a Graphical User Interface (GUI) based Java program to implement a simple calculator supporting the operations addition, subtraction, multiplication and division. Use Swing controls to implement GUI. There may be three text boxes, the first two for accepting the operands and the last for displaying the result. Add four buttons for the above operations. Write neat comments in your program to show how you handle events. (10)

Teaching Plan

No	Contents	No. of Lecture Hours (36hrs)
Module – 1 (Object Orientation and Java basics) (7 hrs)		
1.1	Object Orientation Principles – Object and Class, Data abstraction and Encapsulation	1 hour
1.2	Inheritance, Polymorphism	1 hour
1.3	Dynamic binding, Message communication, Benefits of using Object orientation.	1 hour
1.4	Java programming Environment and Runtime Environment, Development Platforms -Standard, Enterprise. JVM, Java compiler, Bytecode	1 hour
1.5	Java applet, Java Buzzwords, Java program structure, Comments, Garbage Collection, Lexical Issues	1 hour
1.6	Primitive Data types - Integers, Floating Point Types, Characters, Boolean	1 hour
1.7	Literals, Type Conversion and Casting, Variables, Arrays, Strings, Vector	1 hour

	class.	
Module - 2 (Core Java Fundamentals) (7 hrs)		
2.1	Operators - Arithmetic Operators, Bitwise Operators, Relational Operators, Boolean Logical Operators, Assignment Operator, Conditional (Ternary) Operator, Operator Precedence.	1 hour
2.2	Control Statements - Selection Statements, Iteration Statements and Jump Statements.	1 hour
2.3	Object Oriented Programming in Java - Class Fundamentals, Declaring Objects	1 hour
2.4	Object Reference, Introduction to Methods, Constructors, <i>this</i> Keyword	1 hour
2.5	Method Overloading, Using Objects as Parameters, Returning Objects	1 hour
2.6	Recursion, Access Control, static Members	1 hour
2.7	Command-Line Arguments, Variable Length Arguments	1 hour
Module - 3 (More features of Java) (8 hrs)		
3.1	Inheritance - Super class, Sub class, the keyword super, protected Members	1 hour
3.2	Calling Order of Constructors, Method Overriding, the Object class	1 hour
3.3	Abstract Classes and Methods, Using final with Inheritance	1 hour
3.4	Packages and Interfaces - Defining Package, CLASSPATH, Access Protection	1 hour
3.5	Importing Packages, Interfaces	1 hour
3.6	Exception Handling - Checked Exceptions, Unchecked Exceptions, <i>try</i> Block and <i>catch</i> Clause	1 hour
3.7	Multiple <i>catch</i> Clauses, Nested <i>try</i> Statements	1 hour
3.8	<i>throw</i> , <i>throws</i> and <i>finally</i>	1 hour
Module - 4 (Advanced features of Java) (6 hrs)		
4.1	Input/Output - I/O Basics, Reading Console Input	1 hour
4.2	Writing Console Output, PrintWriter Class	1 hour
4.3	Working with Files (Lecture-1)	1 hour

4.4	Working with Files (Lecture-2)	1 hour
4.5	Java Library - String Handling – String Constructors, String Length	1 hour
4.6	Special String Operations - Character Extraction, String Comparison, Searching Strings, Modifying Strings, Using valueOf(), Comparison of StringBuffer and String.	1 hour
Module - 5 (GUI Programming, Event Handling and Multithreaded Programming) (8hrs)		
5.1	Multithreaded Programming - The Java Thread Model, The Main Thread, Creating Thread	1 hour
5.2	Creating Multiple Threads	1 hour
5.3	Suspending, Resuming and Stopping Threads.	1 hour
5.4	Event handling - Event Handling Mechanisms, Delegation Event Model	1 hour
5.5	Event Classes,Sources of Events, Event Listener Interfaces	1 hour
5.6	Using the Delegation Model, Swing fundamentals, Swing Key Features	1 hour
5.7	Model View Controller (MVC), Swing Controls, Components and Containers	1 hour
5.8	Exploring Swing –JFrame, JLabel, JButton, JTextField	1 hour

Estd.



2014

APJ ABDUL KALAM
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SEMESTER VII

MINOR



CSD481	MINI PROJECT	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		PWS	0	0	3	4	2019

Preamble: The objective of this course is to apply the fundamental concepts of different courses learned in respective Minor Streams: Software Engineering, Machine Learning and Networking. This course helps the learners to get an exposure to the development of application software/hardware solutions/ software simulations in the field of Computer Science and Engineering. It enables the learners to understand the different steps to be followed such as literature review and problem identification, preparation of requirement specification & design document, testing, development and deployment. Mini project enables the students to boost their skills, widen the horizon of thinking and their ability to resolve real life problems.

Prerequisite:

A sound knowledge in courses studied in respective minor stream.

Course Outcomes: After the completion of the course the student will be able to

CO#	CO
CO1	Identify technically and economically feasible problems (Cognitive Knowledge Level: Apply)
CO2	Identify and survey the relevant literature for getting exposed to related solutions. (Cognitive Knowledge Level: Apply)
CO3	Perform requirement analysis, identify design methodologies and develop adaptable & reusable solutions of minimal complexity by using modern tools & advanced programming techniques (Cognitive Knowledge Level: Apply)
CO4	Prepare technical report and deliver presentation (Cognitive Knowledge Level: Apply)
CO5	Apply engineering and management principles to achieve the goal of the project (Cognitive Knowledge Level: Apply)

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

Abstract POs defined by National Board of Accreditation			
PO#	Broad PO	PO#	Broad PO
PO1	Engineering Knowledge	PO7	Environment and Sustainability
PO2	Problem Analysis	PO8	Ethics
PO3	Design/Development of solutions	PO9	Individual and team work
PO4	Conduct investigations of complex problems	PO10	Communication
PO5	Modern tool usage	PO11	Project Management and Finance
PO6	The Engineer and Society	PO12	Lifelong learning

Assessment Pattern

Mark Distribution

Total Marks	CIE Marks	ESE Marks
150	75	75

Continuous Internal Evaluation Pattern:

Attendance	10 marks
Project Guide	15 marks
Project Report	10 marks
Evaluation by the Committee (will be evaluating the level of completion and demonstration of functionality/specifications, presentation, oral examination, work knowledge and involvement)	: 40 marks

Student Groups with 4 or 5 members should identify a topic of interest in consultation with a Faculty Advisor/Project Coordinator/Guide. Review the literature and gather information pertaining to the chosen topic. State the objectives and develop a methodology to achieve the objectives. Carryout the design/fabrication or develop codes/programs to achieve the objectives by strictly following steps specified in the teaching plan. Innovative design concepts, performance, scalability, reliability considerations, aesthetics/ergonomic, user experience and security aspects taken care of in the project shall be given due weight.

The progress of the mini project is evaluated based on a minimum of two reviews. The review committee may be constituted by a senior faculty member, Mini Project coordinator and project guide. The internal evaluation shall be made based on the progress/outcome of the project, reports and a viva-voce examination, conducted internally by a 3-member committee. A project report is required at the end of the semester. The project has to be demonstrated for its full design specifications.

End Semester Examination Pattern:

The marks will be distributed as

Presentation	: 30 marks
Demo	: 20 marks
Viva	: 25 marks.
Total	: 75 marks.

TEACHING PLAN

Students are expected to follow the following steps.

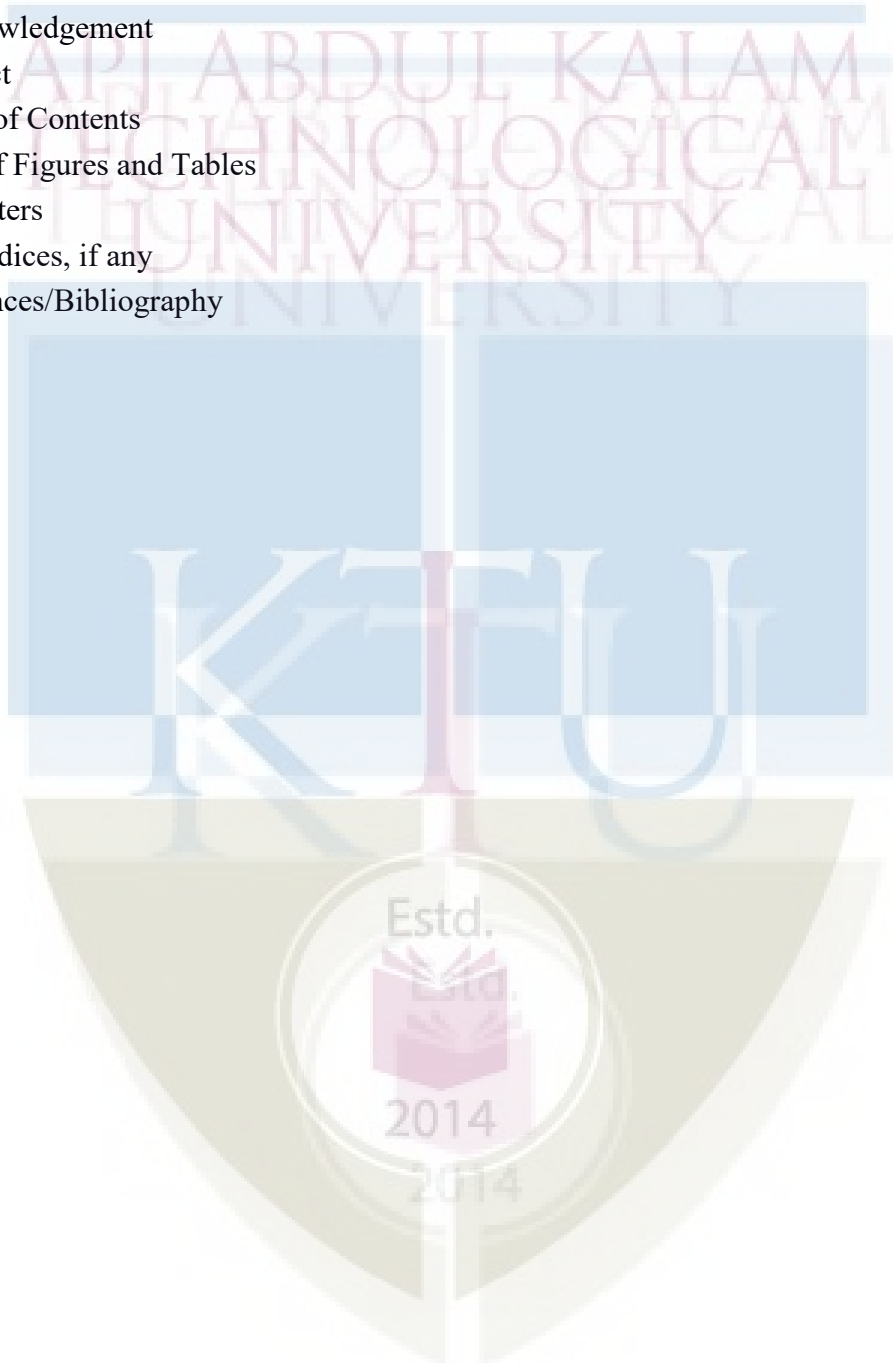
1. Review of Literature and Identification of a problem
2. Create an abstract with a problem statement, solution approach, technology stack, team, etc.
3. Create Requirements Specification
4. Create Design Document . This may include designs like,
 - a. System Architecture Design
 - b. Application Architecture Design
 - c. GUI Design
 - d. API Design
 - e. Database Design
 - f. Technology Stack
5. Deployment, Test Run & Get Results
6. Prepare Project Report

Guidelines for the Report preparation

A bonafide report on the mini project shall be submitted within one week after the final presentation. Minimum number of pages should be 40.

- Use Times New Roman font for the entire report – Chapter/Section Title – Times New Roman 18, Bold; Heading 2 – Times New Roman 16, Bold; Heading 3 – Times New Roman 14, Bold; Body- Times New Roman 12, Normal.
- Line Spacing – Between Heading 2 – 3 lines, between lines in paragraph 1.5 lines.
- Alignments – Chapter/Section Title – Center, Heading 2 & 3 should be Left Aligned. Ensure that all body text is paragraph justified.

- Figures & Tables – Ensure that all Figures and Tables are suitably numbered and given proper names/headings. Write figure title under the figure and table title above the table.
- **Suggestive order of documentation:**
 - i. Top Cover
 - ii. Title page
 - iii. Certification page
 - iv. Acknowledgement
 - v. Abstract
 - vi. Table of Contents
 - vii. List of Figures and Tables
 - viii. Chapters
 - ix. Appendices, if any
 - x. References/Bibliography



APJ ABDUL KALAM
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SEMESTER VII

HONOURS



Preamble: The purpose of this course is to create awareness and understanding among students on the foundation of blockchain technology. The course introduces the cryptographic principles behind blockchain and helps the students understand concepts like consensus, crypto-currency, smart contracts, use cases etc. The course enables students to develop simple decentralized applications using blockchain networks such as Ethereum.

Prerequisite: Basic knowledge in Cryptography and Operating Systems.

Prerequisite: Basic knowledge in Cryptography and Operating Systems.

Course Outcomes: After the completion of the course the student will be able to

CO#	Course Outcomes
CO1	Make use of the concepts of block chain technology. (Cognitive Knowledge Level: Understand)
CO2	Summarize the classification of consensus algorithms. (Cognitive Knowledge Level: Understand)
CO3	Illustrate the concepts of first decentralized crypto currency bitcoin. (Cognitive Knowledge Level: Apply)
CO4	Implement smart contracts and its use cases. (Cognitive Knowledge Level: Apply)
CO5	Develop simple applications using Solidity language on Ethereum platform. (Cognitive Knowledge Level: Apply)

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO 7	PO8	PO 9	PO1 0	PO1 1	PO1 2
CO1												
CO2												

CO3	✓	✓	✓		✓							✓
CO4	✓	✓	✓									✓
CO5	✓	✓	✓		✓	✓						✓

Abstract POs defined by National Board of Accreditation

PO#	Broad PO	PO#	Broad PO
PO1	Engineering Knowledge	PO7	Environment and Sustainability
PO2	Problem Analysis	PO8	Ethics
PO3	Design/Development of solutions	PO9	Individual and team work
PO4	Conduct investigations of complex problems	PO10	Communication
PO5	Modern tool usage	PO11	Project Management and Finance
PO6	The Engineer and Society	PO12	Lifelong learning

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination Marks (%)
	Test1 (%)	Test2 (%)	
Remember	20	20	20
Understand	40	40	40
Apply	40	40	40
Analyze			
Evaluate			

Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance	: 10 marks
Continuous Assessment Tests	: 25 marks
Continuous Assessment Assignment	: 15 marks

Internal Examination Pattern:

Each of the two internal examinations has to be conducted out of 50 marks. First Internal Examination shall be preferably conducted after completing the first half of the syllabus and the Second Internal Examination shall be preferably conducted after completing the remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly covered module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly covered module), each with 7 marks. Out of the 7 questions in Part B, a student should answer any 5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which a student should answer any one. Each question can have a maximum 2 subdivisions and carries 14 marks.

Syllabus

Module 1 (Fundamentals of Blockchain Technology)

Blockchain – Definition, architecture, elements of blockchain, benefits and limitations, types of blockchain. Consensus – definition, types, consensus in blockchain. Decentralization – Decentralization using blockchain, Methods of decentralization, Routes to decentralization, Blockchain and full ecosystem decentralization.

Module 2 (Consensus Algorithms and Bitcoin)

Consensus Algorithms, Crash fault-tolerance (CFT) algorithms – Paxos, Raft. Byzantine faulttolerance (BFT) algorithms – Practical Byzantine Fault Tolerance (PBFT), Proof of work (PoW), Proof of stake (PoS), Types of PoS. Bitcoin – Definition, Cryptographic keys – Private keys, public keys, addresses. Transactions – Lifecycle, coinbase transactions, transaction validation. Blockchain – The genesis block. Mining – Tasks of miners, mining algorithm, hash rate. Wallets – Types of wallets.

Module 3 (Smart Contracts and Use cases)

Smart Contracts – Definition, Smart contract templates, Oracles, Types of oracles, Deploying smart contracts. Decentralization terminology – Decentralized applications, Decentralized Autonomous Organizations. Use cases of Blockchain technology – Government, Health care, Finance, Supply chain management.

Module 4 (Allied Technologies)

Blockchain and allied technologies – Blockchain and Cloud Computing, Blockchain and Artificial Intelligence- Blockchain and cyber security

Module 5 (Ethereum and Solidity)

Ethereum – The Ethereum network. Components of the Ethereum ecosystem – Keys and addresses, Accounts, Transactions and messages. The Ethereum Virtual Machine, Blocks and blockchain. The Solidity language – The layout of a Solidity source code, Structure of a smart contract, variables, data types, control structures, events, inheritance, libraries, functions, error handling. Smart contracts Case study: Voting, Auction

Text Book

1. Imran Bashir,” Mastering Blockchain: A deep dive into distributed ledgers, consensus protocols, smart contracts, DApps, cryptocurrencies, Ethereum, and more”, Packt Publishing, Third edition, 2020.

References

1. Ritesh Modi, “Solidity Programming Essentials: A beginner's guide to build smart contracts for Ethereum and blockchain”, Packt Publishing, First edition, 2018.
2. Kumar Saurabh, Ashutosh Saxena, “Blockchain Technology: Concepts and Applications”, First Edition, Wiley Publications, First edition, 2020.
3. Chandramouli Subramanian, Asha A George, et al,” Blockchain Technology”, Universities Press (India) Pvt. Ltd, First edition, August 2020.
4. Lorne Lantz, Daniel Cawrey, “Mastering Blockchain: Unlocking the Power of Cryptocurrencies, Smart Contracts, and Decentralized Applications”, O'Reilly Media, First edition, 2020.
5. Andreas M. Antonopoulos, Gavin Wood, “Mastering Ethereum: Building Smart Contracts and DApps”, O'Reilly Media, First edition, 2018.

Course Level Assessment Questions**Course Outcome 1 (CO1):**

1. Categorize consensus mechanism used in blockchain
2. Define Blockchain. Explain how decentralization of computing or processing power is achieved by a blockchain

Course Outcome 2 (CO2):

1. Illustrate how Proof of Stake can achieve consensus among peers

Course Outcome 3 (CO3):

1. Describe the use of genesis block.
2. Implement the mining algorithm used in bitcoin.

Course Outcome 4 (CO4):

1. Explain the applications of Block chain in cyber security. Illustrate with an example.

Course Outcome 5 (CO5):

1. Illustrate how blockchain technology can be used in supply chain management.
2. Develop a smart contract application for voting process in which delegated voting is allowed and the counting is automatic and completely transparent at the same time

MODEL QUESTION PAPER**QP CODE:****Reg No:** _____**Name :** _____**PAGES : 3****APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY****SEVENTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR****Course Code: CCT 495****Course Name: Blockchain and Cryptocurrency****Max.Marks:100****Duration: 3 Hours****PART A****Answer all Questions. Each question carries 3 Marks**

1. Explain the benefits, features and limitations of blockchain technology.
2. Define consensus and explain its importance.
3. Differentiate between PoW and PoS.

4. What is a bitcoin? Explain its need.
5. What are the different types of Oracles?
6. Write down the significance of a decentralized organization?
7. Give any two applications of Blockchain in AI?.
8. What is the importance of blockchain in cyber security ?
9. Why Ethereum Virtual machine is important?
10. What is a Smart contract?

(10*3=30 Marks)

PART B

Answer any One Question from each module. Each question carries 14 Marks

11(a) Describe how decentralization is done using blockchain. **(6 marks)**

(b) Briefly describe the different types of blockchain. **(8 marks)**

OR

12(a) Explain the architecture of blockchain with a suitable diagram. **(8 marks)**

(b) What is full ecosystem decentralization? Is it important? **(6 marks)**

13(a) Explain the working of a Crash fault-tolerance (CFT) algorithm. **(8 marks)**

(b) Explain the different types of PoS? **(6 marks)**

OR

14(a) How is transaction validation done? **(6 marks)**

(b) Describe how genesis block Mining is done. **(8 marks)**

15(a) Illustrate how blockchain technology can be implemented in finance sector. **(6 marks)**

(b) What is decentralization? Explain how it can be effectively done. **(8 marks)**

OR

16(a) Illustrate how blockchain technology can be implemented in health sector. **(6 marks)**

(b) How smart contracts be deployed? **(8 marks)**

17(a) Write down the applications of Blockchain technology in Cloud Networks. **(8 marks)**

(b) Illustrate a case in which Cloud computing applications are deployed using blockchain technologies. **(6 marks)**

OR

18(a) Write down the applications of Blockchain technology in AI. (8 marks)

(b) Illustrate a case in which AI applications are deployed using blockchain technologies. (6 marks)

19(a) What are the components of a Ethereum ecosystem? (6 marks)

(b) What are the features of a Ethereum Network? (8 marks)

OR

20(a) Using Solidity language, create a simple bank contract that allows a user to deposit, withdraw and view balance. (8 marks)

(b) Schematically represent the structure of a smart contract. (6 marks)

TEACHING PLAN

Sl.No	Contents	No.of Lecture Hrs (45)
Module 1 (Fundamentals of Blockchain Technology) (9 hours)		
1.1	Blockchain – definition and architecture	1
1.2	Elements of blockchain.	1
1.3	Blockchain – benefits and limitations, types.	1
1.4	Consensus – definition, types, consensus in blockchain	1
1.5	Decentralization using blockchain,	1
1.6	Methods of decentralization	1
1.7	Routes to decentralization	1
1.8	Blockchain	1
1.9	Full ecosystem decentralization	1
Module 2 (Consensus Algorithms and Bitcoin) (10 hours)		
2.1	Consensus Algorithms – Crash fault-tolerance (CFT) algorithms – Paxos, Raft.	1
2.2	Byzantine fault-tolerance (BFT) algorithms – Practical Byzantine Fault Tolerance (PBFT)	1
2.3	Proof of work (PoW), Proof of stake (PoS), Types of PoS	1
2.4	Bitcoin – Definition	1
2.5	Cryptographic keys – Private keys, public keys, addresses.	1
2.6	Transactions – Lifecycle, coinbase transactions, transaction validation	1
2.7	Blockchain – The genesis block. Mining – Tasks of miners	1

2.8	Mining – mining algorithm	1
2.9	Hash rate. Wallets	1
2.10	Types of wallets	1

Module 3 (Smart Contracts and Use cases) (8 hours)

3.1	Smart Contracts – Definition, Smart contract templates	1
3.2	Oracles, Types of oracles.	1
3.3	Deploying smart contracts.	1
3.4	Decentralization terminology –Decentralized applications	1
3.5	Decentralized Autonomous Organizations	1
3.6	Use cases of Blockchain technology – Government, Health care.	1
3.7	Use cases of Blockchain technology – Finance	1
3.8	Supply chain management	1

Module 4 (Allied Technologies) (8 hours)

4.1	Blockchain and Allied Technologies- Overview	1
4.2	Blockchain and Cloud Computing	1
4.3	Applications of Block chain in Cloud	1
4.4	Blockchain and Artificial Intelligence.	1
4.5	Applications of Block chain in AI	1
4.6	Blockchain and Cyber Security.	1
4.7	Case Studies-I	1
4.8	Case Studies-II	1

Module 5 (Ethereum and Solidity) (10 hours)

5.1	Ethereum - The Ethereum network	1
5.2	Components of the Ethereum ecosystem – Keys and addresses, Accounts	1
5.3	Components of the Ethereum ecosystem – Transactions and messages	1
5.4	The Ethereum Virtual Machine	1
5.5	Ethereum Blocks and blockchain	1
5.6	The Solidity language – The layout of a Solidity source code, Structure of a smart contract, variables, data types	1
5.7	The Solidity language – control structures, events, inheritance, libraries	1
5.8	The Solidity language – functions, error handling	1
5.9	Smart contracts Case study: Voting.	1
5.10	Smart contracts Case study: Auction	1

CST497	REINFORCEMENT LEARNING	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		VAC	3	1	0	4	2019

Preamble: This course covers fundamental principles and techniques in reinforcement learning. Reinforcement learning is concerned with building programs that learn how to predict and act in a stochastic environment, based on past experience. Applications of reinforcement learning range from classical control problems, such as power plant optimization or dynamical system control, to game playing, inventory control, and many other fields. Topics include Markov decision process, dynamic programming, Monte Carlo, temporal difference, function approximation reinforcement learning algorithms, and applications of reinforcement learning. This course enables the learners to apply reinforcement learning on real world applications and research problems.

Prerequisite: A pass in CST 294(Computational Fundamentals for Machine Learning)

Course Outcomes: After the completion of the course the student will be able to

CO 1	Solve computational problems using probability and random variables. (Cognitive Knowledge Level: Apply)
CO 2	Apply policy iteration and value iteration reinforcement learning algorithms. (Cognitive Knowledge Level: Apply)
CO 3	Employ Monte Carlo reinforcement learning algorithms. (Cognitive Knowledge Level: Apply)
CO 4	Apply temporal-difference reinforcement learning algorithms. (Cognitive Knowledge Level: Apply)
CO 5	Apply on-policy and off-policy reinforcement learning algorithms with function approximation. (Cognitive Knowledge Level: Apply)

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	✓	✓	✓									✓
CO 2	✓	✓	✓	✓								✓
CO 3	✓	✓	✓	✓								✓
CO 4	✓	✓	✓	✓								✓
CO 5	✓	✓	✓	✓	✓							✓

Abstract POs defined by National Board of Accreditation			
PO#	Broad PO	PO#	Broad PO
PO1	Engineering Knowledge	PO7	Environment and Sustainability
PO2	Problem Analysis	PO8	Ethics
PO3	Design/Development of solutions	PO9	Individual and team work
PO4	Conduct investigations of complex problems	PO10	Communication
PO5	Modern tool usage	PO11	Project Management and Finance
PO6	The Engineer and Society	PO12	Life long learning

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	30%	30%	30%
Understand	30%	30%	30%
Apply	40%	40%	40%
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks

Continuous Assessment Tests : 25 marks

Continuous Assessment Assignment : 15 marks

Internal Examination Pattern:

Each of the two internal examinations has to be conducted out of 50 marks

First Internal Examination shall be preferably conducted after completing the first half of the syllabus and the Second Internal Examination shall be preferably conducted after completing remaining part of the syllabus.

There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly covered module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly covered module), each with 7 marks. Out of the 7 questions in Part B, a student should answer any 5.

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer anyone. Each question can have maximum 2 sub-divisions and carry 14 marks.

Syllabus**Module 1 (Review Of Probability Concepts)**

Probability concepts review - Axioms of probability, concepts of random variables, probability mass function, probability density function, cumulative density functions, Expectation. Concepts of joint and multiple random variables, joint, conditional and marginal distributions. Correlation and independence.

Module 2 (Markov Decision Process)

Introduction to Reinforcement Learning(RL) terminology - Examples of RL, Elements of RL, Limitations and Scope of RL.

Finite Markov Decision Processes - The Agent-Environment Interface, Goals and Rewards, Returns and Episodes, Policies and Value Functions, Optimal Policies and Optimal Value Functions.

Module 3 (Prediction And Control)

Dynamic Programming - Policy Evaluation (Prediction), Policy Improvement, Policy Iteration, Value Iteration.

Monte Carlo (MC) for model free prediction and control - Monte Carlo Prediction, Monte

Carlo Estimation of Action Values, Monte Carlo Control, Monte Carlo Control without Exploring Starts, Off-policy Prediction via Importance Sampling, Incremental Implementation, Off-policy Monte Carlo Control.

Module 4 (Temporal-Difference (TD) Methods For Model Free Prediction And Control)

TD Methods - TD Prediction, Advantages of TD Prediction Methods, Optimality of TD(0), Sarsa: On-policy TD Control, Q-learning: Off-policy TD Control, Expected Sarsa.

n-step Bootstrapping- n-step TD Prediction, n-step Sarsa, step Off-policy Learning, Off-policy Learning Without Importance Sampling: The n-step Tree Backup Algorithm.

Module 5 (Function Approximation Method)

On-policy Prediction with Approximation - Value-function Approximation, The Prediction Objective, Stochastic-gradient Methods, Linear Methods.

Eligibility Traces - The λ -return, TD(λ), n-step Truncated λ -return Methods, Sarsa(λ).

Policy Gradient Methods - Policy Approximation and its Advantages, The Policy Gradient Theorem, REINFORCE: Monte Carlo Policy Gradient, REINFORCE with Baseline, Actor-Critic Methods.

Text book:

- 1 Richard S. Sutton and Andrew G. Barto, Reinforcement Learning: An Introduction, , 2nd Edition
- 2 Alberto Leon-Garcia, Probability, Statistics, and Random Processes for Electrical Engineering, 3rd Edition,

Reference books:

- 1 Reinforcement Learning: State-of-the-Art, Marco Wiering and Martijn van Otterlo, Eds
- 2 Algorithms for Reinforcement Learning, Szepesvari (2010), Morgan & Claypool.
- 3 Artificial Intelligence: A Modern Approach, Stuart J. Russell and Peter Norvig
- 4 Mathematical Statistics and Data Analysis by John A. Rice, University of California, Berkeley, Third edition, published by Cengage.
- 5 Machine Learning: A Probabilistic Perspective, Kevin P. Murphy

Sample Course Level Assessment Questions.**Course Outcome 1 (CO1):**

- 1 Let J and T be independent events, where $P(J)=0.4$ and $P(T)=0.7$. Find $P(J \cap T)$, $P(J \cup T)$ and $P(J \cap T')$
- 2 Let A and B be events such that $P(A)=0.45$, $P(B)=0.35$ and $P(A \cup B)=0.5$. Find $P(A \cap B)$
- 3 A random variable R has the probability distribution as shown in the following table:

r	1	2	3	4	5
$P(R=r)$	0.2	a	b	0.25	0.15

Given that $E(R)=2.85$, find a and b and $P(R>2)$.

- 4 A biased coin (with probability of obtaining a head equal to $p > 0$) is tossed repeatedly and independently until the first head is observed. Compute the probability that the first head appears at an even numbered toss.
- 5 Two players A and B are competing at a quiz game involving a series of questions. On any individual question, the probabilities that A and B give the correct answer are p and q respectively, for all questions, with outcomes for different questions being independent. The game finishes when a player wins by answering a question correctly. Compute the probability that A wins if
 - (i) A answers the first question,
 - (ii) B answers the first question.
- 6 A coin for which $P(\text{heads}) = p$ is tossed until two successive tails are obtained. Find the probability that the experiment is completed on the n th toss.
- 7 An urn contains p black balls, q white balls, and r red balls; and n balls are chosen without replacement.
 - i. Find the joint distribution of the numbers of black, white, and red balls in the sample.
 - ii. Find the joint distribution of the numbers of black and white balls in the sample.
 - iii. Find the marginal distribution of the number of white balls in the sample.
- 8 Suppose that two components have independent exponentially distributed lifetimes, T_1 and T_2 , with parameters α and β , respectively. Find (a) $P(T_1 > T_2)$ and (b) $P(T_1 > 2T_2)$.

- 9 Let Z_1 and Z_2 be independent random variables each having the standard normal distribution. Define the random variables X and Y by $X = Z_1 + 3Z_2$ and $Y = Z_1 + Z_2$. Argue that the joint distribution of (X, Y) is a bivariate normal distribution. What are the parameters of this distribution?
- 10 Given a continuous random variable x , with cumulative distribution function $F_X(x)$, show that the random variable $y = F_X(x)$ is uniformly distributed.
- 11 You roll a fair dice twice. Let the random variable X be the product of the outcomes of the two rolls. What is the probability mass function of X ? What are the expected values and the standard deviation of X ?
- 12 Show that if two events A and B are independent, then A and B' are independent
- 13 Prove that X and Y are independent if and only if $f_{X|Y}(x|y) = f_X(x)$ for all x and y
- 14 A random square has a side length that is a uniform $[0, 1]$ random variable. Find the expected area of the square. Let X be a continuous random variable with the density function $f(x) = 2x$, $0 \leq x \leq 1$
 - i. Find $E(X)$.
 - ii. Find $E(X^2)$ and $Var(X)$.

Course Outcome 2 (CO2):

- 1 What are the main differences between supervised learning and reinforcement learning?
- 2 Give examples of Markovian and non-Markovian environments?
- 3 What are the advantages and disadvantages of value methods vs policy methods?
- 4 Define the optimal state-value function $V^*(s)$ for an MDP.
- 5 Imagine that the rewards are at most 1 everywhere. What is the maximum value that the discounted return can attain? Why?
- 6 Write down the Bellman optimality equation for state-value functions
- 7 Suppose that you are in a casino. You have Rs 20 and will play until you lose it all or as soon as you double your money. You can choose to play two slot machines: 1) slot machine A costs Rs 10 to play and will return Rs 20 with probability 0.05 and Rs 0 otherwise; and 2) slot machine B costs Rs 20 to play and will return Rs 30 with probability 0.01 and Rs 0 otherwise. Until you are done, you will choose to play machine A or machine B in each turn. Describe the state space, action space, rewards and transition probabilities. Assume the discount factor $\gamma = 1$. Rewards should yield a higher reward when terminating with Rs 40 than when terminating with Rs 0. Also, the reward for terminating with Rs 40 should be the same regardless of how we got there (and equivalently for Rs 0).

Course Outcome 3 (CO3):

- 1 Explain policy iteration and value iteration? What are their similarities and differences?
- 2 Why Monte Carlo methods for learning value functions require episodic tasks? How is it that n-step TD methods avoid this limitation and can work with continuing tasks?
- 3 List any three uses of the depth parameter in the Monte-Carlo tree search procedure.
- 4 Given that $q_{\pi}(s, a) > v_{\pi}(s)$, can we conclude that π is not an optimal policy. Justify

Course Outcome 4 (CO4):

- 1 Draw the backup diagram for 2-step Sarsa. Write the corresponding learning rule for 2-step Sarsa.
- 2 Why is Sarsa an on-policy algorithm while Q-learning is an off-policy algorithm?
- 3 How would you differentiate between learning algorithms using on-policy from those that use off-policy?
- 4 When using Temporal Difference learning, why is it better to learn action values (Q-values) rather than state values (V-values)?
- 5 Suppose that a Q-learning agent always chooses the action which maximizes the Q-value. What is one potential problem with that approach?
- 6 Describe any two ways that will force a Q-learning agent to explore.
- 7 Why and when do we need importance sampling?

Course Outcome 5 (CO5):

- 1 How do you deal with a large possible action space in reinforcement learning?
- 2 List any two benefits of policy gradient methods over value function based methods.
- 3 What is the relation between Q-learning and policy gradients methods?
- 4 Consider a five state random walk. There are five states, $s_1, s_2, \dots, s_5$, in a row with two actions each, left and right. There are two terminal states at each end, with a reward of +1 for terminating on the right, after s_5 and a reward of 0 for all other transitions, including the one terminating on the left after s_1 . In designing a linear function approximator, what is the least number of state features required to represent the value of the equi-probable random policy?

Model Question paper

QP Code :

Total Pages: 4

Reg No.: _____

Name: _____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SEVENTH SEMESTER B.TECH DEGREE EXAMINATION (HONOURS), MONTH and YEAR

Course Code: CST497**Course Name: REINFORCEMENT LEARNING**

Max. Marks: 100

Duration: 3 Hours

PART A*Answer all questions, each carries 3 marks.*

- 1 The first three digits of a telephone number are 452. If all the sequences of the remaining four digits are equally likely, what is the probability that a randomly selected telephone number contains seven distinct digits?
- 2 If X is a discrete uniform random variable, i.e., $P(X = k) = 1/n$ for $k = 1, 2, \dots, n$, find $E(X)$ and $Var(X)$.
- 3 Define the discounted return G_t . Give an expression for G_t in terms of G_{t+1} .
- 4 Write down the Bellman expectation equation for state-value functions.
- 5 Suppose that we are doing value iteration with $\gamma = 0$. How many iterations will it take for value iteration to converge to the optimal value function?
- 6 List any three advantages of Monte Carlo methods over dynamic programming techniques?
- 7 Draw the backup diagram for 2-step Q-learning. Write the corresponding learning rule for 2-step Q-learning.
- 8 Why Monte Carlo methods for learning value functions require episodic tasks. How does n -step TD methods avoid this limitation and can work with continuing tasks?
- 9 In using policy gradient methods, if we make use of the average reward formulation rather than the discounted reward formulation, then is it necessary to consider, for problems that do not have a unique start state, a designated start state, s_0 ? Justify.
- 10 Value function based methods are oriented towards finding deterministic

policies whereas policy search methods are geared towards finding stochastic policies. True or false? Justify.

10 x 3 = 30

PART B

Answer any one Question from each module. Each question carries 14 Marks

- 11 a) Three players play 10 independent rounds of a game, and each player has probability $1/3$ of winning each round. Find the joint distribution of the numbers of games won by each of the three players. (7)

- b) Find the joint density of $X + Y$ and X/Y , where X and Y are independent exponential random variables with parameter λ . Show that $X + Y$ and X/Y are independent. (7)

OR

- 12 a) An experiment consists of throwing a fair coin four times. Find the probability mass function and the cumulative distribution function of the following random variables: (7)

- i the number of heads before the first tail
- ii the number of heads following the first tail
- iii the number of heads minus the number of tails
- iv the number of tails times the number of heads.

- b) Let X be a continuous random variable with probability density function on $0 \leq x \leq 1$ defined by $f(x) = 3x^2$. Find the pdf of $Y = X^2$. (7)

- 13 a) What is the difference between a state value function $V(s)$ and a state-action value function $Q(s,a)$? (4)

- b) Consider designing a recycling robot whose job is to collect empty bottles around the building. The robot has a sensor to detect when a bottle is in front of it, and a gripper to pick up the bottle. It also senses the level of its battery. The robot can navigate, as well as pick up a bottle and throw a bottle it is holding in the trash. There is a battery charger in the building, and the robot should not run out of battery. (10)

- i. Describe this problem as an MDP. What are the states and actions?
- ii. Suppose that you want the robot to collect as many bottles as possible, while not running out of battery. Describe what rewards would enable it to achieve this task.

OR

- 14 a) Define the state-value function $V_{\pi}(s)$ for a discounted MDP. (5)
- b) Consider a 4x4 gridworld where the agent starts in the top left, the bottom right state is terminal, rewards are always -1, $\gamma = 1$, and state transitions are deterministic. Consider the policy that always chooses the action to move down except when it is on the bottom row, at which point it chooses the action to move right. Starting with $v_0(s) = 0$ for all s , compute $v_1, v_2, \dots, v_7$. (10)
- 15 a) During a single iteration of the Value Iteration algorithm, we typically iterate over the states in S in some order to update $V_t(s)$ to $V_{t+1}(s)$ for all states s . Is it possible to do this iterative process in parallel? Explain why or why not. (5)
- b) Consider an undiscounted Markov Reward Process with two states A and B. The transition matrix and reward function are unknown, but you have observed two sample episodes: (9)
- A +3 --> A +2 --> B -4 --> A +4 --> B -3
B -2 --> A +3 --> B -3
- Using first-visit Monte-Carlo evaluation, estimate the state-value function $V(A), V(B)$.
 - Using every-visit Monte-Carlo evaluation, estimate the state-value function $V(A), V(B)$.
 - Draw a diagram of the Markov Reward Process that best explains these two episodes. Show rewards and transition probabilities on your diagram.

OR

- 16 a) Suppose you are given a finite set of transition data. Assuming that the Markov model that can be formed with the given data is the actual MDP from which the data is generated, will the value functions calculated by the MC and TD methods necessarily agree? Justify. (4)
- b) With respect to the expected Sarsa algorithm, is exploration required as it is in the normal Sarsa and Q-learning algorithms? Justify. (5)
- c) For a specific MDP, suppose we have a policy that we want to evaluate through the use of actual experience in the environment alone and using Monte Carlo methods. We decide to use the first-visit approach along with the technique of always picking the start state at random from the available set of states. Will this approach ensure complete evaluation of the action value function corresponding to the policy? (5)
- 17 a) Consider the following $Q[S,A]$ table (9)

	State 1	State 2
Action 1	1.5	2.5
Action 2	4	3

Assume the discount factor, $\gamma = 0.5$, and the step size, $\alpha = 0.1$. After the experience $(s, a, r, s') = (1, 1, 5, 2)$, which value of the table gets updated and what is its new value?

- b) What is the difference between Q-learning and Sarsa? (5)

OR

- 18 a) Consider the following Q[S,A] table (9)

	State 1	State 2
Action 1	1.5	2.5
Action 2	4	3

Assume the discount factor, $\gamma = 0.5$, and the step size, $\alpha = 0.1$. After the experience $(s, a, r, s', a') = (1, 1, 5, 2, 1)$, which value of the table gets updated and what is its new value?

- b) For Q-learning to converge we need to correctly manage the exploration vs. exploitation tradeoff. What property needs to be hold for the exploration strategy? (5)
- 19 a) Given the following sequence of states observed from the beginning of an episode, $s_2, s_1, s_3, s_2, s_1, s_2, s_1, s_6$, what is the eligibility value, $e_7(s_1)$, of state s_1 at time step 7 given trace decay parameter λ , discount rate γ , and initial value, $e_0(s_1) = 0$, when accumulating traces are used? What is the eligibility value if replacing traces are used? (8)
- b) Suppose that we are using a policy gradient method to solve a reinforcement learning problem and the policy returned by the method is not optimal. Give three plausible reasons for such an outcome? (6)

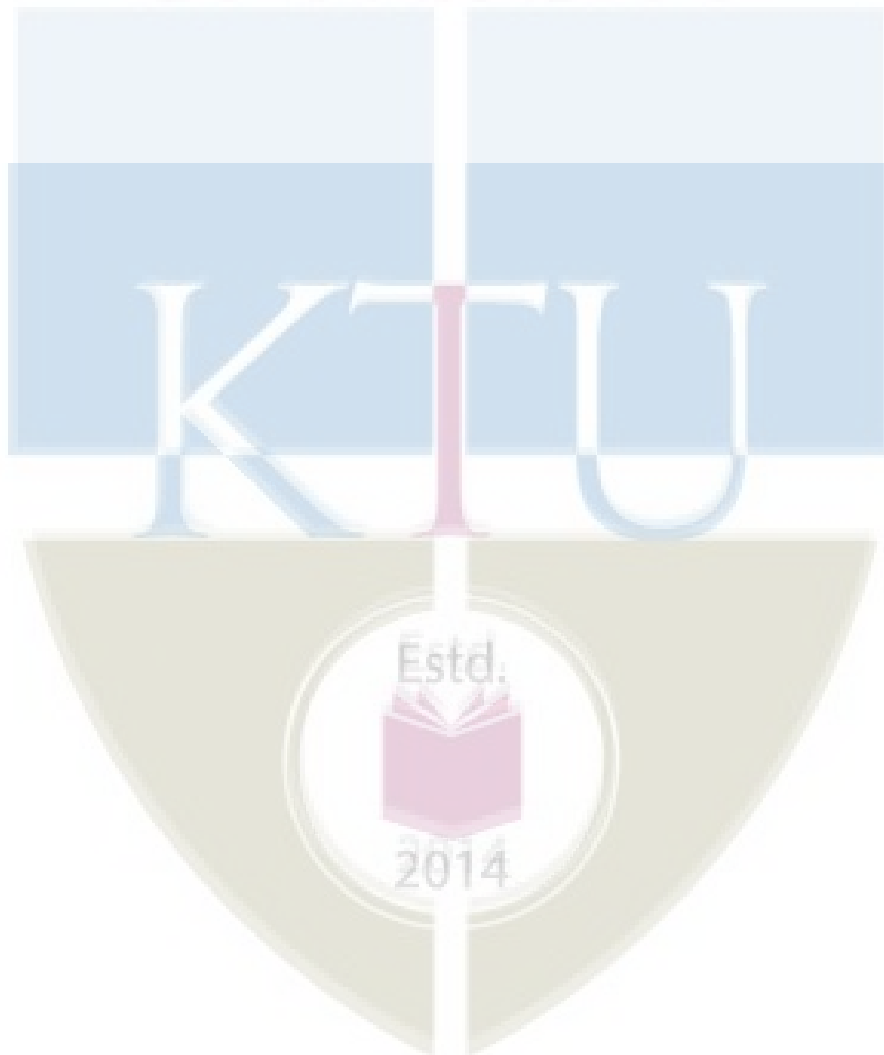
OR

- 20 a) Suppose that we have a Q-value function represented as a sigmoid function of a set of features: (8)

$$Q(\phi, a) = \frac{1}{1 + e^{\theta^T \phi}}$$

Write down the update rule that Sarsa would give for this function.

- b) Suppose that in a particular problem, the agent keeps going back to the same state in a loop. What is the maximum value that can be taken by the eligibility trace of such a state if we consider accumulating traces with $\lambda = 0.25$ and $\gamma = 0.8$? (6)



Teaching Plan

No	Topic	No. of Lectures (42)
Module-1 (Review Of Probability Concepts) TB-2(Ch 2,3,4,5) (8 hours)		
1.1	Axioms of probability, concepts of random variables	1 hour
1.2	Probability mass function	1 hour
1.3	Probability density function	1 hour
1.4	Cumulative density functions	1 hour
1.5.	Expectation of random variables	1 hour
1.6.	Joint and multiple random variables	1 hour
1.7	Conditional and marginal distributions	1 hour
1.8	Correlation and independence	1 hour
Module-2 (Markov Decision Process) TB-1(Ch 1,3)(8 hours)		
2.1.	Introduction to Reinforcement Learning(RL) terminology - Examples of RL, Elements of RL, Limitations and Scope of RL	1 hour
2.2	Finite Markov Decision Processes	1 hour
2.3	The Agent–Environment Interface	1 hour
2.4.	Goals and Rewards	1 hour
2.5.	Returns and Episodes	1 hour
2.6.	Policies and Value Functions	1 hour
2.7	Optimal Policies and Optimal Value Functions	1 hour
2.8	Optimal Policies and Optimal Value Functions	1 hour
Module-3 (Prediction And Control) TB-1(Ch 4,5) (9 hours)		

3.1	Policy Evaluation (Prediction)	1 hour
3.2	Policy Improvement	1 hour
3.3	Policy Iteration, Value Iteration	1 hour
3.4	Monte Carlo Prediction	1 hour
3.5	Monte Carlo Estimation of Action Values	1 hour
3.6	Monte Carlo Control, Monte Carlo Control without Exploring Starts	1 hour
3.7	Off-policy Prediction via Importance Sampling	1 hour
3.8	Incremental Implementation	1 hour
3.9	Off-policy Monte Carlo Control	1 hour
Module-4 (Temporal-Difference(Td) Methods) TB-1 (Ch 6,7) (8 hours)		
4.1	TD Prediction, Advantages of TD Prediction Methods	1 hour
4.2	Optimality of TD(0)	1 hour
4.3	Sarsa: On-policy TD Control	1 hour
4.4	Q-learning: Off-policy TD Control	1 hour
4.5	Expected Sarsa	1 hour
4.6	n-step TD Prediction, n-step Sarsa	1 hour
4.7	n-step Off-policy Learning	1 hour
4.8	Off-policy Learning Without Importance Sampling: The n-step Tree Backup Algorithm	1 hour
Module-5 (Function Approximation Method) TB-1 (Ch 9,12,13) (9 hours)		
5.1	Value-function Approximation	1 hour
5.2	The Prediction Objective	1 hour
5.3	Stochastic-gradient Methods	1 hour
5.4	Linear Methods	1 hour
5.5	The Lambda-return , TD(Lambda)	1 hour
5.6	n-step Truncated Lambda-return Methods, Sarsa(Lambda)	1 hour
5.7	Policy Approximation and its Advantages	1 hour
5.8	The Policy Gradient Theorem, REINFORCE: Monte Carlo Policy Gradient	1 hour
5.9	REINFORCE with Baseline, Actor–Critic Methods	1 hour

ADT 499	SURVEILLANCE VIDEO ANALYTICS	Category	L	T	P	Credit
		Honors	3	1	0	3

Preamble:

This course provide a comprehensive understanding of the principles, techniques, and applications of video analytics in the field of surveillance. The ability to extract meaningful insights and actionable intelligence from surveillance videos is crucial for enhancing situational awareness, detecting anomalies, and making informed decisions. **Prerequisite:** Basic knowledge in set theory.

Prerequisite: Basic concepts in Basic Image Processing and video analytics

Mapping of course outcomes with program outcomes

CO1	Use the probability concepts, statistical pattern recognition to analyze image and video (Cognitive Knowledge level: Apply)
CO2	Demonstrate knowledge and skills to effectively preprocess and post-process data (Cognitive knowledge level: Apply)
CO3	Explain the video analytic architectures, hardware devices, classification trees, and various algorithms for attribute classification (Cognitive Knowledge level: Understand)
CO4	Describe the techniques and algorithms in video processing and motion estimation (Cognitive Knowledge level: Understand)
CO5	Demonstrate the concepts of video coding (Cognitive Knowledge level: Apply)

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	☑											☑
CO2	☑	☑	☑									☑
CO3	☑	☑										☑
CO4	☑	☑										☑
CO5	☑	☑	☑	☑	☑							☑

Abstract POs defined by National Board of Accreditation			
PO#	Broad PO	PO#	Broad PO
PO1	Engineering Knowledge	PO7	Environment and Sustainability
PO2	Problem Analysis	PO8	Ethics
PO3	Design/Development of solutions	PO9	Individual and team work
PO4	Conduct investigations of complex problems	PO10	Communication
PO5	Modern tool usage	PO11	Project Management and Finance
PO6	The Engineer and Society	PO12	Life long learning

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination Marks (%)
	Test 1 (%)	Test 2 (%)	
Remember	20	20	20
Understand	50	50	50
Apply	30	30	30
Analyze			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3

Continuous Internal Evaluation Pattern:

Attendance	10 marks
Continuous Assessment Tests(Average of Internal Tests1&2)	25 marks
Continuous Assessment Assignment	15 marks

Internal Examination Pattern

Each of the two internal examinations has to be conducted out of 50 marks. First series test shall be preferably conducted after completing the first half of the syllabus and the second series test shall be preferably conducted after completing remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly completed module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly completed module), each with 7 marks. Out of the 7 questions, a student should answer any 5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 full questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carries 14 marks.

Syllabus**Module – 1 (Fundamentals and Requirements)**

Probability concepts, Sampling Concepts, Generating Random Variables, Exploratory Data Analysis, Monte Carlo Methods for Inferential Statistics, Data Partitioning, Probability Density Estimation, Statistical Pattern Recognition, and Nonparametric Regression.

Basic image analysis, and the four core analytics categories used in video surveillance; VMD, Heuristics, Conventional Object Detection, and Deep Learning Object Detection(Basics) deep learning neural networks for video analytics, datasets for neural network training (e.g. COCO, ImageNet, Pascal2, Wider, Government datasets)

Module - 2(Pre-processing and Feature Extraction)

Preprocessing and Post processing in data mining – Steps in Preprocessing, Discretization, Manual Approach, Binning, Entropy- based Discretization, Gaussian Approximation, K-tile method, Chi Merge, Feature extraction, selection and construction, Feature extraction Algorithms, Feature selection, Feature construction, Missing Data, Post processing

Module - 3 (Video analytic architecture)

Video analytic architectures, video analytic hardware devices, Classification trees, Algorithms for Normal Attributes, Information Theory and Information. Entropy, Building tree, Highly-Branching Attributes, ID3 to c4.5, CHAID, CART, Regression Trees, Model Trees, Pruning.

Module - 4 (Steps of Video Processing)

Basic Steps of Video Processing: Analog video, Digital Video, Time varying Image Formation models : 3D motion models, Geometric Image formation , Photometric Image formation, sampling of video signals, filtering operations 2-D Motion Estimation: Optical flow, general methodologies, pixel based motion estimation, Block matching algorithm

Module - 5 (Motion Estimation)

Motion estimation: Mesh based motion Estimation, global Motion Estimation, Region based motion estimation, multi resolution motion estimation. Coding: Waveform based coding, Block based transform coding, predictive coding, Application of motion estimation in video coding.

Text Books

1. Richard Szeliski , Computer Vision: Algorithms and Applications, A free electronic copy is available online.
2. Emanuele Trucco and Alessandro Verri, Introductory techniques for 3-D Computer Vision,

Reference Books

1. Multiple View Geometry in Computer Vision (2nd edition) by Richard hartley and Andrew Zisserman
2. Computer Vision: A Modern Approach by David Forsyth and Jean Ponce.
3. Digital Image Processing (Rafael Gonzalez and Richard Woods)
4. Yao wang, Joem Ostarmann and Ya – quin Zhang, Video processing and communication ,1st edition , PHI.
5. M. Tekalp , Digital video Processing, Prentice Hall International

Course Level Assessment Questions

Course Outcome1 (CO1):

1. Explain Monte Carlo Simulation.
2. Discuss the importance of data partitioning in data mining and statistical analysis
3. Explain the concept of deep learning object detection and its significance in computer vision applications.

Course Outcome 2(CO2):

1. Explain the concept of entropy-based discretization in data mining and its role in feature transformation

2. Discuss the challenges and techniques associated with handling missing data in Video analysis.
3. Explain the concept of binning in data preprocessing and its significance in handling continuous variables. Discuss the steps involved in the binning process, including defining bin boundaries, assigning data points to bins, and aggregating data within each bin.

Course Outcome 3 (CO3):

1. Describe the components and architecture of video analytics systems. Explain the key elements involved in video analytic architectures, including hardware devices, software algorithms, and network infrastructure.
2. Discuss the different discretization techniques, such as equal-width binning, equal-frequency binning, and entropy-based discretization.
3. Describe the concept of feature construction in machine learning and its role in enhancing the predictive power of models

Course Outcome 4(CO4): .

1. Explain the concept of geometric image formation in computer vision and its role in understanding the relationship between the 3D world and 2D image observations
2. Discuss the concept of filtering operations in video processing and their significance in enhancing visual quality and extracting relevant information.
3. Explain the concept of the block matching algorithm in motion estimation and its significance in video analysis

Course Outcome 5(CO5):

1. Describe the concept of mesh-based motion estimation in video analysis and its role in accurately tracking object motion
2. Explain the concept of multi-resolution motion estimation in video analysis and its significance in capturing motion information at different levels of detail.

Model Question Paper

QP CODE:

Reg No: _____

Name: _____

PAGES : 4

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

EIGHTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: AIT 493

Course Name SURVEILLANCE VIDEO ANALYTICS

Max.Marks:100

Duration: 3 Hours

PART A

Answer All Questions. Each Question Carries 3 Marks

1. List the pre and post processing techniques used in data mining.
2. Discuss the importance of data partitioning in data mining and statistical analysis.
3. List the data compression technique used in decision tree and types of pruning.
4. Derive the optical flow constraint equation.
5. Explain Gaussian Approximation and its relevance in data analysis.
6. Give the different video analytic architectures available, and specify how they contribute to video analytics.
7. How can 3D motion models be applied in the field of augmented reality (AR)?
8. List any three potential applications of optical flow in computer vision and video analysis?
9. Derive the equation for mesh-based motion estimation technique.
10. How does block-based transform coding contribute to video compression by

exploiting spatial and temporal redundancies?

(10x3=30)

Part B

(Answer any one question from each module. Each question carries 14 Marks)

11. (a) Describe the Monte Carlo method for inferential statistics, steps involved and its significance in addressing complex statistical problems. (7)
- (b) Explain the concept of conventional object detection in computer vision and its key components. (7)

OR

12. (a) Define random variables in probability theory and explain their significance in statistical analysis (7)
- (b) Define the four core analytics categories used in video surveillance (7)
13. (a) Explain the importance of preprocessing and postprocessing in data mining and their respective roles in the overall Video analysis process (14)

OR

14. (a) Explain the k-tile method in inferential statistics, its steps, purpose, and significance. (7)
- (b) Explain the Chi-Merge algorithm used in statistical analysis for merging adjacent intervals in a discretized dataset (7)
15. (a) Discuss how entropy is calculated and interpreted for various video analysis tasks. (7)
- (b) Explain Regression Trees (CART) algorithm in machine learning, the key steps involved in building CART models. (7)

OR

16. (a) Describe the algorithm for handling normal attributes in statistical analysis. (7)
- (b) Explain the concepts of regression trees and pruning in decision tree-based (7)

modeling.

17. (a) Explain in detail the steps involved in structure from motion (SSM) method for 3D reconstruction. (14)

OR

18. (a) Describe the pixel-based motion estimation in video analysis, its principles, methodologies, and applications. (7)

- (b) Describe the concept of mesh-based motion estimation in video analysis and its role in accurately tracking object motion (7)

19. (a) Explain the concept of multi-resolution motion estimation in video analysis and its significance in capturing motion information at different levels. (14)

OR

20. (a) Discuss the various applications of motion estimation in video coding. (14)

Teaching Plan

Module - 1 (Fundamentals and Requirements)		(10 hours)
1.1	Probability concepts, Sampling Concepts, Generating Random Variables	2 hour
1.2	Exploratory Data Analysis, Monte Carlo Methods for Inferential Statistics, Data Partitioning, Probability Density Estimation, Statistical Pattern Recognition, and Nonparametric Regression.	3 hour
1.3	Basic image analysis, and the 4 core analytics categories used in video surveillance;	2 hour
1.4	VMD, Heuristics, Conventional Object Detection, and Deep Learning Object Detection, deep learning.	2 hour
1.5	neural networks for video analytics, datasets for neural network training (e.g. COCO, ImageNet, Pascal2, Wider, Government datasets)	1 hour
Module - 2 (Pre-processing and Feature Extraction)		(9 hours)
2.1	Preprocessing and Post processing in data mining – Steps in Preprocessing	1 hour

2.2	Discretization, Manual Approach, Binning	2 hour
2.3	Entropy- based Discretization, Gaussian Approximation	1 hour
2.4	K-tile method, Chi Merge	1 hour
2.5	Feature extraction algorithms	1 hour
2.6	Feature selection	1 hour
2.7	Feature construction	1 hour
2.8	Missing Data, Post processing	1 hour
		(9 hours)
Module - 3 (Video analytic architecture)		
3.1	Video analytic architectures, video analytic hardware devices	2 hour
3.2	Classification trees, Algorithms for Normal Attributes	2 hour
3.3	Information Theory and Information. Entropy, Building tree	2 hour
3.4	Highly- Branching Attributes, ID3 to c4.5	1 hour
3.5	CHAID, CART	1 hour
3.6	Regression Trees, Model Trees, Pruning.	1 hour
		(9 hours)
Module - 4 (Steps in video processing)		
4.1	Basic Steps of Video Processing: Analog video, Digital Video sampling	1 hour
4.2	Time varying Image Formation models : 3D motion models	2 hour
4.3	Geometric Image formation , Photometric Image formation	2 hour
4.4	video signals, filtering operations	1 hour
4.5	2-D Motion Estimation: Optical flow, general methodologies	2 hour
4.6	pixel based motion estimation, Block matching algorithm.	1 hour
		(8 hours)
Module - 5 (Video Compression)		
5.1	Motion estimation: Mesh based motion Estimation, global Motion estimation	2 hour
5.2	Region based motion estimation	1 hour
5.3	multi resolution motion estimation	1 hour
5.4	Coding: Waveform based coding	1 hour
5.5	Block based transform coding	1 hour
5.6	predictive coding	1 hour

5.7	Application of motion estimation in video coding.	1 hour



APJ ABDUL KALAM
TECHNOLOGICAL
UNIVERSITY

SEMESTER VIII

KTU



CCT402	BIOMETRIC SECURITY	CATEGORY	L	T	P	Credits	Year of Introduction
		PCC	2	1	0	3	2019

Preamble: This course basically aims at imparting fundamental knowledge about concepts and the applications of biometric security. The course also aims at understanding of the techniques, algorithms and applications developed for biometrics and how it can be applied to solve real problems.

Prerequisite: Nil

Course Outcomes: After the completion of the course the student will be able to

CO#	Course Outcomes
CO1	Summarize the fundamental concepts and performance measures in the basic type of biometric systems (Cognitive Knowledge Level: Understand)
CO2	Recognize fingerprint patterns and trace how it can be effectively used in applications. (Cognitive Knowledge Level: Apply)
CO3	Identify Facial patterns and locate how it can be effectively used in applications. (Cognitive Knowledge Level: Apply)
CO4	Acquire and detect iris and ear images and interpret its properties (Cognitive Knowledge Level: Apply)
CO5	Explain the security of biometric systems. (Cognitive Knowledge Level: Understand)

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓			✓						✓
CO2	✓	✓	✓		✓							✓
CO3	✓	✓	✓		✓							✓

CO4												
CO5												

Abstract POs defined by National Board of Accreditation			
PO#	Broad PO	PO#	Broad PO
PO1	Engineering Knowledge	PO7	Environment and Sustainability
PO2	Problem Analysis	PO8	Ethics
PO3	Design/Development of solutions	PO9	Individual and team work
PO4	Conduct investigations of complex problems	PO10	Communication
PO5	Modern tool usage	PO11	Project Management and Finance
PO6	The Engineer and Society	PO12	Lifelong learning

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination Marks (%)
	Test1 (%)	Test2 (%)	
Remember	20	20	20
Understand	40	40	40
Apply	40	40	40
Analyze			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks

Continuous Assessment Tests : 25 marks

Continuous Assessment Assignment : 15 marks

Internal Examination Pattern:

Each of the two internal examinations has to be conducted out of 50 marks. First Internal Examination shall be preferably conducted after completing the first half of the syllabus and the Second Internal Examination shall be preferably conducted after completing the remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly covered module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly covered module), each with 7 marks. Out of the 7 questions in Part B, a student should answer any 5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which a student should answer any one. Each question can have a maximum 2 subdivisions and carries 14 marks.

Syllabus**Module -1 (Introduction to Biometrics)**

Biometric fundamentals – Biometric technologies – Biometrics Vs traditional techniques – Characteristics of a good biometric system – Benefits of biometrics – Key biometric processes: verification, identification and biometric matching – Performance measures in biometric systems, FAR, FRR, FTE rate, EER and ATV rate, Applications of Biometric Systems, Security and Privacy Issues, Physiological Biometrics and Behavioral Biometrics.

Module -2 (Fingerprint Recognition)

Fingerprint recognition: Friction ridge patterns, Acquisition, Feature extraction, matching, indexing, synthesis, palm print.

Module -3 (Face Recognition)

Face recognition: Introduction, image acquisition, face detection. Feature extraction of face recognition, matching, heterogeneous face recognition. Signature-scan, Keystroke Scan– components, working principles.

Module –4 (Iris and Ear Recognition)

Iris recognition, Image acquisition, iris segmentation, normalization. Encoding and matching, quality assessment, performance evaluation

Ear detection and recognition – challenges, gait and hand geometry. Feature extraction and matching

Module –5 (Security of Biometric Systems)

Security of bio-metric systems: adversary attacks, attacks on user interface, attacks on bio-metric processing, database attacks. Biometric standards, biometric databases

Text Books

1. Anil K. Jain, Arun A. Ross, Karthik Nandakumar, “Introduction to Biometrics”, Springer, 2011
2. Jain, P. Flynn, A. Ross, “Handbook of Biometrics” Springer, 2008

Reference Books

1. John R. Vacca, “Biometric Technologies and Verification Systems”, Elsevier, 2007
2. Samir Nanavati, Michael Thieme, Raj Nanavati, “Biometrics – Identity Verification in a Networked World”, Wiley-dreamtech India Pvt Ltd, New Delhi, 2003
3. Paul Reid, “Biometrics for Network Security”, Pearson Education, New Delhi, 2004

Course Level Assessment Questions**Course Outcome 1 (CO1):**

1. The biometric systems' performance metrics are essential for achieving the desired results. List the fundamental parametric levels of a reliable biometric system.

Course Outcome 2 (CO2):

1. Identifying the perpetrators of a crime is always made easier by fingerprint patterns. Use appropriate technology to support your argument and describe how it aids your inquiry.

Course Outcome 3 (CO3):

1. Describe how facial features can be used to identify a person. What are the fundamental criteria that should be taken into account while identifying an unknown identity?

Course Outcome 4 (CO4):

1. Discuss the different steps in capturing Iris and Ear images and explain how it can be effectively used to develop applications .

Course Outcome 5 (CO5):

1. Explain the factors to be considered for developing a good biometric system.

MODEL QUESTION PAPER**QP CODE:****Reg No:** _____**Name :** _____**PAGES : 3****APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY****EIGHTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR****Course Code: CCT 402****Course Name: BIOMETRIC SECURITY****Max.Marks:100****Duration: 3 Hours****PART A****Answer all Questions. Each question carries 3 Marks**

1. What are the characteristics of a good biometric system?
2. List out any three applications of a Biometric system.
3. Give any two Fingerprint biometric methodologies.
4. Explain how indexing is done in Fingerprint Biometrics?
5. Show how feature extraction is done in Face Recognition.
6. List out the weaknesses of a Facial scan.
7. What is normalization?
8. Explain how performance is evaluated in Iris Scan.
9. What is an adversary attack?
10. Write down any three biometric standards.

(10*3=30 Marks)

PART B

Answer any Two Question from each module. Each question carries 14 Marks

11. a) Compare and contrast a Traditional authentication system with Biometric system. (6)
 b) Explain how biometrics can be used in Identification. (8)

OR

12. a) What is the need of a Biometric system? How biometric matching is done? (6)
 b) Explain the different performance measures used in a biometric system. (8)
13. a) Show how feature extraction is done using finger print recognition methodologies?. (8)
 b) Describe the different Friction ridge patters. (6)

OR

14. a) Use a suitable method show how image acquisition and detection is done for fingerprint recognition?. (8)
 b) Explain the method of synthesis used in finger print biometrics. (6)
15. a) Compare the strength and weakness of Fingerprint & Facial scan (6)
 b) What do you mean by heterogeneous face recognition? How is it done? (8)

OR

16. a) Show how deployment of Facial scan is performed (6)
 b) Differentiate between Signature Scan and Keystroke scan. (8)
17. a) Describe the strengths and weaknesses of a Retina vascular pattern. (7)
 b) Show how quality assessment is done for an Iris Scan biometric system (7)

OR

18. a) What are the Challenges in ear detection? Explain (8)
 b) Show how performance measure assessment is done for an Iris Scan biometric system. (6)
19. (a). What is biometric processing? List some of the attacks that can be made on biometric Processing (6)
 (b). List some of the attacks made on a user interface. (8)

OR

20.(a) Why database attacks are so crucial for a biometric system? (8)

(b) The security of a biometric system is very important. Comment. (6)

TEACHING PLAN

Sl.No	Contents	No. of Lecture Hrs (37)
Module -1 (Introduction to Biometrics) (7 hrs)		
1.1	Biometric fundamentals, Biometric technologies	1
1.2	Biometrics Vs traditional techniques.	1
1.3	Characteristics of a good biometric system, Benefits of biometrics	1
1.4	Key biometric processes: verification, identification and biometric matching	1
1.5	Performance measures in biometric systems, FAR, FRR, FTE rate, EER and ATV rate	1
1.6	Applications of Biometric Systems, Security and Privacy Issues	1
1.7	Physiological Biometrics and Behavioral Biometrics	1
Module -2 (Fingerprint recognition) (7 hrs)		
2.1	Fingerprint recognition	1
2.2	Friction ridge patterns	1
2.3	Acquisition	1
2.4	Feature extraction	1
2.5	Matching, indexing	1
2.6	Synthesis	1
2.7	Palm print	1
Module -3 (Face Recognition) (8 hrs)		
3.1	Face recognition: Introduction	1
3.2	Image acquisition	1
3.3	Face detection	1
3.4	Feature extraction of face recognition	1
3.5	Matching	1
3.6	Heterogeneous face recognition	1
3.7	Signature-scan— components, working principles	1
3.8	Keystroke scan— components, working principles	1

Module –4 (Iris and Ear Recognition) (9 hrs)

4.1	Iris recognition	1
4.2	Image acquisition	1
4.3	Iris segmentation, normalization	1
4.4	Encoding and matching	1
4.5	Quality assessment, performance evaluation	1
4.6	Ear detection and recognition	1
4.7	Challenges	1
4.8	Gait and hand geometry	1
4.9	Feature extraction and matching	1

Module –5 (Security of Biometric Systems) (6 hrs)

5.1	Security of bio-metric systems	1
5.2	Adversary attacks	1
5.3	Attacks on user interface	1
5.4	Attacks on bio-metric processing	1
5.5	Database attacks	1
5.6	Biometric standards, Biometric databases	1

CCT 404	COMPREHENSIVE COURSE VIVA	CATEGORY	L	T	P	Credits	Year of Introduction
		PCC	1	0	0	1	2019

Preamble: The objective of this Course viva is to ensure the basic knowledge of each student in the most fundamental core courses in the curriculum. The viva voce shall be conducted based on the core subjects studied from third to eighth semester. This course helps the learner to become competent in placement tests and other competitive examinations.

General Guidelines

1. The course should be mapped with a faculty and classes shall be arranged for practicing questions based on the core courses listed in the curriculum.
2. The viva voce will be conducted by the same three member committee assigned for final project phase II evaluation. It comprises of Project coordinator, expert from Industry/research Institute and a senior faculty from a sister department.
3. The pass minimum for this course is 25.
4. The mark will be treated as internal and should be uploaded along with internal marks of other courses.
5. Comprehensive Viva should be conducted along with final project evaluation by the three member committee.

Mark Distribution Total marks: 50, only CIE, minimum required to pass: 25

CCD 416	PROJECT PHASE II	CATEGORY	L	T	P	Credits	Year of Introduction
		PWS	0	0	6	2	2019

Preamble: The course 'Project Work' is mainly intended to evoke the innovation and invention skills in a student. The course will provide an opportunity to synthesize and apply the knowledge and analytical skills learned, to be developed as a prototype or simulation. The project extends to 2 semesters and will be evaluated in the 7th and 8th semester separately, based on the achieved objectives. One third of the project credits shall be completed in 7th semester and two third in 8th semester. It is recommended that the projects may be finalized in the thrust areas of the respective engineering stream or as interdisciplinary projects. Importance should be given to address societal problems and developing indigenous technologies.

Course Objectives:

- To apply engineering knowledge in practical problem solving.
- To foster innovation in design of products, processes or systems.
- To develop creative thinking in finding viable solutions to engineering problems.

Course Outcomes: After the successful completion of the course the students will be able to

CO#	Course Outcomes
CO1	Model and solve real world problems by applying knowledge across domains (Cognitive knowledge level: Apply).
CO2	Develop products, processes or technologies for sustainable and socially relevant applications (Cognitive knowledge level: Apply).
CO3	Function effectively as an individual and as a leader in diverse teams and to comprehend and execute designated tasks (Cognitive knowledge level: Apply).
CO4	Plan and execute tasks utilizing available resources within timelines, following ethical and professional norms (Cognitive knowledge level: Apply).
CO5	Identify technology/research gaps and propose innovative/creative solutions (Cognitive knowledge level: Analyze).
CO6	Organize and communicate technical and scientific findings effectively in written and oral forms (Cognitive knowledge level: Apply).

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	1	2	2	2	1	1	1	1	2
CO2	2	2	2		1	3	3	1	1		1	1
CO3									3	2	2	1
CO4					2			3	2	2	3	2
CO5	2	3	3	1	2							1
CO6					2			2	2	3	1	1

Abstract POs defined by National Board of Accreditation

PO#	Broad PO	PO#	Broad PO
PO1	Engineering Knowledge	PO7	Environment and Sustainability
PO2	Problem Analysis	PO8	Ethics
PO3	Design/Development of solutions	PO9	Individual and team work
PO4	Conduct investigations of complex problems	PO10	Communication
PO5	Modern tool usage	PO11	Project Management and Finance
PO6	The Engineer and Society	PO12	Lifelong learning

PROJECT PHASE II

Phase 2 Target

- In depth study of the topic assigned in the light of the report prepared under Phase - I;
- Review and finalization of the approach to the problem relating to the assigned topic.
- Preparing a detailed action plan for conducting the investigation, including teamwork.
- Detailed Analysis/ Modeling / Simulation/ Design/ Problem Solving/Experiment as needed.
- Final development of product/ process, testing, results, conclusions and future directions.
- Preparing a paper for Conference Presentation/ Publication in Journals, if possible.
- Presenting projects in Project Expos conducted by the University at the cluster level and/ or state level as well as others conducted in India and abroad.
- Filing Intellectual Property Rights (IPR) if applicable.
- Preparing a report in the standard format for being evaluated by the Department Assessment Board.
- Final project presentation and viva voce by the assessment board including the external expert

Evaluation Guidelines & Rubrics

Total: 150 marks (Minimum required to pass: 75 marks).

- Project progress evaluation by guide: 30 Marks.
- Two interim evaluations by the Evaluation Committee: 50 Marks (25 marks for each evaluation).
- Final evaluation by the Final Evaluation committee: 40 Marks
- Quality of the report evaluated by the evaluation committee: 30 Marks

(The evaluation committee comprises HoD or a senior faculty member, Project coordinator and project supervisor. The final evaluation committee comprises of Project coordinator, expert from Industry/research/academic Institute and a senior faculty from a sister department)

Evaluation by the Guide

The guide/supervisor must monitor the progress being carried out by the project groups on regular basis. In case it is found that progress is unsatisfactory it should be reported to the Department Evaluation Committee for necessary action. The presence of each student in the group and their involvement in all stages of execution of the project shall be ensured by the guide. Project evaluation by the guide: 30 Marks. This mark shall be awarded to the students in his/her group by considering the following aspects:

Project Scheduling & Distribution of Work among Team members: Detailed and extensive

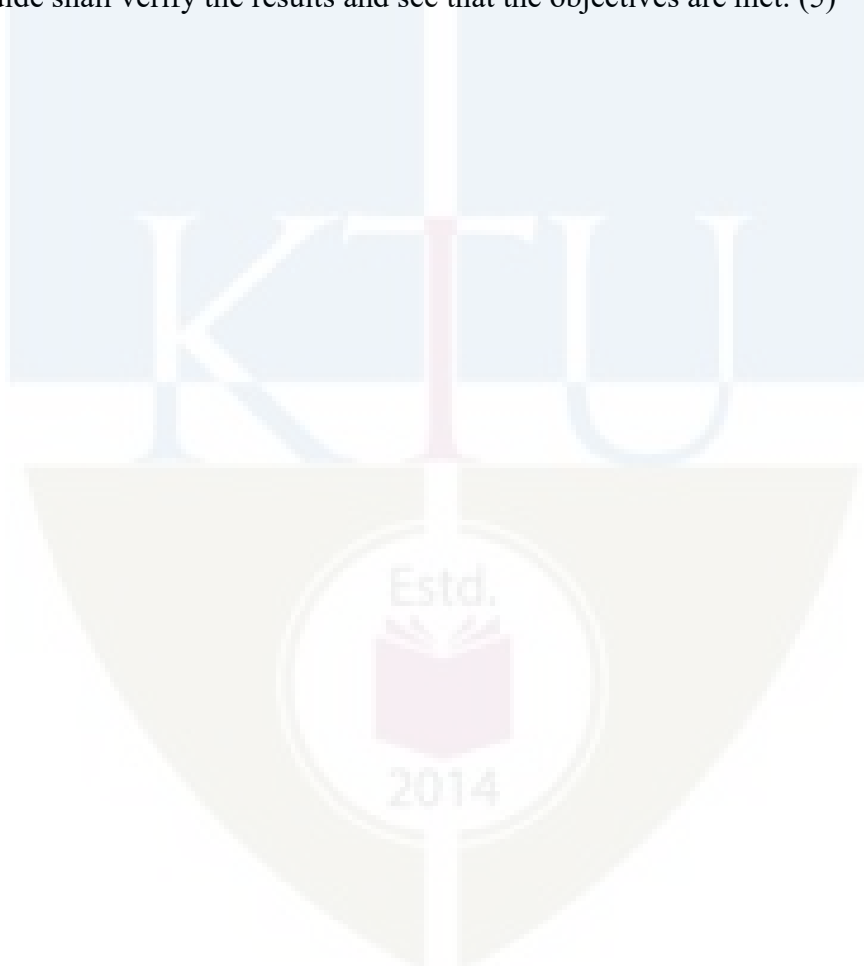
Scheduling with timelines provided for each phase of project. Work breakdown structure well defined. (5)

Literature survey: Outstanding investigation in all aspects. (4)

Student's Diary/ Daily Log: The main purpose of writing daily diary is to cultivate the habit of documenting and to encourage the students to search for details. It develops the students' thought process and reasoning abilities. The students should record in the daily/weekly activity diary the day to day account of the observations, impressions, information gathered and suggestions given, if any. It should contain the sketches & drawings related to the observations made by the students. The daily/weekly activity diary shall be signed after every day/week by the guide. (7)

Individual Contribution: The contribution of each student at various stages. (9)

Completion of the project: The students should demonstrate the project to their respective guide. The guide shall verify the results and see that the objectives are met. (5)



EVALUATION RUBRICS for PROJECT Phase II: Interim Evaluation - 1

No.	Parameters	Marks	Poor	Fair	Very Good	Outstanding
2-a	Novelty of idea, and Implementation scope [CO5] [Group Evaluation]	5	The project is not addressing any useful requirement. The idea is evolved into a non-implementable one. The work presented so far is lacking any amount of original work by the team.	Some of the aspects of the proposed idea can be implemented. There is still lack of originality in the work done so far by the team. The project is a regularly done theme/topic without any freshness in terms of specifications, features, and/or improvements.	Good evidence of an implementable project. There is some evidence for the originality of the work done by the team. There is fresh specifications/features/improvements suggested by the team. The team is doing a design from fundamental principles, and there is some independent learning and engineering ingenuity.	The project has evolved into incorporating an outstandingly novel idea. Original work which is not yet reported anywhere else. Evidence for ingenious way of innovation which is also Implementable. Could be a patentable / publishable work.
			(0 – 1 Marks)	(2 – 3 Marks)	(4 Marks)	(5 Marks)
2-b	Effectiveness of task distribution among team members. [CO3] [Group Evaluation]	5	No task distribution of any kind. Members are still having no clue on what to do.	Task allocation done, but not effectively, some members do not have any idea of the tasks assigned. Some of the tasks were identified but not followed individually well.	Good evidence of task allocation being done, supported by project journal entries, identification of tasks through discussion etc. However, the task distribution seems to be skewed, and depends a few members heavily than others. Mostly the tasks are being followed by the individual members.	Excellent display of task identification and distribution backed by documentary evidence of team brainstorming, and project journal entries. All members are allocated tasks according to their capabilities, and as much as possible in an equal manner. The individual members are following the tasks in an excellent manner.
			(0 – 1 Marks)	(2 – 3 Marks)	(4 Marks)	(5 Marks)
2-c	Adherence to project schedule. [CO4] [Group Evaluation]	5	Little or no evidence of continued planning or scheduling of the project. The students did not stick to the plan what they were going to build nor plan on what materials / resources to use in the project. The students do not have any idea on the budget required even after the end of phase - I. No project journal kept or the journal.	There is some improvement in the primary plan prepared during phase I. There were some ideas on the materials /resources required, but not really thought out. The students have some idea on the finances required, but they have not formalized a budget plan. Schedules were not prepared. The project journal has no useful details on the project.	Good evidence of planning done and being followed up to a good extent after phase I. Materials were listed and thought out, but the plan wasn't followed completely. Schedules were prepared, but not detailed, and needs improvement. Project journal is presented but it is neither complete nor updated regularly.	Excellent evidence of enterprising and extensive project planning and follow-up since phase I. Continued use of project management/version control tool to track the project. Material procurement if applicable is progressing well. Tasks are updated and incorporated in the schedule. A well-kept project journal showed evidence for all the above, in addition to the interaction with the project guide.
			(0 - 1 Marks)	(2 - 3 Marks)	(4 Marks)	(5 Marks)

Phase-II Interim Evaluation - 1 Total Marks: 25

EVALUATION RUBRICS for PROJECT Phase II: Interim Evaluation – 2

No	Parameters	Marks	Poor	Fair	Very Good	Outstanding
2-f	Application of engineering knowledge [CO1] [Individual Assessment]	10	The student does not show any evidence of applying engineering knowledge on the design and the methodology adopted. The student's contribution in application of engineering knowledge in the project is poor.	The student appears to apply some basic knowledge, but not able to show the design procedure and the methodologies adopted in a comprehensive manner.	The student is able to show some evidence of application of engineering knowledge in the design and development of the project to good extent.	Excellent knowledge in design procedure and its adaptation. The student is able to apply knowledge from engineering domains to the problem and develop solutions.
			(0 – 3 Marks)	(4 – 6 Marks)	(7 - 9 Marks)	(10 Marks)
2-g	Involvement of individual members [CO3] [Individual Assessment]	5	No evidence of any Individual participation in the project work.	There is evidence for some amount of individual contribution, but is limited to some of the superficial tasks.	The individual contribution is evident. The student has good amount of involvement in core activities of the project.	Evidence available for the student acting as the core technical lead and has excellent contribution to the project.
			(0 - 1 Marks)	(2 - 3 Marks)	(4 Marks)	(5 Marks)
2-h	Results and inferences upon execution [CO5] [Group Assessment]	5	None of the expected outcomes are achieved yet. The team is unable to derive any inferences on the failures/issues observed. Any kind of observations or studies are not made.	Only a few of the expected outcomes are achieved. A few inferences are made on the observed failures/issues. No further work suggested.	Many of the expected outcomes are achieved. Many observations and inferences are made, and attempts to identify the issues are done. Some suggestions are made for further work.	Most of the stated outcomes are met. Extensive studies are done and inferences drawn. Most of the failures are addressed and solutions suggested. Clear and valid suggestions made for further work.
			(0 - 1 Marks)	(2 - 3 Marks)	(4 Marks)	(5 Marks)
2-i	Documentation and presentation. [CO6] [Individual assessment]	5	The individual student has no idea on the presentation of his/her part. The presentation is of poor quality.	Presentation's overall quality needs to be improved.	The individual's presentation performance is satisfactory.	The individual's presentation is done professionally and with great clarity. The individual's performance is excellent.
			(0 - 1 Marks)	(2 - 3 Marks)	(4 Marks)	(5 Marks)

Phase-II Interim Evaluation - 2 Total Marks: 25

EVALUATION RUBRICS for PROJECT Phase II: Final Evaluation

No	Parameters	Marks	Poor	Fair	Very Good	Outstanding
2-j	Engineering knowledge. [CO1] [Group Assessment]	10	The team does not show any evidence of applying engineering knowledge on the design and the methodology adopted.	The team is able to show some of the design procedure and the methodologies adopted, but not in a comprehensive manner.	The team is able to show evidence of application of engineering knowledge in the design and development of the project to good extent. There is scope for improvement.	Excellent knowledge in design procedure and its adaptation. The team is able to apply knowledge from engineering domains to the problem and develop an excellent solution.
			(0 – 3 Marks)	(4 – 6 Marks)	(7 - 9 Marks)	(10 Marks)
2-k	Relevance of the project with respect to societal and/or industrial needs. [Group Assessment] [CO2]	5	The project as a whole do not have any societal / industrial relevance at all.	The project has some relevance with respect to social and/or industrial application. The team has however made not much effort to explore further and make it better.	The project is relevant to the society and/or industry. The team is mostly successful in translating the problem into an engineering specification and managed to solve much of it.	The project is exceptionally relevant to society and/or industry. The team has made outstanding contribution while solving the problem in a professional and/or ethical manner.
			(0 - 1 Marks)	(2 - 3 Marks)	(4 Marks)	(5 Marks)
2-i	Innovation / novelty / Creativity [CO5] [Group Assessment]	5	The project is not addressing any useful requirement. The idea is evolved into a non-implementable one. The work presented so far is lacking any amount of original work by the team.	Some of the aspects of the proposed idea appears to be practical. There is still lack of originality in the work done. The project is a regularly done theme/topic without any freshness in terms of specifications, features, and/or improvements.	Good evidence of an implementable project. There is some evidence for the originality of the work done by the team. There is fresh specifications/features/improvements suggested by the team. The team is doing a design from fundamental principles, and there is some independent learning and engineering ingenuity. Could be translated into a product / process if more work is done.	The project has evolved into incorporating an outstandingly novel idea. Original work which is not yet reported anywhere else. Evidence for ingenious way of innovation which is also Implementable. Could be a patentable publishable work.
			(0 - 1 Marks)	(2 - 3 Marks)	(4 Marks)	(5 Marks)
2-m	Quality of results / conclusions / solutions. [CO1] [Group Assessment]	10	None of the expected outcomes are achieved. The team is unable to derive any inferences on the failures/issues observed. Any kind of observations or studies is not made.	Only a few of the expected outcomes are achieved. A few inferences are made on the observed failures/issues. No further work suggested.	Many of the expected outcomes are achieved. Many observations and inferences are made, and attempts to identify the issues are done. Some suggestions are made for further work.	Most of the stated outcomes are met. Extensive studies are done and inferences drawn. Most of the failures are addressed and solutions suggested. Clear and valid suggestions made for further work.
			(0 – 3 Marks)	(4 – 6 Marks)	(7 - 9 Marks)	(10 Marks)

Phase-II Final Evaluation, Marks: 40

EVALUATION RUBRICS for PROJECT Phase II: Report Evaluation						
Sl. No.	Parameters	Marks	Poor	Fair	Very Good	Outstanding
2-o	Report [CO6]	30	The prepared report is shallow and not as per standard format. It does not follow proper organization. Contains mostly unacknowledged content. Lack of effort in preparation is evident. References are not cited. Unprofessional and inconsistent formatting.	Project report follows the standard format to some extent. However, its organization is not very good. Language needs to be improved. All references are not cited properly in the report. There is lack of formatting consistency.	Project report shows evidence of systematic documentation. Report is mostly following the standard style format and there are only a few issues. Organization of the report is good. Mostly consistently formatted. Most of references/sources are cited, acknowledged properly.	The report is exceptionally good. Neatly organized. All references cited properly. Diagrams/Figures, Tables and equations are properly numbered, and listed and clearly shown. Language is excellent and follows professional styles. Consistent formatting and exceptional readability.
			(0 - 11 Marks)	(12 - 18 Marks)	(19 - 28 Marks)	(29 - 30 Marks)
Phase - II Project Report Marks: 30						

APJ ABDUL KALAM
TECHNOLOGICAL
UNIVERSITY

SEMESTER VIII

PROGRAM ELECTIVE III



CST414	DEEP LEARNING	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		PEC	2	1	0	3	2019

Preamble: Deep Learning is the recently emerged branch of machine learning, particularly designed to solve a wide range of problems in Computer Vision and Natural Language Processing. In this course, the building blocks used in deep learning are introduced. Specifically, neural networks, deep neural networks, convolutional neural networks and recurrent neural networks. Learning and optimization strategies such as Gradient Descent, Nesterov Accelerated Gradient Descent, Adam, AdaGrad and RMSProp are also discussed in this course. This course will help the students to attain sound knowledge of deep architectures used for solving various Vision and NLP tasks. In future, learners can master modern techniques in deep learning such as attention mechanisms, generative models and reinforcement learning.

Prerequisite: Basic understanding of probability theory, linear algebra and machine learning

Course Outcomes: After the completion of the course, the student will be able to

CO1	Illustrate the basic concepts of neural networks and its practical issues (Cognitive Knowledge Level: Apply)
CO2	Outline the standard regularization and optimization techniques for deep neural network (Cognitive Knowledge Level: understand)
CO3	Implement the foundation layers of CNN (pooling, convolutions) (Cognitive Knowledge Level: Apply)
CO4	Implement a sequence model using recurrent neural networks (Cognitive Knowledge Level: Apply)
CO5	Use different neural network/deep learning models for practical applications. (Cognitive Knowledge Level: Apply)

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

Abstract POs defined by National Board of Accreditation			
PO#	Broad PO	PO#	Broad PO
PO1	Engineering Knowledge	PO7	Environment and Sustainability
PO2	Problem Analysis	PO8	Ethics
PO3	Design/Development of solutions	PO9	Individual and team work
PO4	Conduct investigations of complex problems	PO10	Communication
PO5	Modern tool usage	PO11	Project Management and Finance
PO6	The Engineer and Society	PO12	Life long learning

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination Marks (%)
	Test 1 (%)	Test 2 (%)	
Remember	30	30	30
Understand	30	30	30
Apply	40	40	40

Analyze			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3

Continuous Internal Evaluation Pattern:

Attendance	10 marks
Continuous Assessment Tests(Average of Internal Tests 1 & 2)	25 marks
Continuous Assessment Assignment	15 marks

Internal Examination Pattern

Each of the two internal examinations has to be conducted out of 50 marks. First series test shall be preferably conducted after completing the first half of the syllabus and the second series test shall be preferably conducted after completing remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly completed module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly completed module), each with 7 marks. Out of the 7 questions, a student should answer any 5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 full questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carries 14 marks.

Syllabus

Module-1 (Neural Networks)

Introduction to neural networks -Single layer perceptrons, Multi Layer Perceptrons (MLPs), Representation Power of MLPs, Activation functions - Sigmoid, Tanh, ReLU, Softmax. , Risk minimization, Loss function, Training MLPs with backpropagation, Practical issues in neural network training - The Problem of Overfitting, Vanishing and exploding gradient problems, Difficulties in convergence, Local and spurious Optima, Computational Challenges. Applications of neural networks.

Module-2 (Deep learning)

Introduction to deep learning, Deep feed forward network, Training deep models, Optimization techniques - Gradient Descent (GD), GD with momentum, Nesterov accelerated GD, Stochastic GD, AdaGrad, RMSProp, Adam. Regularization Techniques - L1 and L2 regularization, Early stopping, Dataset augmentation, Parameter sharing and tying, Injecting noise at input, Ensemble methods, Dropout, Parameter initialization.

Module-3 (Convolutional Neural Network)

Convolutional Neural Networks – convolution operation, motivation, pooling, Convolution and Pooling as an infinitely strong prior, variants of convolution functions, structured outputs, data types, efficient convolution algorithms.

Module- 4 (Recurrent Neural Network)

Recurrent neural networks – Computational graphs, RNN design, encoder – decoder sequence to sequence architectures, deep recurrent networks, recursive neural networks, modern RNNs LSTM and GRU.

Module-5 (Application Areas)

Applications – computer vision, speech recognition, natural language processing, common word embedding: continuous Bag-of-Words, Word2Vec, global vectors for word representation (GloVe). Research Areas – autoencoders, representation learning, boltzmann machines, deep belief networks.

Text Books

1. Goodfellow, I., Bengio, Y., and Courville, A., Deep Learning, MIT Press, 2016.
2. Neural Networks and Deep Learning, Aggarwal, Charu C.
3. Fundamentals of Deep Learning: Designing Next-Generation Machine Intelligence Algorithms (1st. ed.). Nikhil Buduma and Nicholas Locascio. 2017. O'Reilly Media, Inc.

Reference Books

1. Satish Kumar, Neural Networks: A Classroom Approach, Tata McGraw-Hill Education, 2004.
2. Yegnanarayana, B., Artificial Neural Networks PHI Learning Pvt. Ltd, 2009.
3. Michael Nielsen, Neural Networks and Deep Learning, 2018

Course Level Assessment Questions

Course Outcome1 (CO1):

1. Suppose you have a 3-dimensional input $x = (x_1, x_2, x_3) = (2, 2, 1)$ fully connected to 1 neuron which is in the hidden layer with activation function sigmoid. Calculate the output of the hidden layer neuron.
2. Design a single layer perceptron to compute the **NAND (not-AND)** function. This function receives two binary-valued inputs x_1 and x_2 , and returns 0 if both inputs are 1, and returns 1 otherwise.
3. Suppose we have a fully connected, feed-forward network with no hidden layer, and 5 input units connected directly to 3 output units. Briefly explain why adding a hidden layer with 8 linear units does not make the network any more powerful.
4. Briefly explain one thing you would use a validation set for, and why you can't just do it using the test set.
5. Give a method to fight vanishing gradients in fully-connected neural networks. Assume we are using a network with Sigmoid activations trained using SGD.
6. You would like to train a fully-connected neural network with 5 hidden layers, each with 10 hidden units. The input is 20-dimensional and the output is a scalar. What is the total number of trainable parameters in your network?

Course Outcome 2(CO2):

1. Derive a mathematical expression to show L2 regularization as weight decay. Explain how L2 regularization improves the performance of deep feed forward neural networks.
2. In stochastic gradient descent, each pass over the dataset requires the same number of arithmetic operations, whether we use minibatches of size 1 or size 1000. Why can it nevertheless be more computationally efficient to use minibatches of size 1000?

3. State how to apply early stopping in the context of learning using Gradient Descent. Why is it necessary to use a validation set (instead of simply using the test set) when using early stopping?
4. Suppose that a model does well on the training set, but only achieves an accuracy of 85% on the validation set. You conclude that the model is overfitting, and plan to use L1 or L2 regularization to fix the issue. However, you learn that some of the examples in the data may be incorrectly labeled. Which form of regularisation would you prefer to use and why?
5. Describe one advantage of using Adam optimizer instead of basic gradient descent.

Course Outcome 3(CO3):

1. Draw and explain the architecture of convolutional neural networks.
2. Consider a convolution layer. The input consists of 6 feature maps of size 20×20 . The output consists of 8 feature maps, and the filters are of size 5×5 . The convolution is done with a stride of 2 and zero padding, so the output feature maps are of size 10×10 .
 - a. Determine the number of weights in this convolution layer.
 - b. Determine the number of weights if we made this a fully connected layer, but the number of input and output units are kept the same as in the network.
3. Suppose two people A and B have implemented two neural networks for recognizing handwritten digits from 16×16 grayscale images. Each network has a single hidden layer, and makes predictions using a softmax output layer with 10 units, one for each digit class.
 - a. A's network is a convolutional net. The hidden layer consists of three 16×16 convolutional feature maps, each with filters of size 5×5 , and uses the logistic nonlinearity. All of the hidden units are connected to all of the output units.
 - b. B's network is a fully connected network with no weight sharing. The hidden layer consists of 768 logistic units (the same number of units as in A's convolutional layer).
4. Briefly explain one advantage of A's approach and one advantage of B's approach.
5. Why do the layers in a deep architecture need to be non-linear?
6. Give two benefits of using convolutional layers instead of fully connected ones for visual tasks.
7. You have an input volume of $32 \times 32 \times 3$. What are the dimensions of the resulting volume after convolving a 5×5 kernel with zero padding, stride of 1, and 2 filters?

Course Outcome 4(CO4): .

1. Draw and explain the architecture of LSTM.
2. Name at least one benefit of the LSTM model over the bag-of-vectors model.
3. Give one advantage of GloVe over Skipgram/CBOW models.
4. What are two ways practitioners deal with having two different sets of word vectors U and V at the end of training both Glove and word2vec?
5. If we have a recurrent neural network (RNN), we can view it as a different type of network by "unrolling it through time". Briefly explain what that means.
6. Briefly explain how “unrolling through time” is related to “weight sharing” in convolutional networks.

Course Outcome 5(CO5):

1. Development a deep learning solution for problems in the domain i) natural language processing or ii) Computer vision
2. Illustrate the workings of the RNN with an example of a single sequence defined on a vocabulary of four words.
3. Is an autoencoder for supervised learning or for unsupervised learning? Explain briefly.
4. Sketch the architecture of an autoencoder network.
5. Describe how to train an autoencoder network.



Model Question Paper

QP CODE:

Reg No: _____

Name: _____

PAGES : 4

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

EIGHTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: CST414

Course Name: Deep Learning

Max. Marks : 100

Duration: 3 Hours

PART A

Answer All Questions. Each Question Carries 3 Marks

1. Discuss the limitation of a single layer perceptron with an example.
2. List the advantages and disadvantages of sigmoid and ReLU activation functions.
3. Derive weight updating rule in gradient descent when the error function is a) mean squared error b) cross entropy.
4. Discuss methods to prevent overfitting in neural networks.
5. What happens if the stride of the convolutional layer increases? What can be the maximum stride? Explain.
6. Draw the architecture of a simple CNN and write short notes on each block.
7. How does a recursive neural network work?
8. List down the differences between LSTM and RNN.
9. Illustrate the use of deep learning concepts in Speech Recognition.

10. What is an autoencoder? Give one application of an autoencoder

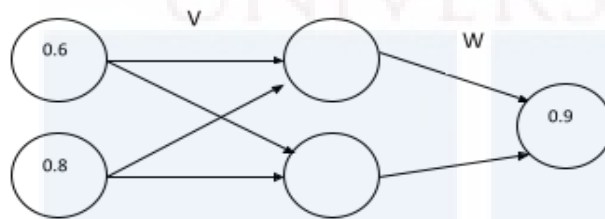
(10x3=30)

Part B

(Answer any one question from each module. Each question carries 14 Marks)

11. (a) Update the parameters in the given MLP using gradient descent with learning rate as 0.5 and activation function as ReLU. Initial weights are given as (10)

$$V = \begin{bmatrix} 0.1 & 0.2 \\ 0.1 & 0.1 \end{bmatrix} \quad W = \begin{bmatrix} 0.1 & 0.1 \end{bmatrix}$$

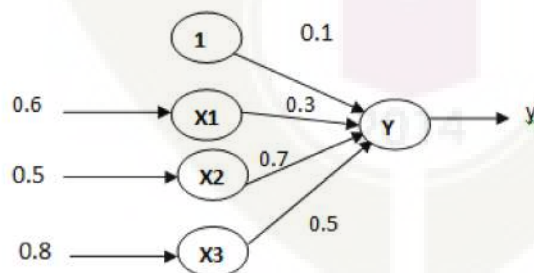


- (b) Explain the importance of choosing the right step size in neural networks. (4)

OR

12. (a) Draw the architecture of a multi-layer perceptron. Derive update rules for parameters in the multi-layer neural network through the gradient descent (10)

- (b) Calculate the output of the following neuron Y if the activation function is a (4)



binary sigmoid.

13. (a) Explain, what might happen in ADAGRAD, where momentum is expressed as $\Delta w_t = -\eta g_t / \sqrt{(\sum_{\tau=1}^t g_\tau^2)}$ where the denominator computes the L2 norm of all previous gradients on a per-dimension basis and η is a global learning rate shared by all dimensions. (6)

- (b) Differentiate gradient descent with and without momentum. Give equations for weight updation in GD with and without momentum. Illustrate plateaus, saddle points and slowly varying gradient. (8)

OR

14. (a) Suppose a supervised learning problem is given to model a deep feed forward neural network. Suggest solutions for the following a) small sized dataset for training b) dataset with unlabeled data c) large data set but data from different distribution. (9)

- (b) Describe the effect in bias and variance when a neural network is modified with more number of hidden units followed with dropout regularization (5)

15. (a) Draw and explain the architecture of Convolutional Neural Networks (8)

- (b) Suppose that a CNN was trained to classify images into different categories. It performed well on a validation set that was taken from the same source as the training set but not on a testing set, which comes from another distribution. What could be the problem with the training of such a CNN? How will you ascertain the problem? How can those problems be solved? (6)

OR

16. (a) What is the motivation behind convolution neural networks? (4)

- (b) Discuss all the variants of the basic convolution function. (10)

17. (a) Describe how an LSTM takes care of the vanishing gradient problem. Use some hypothetical numbers for input and output signals to explain the concept. (8)

- (b) Draw and explain the architecture of Recurrent Neural Networks (6)

OR

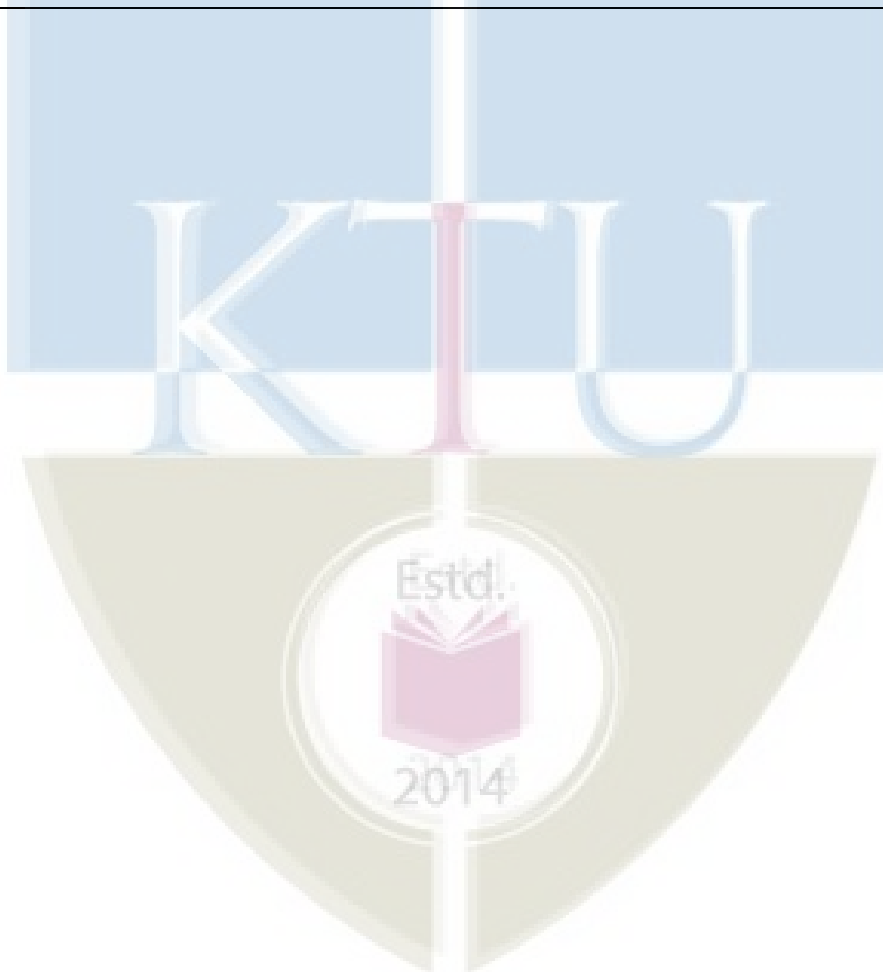
18. (a) Explain the application of LSTM in Natural Language Processing. (8)
- (b) Discuss the architecture of GRU. (6)
19. (a) Explain any two word embedding techniques (8)
- (b) Explain the merits and demerits of using Autoencoders in Computer Vision. (6)
- OR**
20. (a) Illustrate the use of representation learning in object classification. (7)
- (b) Compare Boltzmann Machine with Deep Belief Network. (7)

Teaching Plan

No	Contents	No. of Lecture Hours (36 hrs)
Module-1 (Neural Networks) (7 hours)		
1.1	Introduction to neural networks -Single layer perceptrons	1
1.2	Multi Layer Perceptrons (MLPs), Representation Power of MLPs	1
1.3	Activation functions - Sigmoid, Tanh, ReLU, Softmax. , Risk minimization, Loss function	1
1.4	Training MLPs with backpropagation	1
1.5	Illustration of back propagation algorithm	1
1.6	Practical issues in neural network training - The Problem of Overfitting, Vanishing and exploding gradient problems	1
1.7	Difficulties in convergence, Local and spurious Optima, Computational Challenges.	1
Module-2 (Deep learning) (9 hours)		
2.1	Introduction to deep learning, Deep feed forward network	1
2.2	Training deep models, Concepts of Regularization and optimization,	1

2.3	Gradient Descent (GD), GD with momentum,	1
2.4	Nesterov accelerated GD, Stochastic GD,	1
2.5	AdaGrad, RMSProp, Adam,	1
2.6	L1 and L2 regularization, Early stopping, Dataset augmentation,	1
2.7	Parameter sharing and tying, Injecting noise at input, Ensemble methods	1
2.8	Parameter sharing and tying, Injecting noise at input, Ensemble methods	1
2.9	Dropout, Parameter initialization.	
Module-3 (Convolutional Neural Network) (6 hours)		
3.1	Convolutional Neural Networks – convolution operation	1
3.2	motivation, pooling	1
3.3	Convolution and Pooling as an infinitely strong prior	1
3.4	Variants of convolution functions	1
3.5	structured outputs, data types.	1
3.6	Efficient convolution algorithms.	1
Module- 4 (Recurrent Neural Network) (5 hours)		
4.1	Recurrent neural networks – Computational graphs, RNN design	1
4.2	Encoder – decoder sequence to sequence architectures	1
4.3	Deep recurrent networks, recursive neural networks	1
4.4	Modern RNNs LSTM	1
4.5	GRU	1
Module-5 (Application Areas)(9 hours)		
5.1	Computer vision. (TB1: Section 12.2)	1
5.2	Speech recognition. (TB1: Section 12.3)	1
5.3	Natural language processing. (TB1: Section 12.4)	1
5.4	Common Word Embedding - Continuous Bag-of-Words, Word2Vec (TB3: Section 2.6)	1

5.5	Common Word Embedding - Global Vectors for Word Representation(GloVe) (TB3: Section 2.9.1- Pennigton 2014)	1
5.6	Brief introduction on current research areas - Autoencoders, Representation learning. (TB3: Section 4.10)	1
5.7	Brief introduction on current research areas - representation learning. (TB3: Section 9.3)	1
5.8	Brief introduction on current research areas - Boltzmann Machines, Deep belief networks. (TB1: Section 20.1, TB3 Section 6.3)	1
5.9	Brief introduction on current research areas - Deep belief networks. (TB1: Section 20.3)	1



CST424	PROGRAMMING PARADIGMS	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		PEC	2	1	0	3	2019

Preamble: The course provides the learners a clear understanding of the main constructs of contemporary programming languages and the various systems of ideas that have been used to guide the design of programming languages. This course covers the concepts of Names, Bindings & Scope, Statement-Level Control Structures, Sub Programs, Support for Object Oriented Programming, Exception Handling, Concurrency Control, Functional Programming and Logic Programming. This course helps the learners to equip with the knowledge necessary for the critical evaluation of existing and upcoming programming languages. It also enables the learner to choose the most appropriate language for a given programming task, apply that language's approach to structure or organize the code, classify programming languages based on their features and to design new generation languages.

Prerequisite: Sound knowledge in Programming in C and Object-Oriented Programming.

Mapping of course outcomes with program outcomes

CO1	Explain the criteria for evaluating programming languages and compare Imperative, Functional and Logic programming languages (Cognitive Knowledge Level: Understand)
CO2	Illustrate the characteristics of data types and variables (Cognitive Knowledge Level: Apply)
CO3	Comprehend how control flow structures and subprograms help in developing the structure of a program to solve a computational problem (Cognitive Knowledge Level: Apply)
CO4	Explain the characteristics of Object-Oriented Programming Languages (Cognitive Knowledge Level: Understand)
CO5	Compare concurrency constructs in different programming languages (Cognitive Knowledge Level: Understand)

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

Abstract POs defined by National Board of Accreditation			
PO#	Broad PO	PO#	Broad PO
PO1	Engineering Knowledge	PO7	Environment and Sustainability
PO2	Problem Analysis	PO8	Ethics
PO3	Design/Development of solutions	PO9	Individual and team work
PO4	Conduct investigations of complex problems	PO10	Communication
PO5	Modern tool usage	PO11	Project Management and Finance
PO6	The Engineer and Society	PO12	Life long learning

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination Marks (%)
	Test 1 (%)	Test 2 (%)	
Remember	30	30	30
Understand	40	40	40

Apply	30	30	30
Analyze			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3

Continuous Internal Evaluation Pattern:

Attendance	10 marks
Continuous Assessment Tests (Average of Internal Tests 1 & 2)	25 marks
Continuous Assessment Assignment	15 marks

Internal Examination Pattern

Each of the two internal examinations has to be conducted out of 50 marks. First series test shall be preferably conducted after completing the first half of the syllabus and the second series test shall be preferably conducted after completing the remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the two completed modules and 1 question from the partly completed module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed two modules and 1 question from the partly completed module), each with 7 marks. Out of the 7 questions, a student should answer any 5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 full questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carries 14 marks.

Course Level Assessment Questions

Course Outcome1 (CO1):

1. Compare any three programming languages based on the language evaluation criteria. Prepare a list of characteristics that affect the language evaluation criteria.
2. Identify the advantages and disadvantages of imperative, functional and logic programming languages.

Course Outcome 2 (CO2):

1. Two most important design issues that are specific to character string types are
(1) whether a string is simply a special kind of character array or a primitive type.
(2) whether strings have static or dynamic length.
Identify the implementations options for the above two cases.
2. Consider the following records of a particular language. Let the size of each char variable be 1 byte, int be 4 bytes and and Boolean be 1 bit.

```
Struct Student
{
    int id;
    char name[2];
    int age;
    boolean scholarship;
}
```

Draw and comment on the possible memory layouts for the record for a 32-bit aligned machine

Course Outcome 3(CO3):

1. Explain three situations where a combined counting and logical looping statement is needed.
2. Describe the ways that aliases can occur with pass-by-reference parameters.
3. Identify the two fundamental design considerations for parameter-passing methods.
4. What will be the output of the given program segment if it uses the following parameter passing mechanisms:
a) call by reference
b) call by value

```
x : integer -- global
procedure foo(y : integer)
y := 3
print x
...
```



```
x := 2  
foo(x)  
print x
```

Course Outcome 4 (CO4):

1. Describe the role of a virtual method table in implementing dynamic method binding.
2. Identify the merits and demerits of inheritance.

Course Outcome 5 (CO5):

1. Evaluate the use of semaphores and monitors for providing competition synchronization and cooperation synchronization.

Syllabus

Module – 1

Introduction – Role of Programming Languages, Programming Domains, Language Evaluation Criteria, Influence on Language Design, Language Design Trade-offs, Implementation Methods. Names, Bindings & Scope – Names, Variables, Concept of Binding, Scope and Lifetime, Referencing Environments.

Module - 2

Data Types – Primitive Data Types, Character String Types, User-Defined Ordinal Types, Array Types, Record Types, List Types, Pointer & Reference Types, Type Checking, Strong Typing, Type Equivalence. Expressions – Arithmetic Expressions, Overloaded Operators, Type Conversions, Relational and Boolean Expressions, Short-Circuit Evaluation. Assignment - Assignment Statements, Mixed-mode Assignment.

Module - 3

Statement-Level Control Structures – Selection Statements, Iterative Statements, Unconditional Branching, Guarded Commands. Subprograms – Design Issues of Subprograms, Local Referencing Environments, Parameter Passing Methods, Subprograms as Parameters, Overloaded Subprograms, Closures, Co-routines

Module - 4

Support for Object Oriented Programming – Inheritance, Dynamic Binding, Design Issues for Object Oriented Languages, Support for Object Oriented Programming in C++, Implementation of Object-oriented Constructs. Exception Handling – Basic Concepts, Design Issues.

Module - 5

Concurrency – Subprogram Level Concurrency, Semaphores, Monitors, Message Passing. Functional Programming Languages – Introduction to LISP and Scheme, Comparison of

Functional and Imperative Languages. Logic Programming Languages – Basic Elements of Prolog, Applications of Logic Programming.

Text Books

1. Robert W Sebesta, Concepts of Programming Languages, 10th Edition, Pearson.
2. Scott M L, Programming Language Pragmatics, 3rd Edition, Morgan Kauffman Publishers.

ReferenceBooks

1. Kenneth C. Loudon, Programming Languages: Principles and Practice, 2nd Edition, Cengage Learning.
2. Tucker A. B. and R. E. Noonan, Programming Languages: Principles and Paradigms, 2nd Edition. –TMH.
3. Ravi Sethi, Programming Languages: Concepts & Constructs, 2nd Edition., Pearson Education.
4. David A. Watt, Programming Language Design Concepts, Wiley Dreamtech.

Model Question Paper

QP CODE:

Reg No: _____

Name: _____

PAGES : 4

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

EIGHTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: CST424

Course Name: Programming Paradigms

Max. Marks : 100

Duration: 3 Hours

PART A

Answer All Questions. Each Question Carries 3 Marks

1. Differentiate between readability and writability.
2. Define binding and binding time.
3. What are the advantages of user-defined enumeration types?
4. Define narrowing and widening conversions.
5. Why for statement in C language is more flexible than that of older languages?

6. What are the advantages and disadvantages of dynamic local variables in subprograms?
7. Illustrate the concept of dynamic method binding with an example.
8. Is it mandatory to use constructors in object-oriented languages? Justify your answer.
9. What are the applications of logic programming languages?
10. Explain the working of let and let-rec constructs in Scheme.

(10x3=30)

Part B**(Answer any one question from each module. Each question carries 14 Marks)**

- 11.(a) Explain different criteria used for evaluating languages. (7)
- (b) Consider the following pseudocode: (7)
- ```
x : integer := 3
y : integer := 4
procedure add
 x := x + y
procedure second(P : procedure)
 x : integer := 5
 P()
 procedure first
 y : integer := 6
 second(add)
 first()

write integer(x)
```
- (a) What does this program print if the language uses static scoping? Give reasons.
- (b) What does it print if the language uses dynamic scoping? Give reasons.

**OR**

- 12.(a) With respect to storage binding, explain the meanings, purposes, advantages and disadvantages of four categories of scalar variables. (7)
- (b) What is meant by referencing environment of a statement? Show the (7)

referencing environment at the indicated program points (1), (2), (3) & (4) for the following program segment. Assume that the programming language is statically scoped.

**program example;**

```
var a, b : integer;
procedure sub1;
 var x, y: integer;
 begin { sub1 }
 (1)
 end { sub1 }
procedure sub2;
 var x : integer;

 procedure sub3;
 var x: integer;
 begin { sub3 }
 (2)
 end { sub3 }
 begin { sub2 }
 (3)
 end { sub2 }
begin {example}
 (4)
end {example }
```

13.(a) Explain any two issues associated with the pointer data types and also indicate how dangling pointer problem can be solved. (7)

(b) Describe the lazy and eager approaches for reclaiming garbage. (7)

OR

14.(a) What is meant by side effect and illustrate the advantages of referential transparency? (8)

(b) Explain the terms: compound assignment operator, coercion and short circuit evaluation. (6)

15.(a) Illustrate the different categories of iteration control statements. (8)

(b) Explain the techniques used for identifying the correct referencing environment for a subprogram that was sent as a parameter. (6)

OR

16.(a) Describe the implementation models of Parameter passing. (10)

(b) Differentiate coroutines from conventional subprograms. (4)

17.(a) What is meant by an exception handler? Explain how exceptions are handled in object-oriented languages. (7)

(b) Describe the design issues in object-oriented languages. (7)

OR

18.(a) Illustrate how a virtual method table can be used for implementing dynamic method binding. (7)

(b) Explain the different categories, merits and demerits of inheritance. (7)

19.(a) Compare functional and imperative programming languages. (7)

(b) Explain the role of monitors in concurrency. (7)

OR

20.(a) Explain the searching strategies used in Prolog. Why backward chaining is preferred over forward chaining in Prolog? (10)

(b) **(let ((a 6)** (4)

**(b 8)**

**(square (lambda (x) (\* x x)))**

**(plus +))**

**(sqrt (plus (square a) (square b))))**

Write the output of the above code? Explain how let and lambda construct works?

## Teaching Plan

| No                        | Contents                                                                                                   | No. of Lecture Hours<br>(36 hrs.) |
|---------------------------|------------------------------------------------------------------------------------------------------------|-----------------------------------|
| <b>Module-1 (7 hours)</b> |                                                                                                            |                                   |
| 1.1                       | Introduction: Reasons for studying Concepts of programming languages, Programming Domains                  | 1 hour                            |
| 1.2                       | Language Evaluation Criteria                                                                               | 1 hour                            |
| 1.3                       | Influence on Language Design, Language Design Trade-offs                                                   | 1 hour                            |
| 1.4                       | Implementation Methods                                                                                     | 1 hour                            |
| 1.5                       | Names, Variables                                                                                           | 1 hour                            |
| 1.6                       | Concept of Binding                                                                                         | 1 hour                            |
| 1.7                       | Scope and Lifetime, Referencing Environments                                                               | 1 hour                            |
| <b>Module-2 (7 hours)</b> |                                                                                                            |                                   |
| 2.1                       | Primitive Data Types, Character String Types                                                               | 1 hour                            |
| 2.2                       | User-Defined Ordinal Types, Array Types                                                                    | 1 hour                            |
| 2.3                       | Record Types, List Types, Pointer and Reference Types                                                      | 1 hour                            |
| 2.4                       | Implementation of pointer and reference types, Type Checking, Strong Typing, Type Equivalence              | 1 hour                            |
| 2.5                       | Expressions and Assignment Statements, Arithmetic Expressions                                              | 1 hour                            |
| 2.6                       | Overloaded Operators, Type Conversions                                                                     | 1 hour                            |
| 2.7                       | Relational and Boolean Expressions, Short-Circuit Evaluation, Assignment Statements, Mixed-mode Assignment | 1 hour                            |
| <b>Module-3 (8 hours)</b> |                                                                                                            |                                   |
| 3.1                       | Selection Statements, Iterative Statements                                                                 | 1 hour                            |
| 3.2                       | Unconditional Branching                                                                                    | 1 hour                            |

|                           |                                                   |        |
|---------------------------|---------------------------------------------------|--------|
| 3.3                       | Guarded Commands                                  | 1 hour |
| 3.4                       | Subprograms: Design Issues of Subprograms         | 1 hour |
| 3.5                       | Local Referencing Environments                    | 1 hour |
| 3.6                       | Parameter Passing Methods                         | 1 hour |
| 3.7                       | Subprograms as Parameters, Overloaded Subprograms | 1 hour |
| 3.8                       | Closures, Co-routines                             | 1 hour |
| <b>Module-4 (7 hours)</b> |                                                   |        |
| 4.1                       | Inheritance                                       | 1 hour |
| 4.2                       | Dynamic Binding                                   | 1 hour |
| 4.3                       | Design Issues for Object Oriented Languages       | 1 hour |
| 4.4                       | Support for Object Oriented Programming in C++    | 1 hour |
| 4.5                       | Implementation of Object-Oriented Constructs      | 1 hour |
| 4.6                       | Exception Handling – Basic Concepts               | 1 hour |
| 4.7                       | Exception Handling - Design Issues                | 1 hour |
| <b>Module-5 (7 hours)</b> |                                                   |        |
| 5.1                       | Subprogram Level Concurrency                      | 1 hour |
| 5.2                       | Semaphores, Monitors                              | 1 hour |
| 5.3                       | Message Passing                                   | 1 hour |
| 5.4                       | Introduction to LISP and Scheme                   | 1 hour |
| 5.5                       | Comparison of Functional and Imperative Languages | 1 hour |
| 5.6                       | Basic Elements of Prolog                          | 1 hour |
| 5.7                       | Applications of Logic Programming                 | 1 hour |



|                    |                                                       |                 |          |          |          |               |                                 |
|--------------------|-------------------------------------------------------|-----------------|----------|----------|----------|---------------|---------------------------------|
| <b>CCT<br/>434</b> | <b>STEGANOGRAPHY<br/>AND DIGITAL<br/>WATERMARKING</b> | <b>CATEGORY</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>CREDIT</b> | <b>YEAR OF<br/>INTRODUCTION</b> |
|                    |                                                       | <b>PEC</b>      | <b>2</b> | <b>1</b> | <b>0</b> |               |                                 |

**Preamble:** Study of this course provides the learners a clear understanding of the fundamental concepts of steganography and digital watermarking. The course helps the learners to understand the various weak points and threats faced in watermarking. This course covers the security measures in watermarking and help students to learn about how to perform steganalysis.

**Course Outcomes:** After the completion of the course, the student will be able to

| <b>CO#</b> | <b>Course Outcomes</b>                                                                                                      |
|------------|-----------------------------------------------------------------------------------------------------------------------------|
| <b>CO1</b> | Comprehend the importance and properties of watermarking and steganography<br>(Cognitive knowledge level: Understand)       |
| <b>CO2</b> | Familiarize the different watermarking domains and watermarking models (Cognitive knowledge level: Apply)                   |
| <b>CO3</b> | Explore the different watermarking attacks and tools used in watermarking (Cognitive knowledge level: Understand)           |
| <b>CO4</b> | Summarize the security requirements of watermark and content authentication.<br>(Cognitive knowledge level: Understand)     |
| <b>CO5</b> | Explore the different types of steganography and algorithms used to perform steganalysis.(Cognitive knowledge level: Apply) |



## Mapping of course outcomes with program outcomes

|     | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | P10 | P11 | P12 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| CO1 | ✓   | ✓   | ✓   |     |     |     |     |     |     |     |     | ✓   |
| CO2 | ✓   | ✓   | ✓   |     | ✓   |     |     |     |     |     |     | ✓   |
| CO3 | ✓   | ✓   | ✓   |     | ✓   |     |     |     |     |     |     | ✓   |
| CO4 | ✓   | ✓   | ✓   |     |     |     |     |     |     |     |     | ✓   |
| CO5 | ✓   | ✓   | ✓   |     | ✓   |     |     |     |     |     |     | ✓   |

| Abstract POs defined by National Board of Accreditation |                                            |      |                                |
|---------------------------------------------------------|--------------------------------------------|------|--------------------------------|
| PO#                                                     | Broad PO                                   | PO#  | Broad PO                       |
| PO1                                                     | Engineering Knowledge                      | PO7  | Environment and Sustainability |
| PO2                                                     | Problem Analysis                           | PO8  | Ethics                         |
| PO3                                                     | Design/Development of solutions            | PO9  | Individual and teamwork        |
| PO4                                                     | Conduct investigations of complex problems | PO10 | Communication                  |
| PO5                                                     | Modern tool usage                          | PO11 | Project Management and Finance |
| PO6                                                     | The Engineer and Society                   | PO12 | Lifelong learning              |

| Assessment Pattern<br>Bloom's Category | Test 1 (Marks in<br>percentage) | Test 2 (Marks in<br>percentage) | End Semester<br>Examination (Marks<br>in percentage) |
|----------------------------------------|---------------------------------|---------------------------------|------------------------------------------------------|
| Remember                               | 40                              | 40                              | 40                                                   |
| Understand                             | 40                              | 40                              | 40                                                   |
| Apply                                  | 20                              | 20                              | 20                                                   |
| Analyze                                |                                 |                                 |                                                      |
| Evaluate                               |                                 |                                 |                                                      |
| Create                                 |                                 |                                 |                                                      |

### Mark Distribution

| Total Marks | CIE Marks | ESE Marks | ESE Duration |
|-------------|-----------|-----------|--------------|
| 150         | 50        | 100       | 3            |

### Continuous Internal Evaluation Pattern:

Attendance : 10 marks

Continuous Assessment Test : 25 marks

Continuous Assessment Assignment : 15 marks

**Internal Examination Pattern:** Each of the two internal examinations has to be conducted out of 50 marks. The first series test shall be preferably conducted after completing the first half of the syllabus. The second series test shall be preferably conducted after completing the remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly completed module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly completed module), each with 7 marks. Out of the 7 questions, a student should answer any 5.

**End Semester Examination Pattern:** There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which a student should answer anyone. Each question can have maximum 2 sub-divisions and carries 14 marks.

## Syllabus

### Module 1(Introduction)

Introduction, Information Hiding, Steganography and Watermarking, Importance of digital watermarking, Importance of steganography, Differences between watermarking and Steganography, Applications of watermarking, Properties of watermarking system, Evaluating Watermarking systems, Classification in Digital watermarking-based on characteristics, classification based on Applications

### Module 2(Models of Watermarking)

Models of watermarking-Notation, Communications, Communication based models of watermarking, Geometric models of watermarking-Distributions and Regions in Media Space, Marking Spaces, Spatial domain watermarking, Frequency domain watermarking  
Watermarking using side Information-Formal definition of the problem, Signal and Channel Models, Optimal Watermarking for a Single Cover Work, Optimal Coding for Multiple Cover Works, Understanding Shannon's Theorem.

### Module 3(Watermarking Attacks)

Watermarking attacks and tools: Image processing attacks-Attack by filtering, attack by remodulation, attack by JPEG coding distortion, attack by JPEG 2000 compression Geometric attacks-attack by image scaling, attack by rotation, attack by image clipping, attack by linear transformation, attack by collage, attack by template, cryptographic attacks, protocol attack, Watermarking tools

### Module 4(Watermark Security)

Watermark Security - Security Requirements, Restricting Watermark Operations, Public and Private Watermarking, Watermark Security and Cryptography-The Analogy between Watermarking and Cryptography, Preventing Unauthorized Detection, Preventing Unauthorized Embedding, Preventing Unauthorized Removal, Content Authentication- Exact Authentication, Selective Authentication , Localization, Restoration

### Module 5(Steganography and Steganalysis)

Steganography and Steganalysis: Types of steganography-technical steganography, Linguistic steganography, Digital steganography, Applications of steganography-covert communication, one time pad communication, Steganographic tools-S-Tools, StegoDos, EzStego, JSteg-Jpeg, Significant Steganalysis Algorithms-LSB Embedding and the Histogram Attack, Sample Pairs Analysis, Properties of Steganographic and Steganalysis System

**Textbooks**

1. Frank Y. Shih ,“Digital Watermarking and Steganography Fundamentals and Techniques” Taylor & Francis Group, LLC, Second Edition , 2017
2. Ingemar J. Cox, Matthew L. Miller, Jeffrey A. Bloom, Jessica Fridrich, Ton Kalker “Digital Watermarking and Steganography”, Elsevier Inc, Second Edition, 2008

**References**

1. David Meg'ias, Wojciech Mazurczyk , Minoru Kuribayashi “Data Hiding and Its Applications: Digital Watermarking and Steganography” MDPI AG, 10 November 2021
2. Muhammad Nuh Al-Azhar “Steganography Forensic: Metadata Analysis for Steganography Detection”, LAMBERT Academic Publishing, 2016

**Sample Course Level Assessment Questions**

**Course Outcome 1 (CO1):** Explain the properties of watermarking and steganography.

**Course Outcome 2 (CO2):** Illustrate the importance of spatial and frequency domain watermarking.

**Course Outcome 3 (CO3):** Describe the different attacks in watermarking.

**Course Outcome 4 (CO4):** How to prevent unauthorized detection and unauthorized embedding in watermark security.

**Course Outcome 5 (CO5):** Illustrate the working of any three steganographic tools with suitable examples.

**Model Question Paper****QP CODE:****Reg No:** \_\_\_\_\_**Name :** \_\_\_\_\_**PAGES : 3****APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY****EIGHTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR****Course Code: CCT 434****Course Name: STEGANOGRAPHY AND DIGITAL WATERMARKING****Max.Marks:100****Duration: 3 Hours****PART A****Answer all Questions. Each question carries 3 Marks**

1. Differentiate between watermarking and steganography.
2. Describe any three applications of watermarking.
3. What are the different notations used in watermarking models?
4. Illustrate the working of any one communication model of watermarking.
5. Differentiate between attack by filtering and attack by remodulation.
6. What are sensitivity analysis attacks?
7. Compare and contrast watermarking and cryptography.
8. How is content authentication performed in watermarking?
9. What are the differences between technical and linguistic steganography?
10. Differentiate between covert communication and one time pad communication.

**PART B****Answer any one Question from each module.****Each question carries 14 Marks**

11. a) Explain the classification of digital watermarking based on characteristics.

**(8)**

- b) How are watermarking systems evaluated?

**(6)****OR**

12. a) Explain (i) copyright protection  
 (ii) Data Authentication  
 (iii) Copy control  
 (iv) Device control (8)  
 b) Why digital watermarking is considered as important? (6)

13. a) Differentiate optimal watermarking for a Single Cover Work and optimal coding for Multiple Cover Works. (8)  
 b) State and explain Shannon's Theorem (6)

**OR**

14. a) Compare substitutive watermarking and additive watermarking in spatial domain. (8)  
 b) Explain the basic model of watermarking with figure. (6)
15. a) Describe any three watermarking attacks. Explain any three watermarking tools. (8)  
 b) Differentiate between cryptographic attacks and protocol attacks. (6)

**OR**

16. a) Explain briefly the geometric attacks of watermarking (8)  
 b) Describe (i) Gradient Descent Attacks  
 (ii) Pathological Distortions  
 (iii) Attack by JPEG 2000 compression (6)
17. a) How localization and restoration are performed in the context of content authentication? (8)  
 b) How to prevent unauthorized Detection and unauthorized Embedding (6)

**OR**

18. a) Explain the security requirements to be considered in watermark security. (8)  
 b) Differentiate Public and private Watermarking with examples. (6)
19. a) Explain different types of steganography (8)  
 b) Illustrate the use of any three steganographic tools. (6)

**OR**

20. a) Illustrate any two steganalysis algorithms with examples. (8)  
 b) Explain the different properties of steganographic systems (6)

## TEACHING PLAN

| No.                                               | Contents                                                                                              | No of Lecture Hrs (37) |
|---------------------------------------------------|-------------------------------------------------------------------------------------------------------|------------------------|
| <b>Module 1(Introduction) (7 hrs)</b>             |                                                                                                       |                        |
| 1.1                                               | Introduction, Information Hiding                                                                      | 1 hour                 |
| 1.2                                               | Steganography and Watermarking                                                                        | 1 hour                 |
| 1.3                                               | Importance of digital watermarking, Importance of Steganography                                       | 1 hour                 |
| 1.4                                               | Differences between watermarking and Steganography                                                    | 1 hour                 |
| 1.5                                               | Applications of watermarking, Properties of watermarking system                                       | 1 hour                 |
| 1.6                                               | Evaluating Watermarking systems                                                                       | 1 hour                 |
| 1.7                                               | Classification in Digital watermarking-based on characteristics ,classification based on Applications | 1 hour                 |
| <b>Module 2 (Models of Watermarking) (10 hrs)</b> |                                                                                                       |                        |
| 2.1                                               | Models of Watermarking-Notation                                                                       | 1 hour                 |
| 2.2                                               | Communications, Communication based models of Watermarking                                            | 1 hour                 |
| 2.3                                               | Geometric models of watermarking                                                                      | 1 hour                 |
| 2.4                                               | Distributions and Regions in Media Space                                                              | 1 hour                 |
| 2.5                                               | Marking Spaces                                                                                        | 1 hour                 |
| 2.6                                               | Spatial domain watermarking, Frequency domain watermarking                                            | 1 hour                 |
| 2.7                                               | Watermarking using side Information-Formal definition of the problem                                  | 1 hour                 |
| 2.8                                               | Signal and Channel Models                                                                             | 1 hour                 |

|                                                          |                                                                                                   |        |
|----------------------------------------------------------|---------------------------------------------------------------------------------------------------|--------|
| 2.9                                                      | Optimal Watermarking for a Single Cover Work                                                      | 1 hour |
| 2.10                                                     | Optimal Coding for Multiple Cover Works, Understanding Shannon's Theorem                          | 1 hour |
| <b>Module 3(Watermarking Attacks) (7 hrs)</b>            |                                                                                                   |        |
| 3.1                                                      | Watermarking attacks and tools: Image processing attacks                                          | 1 hour |
| 3.2                                                      | Attack by filtering, attack by remodulation, attack by JPEG coding distortion                     | 1 hour |
| 3.3                                                      | Attack by JPEG 2000 compression Geometric attacks-attack by image scaling, attack by rotation     | 1 hour |
| 3.4                                                      | Attack by image clipping, attack by linear transformation                                         | 1 hour |
| 3.5                                                      | Attack by collage, attack by template, cryptographic attacks, protocol attack, Watermarking tools | 1 hour |
| 3.6                                                      | Scrambling Attacks, Pathological Distortions, Copy Attacks                                        | 1 hour |
| 3.7                                                      | Ambiguity Attacks, Sensitivity Analysis Attacks, Gradient Descent Attacks                         | 1 hour |
| <b>Module 4(Watermark Security) (6 hrs)</b>              |                                                                                                   |        |
| 4.1                                                      | Watermark Security - Security Requirements                                                        | 1 hour |
| 4.2                                                      | Restricting Watermark Operations, Public and Private Watermarking                                 | 1 hour |
| 4.3                                                      | Watermark Security and Cryptography-The Analogy between Watermarking and Cryptography             | 1 hour |
| 4.4                                                      | Preventing Unauthorized Detection, Preventing Unauthorized Embedding                              | 1 hour |
| 4.5                                                      | Preventing Unauthorized Removal, Content Authentication- Exact Authentication                     | 1 hour |
| 4.6                                                      | Content Authentication-Selective Authentication , Localization, Restoration                       | 1 hour |
| <b>Module 5 (Steganography and Steganalysis) (6 hrs)</b> |                                                                                                   |        |



|     |                                                                                                   |        |
|-----|---------------------------------------------------------------------------------------------------|--------|
| 5.1 | Steganography and Steganalysis: Types of steganography-technical steganography                    | 1 hour |
| 5.2 | Linguistic steganography, Digital steganography                                                   | 1 hour |
| 5.3 | Applications of steganography-covert communication, one time pad communication                    | 1 hour |
| 5.4 | Steganographic tools-S-Tools, StegoDos, EzStego, JSteg-Jpeg                                       | 1 hour |
| 5.5 | Significant Steganalysis Algorithms-LSB Embedding and the Histogram Attack, Sample Pairs Analysis | 1 hour |
| 5.6 | Properties of Steganographic and Steganalysis Systems                                             | 1 hour |



| CST444 | SOFT COMPUTING | CATEGORY | L | T | P | CREDIT | YEAR OF INTRODUCTION |
|--------|----------------|----------|---|---|---|--------|----------------------|
|        |                | PEC      | 2 | 1 | 0 | 3      | 2019                 |

**Preamble:** This course enables the learners to understand the concepts of Soft Computing techniques and its applications. It covers Artificial Neural Networks, operations and models of fuzzy logic, genetic algorithms and multi objective optimization techniques. This course helps the students to develop algorithms and solutions for different real world applications.

**Prerequisite:** NIL.

#### Mapping of course outcomes with program outcomes

|     |                                                                                                                                                              |
|-----|--------------------------------------------------------------------------------------------------------------------------------------------------------------|
| CO1 | Describe soft computing techniques and the basic models of Artificial Neural Network (Cognitive Knowledge Level: Understand)                                 |
| CO2 | Solve practical problems using neural networks (Cognitive Knowledge Level: Apply)                                                                            |
| CO3 | Illustrate the operations, model and applications of fuzzy logic (Cognitive Knowledge Level: Apply)                                                          |
| CO4 | Illustrate the concepts of Genetic Algorithm (Cognitive Knowledge Level: Apply)                                                                              |
| CO5 | Describe the concepts of multi-objective optimization models and the need for using hybrid soft computing approaches (Cognitive Knowledge Level: Understand) |

#### Mapping of course outcomes with program outcomes

|     | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|
| CO1 |     |     |     |     |     |     |     |     |     |      |      |      |
| CO2 |     |     |     |     |     |     |     |     |     |      |      |      |
| CO3 |     |     |     |     |     |     |     |     |     |      |      |      |
| CO4 |     |     |     |     |     |     |     |     |     |      |      |      |
| CO5 |     |     |     |     |     |     |     |     |     |      |      |      |

| Abstract POs defined by National Board of Accreditation |                                            |      |                                |
|---------------------------------------------------------|--------------------------------------------|------|--------------------------------|
| PO#                                                     | Broad PO                                   | PO#  | Broad PO                       |
| PO1                                                     | Engineering Knowledge                      | PO7  | Environment and Sustainability |
| PO2                                                     | Problem Analysis                           | PO8  | Ethics                         |
| PO3                                                     | Design/Development of solutions            | PO9  | Individual and team work       |
| PO4                                                     | Conduct investigations of complex problems | PO10 | Communication                  |
| PO5                                                     | Modern tool usage                          | PO11 | Project Management and Finance |
| PO6                                                     | The Engineer and Society                   | PO12 | Life long learning             |

### Assessment Pattern

| Bloom's Category | Continuous Assessment Tests |            | End Semester Examination Marks (%) |
|------------------|-----------------------------|------------|------------------------------------|
|                  | Test 1 (%)                  | Test 2 (%) |                                    |
| Remember         | 30                          | 30         | 30                                 |
| Understand       | 30                          | 30         | 30                                 |
| Apply            | 40                          | 40         | 40                                 |
| Analyze          |                             |            |                                    |
| Evaluate         |                             |            |                                    |
| Create           |                             |            |                                    |

### Mark Distribution

| Total Marks | CIE Marks | ESE Marks | ESE Duration |
|-------------|-----------|-----------|--------------|
| 150         | 50        | 100       | 3            |

**Continuous Internal Evaluation Pattern:**

|                                                              |          |
|--------------------------------------------------------------|----------|
| Attendance                                                   | 10 marks |
| Continuous Assessment Tests(Average of Internal Tests 1 & 2) | 25 marks |
| Continuous Assessment Assignment                             | 15 marks |

**Internal Examination Pattern**

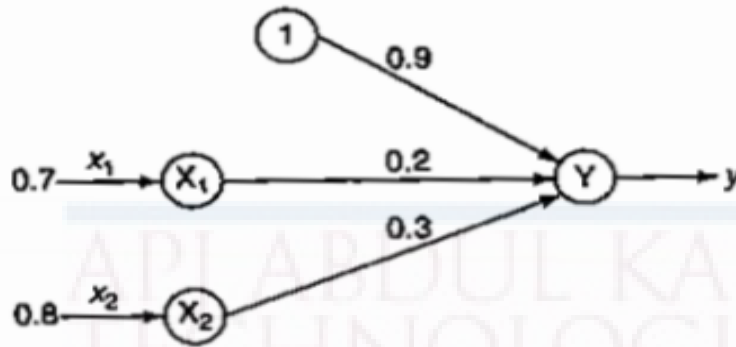
Each of the two internal examinations has to be conducted out of 50 marks. First series test shall be preferably conducted after completing the first half of the syllabus and the second series test shall be preferably conducted after completing remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly completed module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly completed module), each with 7 marks. Out of the 7 questions, a student should answer any 5.

**End Semester Examination Pattern:**

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 full questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carries 14 marks.

**Course Level Assessment Questions****Course Outcome 1 (CO1):**

1. Describe the necessity of Activation function? Examine the various aspects of sigmoidal activation function. List the drawbacks. Calculate the net output of the following neural network using the bipolar and binary sigmoidal activation function.



2. Explain the architecture of McCulloch-Pitts Neuron network model. Implement NAND(NOT-AND) gate function using M-P Neuron Model(with binary input).

### Course Outcome 2(CO2):

1. Find the weights required to perform classification of patterns shown below using perceptron network. The patterns (1,1,-1) and ( 1, -1,-1) are belonging to the target class -1. The patterns (-1,1,1) and (-1,-1,1) are belonging to the target class +1. Assume suitable learning rate and initial weights.
2. Explain the architecture and training algorithm of Adaline network . Use Adaline network to train NOR logic function with bipolar inputs and targets. Perform 2 epochs of training.

### Course Outcome 3(CO3):

1. There is an imprecise relationship between the ambient temperature for clay masonry bricks and their compressive strengths. Let X be a fuzzy set of fracture strengths and Y be a fuzzy set of temperatures with the following membership functions:

$$X = \left\{ \frac{1.0}{1500} + \frac{0.8}{2175} + \frac{0.6}{7000} + \frac{0.5}{12750} + \frac{0.3}{16500} + \frac{0.1}{20000} \right\}$$

$$Y = \left\{ \frac{0.2}{20} + \frac{0.4}{25} + \frac{0.5}{32} + \frac{1.0}{50} + \frac{0.6}{90} + \frac{0.3}{105} \right\}$$

- (a) Find the Cartesian Product of X and Y and represent it as relation R.  
Suppose there is a second fuzzy set of masonry lengths given as

$$Z = \left\{ \frac{0.4}{1500} + \frac{0.5}{2175} + \frac{0.6}{7000} + \frac{0.8}{12750} + \frac{0.9}{16500} + \frac{1.0}{20000} \right\}$$

- (b) Find  $S = Z \circ R$  using max-min composition (c) Find  $T = Z \circ R$  using max-product composition

2. Given two universes  $X=\{x_1, x_2, x_3, x_4, x_5\}$  and  $Y=\{y_1, y_2, y_3, y_4, y_5\}$ , the fuzzy sets A defined on X and fuzzy set B defined on Y are given below:

$$A = \left\{ \frac{0.4}{x_1} + \frac{0.7}{x_2} + \frac{1}{x_3} + \frac{0.8}{x_4} + \frac{0.6}{x_5} \right\} \quad B = \left\{ \frac{0.2}{y_1} + \frac{0.6}{y_2} + \frac{1}{y_3} + \frac{0.9}{y_4} + \frac{0.7}{y_5} \right\}$$

(i) Find the relation  $R = A \times B$

Consider another fuzzy set C defined on the universe  $V=\{v_1, v_2, v_3\}$ ,  $C = \left\{ \frac{0.4}{v_1} + \frac{1}{v_2} + \frac{0.8}{v_3} \right\}$

(ii) Find  $P = B \times C$ . Using max-min composition, Find  $R \circ P$ .

#### Course Outcome 4(CO4):

1. Illustrate the various types of cross over with suitable examples.
2. Using Genetic algorithm with Roulette wheel selection method maximize the function  $f(x)=x^2$  over  $\{0, 1, 2, \dots, 31\}$  with initial x values of (13, 24, 8, 19). Show one crossover and mutation.

#### Course Outcome 5(CO5):

1. Explain strong dominance and weak pareto-optimality.
2. What are the different classifications of neuro-fuzzy hybrid systems?

### Syllabus

#### Module – 1 (Introduction to Soft Computing & Artificial Neural Network)

Introduction to Soft Computing. Difference between Hard Computing & Soft Computing. Applications of Soft Computing. Artificial Neurons Vs Biological Neurons. Basic models of artificial neural networks – Connections, Learning, Activation Functions. McCulloch and Pitts Neuron. Hebb network.

#### Module – 2 (Supervised Learning Network)

Perceptron Networks– Learning rule, Training and testing algorithm. Adaptive Linear Neuron– Architecture, Training and testing algorithm. Back propagation Network – Architecture, Training and testing algorithm.

#### Module - 3 (Fuzzy Logic & Defuzzification)

Fuzzy sets – properties, operations on fuzzy set. Fuzzy membership functions, Methods of membership value assignments – intuition, inference, Rank Ordering. Fuzzy relations– operations on fuzzy relation. Fuzzy Propositions. Fuzzy implications. Defuzzification– Lamda cuts, Defuzzification methods.



**Module - 4 (Fuzzy Inference System & Genetic Algorithm)**

Fuzzy Inference Systems - Mamdani and Sugeno types. Fuzzy Logic Controller. Concepts of genetic algorithm. Operators in genetic algorithm - coding, selection, cross over, mutation. Stopping condition for genetic algorithm.

**Module - 5 (Multi Objective Optimization & Hybrid Systems)**

Multi objective optimization problem. Principles of Multi- objective optimization, Dominance and pareto-optimality. Optimality conditions. Neuro-fuzzy hybrid systems. Genetic – neuro hybrid systems.

**Text Books**

1. S.N.Sivanandam and S.N. Deepa, Principles of Soft Computing , 2<sup>nd</sup> Edition, John Wiley & Sons.
2. Kalyanmoy Deb, Multi-objective Optimization using Evolutionary Algorithms, 1<sup>st</sup> Edition, John Wiley & Sons.

**Reference Books**

1. Timothy J Ross, Fuzzy Logic with Engineering Applications, John Wiley & Sons, 2016.
2. T.S.Rajasekaran, G.A.Vijayalakshmi Pai “Neural Networks, Fuzzy Logic & Genetic Algorithms Synthesis and Applications”, Prentice-Hall India.
3. Simon Haykin, “Neural Networks- A Comprehensive Foundation”, 2/e, Pearson Education.
4. Zimmermann H. J, “Fuzzy Set Theory & Its Applications”, Allied Publishers Ltd.

**Model Question Paper**

**QP CODE:**

**Reg No:** \_\_\_\_\_

**Name:** \_\_\_\_\_

**PAGES : 4**

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY**

**EIGHTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR**

**Course Code: CST 444**

**Course Name: Soft Computing**

**Max. Marks : 100**

**Duration: 3 Hours**

**PART A**

**Answer All Questions. Each Question Carries 3 Marks**

1. Explain the architecture of a simple Artificial Neural network? Compare it with a biological neuron.
2. A 4-input neuron has weights 1, 2, 3 and 4. The transfer function is linear with the constant of proportionality being equal to 2. The inputs are 4, 10, 5 and 20 respectively. Predict the output?
3. Explain the Widrow-Hoff learning rule for supervised learning in neural networks with help of an example. Why is it sometimes called the LMS learning rule?
4. Implement one epoch of Adaline algorithm for AND logic function with binary inputs and bipolar outputs. Initial weights are  $w_1=0.2$ ,  $w_2=0.1$  and learning rate parameter  $\eta=0.2$ .
5. Consider two fuzzy sets  $A = \left\{ \frac{0.2}{0} + \frac{0.3}{1} + \frac{1}{2} + \frac{0.1}{3} + \frac{0.5}{4} \right\}$   $B = \left\{ \frac{0.1}{0} + \frac{0.25}{1} + \frac{0.9}{2} + \frac{0.7}{3} + \frac{0.3}{4} \right\}$  Find the following: (a) Algebraic sum (b) Algebraic product (c) Bounded sum.
6. Using your own intuition and definition of universe of discourse, plot membership



functions for liquid level (Empty, very less, less, full, very full) in a tank.

7. Explain Stochastic Universal Sampling with an example.
8. Explain any two mutation methods.
9. Differentiate between linear and nonlinear Multi Objective Optimization Problem.
10. What are the characteristics of neuro fuzzy hybrid systems?

(10x3=30)

### Part B

(Answer any one question from each module. Each question carries 14 Marks)

11. (a) Implement XOR function using M-P Neuron Model (with binary input). Why M-P neuron is widely used in processing binary data? (8)

- (b) Using Hebb Network calculate the weight required to perform the following classification of given input pattern. (6)

L  $\square$  belongs to the members of the class(+)  $\square$  target value +1

U  $\square$  does not belongs to members of class(.)  $\square$  target value -1

|   |   |   |
|---|---|---|
| + | . | . |
| + | . | . |
| + | + | + |

L

|   |   |   |
|---|---|---|
| + | . | + |
| + | . | + |
| + | + | + |

U

OR

12. (a) Compare the three learning approaches in Artificial Neural Network. How is the critic information used in learning process. (8)
- (b) Define Hebb Law. Design a Hebb Network to implement logical AND function. Use bipolar input and targets. (7)

13. (a) Discuss the training algorithm and explain the weight updates in back propagation networks. (10)

(b) Implement one epoch of Perceptron training algorithm for OR logic function with binary input and bipolar output. (4)

OR

14. (a) Explain how synaptic weights are adapted iteration by iteration using error correction rule in Perceptron convergence algorithm for an OR gate with bipolar inputs and outputs. Initial weights are all zero and learning rate parameter  $\eta=0.1$ . (10)

(b) Explain Perceptron convergence theorem and discuss Perceptron algorithm based on XOR logic function. (4)

15. (a) Three fuzzy sets are defined as follows: (10)

$$A = \left\{ \frac{0.1}{30} + \frac{0.2}{60} + \frac{0.3}{90} + \frac{0.4}{120} \right\}, B = \left\{ \frac{1}{1} + \frac{0.2}{2} + \frac{0.5}{3} + \frac{0.7}{4} + \frac{0.3}{5} + \frac{0}{6} \right\},$$

$$C = \left\{ \frac{0.33}{100} + \frac{0.65}{200} + \frac{0.92}{300} + \frac{0.21}{400} \right\}$$

Find: (i)  $R = A \times B$  (ii)  $S = B \times C$  (iii)  $T = RoS$ , using Max-Min composition  
(iv)  $T = RoS$ , using Max-Product composition.

(b) For the fuzzy sets given  $A = \left\{ \frac{0.5}{x_1} + \frac{0.2}{x_2} + \frac{0.9}{x_3} \right\}$  and  $B = \left\{ \frac{1}{y_1} + \frac{0.5}{y_2} + \frac{1}{y_3} \right\}$ . Find relation R by performing Cartesian product over the given fuzzy sets. (4)

OR

16. (a) Using inference approach, find the membership values for each of the triangular shapes (I, R, IR, T) for a triangle with angles  $120^\circ$ ,  $50^\circ$ ,  $10^\circ$ . (8)

(b) Using Zadeh's notation, determine the  $\lambda$  - cut sets for the given fuzzy sets: (6)

$$S_1 = \left\{ \frac{0}{0} + \frac{0.5}{20} + \frac{0.65}{40} + \frac{0.85}{60} + \frac{1.0}{80} + \frac{1.0}{100} \right\}$$

$$S_2 = \left\{ \frac{0}{0} + \frac{0.45}{20} + \frac{0.6}{40} + \frac{0.8}{60} + \frac{0.95}{80} + \frac{1.0}{100} \right\}$$

Express the following for  $\lambda = 0.5$ : a)  $S_1 \cup S_2$     b)  $S_2'$     c)  $S_1 \hat{\cap} S_2$

17. (a) Differentiate between value encoding and permutation encoding. (8)

(b) Explain the stopping conditions for genetic algorithm. (6)

OR

18. (a) Apply Mamdani fuzzy model to design a controller to determine the wash time of a domestic washing machine. Assume input is dirt and grease of the cloth. Use three descriptors for input variable and five descriptors for output variables. Derive the set of rules for controller action and defuzzification. Design should be supported by figure wherever possible. (10)

(b) Explain Single-Point Crossover and Two-Point Crossover with example. (4)

19. (a) Explain convex and non convex MOOP? How to find a non dominated set. (10)

(b) What are the properties of dominance relation? (4)

OR

20. (a) Explain Genetic Neuro-Hybrid System with block diagram. Also write the advantages of Genetic- Neuro Hybrid systems. (8)

(b) Discuss the classification of Neuro-Fuzzy Hybrid System. (6)

**Teaching Plan**

| No                                                                                         | Contents                                                                             | No. of Lecture Hours<br>(35 hrs) |
|--------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|----------------------------------|
| <b>Module-1 (Introduction to Soft Computing &amp; Artificial Neural Network) (6 hours)</b> |                                                                                      |                                  |
| 1.1                                                                                        | Introduction to Soft Computing                                                       | 1 hour                           |
| 1.2                                                                                        | Difference between Hard Computing & Soft Computing & Applications of Soft Computing  | 1 hour                           |
| 1.3                                                                                        | Artificial Neurons Vs Biological Neurons, Basic models of artificial neural networks | 1 hour                           |
| 1.4                                                                                        | Activation Functions                                                                 | 1 hour                           |
| 1.5                                                                                        | McCulloch and Pitts Neuron                                                           | 1 hour                           |
| 1.6                                                                                        | Hebb network                                                                         | 1 hour                           |
| <b>Module-2 (Supervised Learning Network) (7 hours)</b>                                    |                                                                                      |                                  |
| 2.1                                                                                        | Perceptron networks – Learning rule, Training and testing algorithm                  | 1 hour                           |
| 2.2                                                                                        | Perceptron networks – Problems                                                       | 1 hour                           |
| 2.3                                                                                        | Adaptive Linear Neuron (Lecture I)                                                   | 1 hour                           |
| 2.4                                                                                        | Adaptive Linear Neuron (Lecture II)                                                  | 1 hour                           |
| 2.5                                                                                        | Adaptive Linear Neuron-Problems (Lecture III)                                        | 1 hour                           |
| 2.6                                                                                        | Back propagation Network (Lecture I)                                                 | 1 hour                           |
| 2.7                                                                                        | Back propagation Network (Lecture II)                                                | 1 hour                           |
| <b>Module-3 (Fuzzy Logic &amp; Defuzzification) (8 hours)</b>                              |                                                                                      |                                  |
| 3.1                                                                                        | Introduction to Fuzzy Set, Properties & operations on fuzzy sets                     | 1 hour                           |
| 3.2                                                                                        | Fuzzy membership functions, Fuzzification                                            | 1 hour                           |
| 3.3                                                                                        | Methods of membership value assignments                                              | 1 hour                           |
| 3.4                                                                                        | Fuzzy relations, Operations on Fuzzy Relation                                        | 1 hour                           |

|                                                                              |                                                                            |        |
|------------------------------------------------------------------------------|----------------------------------------------------------------------------|--------|
| 3.5                                                                          | Fuzzy Propositions & Fuzzy Implications                                    | 1 hour |
| 3.6                                                                          | Lamda cuts for fuzzy sets                                                  | 1 hour |
| 3.7                                                                          | Defuzzification methods(Lecture I)                                         | 1 hour |
| 3.8                                                                          | Defuzzification methods(Lecture II)                                        | 1 hour |
| <b>Module-4 (Fuzzy Inference System &amp; Genetic Algorithm) (6 hours)</b>   |                                                                            |        |
| 4.1                                                                          | Fuzzy Inference Systems - Mamdani type                                     | 1 hour |
| 4.2                                                                          | Fuzzy Inference Systems - Sugeno type                                      | 1 hour |
| 4.3                                                                          | Fuzzy Logic Controller                                                     | 1 hour |
| 4.4                                                                          | Introduction to genetic algorithm, operators in genetic algorithm - coding | 1 hour |
| 4.5                                                                          | Selection, Cross over                                                      | 1 hour |
| 4.6                                                                          | Mutation, stopping condition for genetic algorithm                         | 1 hour |
| <b>Module-5 (Multi-Objective Optimization &amp; Hybrid System) (8 hours)</b> |                                                                            |        |
| 5.1                                                                          | MOOP-Linear & Non linear, Convex & Non Convex                              | 1 hour |
| 5.2                                                                          | Principles of MOO-Illustrating Pareto Optimal Solutions, Objectives in MOO | 1 hour |
| 5.3                                                                          | Dominance & Pareto-Optimality-Concept of Domination                        | 1 hour |
| 5.4                                                                          | Properties of Dominance Relation, Pareto Optimality                        | 1 hour |
| 5.5                                                                          | Procedure for finding a non dominated set                                  | 1 hour |
| 5.6                                                                          | Optimality Conditions                                                      | 1 hour |
| 5.7                                                                          | Neuro Fuzzy hybrid system-Classification& characteristics                  | 1 hour |
| 5.8                                                                          | Genetic –neuro hybrid systems                                              | 1 hour |

| CST454 | FUZZY SET THEORY<br>AND APPLICATIONS | CATEGORY | L | T | P | CREDIT | YEAR OF<br>INTRODUCTION |
|--------|--------------------------------------|----------|---|---|---|--------|-------------------------|
|        |                                      | PEC      | 2 | 1 | 0 | 3      | 2019                    |

**Preamble:** This course equips the students to understand the concepts of fuzziness and its use in building better solutions to problems. The course covers basic concepts of fuzzy sets, fuzzy relations, fuzzy logic and building of fuzzy approximation-based solutions. It helps students to design and develop fuzzy based solutions to real world applications.

**Prerequisite:** Basic knowledge in set theory.

**Course Outcomes:** After the completion of the course, the student will be able to

|     |                                                                                                                                                                |
|-----|----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| CO1 | Explain fuzzy logic based problem solving ( <b>Cognitive Knowledge Level: Understand</b> )                                                                     |
| CO2 | Summarize the concepts of crisp sets, crisp relations, crisp logic with fuzzy sets, fuzzy relations and fuzzy logic( <b>Cognitive Knowledge Level: Apply</b> ) |
| CO3 | Develop fuzzy systems by selecting appropriate membership functions, fuzzification and defuzzification methods ( <b>Cognitive Knowledge Level: Apply</b> )     |
| CO4 | Develop solutions using graphical and rule-based methods( <b>Cognitive Knowledge Level: Apply</b> )                                                            |
| CO5 | Make use of fuzzy logic inference to solve real world problems( <b>Cognitive Knowledge Level: Apply</b> )                                                      |

**Mapping of course outcomes with program outcomes**

|     | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|
| CO1 |     |     |     |     |     |     |     |     |     |      |      |      |
| CO2 |     |     |     |     |     |     |     |     |     |      |      |      |
| CO3 |     |     |     |     |     |     |     |     |     |      |      |      |
| CO4 |     |     |     |     |     |     |     |     |     |      |      |      |

|     |                                                                                   |                                                                                   |  |                                                                                   |                                                                                   |  |  |  |  |  |                                                                                     |
|-----|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|--|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|--|--|--|--|--|-------------------------------------------------------------------------------------|
| CO5 |  |  |  |  |  |  |  |  |  |  |  |
|-----|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|--|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|--|--|--|--|--|-------------------------------------------------------------------------------------|

| Abstract POs defined by National Board of Accreditation |                                            |      |                                |
|---------------------------------------------------------|--------------------------------------------|------|--------------------------------|
| PO#                                                     | Broad PO                                   | PO#  | Broad PO                       |
| PO1                                                     | Engineering Knowledge                      | PO7  | Environment and Sustainability |
| PO2                                                     | Problem Analysis                           | PO8  | Ethics                         |
| PO3                                                     | Design/Development of solutions            | PO9  | Individual and team work       |
| PO4                                                     | Conduct investigations of complex problems | PO10 | Communication                  |
| PO5                                                     | Modern tool usage                          | PO11 | Project Management and Finance |
| PO6                                                     | The Engineer and Society                   | PO12 | Life long learning             |

### Assessment Pattern

| Bloom's Category | Continuous Assessment Tests |            | End Semester Examination Marks (%) |
|------------------|-----------------------------|------------|------------------------------------|
|                  | Test 1 (%)                  | Test 2 (%) |                                    |
| Remember         | 20                          | 20         | 20                                 |
| Understand       | 50                          | 50         | 50                                 |
| Apply            | 30                          | 30         | 30                                 |
| Analyze          |                             |            |                                    |
| Evaluate         |                             |            |                                    |
| Create           |                             |            |                                    |

### Mark Distribution

| Total Marks | CIE Marks | ESE Marks | ESE Duration |
|-------------|-----------|-----------|--------------|
| 150         | 50        | 100       | 3            |



**Continuous Internal Evaluation Pattern:**

|                                                           |          |
|-----------------------------------------------------------|----------|
| Attendance                                                | 10 marks |
| Continuous Assessment Tests(Average of Internal Tests1&2) | 25 marks |
| Continuous Assessment Assignment                          | 15 marks |

**Internal Examination Pattern**

Each of the two internal examinations has to be conducted out of 50 marks. First series test shall be preferably conducted after completing the first half of the syllabus and the second series test shall be preferably conducted after completing remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly completed module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly completed module), each with 7 marks. Out of the 7 questions, a student should answer any 5.

**End Semester Examination Pattern:**

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 full questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carries 14 marks.

**Syllabus****Module – 1 (Basic Fuzzy Set Theory)**

The case for imprecision, Utility and Limitations of Fuzzy Systems, Fuzzy Sets and Membership, Classical Sets – Properties, Operations, Fuzzy Sets – Properties and Operations, Classical Relations – Cartesian Product, Operations and Properties of Crisp Relations, Composition, Fuzzy Relations – Cardinality, Operations, Properties, Fuzzy Cartesian Product and Composition.

**Module – 2 (Fuzzy Membership Functions)**

Tolerance and Equivalence Relations – Crisp and Fuzzy, Similarity Methods – Cosine, Min-max, Fuzzy Membership Functions – Features, Fuzzification, Defuzzification to Crisp Sets,  $\lambda$ -Cuts for Fuzzy Relations, Linguistic Hedges.

**Module - 3 ( Fuzzification and Defuzzification Methods)**

Development of Membership Functions –Intuition, Inference, Rank ordering, Inductive reasoning. Defuzzification to Scalars - Max membership principle, Centroid method, Weighted average method, Mean max membership, Center of sums, Center of largest area, First (or last) of maxima.



**Module - 4 (Fuzzy Inference)**

Classical Logic, Fuzzy Logic, Approximate Reasoning, Fuzzy (Rule-Based) Systems - Multiple conjunctive antecedents, Multiple disjunctive antecedents, Aggregation of fuzzy rules, Graphical Techniques of Inference.

**Module - 5 (Fuzzy Applications)**

Applications of Fuzzy Systems - Fuzzy Classification, Fuzzy Pattern Recognition, Fuzzy Control Systems, Fuzzy Systems and Neural Networks, Fuzzy Clustering, Fuzzy Databases and Information retrieval systems.

**Text Books**

1. Fuzzy Logic with Engineering Applications – Timothy J. Ross, Third Edition, John Wiley and Sons, 2010
2. Fuzzy Sets and Fuzzy Logic: Theory and Applications - George J. Klir and Bo Yuan , Prentice Hall, 1995.

**Reference Books**

1. Kenneth H. Rosen, Discrete Mathematics and Its Applications with Combinatorics and Graph Theory, Seventh Edition, MGH, 2011
2. Trembly J.P and Manohar R, “Discrete Mathematical Structures with Applications to Computer Science”, TataMc Graw Hill Pub. Co. Ltd., New Delhi, 2003.
3. Bernard Kolman, Robert C. Busby, Sharan Cutler Ross, “Discrete Mathematical Structures”, Pearson Education Pvt Ltd., New Delhi, 2003
4. Kenneth H. Rosen, “Discrete Mathematics and its Applications”, 5/e, TataMc Graw Hill Pub. Co. Ltd, New Delhi 2003

**Course Level Assessment Questions****Course Outcome1 (CO1):**

1. What are the limitations of crisp systems?
2. Explain the difference between randomness and fuzziness.
3. Find some examples of prospective fuzzy variables in daily life.

**Course Outcome 2(CO2):**

1. The strength of two types of concrete needs to be compared. Four concrete masonry units (CMUs) from each type of concrete are stressed until they fail. The lowest stress at failure of a CMU is denoted 1, and the highest stress at failure is denoted 4, so the CMUs are rank ordered by failure stress, that is,  $X = \{1, 2, 3, 4\}$ . Since “failure” of CMUs is fuzzy, the membership value for a specific CMU represents the judgment that the CMU really failed. The following fuzzy sets represent the failure estimates for the two different concrete types:

$$A = \left\{ \frac{0 \cdot 15}{1} + \frac{0.25}{2} + \frac{0 \cdot 6}{3} + \frac{0.9}{4} \right\}$$

$$B = \left\{ \frac{0.2}{1} + \frac{0.3}{2} + \frac{0.5}{3} + \frac{0.8}{4} \right\}$$

Calculate the union, intersection and difference for the two concrete types.

2. An engineer is testing the properties, strength and weight of steel. Suppose he has two fuzzy sets A, defined on a universe of three discrete strengths,  $\{s_1, s_2, s_3\}$ , and B, defined on a universe of three discrete weights,  $\{w_1, w_2, w_3\}$ . Suppose A and B represent a “high-strength steel” and a “near-optimum weight,” respectively, as shown below

$$A = \left\{ \frac{1}{s_1} + \frac{0.5}{s_2} + \frac{0.2}{s_3} \right\}$$

$$B = \left\{ \frac{1}{w_1} + \frac{0.5}{w_2} + \frac{0.2}{w_3} \right\}$$

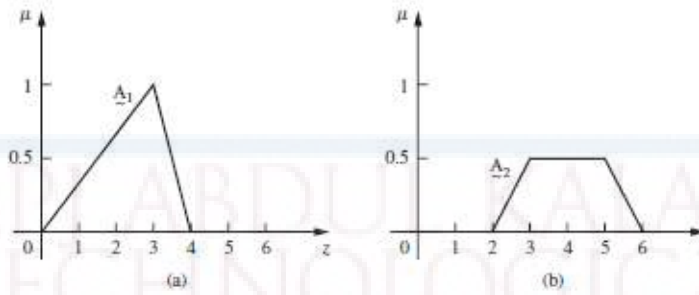
- Find the fuzzy relation for the Cartesian product, R, of A and B
- Introducing another fuzzy set, C, which represents a set of “moderately good” steel strengths

$$C = \left\{ \frac{0.1}{s_1} + \frac{0.6}{s_2} + \frac{1}{s_3} \right\}$$

Find  $C \circ R$  using max–min composition

### Course Outcome 3(CO3):

- Using your own intuition and your own definitions of the universe of discourse, plot fuzzy membership functions for “age of people” who are:
  - very young
  - young
  - middle-aged
  - old
- Define membership functions for approximately isosceles triangle, approximately equilateral and approximately right-angled triangles.
  - Find the membership value for the triangle represented by the angles  $80^\circ$ ,  $75^\circ$ ,  $25^\circ$ , in the above triangles.
- In metallurgy, materials are made with mixtures of various metals and other elements to achieve certain desirable properties. In a particular preparation of steel, three elements, namely, iron, manganese, and carbon, are mixed in two different proportions. The samples obtained from these two different proportions are placed on a normalized scale and are represented as fuzzy sets A1 and A2. Do a logical union of the membership functions A1 and A2 and find the defuzzified value of the resulting membership function.

**Course Outcome 4(CO4):**

1. Consider the following two discrete fuzzy sets, which are defined on universe  $X = \{-5, 5\}$ :

$$A = \text{"zero"} = \left\{ \frac{0}{-2} + \frac{0.5}{-1} + \frac{1}{0} + \frac{0.5}{1} + \frac{0}{2} \right\}$$

$$B = \text{"positive medium"} = \left\{ \frac{0}{0} + \frac{0.6}{1} + \frac{1}{2} + \frac{0.6}{3} + \frac{0}{4} \right\}$$

Construct the relation for IF  $x$  is "zero" THEN  $y$  is "positive medium"

2. A metro train system uses fuzzy logic in ensuring smooth ride on the train. The metro train system has fixed stops and the distance between the stops are known. The system uses fuzzy logic in deciding the pressure applied on the brakes. The amount of pressure applied depends on the distance to the next stop and the speed of the train. Design appropriate membership functions for the input and illustrate the use of Mamdani Inference in arriving at the brake pressure.

**Course Outcome 5(CO5):**

1. A fuzzy systems needs to be designed to provide a rating for a web store as "excellent", "good" or "poor". The web store can be rated based on the products available, the customer service and the discount provided. Design appropriate membership functions and fuzzy rules for generating the fuzzy based rating system.
2. Design a fuzzy control system for an air-conditioning application. Make appropriate decisions regarding inputs and outputs.

## Model Question Paper

**QP CODE:**

**Reg No:** \_\_\_\_\_

**Name:** \_\_\_\_\_

**PAGES : 4**

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY**

**EIGHTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR**

**Course Code: CST454**

**Course Name: Fuzzy Set Theory and Applications**

**Max.Marks:100**

**Duration: 3 Hours**

### **PART A**

**Answer All Questions. Each Question Carries 3 Marks**

1. Illustrate where a fuzzy logic based application is suitable.
2. Consider a LAN using Ethernet protocol with maximum bandwidth of 10 Mbps. Traffic rates can be represented using two fuzzy variables, Quiet and Congested. If the universal set  $X = \{0,1,2,3,4,5,6,7,8,9,10\}$  represents bandwidth usage in Mbps, then draw possible membership functions for the fuzzy variables.
3. Define fuzzy tolerance and equivalence relations.
4. Given two data points, illustrate how a similarity measure between them can be computed.
5. Define a convex normalized fuzzy set.
6. How does augmented query help in information retrieval.
7. Given the propositions
  - (i)  $C \vee D$
  - (ii)  $\sim H \Rightarrow (A \wedge \sim B)$
  - (iii)  $(C \vee D) \Rightarrow \sim H$

(iv)  $(A \wedge \sim B) \Rightarrow (R \vee S)$

Infer  $(R \vee S)$  from the above propositions and state the tautologies used.

8. Write a predicate logic statement for “Ram likes all kinds of food”.
9. Given the relation R below, find  $\lambda$ -cut for the relation using suitable  $\lambda$  value.

|     |     |     |     |     |
|-----|-----|-----|-----|-----|
| 1   | 0.8 | 0   | 0.1 | 0.2 |
| 0.8 | 1   | 0.4 | 0   | 0.9 |
| 0   | 0.4 | 1   | 0   | 0   |
| 0.1 | 0   | 0   | 1   | 0.5 |
| 0.2 | 0.9 | 0   | 0.5 | 1   |

10. Define maximum approaching degree.

(10x3=30)

### Part B

(Answer any one question from each module. Each question carries 14 Marks)

11. (a) An engineer is testing the properties, strength and weight of steel. Suppose he has two fuzzy sets A, defined on the universe of three discrete strengths  $\{s_1, s_2, s_3\}$  and B, defined on the universe of discrete weights  $\{w_1, w_2, w_3\}$ . Suppose A represents a “high-strength steel” and B a “near-optimum weight”.

$$A = \left\{ \frac{1}{s_1} + \frac{0.5}{s_2} + \frac{0.2}{s_3} \right\}, B = \left\{ \frac{1}{w_1} + \frac{0.5}{w_2} + \frac{0.3}{w_3} \right\}$$

Find fuzzy Cartesian product, R, of A and B.

- (b) Let a fuzzy set  $C = \left\{ \frac{0.1}{s_1} + \frac{0.6}{s_2} + \frac{1}{s_3} \right\}$  be introduced, which represents a set of “moderately good” steel strength. Find the max-min composition of C and R. (5)
- (c) Define 5 operations associated with crisp relations. (5)

OR

12. (a) How is excluded middle axiom different for crisp and fuzzy sets? (4)
- (b) Differentiate between crisp and fuzzy sets with respect to their membership functions. (4)
- (c) Illustrate any 4 operations associated with a fuzzy relation. (6)

13. (a) A structural designer is considering four different kinds of structural beams { S1, S2, S3, S4} for a new building. Laboratory experiments on the deflection resistance for these four kinds of beams have been performed, and the engineer wants to determine their suitability in the new structure. The following data have been observed based on the overall deflection capacity of each beam type: (10)

|                      |                | S1  | S2  | S3  | S4  |
|----------------------|----------------|-----|-----|-----|-----|
| No deflection        | X <sub>1</sub> | 0.3 | 0.6 | 0.5 | 0.8 |
| Some deflection      | X <sub>2</sub> | 0.6 | 0.3 | 0.5 | 0.2 |
| Excessive deflection | X <sub>3</sub> | 0.1 | 0.1 | 0   | 0   |

Use cosine amplitude method to determine the similarity of the four beam types.

- (b) Given a fuzzy set “tall” =  $\left\{ \frac{0.1}{s_1} + \frac{0.6}{s_2} + \frac{1}{s_3} \right\}$ , illustrate how the fuzzy set “very tall” be defined? (4)

OR

14. (a) Define tolerance and equivalence relations. Check whether the relation R given below is tolerance or equivalence relation. (4)

$$R = \begin{bmatrix} 1 & 0.8 & 0 & 0.1 & 0.2 \\ 0.8 & 1 & 0.4 & 0 & 0.9 \\ 0 & 0.4 & 1 & 0 & 0 \\ 0.1 & 0 & 0 & 1 & 0.5 \\ 0.2 & 0.9 & 0 & 0.5 & 1 \end{bmatrix}$$

- (b) Given the following data regarding three cities and the quality of their bridges, find the similarity between the cities using max-min method. (10)

|      |                | C1   | C2   | C3   |
|------|----------------|------|------|------|
| Poor | Q <sub>1</sub> | 0.00 | 0.10 | 0.10 |
| Fair | Q <sub>2</sub> | 0.04 | 0.04 | 0.08 |
| Good | Q <sub>3</sub> | 0.02 | 0.04 | 0.06 |
|      |                |      |      |      |

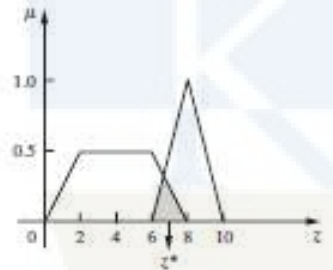


15. (a) Explain the process of developing membership functions using the inference method. (6)

(b) The following raw data were determined in a pair wise comparison of new premium car preferences in a poll of 100 people. When it was compared with a Porsche (P), 79 of those polled preferred a BMW (B), 85 preferred a Mercedes (M), 59 preferred a Lexus (L), and 67 preferred an Infinity (I). When a BMW was compared, the preferences were 21 – P, 23 – M, 37 – L, and 45 – I. When a Mercedes was compared, the preferences were 15 – P, 77 – B, 35 – L, and 48 – I. When a Lexus was compared, the preferences were 41 – P, 63 – B, 65 – M, and 51 – I. Finally, when an Infinity was compared, the preferences were 33 – P, 55 – B, 52 – M, and 49 – L. Using rank ordering, plot the membership function for “most preferred car.” (8)

OR

16. (a) 1. Defuzzify the following region using centroid method. (9)



(b) 2. Defuzzify the region given in 16(a) using weighted average method. (5)

17. (a) For a distillation process, the objective is to separate components of a mixture in the input stream. The relationship between the input variable, temperature, and the output variable, distillate fractions, is not precise but the human operator of this process has developed an intuitive understanding of this relationship. The universe for each of these variables is (8)

$X = \text{universe of temperatures (degree fahrenheit)} = \{160, 165, 170, 175, 180, 185, 190, 195\}.$

$Y = \text{universe of distillate fractions (percentage)} = \{77, 80, 83, 86, 89, 92, 95, 98\}.$

Given two fuzzy sets

$$A = \text{“temperature of input steam is hot”} = \left\{ \frac{0}{175} + \frac{0.7}{180} + \frac{1}{185} + \frac{0.4}{190} \right\}$$

$$B = \text{"separation of mixture is good"} = \left\{ \frac{0}{89} + \frac{0.5}{92} + \frac{0.8}{95} + \frac{1}{98} \right\}.$$

Find the fuzzy relation corresponding to " IF  $x$  is  $\tilde{A}$ , THEN  $y$  is  $\tilde{B}$

- (b) Show how inference is done using Generalized Modus Ponens (6)

OR

18. (a) Illustrate how graphical inference is done using Mamdani method. (6)

- (b) A restaurant uses a fuzzy inference system to calculate the tips given to its employees. The tips are based on the timeliness of service and quality of service of the waiters. Design appropriate membership functions for the input and illustrate the use of Sugeno Inference in arriving at the tip amount. (8)

19. (a) Explain fuzzy pattern recognition using multiple features. (7)

- (b) Describe how fuzziness in information retrieval can enhance the quality of search results. (7)

OR

20. (a) Design a fuzzy control system for an air-conditioning system. (7)

- (b) Illustrate how the join operation is performed in fuzzy databases. (7)

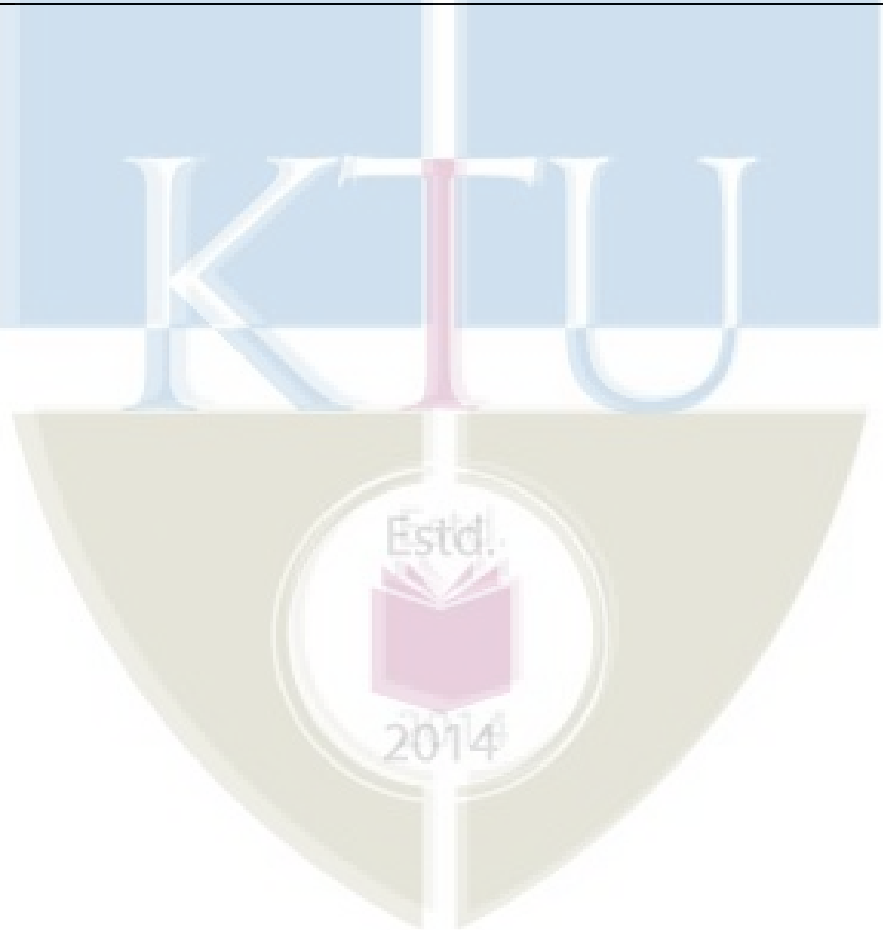
### Teaching Plan

| No                                                | Contents                                                                                        | No. of Lecture Hours<br>(36 hrs) |
|---------------------------------------------------|-------------------------------------------------------------------------------------------------|----------------------------------|
| <b>Module-1(Basic Fuzzy Set Theory) (6 hours)</b> |                                                                                                 |                                  |
| 1.1                                               | Introduction to Fuzzy Concepts – Case for imprecision- utility and limitations of Fuzzy Systems | 1 hour                           |
| 1.2                                               | Classical Sets – Properties, Operations                                                         | 1 hour                           |
| 1.3                                               | Fuzzy Sets – Properties, Operations                                                             | 1 hour                           |
| 1.4                                               | Classical Relations – Properties, Operations – Cartesian Product,                               | 1 hour                           |



|                                                                       |                                                                                          |        |
|-----------------------------------------------------------------------|------------------------------------------------------------------------------------------|--------|
|                                                                       | Composition                                                                              |        |
| 1.5                                                                   | Fuzzy Relations – Properties, Operations, Cardinality                                    | 1 hour |
| 1.6                                                                   | Fuzzy Cartesian Product, Fuzzy Composition                                               | 1 hour |
| <b>Module-2 (Fuzzy Membership Functions) (6 hours)</b>                |                                                                                          |        |
| 2.1                                                                   | Tolerance and Equivalence Relations - Crisp                                              | 1 hour |
| 2.2                                                                   | Tolerance and Equivalence Relations - Fuzzy                                              | 1 hour |
| 2.3                                                                   | Similarity Methods – Cosine, Minmax                                                      | 1 hour |
| 2.4                                                                   | Fuzzy Membership Functions- Features                                                     | 1 hour |
| 2.5                                                                   | Fuzzification, Defuzzification to crisp sets – $\lambda$ -cuts                           | 1 hour |
| 2.6                                                                   | Linguistic Hedges                                                                        | 1 hour |
| <b>Module-3 (Fuzzification and Defuzzification Methods) (7 hours)</b> |                                                                                          |        |
| 3.1                                                                   | Development of Membership Functions – Intuition, Inference                               | 1 hour |
| 3.2                                                                   | Development of Membership Functions – Rank Ordering                                      | 1 hour |
| 3.3                                                                   | Development of Membership Functions – Inductive reasoning                                | 1 hour |
| 3.4                                                                   | Defuzzification – Max membership principle, weighted average method, mean max membership | 1 hour |
| 3.5                                                                   | Defuzzification – Centroid method                                                        | 1 hour |
| 3.6                                                                   | Defuzzification – Center of Sums, Center of Largest area, First/Last of maxima           | 1 hour |
| 3.7                                                                   | Defuzzification - exercises                                                              | 1 hour |
| <b>Module-4 (Fuzzy Inference) (9 hours)</b>                           |                                                                                          |        |
| 4.1                                                                   | Classical Logic – Propositional Logic                                                    | 1 hour |
| 4.2                                                                   | Classical Logic – Predicate Logic                                                        | 1 hour |
| 4.3                                                                   | Fuzzy Logic                                                                              | 1 hour |
| 4.4                                                                   | Fuzzy Approximation based reasoning                                                      | 1 hour |
| 4.5                                                                   | Fuzzy Rule based systems                                                                 | 1 hour |
| 4.6                                                                   | Multiple conjunctive and disjunctive antecedents, aggregation                            | 1 hour |
| 4.7                                                                   | Graphical Techniques for Inference                                                       | 1 hour |
| 4.8                                                                   | Illustration of Graphical Techniques for Inference                                       | 1 hour |

|                                                |                                       |        |
|------------------------------------------------|---------------------------------------|--------|
| 4.9                                            | Fuzzy Inference - Exercises           | 1 hour |
| <b>Module-5 (Fuzzy Applications) (8 hours)</b> |                                       |        |
| 5.1                                            | Fuzzy Control Systems                 | 1 hour |
| 5.2                                            | Illustration of Fuzzy Control Systems | 1 hour |
| 5.3                                            | Fuzzy Classification                  | 1 hour |
| 5.4                                            | Fuzzy Pattern Recognition             | 1 hour |
| 5.5                                            | Fuzzy Systems and Neural Networks     | 1 hour |
| 5.6                                            | Fuzzy Clustering                      | 1 hour |
| 5.7                                            | Fuzzy Databases                       | 1 hour |
| 5.8                                            | Fuzzy Information Retrieval Systems   | 1 hour |



| CST464 | EMBEDDED SYSTEMS | CATEGORY | L | T | P | CREDIT | YEAR OF INTRODUCTION |
|--------|------------------|----------|---|---|---|--------|----------------------|
|        |                  | PEC      | 2 | 1 | 0 | 3      | 2019                 |

**Preamble:** The objective of this course is to familiarize learners with the technologies behind embedded computing systems. This course introduces and explains the role of different hardware, software, and firmware components involved in the design and development of embedded systems. It discusses how real time operating systems incorporate specific features to ensure timeliness of critical tasks. The course also aims to provide insights about the design followed in several real-world embedded devices and expose the recent trends in embedded system design to the students.

**Prerequisite:** Basic knowledge of Operating Systems, Computer Organization and Architecture.

**Course Outcomes:** After the completion of the course the student will be able to

|     |                                                                                                                                                                  |
|-----|------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| CO1 | Describe the characteristics of different hardware/software components of an embedded system. <b>(Cognitive Knowledge Level: Understand)</b>                     |
| CO2 | Map the design of an embedded system to an appropriate computational model. <b>(Cognitive Knowledge Level: Apply)</b>                                            |
| CO3 | Recommend appropriate process synchronization / communication / scheduling mechanisms for specific system scenarios. <b>(Cognitive Knowledge Level: Analyze)</b> |
| CO4 | Describe the role of real-time operating systems in embedded devices. <b>(Cognitive Knowledge Level: Understand)</b>                                             |
| CO5 | Make use of design strategies for developing real-world embedded systems. <b>(Cognitive Knowledge Level: Apply)</b>                                              |

**Mapping of course outcomes with program outcomes**

|     | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|
| CO1 |     |     |     |     |     |     |     |     |     |      |      |      |
| CO2 |     |     |     |     |     |     |     |     |     |      |      |      |

|            |  |  |  |  |  |  |  |  |  |  |  |  |
|------------|--|--|--|--|--|--|--|--|--|--|--|--|
| <b>CO3</b> |  |  |  |  |  |  |  |  |  |  |  |  |
| <b>CO4</b> |  |  |  |  |  |  |  |  |  |  |  |  |
| <b>CO5</b> |  |  |  |  |  |  |  |  |  |  |  |  |

| Abstract POs defined by National Board of Accreditation |                                            |             |                                |
|---------------------------------------------------------|--------------------------------------------|-------------|--------------------------------|
| PO#                                                     | Broad PO                                   | PO#         | Broad PO                       |
| <b>PO1</b>                                              | Engineering Knowledge                      | <b>PO7</b>  | Environment and Sustainability |
| <b>PO2</b>                                              | Problem Analysis                           | <b>PO8</b>  | Ethics                         |
| <b>PO3</b>                                              | Design/Development of solutions            | <b>PO9</b>  | Individual and team work       |
| <b>PO4</b>                                              | Conduct investigations of complex problems | <b>PO10</b> | Communication                  |
| <b>PO5</b>                                              | Modern tool usage                          | <b>PO11</b> | Project Management and Finance |
| <b>PO6</b>                                              | The Engineer and Society                   | <b>PO12</b> | Lifelong learning              |

### Assessment Pattern

| Bloom's Category | Continuous Assessment Tests |            | End Semester Examination Marks (%) |
|------------------|-----------------------------|------------|------------------------------------|
|                  | Test 1 (%)                  | Test 2 (%) |                                    |
| Remember         | 20                          | 20         | 20                                 |
| Understand       | 50                          | 50         | 50                                 |
| Apply            | 30                          | 30         | 30                                 |
| Analyze          |                             |            |                                    |
| Evaluate         |                             |            |                                    |
| Create           |                             |            |                                    |

**Mark Distribution**

| Total Marks | CIE Marks | ESE Marks | ESE Duration |
|-------------|-----------|-----------|--------------|
| 150         | 50        | 100       | 3            |

**Continuous Internal Evaluation Pattern:**

|                                                              |          |
|--------------------------------------------------------------|----------|
| Attendance                                                   | 10 marks |
| Continuous Assessment Tests(Average of Internal Tests 1 & 2) | 25 marks |
| Continuous Assessment Assignment                             | 15 marks |

**Internal Examination Pattern**

Each of the two internal examinations has to be conducted out of 50 marks. First series test shall be preferably conducted after completing the first half of the syllabus and the second series test shall be preferably conducted after completing the remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly completed module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly completed module), each with 7 marks. Out of the 7 questions, a student should answer any 5.

**End Semester Examination Pattern:**

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 full questions from each module of which student should answer any one. Each question can have a maximum of 2 subdivisions and carries 14 marks.

**Syllabus****Module – 1 ( Introduction to Embedded Systems )**

Embedded Systems – Definitions, Embedded Systems vs. General Computing Systems, History, Classification, Application Areas, Purpose. Building Blocks of a Typical Embedded System – System Core (Microprocessors, Microcontrollers, DSP, ASICs, PLDs), Memory (Different ROMs and RAMs), Sensors and Actuators, I/O Subsystem Interface, Communication Interface, Embedded Firmware, Other System Components (Reset and Brown-out Protection Circuits,

Oscillator Unit, Real-Time Clock, Watchdog Timer), Printed Circuit Board. Embedded System Design Process – Requirements, Specification, Architecture Design, Designing Hardware and Software Components, System Integration.

### **Module - 2 ( System Modeling and Hardware Software Co-Design )**

Computational Models in Embedded Design – Data Flow Graph, Control Data Flow Graph, State Machine Model, Sequential Program Model, Concurrent Process Model, Object-Oriented Model. Hardware Software Co-Design – Traditional Embedded Development Cycle, History, Advantages of the Co-Design Methodology, The Co-Design Process, Fundamental Issues in Hardware Software Co-Design. Hardware software trade-offs.

### **Module - 3 ( Real-Time Embedded System Design )**

**Prerequisite Topics:** Operating System – Basics, Types. Basics of Tasks, Process and Threads. Multiprocessing and Multitasking. Task Scheduling – Non-Preemptive (FIFO, LIFO, SJF) and Preemptive (SRT, RR, Priority-based, Rate-based).

Task Communication – Shared Memory, Message Passing, Remote Procedure Call and Sockets. Task Synchronization – Synchronization Issues – Race Condition, Deadlock, Priority Inversion, Priority Inheritance, Priority Ceiling. Synchronization Techniques – Spin Lock, Sleep & Wakeup, Semaphores. Selection of an RTOS for an Embedded Design – Functional and Non-Functional Requirements.

### **Module 4 – ( Embedded Firmware Design and Development, and EDLC )**

Embedded Firmware Design and Development – Firmware Design Approaches, Firmware Development Languages. Integration of Embedded Hardware and Firmware.

Embedded Product Development Life Cycle – Objectives, Different Phases, Modeling Techniques – Waterfall Model, Incremental Model, Evolutionary Model, Spiral Model.

### **Module 5 ( Embedded System Industry – Case Studies and Applications )**

Design Case Studies – Battery Operated Smart Card Reader, Automated Meter Reading System, Smart Watch.

Automotive and Aerospace Systems – Networked Control Systems in Cars and Airplanes, Vehicular Networks – CAN bus, Time-triggered Architecture, FlexRay and LIN.

Internet of Things Systems – IoT System Architectures - Use Cases (Smart Appliance, Monitoring and Control Systems). Networks for IoT – Networking concepts, Bluetooth, Bluetooth Low Energy, 802.15.4, ZigBee and WiFi. Databases and Timewheels. Smart Home Example.



**Text Books:**

1. K. V. Shibu, *Introduction to Embedded Systems*, McGraw Hill Education, Second Edition, 2017.
2. James K. Peckol, *Embedded Systems: A Contemporary Design Tool*, John Wiley & Sons, Second Edition, 2019.
3. Marilyn Wolf, *Computers as Components-Principles of Embedded Computing System Design*, Morgan Kaufmann, Elsevier, Fourth Edition, 2016.

**References:**

1. Jorgen Staunstrup and Wayne Wolf, *Hardware/Software Co-Design: Principles and Practice*, Springer Science & Business Media, 2013.
2. Raj Kamal, *Embedded Systems: Architecture, Programming and Design*. Tata McGraw-Hill Education, 2011.
3. Daniel D. Gajski, Samar Abdi, Andreas Gerstlauer, and Gunar Schirner, *Embedded System Design: Modeling, Synthesis and Verification*, Springer Science & Business Media, 2009.
4. Peter Marwedel, *Embedded System Design: Embedded Systems Foundations of Cyber-Physical Systems, and the Internet of Things*, Springer, 2017.

**Course Level Assessment Questions****Course Outcome 1 (CO1):**

1. What are Sensors? Explain its role in Embedded System Design. Illustrate with an example.
2. How do sensors communicate data with other computing devices in an embedded system?
3. What are the advantages and disadvantages of using a microprocessor as the compute engine of an embedded device?
4. What is a watchdog timer? What can go wrong if your system does not have one?
5. Elaborate the steps involved in the design of an embedded system with appropriate diagrams.

**Course Outcome 2 (CO2):**

1. Draw a class diagram to represent a smart eyeglass that automatically changes the glass shade according to the external light.
2. Design a Seat Belt Warning System and explain its working using a state machine model.



3. Represent the authentication process of an ATM machine using one of the following computational models:
  1. Control Data Flow Graph.
  2. State Transition Diagram.
4. Draw the Finite State Machine diagram for an automated tea/coffee vending machine.
5. Draw a CDFG for the following program fragment.

```

fun0();
if (cond1) fun1();
else fun2();
fun3();
switch (test1) {
 case 1 : fun4();
 break;
 case 2: fun5();
 break;
 case 3: fun6();
 break;
}
fun7();

```

### Course Outcome 3(CO3):

1. Explain the working of spin locks. When are spin locks preferred to sleep and wake up mechanisms to synchronize process execution?
2. Assume 3 tasks with the following characteristics:

| Task | Arrival Time | Execution Time |
|------|--------------|----------------|
| A    | 0            | 7              |
| B    | 2            | 9              |
| C    | 4            | 6              |

- A goes for I/O for 5 units after 4 units of execution time in CPU.
- B and C are CPU bound tasks.
- Find out if a First Come First Serve or Shortest Job First scheduling strategy will offer the shortest average waiting time for the above scenario.

3. An organization maintains energy smart buildings with the help of different types of computing devices spread across different levels of a building. What process communication mechanism do you recommend? Why?
4. With an example, illustrate how priority inversion can cause high priority tasks to miss deadlines.
5. Consider the following scenario:
  - There are three tasks, H, M and L with high, medium, and low priority. Task L and task H share a resource. Shortly after Task L takes the resource, Task H becomes ready to run. However, Task H must wait for Task L to finish with the resource, so it pends. Before Task L finishes with the resource, Task M becomes ready to run, preempting Task L. While Task M runs, Task H, the highest-priority task in the system, remains in a pending state.

How can you prevent the high priority task H, from missing any deadlines?

**Course Outcome 4 (CO4): .**

1. Differentiate General Purpose Operating System (GPOS) from Real-Time Operating System (RTOS).
2. Explain briefly the functional and non-functional requirements that need to be addressed in the selection of an RTOS.
3. What are the characteristics of a real-time system?
4. How does a hard real-time system differ from a soft-real time system? Explain with an example.
5. Identify the reasons for choosing an operating system-based firmware to a super-loop model-based firmware in an embedded device.

**Course Outcome 5(CO5):**

1. Prepare a requirement chart for a robotic vacuum cleaner. Fine tune the requirement chart to list the product specifications (Assignment, preferably group work).
2. Suppose you want to make an old building energy smart. Analyze existing systems and prepare a report on how this can be achieved following an Embedded product Development Life Cycle (EDLC) model (Assignment, preferably group work). (Allow groups to make necessary assumptions such as prevailing climatic conditions).
3. Design a baby monitoring system with suitable active devices and networking components. Represent your system with a suitable diagram.
4. Identify the components required to build a battery-operated smart card reader and design the system using these components.

5. Draw a sequential diagram representing the working of an automated energy metre reading system.

**Model Question Paper**

**QP CODE:**

**Reg No:** \_\_\_\_\_

**Name:** \_\_\_\_\_

**PAGES : 4**

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY**

**EIGHTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR**

**Course Code: CST464**

**Course Name: Embedded Systems**

**Max. Marks : 100**

**Duration: 3 Hours**

**PART A**

**Answer All Questions. Each Question Carries 3 Marks**

1. Differentiate between PLD and ASIC.
2. List the factors that need to be considered in the selection of memory for embedded systems.
3. How does building an embedded system become a hardware-software co-design problem?
4. If the time to market of an embedded device is critical, would you prefer a high level language or assembly language for developing the firmware? Justify.
5. Explain the various factors that need to be considered for the selection of a scheduling algorithm.
6. What is the difference between 'Hard' and 'Soft' real-time systems? Give an example for 'Hard' and 'Soft' real-time kernels.
7. When will you choose a concurrent process model for an embedded device?

8. What are the three primary objectives of EDLC? List the different phases of this development life cycle.
9. Why are traditional databases not preferred in embedded devices?
10. Draw the functional block diagram of a fully automatic washing machine.

(10x3=30)

**Part B**

**(Answer any one question from each module. Each question carries 14 Marks)**

11. (a) What is embedded firmware? Which are the different approaches used for embedded firmware development? (6)
- (b) List out the requirements for a smartwatch that can show time as well as measure the user's vitals such as blood pressure, pulse rate and body temperature. Think of the physical and functional aspects of the product and also what extra features can be added over the basic functions. (8)

**OR**

12. (a) Describe various on-board communication interfaces used in embedded systems. (10)
- (b) Explain the role of a watchdog timer in an embedded system. (4)
13. (a) Explain the object oriented program model for embedded system design. Under which circumstances is this model considered as the best? (6)
- (b) Design and draw a concurrent program model for the Seat Belt Warning System of an automobile. Clearly specify your assumptions in the design. (8)

**OR**

14. (a) Suppose you are designing a digital motion camera. What are the tradeoffs in implementing the multimedia codec part of the camera in hardware and in software? (6)
- (b) Draw the state machine diagram of an automatic dawn-dusk solar street light with a motion sensor. (8)
  - The light automatically turns on when the ambient light is below 'x' lumens.
  - The streetlight operates at low power when no motion is detected for 30 secs.

15. (a) Identify the type of synchronization mechanism best suited for each of the following scenarios and explain why. (6)
1. Updating a single byte memory location shared by different tasks, some of which are time-critical.
  2. Updating a block of memory that is shared between multiple low priority tasks.
  3. Multiple instances of a resource shared between tasks.
- (b) Under what circumstances would you use the following task communication mechanisms? (8)
1. Sockets.
  2. Remote Procedure Call
  3. Shared Memory

**OR**

16. (a) What is priority inversion? In case of priority inversion, what techniques can be adopted to ensure that the critical tasks are able to meet their deadlines? (7)
- (b) Three processes with process IDs P1, P2, P3 with estimated completion time 6, 2, 4 milliseconds respectively, enters the ready queue together in the order P1, P3, P2. Process P4 with estimated execution time 4 milliseconds entered the ready queue 3 milliseconds later the start of execution of P1. Calculate the waiting time and Turn Around Time (TAT) for each process and the Average waiting time and Turn Around Time (Assuming there is no I/O waiting for the processes) in RR algorithm with Time slice = 2 ms. (7)
17. (a) An embedded product under consideration is very complex in nature and there is a possibility for change in requirements of the product. Also the risk associated with the development of this product is very high. Which is the best suited life cycle method to handle this product development? Justify your answer. (8)
- (b) Explain the similarities and differences between iterative and incremental life cycle models. (6)

**OR**

18. (a) When do you prefer a super-loop-based firmware design approach over an RTOS based approach? What are the limitations of the super-loop based approach and how do you overcome them? (8)
- (b) Briefly explain the different approaches used for embedding firmware into the hardware of an embedded device. (6)
19. (a) Identify the components required to build an automated energy metre reading system and design it with these components (6)

- (b) List any four wireless standards used for building IoT networks and compare their characteristics (8)

OR

20. (a) Draw a sequential diagram representing the working of a battery-operated smart card reader. (6)
- (b) Explain the different communication buses used in automotive applications. (8)

### Teaching Plan

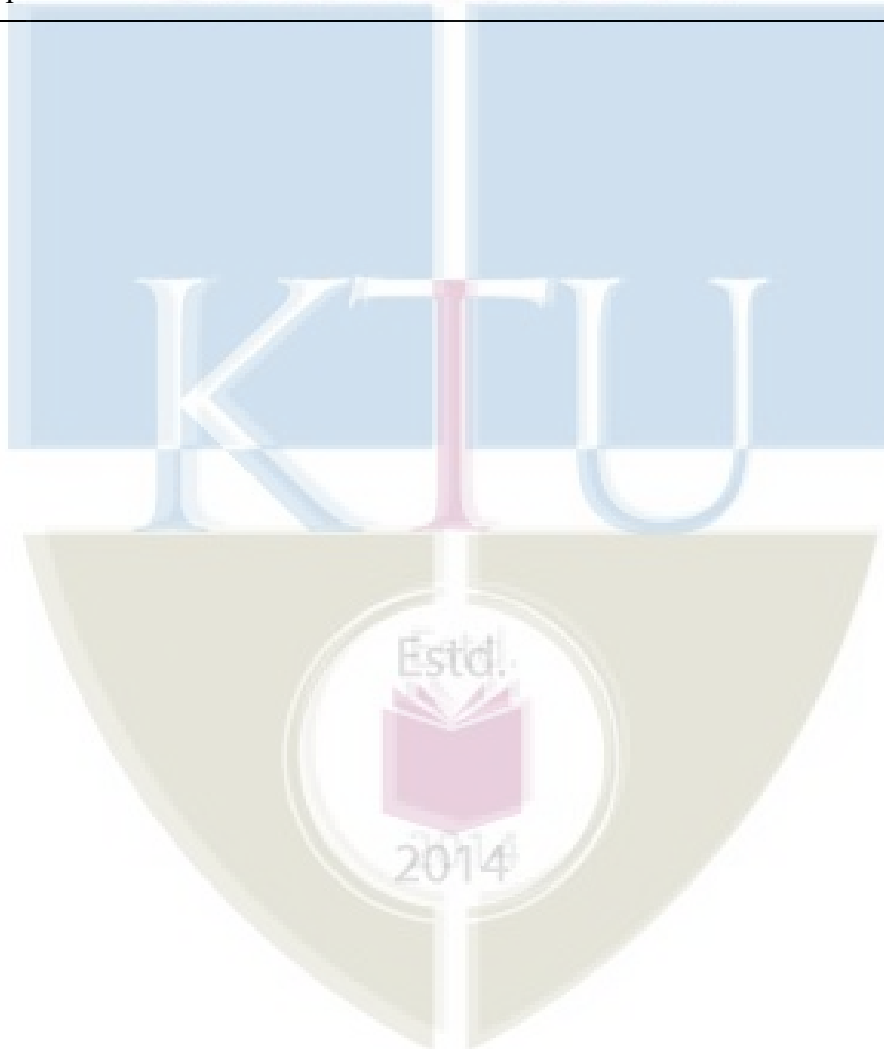
| No                                                                          | Contents                                                                                                                                                       | No. of Lecture Hours<br>(35 hrs) |
|-----------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------|
| <b>Module-1 (Introduction to Embedded Systems) (8 hours)</b>                |                                                                                                                                                                |                                  |
| 1.1                                                                         | Introduction–Embedded Systems, Characteristics and Quality Attributes of Embedded Systems                                                                      | 1 hour                           |
| 1.2                                                                         | System Core (Microprocessors, Microcontrollers, DSP, ASICs, PLDs)                                                                                              | 1 hour                           |
| 1.3                                                                         | System Core (Microprocessors, Microcontrollers, DSP, ASICs, PLDs)                                                                                              | 1 hour                           |
| 1.4                                                                         | Memory (Different ROMs and RAMs), Sensors and Actuators, I/O Subsystem Interface                                                                               | 1 hour                           |
| 1.5                                                                         | Communication Interface                                                                                                                                        | 1 hour                           |
| 1.6                                                                         | Embedded Firmware, Other System Components (Reset and Brown-out Protection Circuits, Oscillator Unit, Real-Time Clock, Watchdog Timer), Printed Circuit Board. | 1 hour                           |
| 1.7                                                                         | Embedded System Design Process – Requirements, Specification, Architecture Design.                                                                             | 1 hour                           |
| 1.8                                                                         | Embedded System Design Process–Designing Hardware and Software Components, System Integration.                                                                 | 1 hour                           |
| <b>Module-2 (System Modeling and Hardware Software Co-Design) (6 hours)</b> |                                                                                                                                                                |                                  |
| 2.1                                                                         | Computational Models in Embedded Design – Data Flow Graph, Control Data Flow Graph                                                                             | 1 hour                           |
| 2.2                                                                         | Computational Models in Embedded Design – State Machine Model, Sequential Program Model                                                                        | 1 hour                           |



|                                                                                      |                                                                                                                                                    |        |
|--------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------|--------|
| 2.3                                                                                  | Computational Models in Embedded Design – Concurrent Process Model, Object-Oriented Model.                                                         | 1 hour |
| 2.4                                                                                  | Hardware Software Co-Design – Traditional Embedded Development Cycle, History, Advantages of the Co-Design Methodology                             | 1 hour |
| 2.5                                                                                  | The Co-Design Process                                                                                                                              | 1 hour |
| 2.6                                                                                  | Fundamental Issues in Hardware Software Co-Design. Hardware software trade-offs.                                                                   | 1 hour |
| <b>Module-3 (Real-Time Embedded System Design) (7 hours)</b>                         |                                                                                                                                                    |        |
| 3.1                                                                                  | Task Communication–Shared Memory, Message Passing                                                                                                  | 1 hour |
| 3.2                                                                                  | Task Communication–Remote Procedure Call and Sockets                                                                                               | 1 hour |
| 3.3                                                                                  | Task Synchronization–Synchronization Issues – Race Condition, Deadlock                                                                             | 1 hour |
| 3.4                                                                                  | Task Synchronization–Synchronization Issues – Priority Inversion, Priority Inheritance, Priority Ceiling.                                          | 1 hour |
| 3.5                                                                                  | Synchronization Techniques – Spin Lock, Sleep & Wakeup, Semaphores                                                                                 | 1 hour |
| 3.6                                                                                  | Synchronization Techniques – Spin Lock, Sleep & Wakeup, Semaphores                                                                                 | 1 hour |
| 3.7                                                                                  | Selection of an RTOS for an Embedded Design – Functional and Non-Functional Requirements                                                           | 1 hour |
| <b>Module-4 (Embedded Firmware Design and Development, and EDLC) (6 hours)</b>       |                                                                                                                                                    |        |
| 4.1                                                                                  | Firmware Design Approaches                                                                                                                         | 1 hour |
| 4.2                                                                                  | Firmware Development Languages                                                                                                                     | 1 hour |
| 4.3                                                                                  | Firmware Development Languages                                                                                                                     | 1 hour |
| 4.4                                                                                  | Integration of Embedded Hardware and Firmware                                                                                                      | 1 hour |
| 4.5                                                                                  | Embedded Product Development Life Cycle–Objectives, Different Phases                                                                               | 1 hour |
| 4.6                                                                                  | Embedded Product Development Life Cycle – Modeling Techniques – Waterfall Model, Incremental Model, Evolutionary Model, Spiral Model (Review Only) | 1 hour |
| <b>Module-5 (Embedded System Industry – Case Studies and Applications) (8 hours)</b> |                                                                                                                                                    |        |
| 5.1                                                                                  | Design Case Studies–Battery Operated Smart Card Reader                                                                                             | 1 hour |
| 5.2                                                                                  | Design Case Studies–Automated Meter Reading System                                                                                                 | 1 hour |
| 5.3                                                                                  | Design Case Studies–Smart Watch                                                                                                                    | 1 hour |



|     |                                                                                                                                  |        |
|-----|----------------------------------------------------------------------------------------------------------------------------------|--------|
| 5.4 | Automotive and Aerospace Systems – Networked Control Systems in Cars and Airplanes                                               | 1 hour |
| 5.5 | Automotive and Aerospace Systems – Vehicular Networks – CAN bus, Time-triggered Architecture, FlexRay and LIN                    | 1 hour |
| 5.6 | Internet of Things Systems – IoT System Architectures – Use Cases (Smart Appliance, Monitoring and Control Systems)              | 1 hour |
| 5.7 | Internet of Things Systems – Networks for IoT – Networking concepts, Bluetooth, Bluetooth Low Energy, 802.15.4, ZigBee and WiFi. | 1 hour |
| 5.8 | Internet of Things Systems – Databases and Timewheels, Smart Home Example                                                        | 1 hour |



| CST474 | COMPUTER VISION | CATEGORY | L | T | P | CREDIT | YEAR OF INTRODUCTION |
|--------|-----------------|----------|---|---|---|--------|----------------------|
|        |                 | PEC      | 2 | 1 | 0 | 3      | 2019                 |

**Preamble:** Computer vision is a field of artificial intelligence (AI) that enables computers and systems to derive meaningful information from digital images, videos and other visual inputs. The curriculum covers the basics of image formation, key computer vision concepts, methods, techniques, pattern recognition, various problems in designing computer vision and object recognition systems. This course enables the learners to understand the fundamentals of computer vision and develop applications in computer vision.

**Prerequisite:** Nil

**Course Outcomes:** After the completion of the course, the student will be able to

|     |                                                                                                                                                                                                                  |
|-----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| CO1 | Summarize basic concepts, terminology, theories, models and methods in the field of computer vision.<br>(Cognitive Knowledge Level: Understand)                                                                  |
| CO2 | Explain basic methods of computer vision related to multi-scale representation, edge detection, detection of other primitives, stereo, motion and object recognition.<br>(Cognitive Knowledge Level: Understand) |
| CO3 | Describe principles of Segmentation, Motion Segmentation and Classification<br>(Cognitive Knowledge Level: Understand)                                                                                           |
| CO4 | Select appropriate object Tracking and detection methods for computer vision applications (Cognitive Knowledge Level: Understand).                                                                               |
| CO5 | Implement a computer vision system for a specific problem (Cognitive Knowledge Level: Apply)                                                                                                                     |

**Mapping of course outcomes with program outcomes**

|     | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|
| CO1 |     |     |     |     |     |     |     |     |     |      |      |      |
| CO2 |     |     |     |     |     |     |     |     |     |      |      |      |
| CO3 |     |     |     |     |     |     |     |     |     |      |      |      |

|     |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                   |  |  |  |  |  |                                                                                     |
|-----|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|--|--|--|--|--|-------------------------------------------------------------------------------------|
| CO4 |  |                                                                                   |  |                                                                                   |                                                                                   |  |  |  |  |  |  |
| CO5 |  |  |  |  |  |  |  |  |  |  |  |

| Abstract POs defined by National Board of Accreditation |                                            |      |                                |
|---------------------------------------------------------|--------------------------------------------|------|--------------------------------|
| PO#                                                     | Broad PO                                   | PO#  | Broad PO                       |
| PO1                                                     | Engineering Knowledge                      | PO7  | Environment and Sustainability |
| PO2                                                     | Problem Analysis                           | PO8  | Ethics                         |
| PO3                                                     | Design/Development of solutions            | PO9  | Individual and team work       |
| PO4                                                     | Conduct investigations of complex problems | PO10 | Communication                  |
| PO5                                                     | Modern tool usage                          | PO11 | Project Management and Finance |
| PO6                                                     | The Engineer and Society                   | PO12 | Lifelong learning              |

### Assessment Pattern

| Bloom's Category | Continuous Assessment Tests |            | End Semester Examination Marks (%) |
|------------------|-----------------------------|------------|------------------------------------|
|                  | Test 1 (%)                  | Test 2 (%) |                                    |
| Remember         | 30                          | 30         | 30                                 |
| Understand       | 50                          | 50         | 50                                 |
| Apply            | 20                          | 20         | 20                                 |
| Analyze          |                             |            |                                    |
| Evaluate         |                             |            |                                    |
| Create           |                             |            |                                    |

**Mark Distribution**

| Total Marks | CIE Marks | ESE Marks | ESE Duration |
|-------------|-----------|-----------|--------------|
| 150         | 50        | 100       | 3            |

**Continuous Internal Evaluation Pattern:**

|                                                           |          |
|-----------------------------------------------------------|----------|
| Attendance                                                | 10 marks |
| Continuous Assessment Tests(Average of Internal Tests1&2) | 25 marks |
| Continuous Assessment Assignment                          | 15 marks |

**Internal Examination Pattern**

Each of the two internal examinations has to be conducted out of 50 marks. First series test shall be preferably conducted after completing the first half of the syllabus and the second series test shall be preferably conducted after completing remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly completed module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly completed module), each with 7 marks. Out of the 7 questions, a student should answer any 5.

**End Semester Examination Pattern:**

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 full questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carries 14 marks.

**Syllabus****Module – 1 (Image Formation and Filtering)**

Geometric Camera Models - Pinhole perspective, Intrinsic and Extrinsic Parameters, Geometric Camera Calibration. Linear Filters- Linear Filters and Convolution, Shift Invariant Linear Systems. Filters as Templates - Normalized Correlation and Finding Patterns.

**Module - 2(Local Image Features and Stereo Vision)**

Image Gradients - Computing the Image Gradient, Gradient Based Edge and Corner Detection. Stereopsis- Binocular Camera Geometry, Epipolar Constraint, Binocular Reconstruction, Local Methods for Binocular Fusion, Global Methods for Binocular Fusion.

**Module - 3 (Segmentation)**

Segmentation - Background subtraction, Interactive segmentation, Forming image regions. Segmentation by clustering - Watershed Algorithm. Motion Segmentation by Parameter Estimation- Optical Flow and Motion, Flow Models, Motion Segmentation with Layers.

**Module- 4 (Classification and Tracking)**

Classification - Classification Basics, Two-class and Multiclass classifiers, Error, Overfitting and Regularization, Cross Validation, Classifying Images of Single Objects.

Tracking - Tracking Basics, Simple Tracking Strategies, Tracking by detection, Tracking Linear Dynamical models with Kalman filters.

**Module - 5 (Finding Objects and other Applications)**

Object detection - The Sliding Window Method. Object Recognition -Goals of Object Recognition System. Applications - Robot Navigation by stereo vision, Face detection, Face recognition, Activity Recognition, Tracking people.

**Text Books**

1. Forsyth, David, and Jean Ponce. Computer vision: A modern approach. Prentice hall, 2011.

**Reference Books**

1. Szeliski, Richard, Computer vision: algorithms and applications. Springer Science & Business Media, 2010.
2. Medioni, Gerard, Emerging topics in computer vision. and Sing Bing Kang. Prentice Hall PTR, 2004.
3. Trucco, Emanuele, and Alessandro Verri, Introductory techniques for 3-D computer vision. Vol. 201. Englewood Cliffs: Prentice Hall, 1998.
4. Faugeras, Olivier, and Olivier Autor Faugeras, Three-dimensional computer vision: a geometric viewpoint. MIT press, 1993.

**Course Level Assessment Questions****Course Outcome 1 (CO1):**

1. Explain the relationship between coordinates involved in a pinhole camera imaging setup.
2. Explain the basic principle behind geometric camera calibration.
3. Describe how linear filters can be used for smoothing digital images.
4. How does normalised correlation help in matching patterns in images?

**Course Outcome 2 (CO2):**

1. Describe edge detection methods for computer vision.
2. List any five applications of object recognition.
3. Explain how the epipolar constraint simplifies the correspondence search between two stereo images.
4. List and explain the different methods used for binocular fusion.
5. Explain the different corner detection methods.

**Course Outcome 3 (CO3):**

1. Explain the principle of background subtraction.
2. Describe the watershed algorithm for image segmentation.
3. What is meant by optical flow? How can it be utilized for segmenting images?
4. Describe motion segmentation with layers.
5. What is overfitting in the context of classification?
6. Explain the principle behind classification of single images.

**Course Outcome 4 (CO4):**

1. Explain 'Mean Shift Algorithm' to track an object using matching.
2. Describe an algorithm to track a moving object (dynamic object).
3. Explain the sliding window method for object detection.
4. Assume that we have the dynamics

$$x_i \sim N(d_i x_{i-1}, \sigma_{d_i}^2)$$

$$y_i \sim N(m_i x_i, \sigma_{m_i}^2)$$

- a.  $P(x_i | x_{i-1})$  is a normal density with mean  $d_i x_{i-1}$  and variance  $\sigma_{d_i}^2$ . What is  $(x_{i-1} | x_i)$ ?
- b. Show how to obtain a representation of  $P(x_i | y_{i+1}, \dots, y_N)$  using a Kalman Filter.

**Course Outcome 5 (CO5):**

1. Explain how to implement a computer vision system.
2. Illustrate a computer vision system with the help of a neat diagram.
3. Discuss the components of a computer vision system for object recognition.
4. Explain how activity recognition can be done using computer vision.
5. Illustrate a face recognition system with the help of a diagram.

**Assignment Questions**

6. Implement a voxel-based approach to visual hull construction.
7. Implement a computer vision system for object recognition.



## Model Question Paper

**QP CODE:**

**Reg No:** \_\_\_\_\_

**Name:** \_\_\_\_\_

**PAGES : 3**

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY**

**EIGHTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR**

**Course Code: CST474**

**Course Name: COMPUTER VISION**

**Max.Marks:100**

**Duration: 3 Hours**

### **PART A**

**Answer All Questions. Each Question Carries 3 Marks**

1. State three properties of shift invariant linear systems.
2. Explain the term normalized correlation.
3. What is image rectification? Mention its significance?
4. Illustrate epipolar geometry and show epipolar lines and epipoles.
5. Explain the term flow model.
6. How does background subtraction help in segmenting an image?
7. What is a Kalman filter? Give its applications.
8. State any three simple tracking strategies.
9. State the goals of an object recognition system.
10. Explain the task of face recognition.

**(10x3=30)**

### **Part B**

**(Answer any one question from each module. Each question carries 14 Marks)**



11. (a) Demonstrate the relationship between a point in the world coordinate frame and its corresponding image point using camera parameters. (9)
- (b) Show that convolving a function with a  $\delta$  function simply reproduces the original function. (5)

**OR**

12. (a) What is linear filtering? Explain two applications of linear filtering to image processing. (7)
- (b) Explain an application of normalised correlation to find patterns. (7)
13. (a) Show that smoothing an image and then computing the gradient is same as convolving an image with the derivative of a smoothing function. (5)
- (b) State the epipolar constraint and derive its representations using the Essential matrix and the Fundamental matrix. (9)

**OR**

14. (a) Explain the algorithm for computing edges using gradients. (9)
- (b) Define binocular fusion. Explain two local methods for binocular fusion. (5)
15. (a) Discuss the different interactive segmentation approaches. (7)
- (b) What is meant by optical flow? How can it be utilized for segmenting images? (7)

**OR**

16. (a) Explain the Watershed algorithm. (7)
- (b) How can we perform motion segmentation by parameter estimation? (7)
17. (a) Explain tracking algorithm using Kalman filtering. (7)
- (b) Illustrate the tracking by detection algorithm. (7)

**OR**

18. (a) Explain the various kinds of errors in classification and the relationship between them. (7)
- (b) What is overfitting and how does regularization help to minimise it? (7)
19. (a) Explain human activity recognition with appearance features. (7)

- (b) Describe the Sliding window method for detecting objects in images. (7)

**OR**

20. (a) Explain the principle of detecting faces in an image. (7)

- (b) What are the various strategies for object recognition? (7)

### Teaching Plan

| No                                                         | Contents                                                       | No. of Lecture Hours<br>(36hrs) |
|------------------------------------------------------------|----------------------------------------------------------------|---------------------------------|
| <b>Module 1 Image Formation and Filtering (7)</b>          |                                                                |                                 |
| 1.1                                                        | Geometric Camera model - Pinhole perspective                   | 1                               |
| 1.2                                                        | Geometric Camera model - Intrinsic Parameters                  | 1                               |
| 1.3                                                        | Geometric Camera model - Extrinsic Parameters                  | 1                               |
| 1.4                                                        | Geometric Camera Calibration – Linear Approach                 | 1                               |
| 1.5                                                        | Linear Filters and Convolution                                 | 1                               |
| 1.6                                                        | Shift Invariant Linear Systems - Discrete convolution          | 1                               |
| 1.7                                                        | Normalized Correlation and Finding patterns                    | 1                               |
| <b>Module 2 Local Image Features and Stereo Vision (8)</b> |                                                                |                                 |
| 2.1                                                        | Local Image Features - Computing the Image Gradient            | 1                               |
| 2.2                                                        | Gradient Based Edge Detection                                  | 1                               |
| 2.3                                                        | Gradient Based Corner Detection                                | 1                               |
| 2.4                                                        | Stereopsis - Binocular Camera Geometry and Epipolar Constraint | 1                               |
| 2.5                                                        | Essential Matrix and Fundamental Matrix                        | 1                               |
| 2.6                                                        | Binocular Reconstruction                                       | 1                               |
| 2.7                                                        | Local Methods for Binocular Fusion                             | 1                               |
| 2.8                                                        | Global Methods for Binocular Fusion                            | 1                               |
| <b>Module 3 Segmentation (6)</b>                           |                                                                |                                 |

|                                                            |                                                                       |   |
|------------------------------------------------------------|-----------------------------------------------------------------------|---|
| 3.1                                                        | Segmentation basics                                                   | 1 |
| 3.2                                                        | Applications - Background Subtraction, Interactive Segmentation       | 1 |
| 3.3                                                        | Forming Image Regions                                                 | 1 |
| 3.4                                                        | Segmentation by clustering - The Watershed Algorithm                  | 1 |
| 3.5                                                        | Motion Segmentation by Parameter Estimation - Optical Flow and Motion | 1 |
| 3.6                                                        | Flow Models and Motion Segmentation with Layers                       | 1 |
| <b>Module 4 Classification and Tracking (8)</b>            |                                                                       |   |
| 4.1                                                        | Classification Basics, Two-class and Multiclass classifier            | 1 |
| 4.2                                                        | Error, Overfitting and Regularization                                 | 1 |
| 4.3                                                        | Cross Validation, Classifying Images of Single Objects                | 1 |
| 4.4                                                        | Tracking Basics, Simple Tracking Strategies                           | 1 |
| 4.5                                                        | Tracking by detection                                                 | 1 |
| 4.6                                                        | Linear Dynamical models                                               | 1 |
| 4.7                                                        | The Kalman Filter background                                          | 1 |
| 4.8                                                        | Kalman filter algorithm                                               | 1 |
| <b>Module 5 Finding Objects and other Applications (7)</b> |                                                                       |   |
| 5.1                                                        | Detecting Objects in Images- The Sliding Window Method                | 1 |
| 5.2                                                        | Object Recognition - Goals of Object Recognition System               | 1 |
| 5.3                                                        | Application of binocular stereo vision - Robot Navigation             | 1 |
| 5.4                                                        | Face detection                                                        | 1 |
| 5.5                                                        | Face recognition                                                      | 1 |
| 5.6                                                        | Activity recognition                                                  | 1 |
| 5.7                                                        | Tracking people                                                       | 1 |

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# **SEMESTER VIII**

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## **PROGRAM ELECTIVE IV**

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|               |                  |                 |          |          |          |                |                             |
|---------------|------------------|-----------------|----------|----------|----------|----------------|-----------------------------|
| <b>CCT416</b> | <b>CYBER LAW</b> | <b>CATEGORY</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>Credits</b> | <b>Year of Introduction</b> |
|               |                  | <b>PEC</b>      | <b>2</b> | <b>1</b> | <b>0</b> | <b>3</b>       | <b>2019</b>                 |

**Preamble:** This course provides a solid foundation that furnishes the learner with in depth knowledge of current Cyber laws. The course provides an insight into the laws keeping in view of the latest developments in IPRs related to computer field and growing cyber related crimes. The course also helps to create an understanding on Intellectual Properties and the importance of it, trademarks and Trade secrets and to create awareness of unfair competition and its methods.

**Course Outcomes:** After the completion of the course the student will be able to

| CO# | Course Outcomes                                                                                                                                                                              |
|-----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| CO1 | Highlight the basics and importance of Cyber space and IT act. <b>(Cognitive Knowledge Level: Understand)</b>                                                                                |
| CO2 | Comprehend the importance and need for Electronic Governance, internet service providers and their liability. <b>(Cognitive Knowledge Level: Understand)</b>                                 |
| CO3 | Use the provision of Cyber law to deal with types of Cyber Crimes, Cybercrime Complaints and National cyber security policy. <b>(Cognitive Knowledge Level: Apply)</b>                       |
| CO4 | Explain the procedure for registration, characteristics, publication, infringement and term of copyright and also know the other forms of IPR <b>(Cognitive Knowledge Level: Understand)</b> |
| CO5 | Deduce the legal aspects of Domain name and other cyber related disputes. <b>(Cognitive Knowledge Level: Apply)</b>                                                                          |

### Mapping of course outcomes with program outcomes

|     | PO1                                                                                 | PO2                                                                                 | PO3                                                                                 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12                                                                                  |
|-----|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-----|-----|-----|-----|-----|-----|------|------|---------------------------------------------------------------------------------------|
| CO1 |  |  |  |     |     |     |     |     |     |      |      |  |
| CO2 |  |  |  |     |     |     |     |     |     |      |      |  |

|     |   |   |   |  |  |  |  |  |  |  |  |   |
|-----|---|---|---|--|--|--|--|--|--|--|--|---|
| CO3 | ✓ | ✓ | ✓ |  |  |  |  |  |  |  |  | ✓ |
| CO4 | ✓ | ✓ | ✓ |  |  |  |  |  |  |  |  | ✓ |
| CO5 | ✓ | ✓ | ✓ |  |  |  |  |  |  |  |  | ✓ |

### Abstract POs defined by National Board of Accreditation

| PO# | Broad PO                                   | PO#  | Broad PO                       |
|-----|--------------------------------------------|------|--------------------------------|
| PO1 | Engineering Knowledge                      | PO7  | Environment and Sustainability |
| PO2 | Problem Analysis                           | PO8  | Ethics                         |
| PO3 | Design/Development of solutions            | PO9  | Individual and team work       |
| PO4 | Conduct investigations of complex problems | PO10 | Communication                  |
| PO5 | Modern tool usage                          | PO11 | Project Management and Finance |
| PO6 | The Engineer and Society                   | PO12 | Lifelong learning              |

### Assessment Pattern

| Bloom's Category | Continuous Assessment Tests |           | End Semester Examination |
|------------------|-----------------------------|-----------|--------------------------|
|                  | Test1 (%)                   | Test2 (%) | Marks (%)                |
| Remember         | 30                          | 30        | 30                       |
| Understand       | 30                          | 30        | 30                       |
| Apply            | 40                          | 40        | 40                       |
| Analyze          |                             |           |                          |
| Evaluate         |                             |           |                          |
| Create           |                             |           |                          |

**Mark Distribution**

| Total Marks | CIE Marks | ESE Marks | ESE Duration |
|-------------|-----------|-----------|--------------|
| 150         | 50        | 100       | 3 hours      |

**Continuous Internal Evaluation Pattern:**

Attendance : 10 marks

Continuous Assessment Tests : 25 marks

Continuous Assessment Assignment : 15 marks

**Internal Examination Pattern:**

Each of the two internal examinations has to be conducted out of 50 marks. First Internal Examination shall be preferably conducted after completing the first half of the syllabus and the Second Internal Examination shall be preferably conducted after completing the remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly covered module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly covered module), each with 7 marks. Out of the 7 questions in Part B, a student should answer any 5.

**End Semester Examination Pattern:**

There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which a student should answer any one. Each question can have a maximum 2 subdivisions and carries 14 marks.

**Syllabus****Module 1 (Cyber Space)**

Fundamental definitions -Interface of Technology and Law – Jurisprudence and-Jurisdiction in Cyber Space - Indian Context of Jurisdiction - Enforcement agencies – Need for IT act - UNCITRAL – E-Commerce basics .Information Technology Act, 2000 - Aims and Objects — Overview of the Act – Jurisdiction

**Module 2 (Electronic Governance)**

Legal Recognition of Electronic Records and Electronic Evidence -Digital Signature Certificates - Securing Electronic records and secure digital signatures - Duties of Subscribers - Role of Certifying



Authorities - Regulators under the Act -The Cyber Regulations Appellate Tribunal - Internet Service Providers and their Liability– Powers of Police under the Act – Impact of the Act on other Laws . Cyber Crimes -Meaning of Cyber Crimes –Different Kinds of Cyber crimes – Cyber crimes under IPC

### **Module 3 (Cr.P.C and Indian Evidence Law)**

Cybercrimes under the Information Technology Act 2000 - Cyber crimes under International Law – Hacking, Child Pornography, Cyber Stalking, Denial of service Attack, Virus Dissemination, Software Piracy, Internet Relay Chat (IRC) Crime, Credit Card Fraud, Net Extortion, Phishing etc - Cyber Terrorism Violation of Privacy on Internet - Data Protection and Privacy – Indian Court cases

### **Module 4 (Intellectual Property Rights)**

Copyrights- Software – Copyrights vs Patents debate - Authorship and Assignment Issues - Copyright in Internet - Multimedia and Copyright issues - Software Piracy - Trademarks - Trademarks in Internet – Copyright and Trademark cases.

### **Module 5 (Patents and Legal aspects)**

Understanding Patents - European Position on Computer related Patents, Legal position on Computer related Patents - Indian Position on Patents – Case Law, Domain names -registration - Domain Name Disputes-Cyber Squatting-IPR cases.

### **Text books**

1. Justice Yatindra Singh,” Cyber Laws”, Universal Law Publishing Co., New Delhi, 2020
2. Farouq Ahmed,”Cyber Law in India”, New Era publications, New Delhi,2017
3. S.R.Myneni, “Information Technology Law(Cyber Laws)”, Asia Law House, Hyderabad,3<sup>rd</sup> Edition, 2023

### **References**

1. Chris Reed, “Internet Law-Text and Materials”, Cambridge University Press, 2<sup>nd</sup> Edition,2004
2. Pawan Duggal,” Cyber Law- the Indian perspective”, Universal Law Publishing Co., New Delhi,2016.

### **Course Level Assessment Questions**

#### **Course Outcome 1 (CO1):**

1. What is a cyber space? Explain the interface of technology and law
2. Write down the need for IT act and explain IT act 2000.

**Course Outcome 2 (CO2):**

1. Define the term cybercrime. List and explain the cybercrimes under IPC.

**Course Outcome 3 (CO3):**

1. What is cyberstalking? What are its implications and how the case laws are applied?

**Course Outcome 4 (CO4):**

1. Describe the various types of intellectual property rights and state its objectives
2. Explain authorship and assignment issues.

**Course Outcome 5 (CO5):**

1. Differentiate between Legal position on Computer related Patents and Indian Position on Patents.
2. How laws are applied on infringement of Domain name disputes?

**MODEL QUESTION PAPER****QP CODE:****Reg No:** \_\_\_\_\_**Name :** \_\_\_\_\_**PAGES : 3****APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY****EIGHTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR****Course Code: CCT 416****Course Name: Cyber Law****Max.Marks:100****Duration: 3 Hours****PART A****Answer all Questions. Each question carries 3 Marks**

1. Define the terms jurisprudence and jurisdiction in cyber space.
2. What are the aims and objectives of IT Act 2000?
3. Write down the the role of Certifying Authorities in digital signature.
4. Define a cybercrime.
5. Differentiate between software piracy and phishing.
6. What is the role of an ISP?
7. Elucidate trademark in internet with example.
8. How is copyright issues identified and handled ?

9. Describe European Position on Computer related Patents
10. What is Cybersquatting?

(10\*3=30 Marks)

### PART B

**Answer any Two Question from each module. Each question carries 14 Marks**

- 11(a) Explain the interface of technology and law in the context of cyberspace. (8 marks)
- (b) Write down the need of IT Act. (6 marks)

**OR**

- 12(a) Explain Jurisdiction in Cyber Space. (8 marks)
- (b) Write down the role of enforcement agencies. (6 marks)

- 13(a) Give a detailed description on Digital Signature Certificate. (8marks)
- (b) Explain the different kinds of cyber crimes with possible scenarios. (6 marks)

**OR**

- 14(a) Explain the role of Certifying Authorities. (6marks)
- (b) What are the duties performed by the Cyber Regulations Appellate Tribunal? (8 marks)

- 15(a) What is Denial of service Attack? Give an example (6 marks)
- (b) What is Internet Relay Chat (IRC) Crime? How is it identified? (8marks)

**OR**

- 16(a) What is cyber terrorism?. (6marks)
- (b)Write down the scenarios in which data privacy is violated? (8marks)

- 17(a)Differentiate between copyright and patents?. (8marks)
- (b)Write down the different copyright issues?. (6marks)

**OR**

- 18(a)What is a trademark? How is it achieved?. (6marks)
- (b)Write down the cases which involve infringement of trademarks. (8 marks)

- 19(a) What is a Case Law? Explain (6marks)
- (b)What are the steps involved in the registration of a Domain Name? (8marks)

**OR**

- 20(a)Explain the Legal positions on Computer related Patents. (8marks)
- (b)What is IPR? Write down the different IPR cases (6 marks)

## TEACHING PLAN

| Sl.No                                                     | Contents                                                                                   | No.of Lecture Hrs<br>(36) |
|-----------------------------------------------------------|--------------------------------------------------------------------------------------------|---------------------------|
| <b>Module 1 (Cyber Space) ( 6 hrs)</b>                    |                                                                                            |                           |
| 1.1                                                       | Fundamental definitions ,Interface of Technology and Law                                   | 1                         |
| 1.2                                                       | Jurisprudence and-Jurisdiction in Cyber Space ,Indian Context of Jurisdiction              | 1                         |
| 1.3                                                       | Enforcement agencies                                                                       | 1                         |
| 1.4                                                       | Need for IT act ,UNCITRAL, E-Commerce basics                                               | 1                         |
| 1.5                                                       | Information Technology Act, 2000                                                           | 1                         |
| 1.6                                                       | Aims and Objects — Overview of the Act, Jurisdiction                                       | 1                         |
| <b>Module 2 (Electronic Governance) ( 8 hrs)</b>          |                                                                                            |                           |
| 2.1                                                       | Legal Recognition of Electronic Records and Electronic Evidence                            | 1                         |
| 2.2                                                       | Digital Signature Certificates - Securing Electronic records and secure digital signatures | 1                         |
| 2.3                                                       | Duties of Subscribers - Role of Certifying Authorities                                     | 1                         |
| 2.4                                                       | Regulators under the Act                                                                   | 1                         |
| 2.5                                                       | The Cyber Regulations Appellate Tribunal, Internet Service Providers and their Liability   | 1                         |
| 2.6                                                       | Powers of Police under the Act, Impact of the Act on other Laws                            | 1                         |
| 2.7                                                       | Meaning of Cyber Crimes –Different Kinds of Cyber crimes                                   | 1                         |
| 2.8                                                       | Cybercrimes under IPC                                                                      | 1                         |
| <b>Module 3 (Cr.P.C and Indian Evidence Law) ( 8 hrs)</b> |                                                                                            |                           |
| 3.1                                                       | Introduction                                                                               | 1                         |
| 3.2                                                       | Cybercrimes under the Information Technology Act 2000                                      | 1                         |
| 3.3                                                       | Cyber crimes under International Law                                                       | 1                         |
| 3.4                                                       | Hacking, Child Pornography, Cyber Stalking,                                                | 1                         |
| 3.5                                                       | Denial of service Attack , Virus Dissemination, Software Piracy                            | 1                         |
| 3.6                                                       | Internet Relay Chat (IRC) Crime, Credit Card Fraud, Net Extortion, Phishing                | 1                         |
| 3.7                                                       | Cyber Terrorism Violation of Privacy on Internet                                           | 1                         |
| 3.8                                                       | Data Protection and Privacy – Indian Court cases                                           | 1                         |
| <b>Module 4 (Intellectual Property Rights)( 7 hrs)</b>    |                                                                                            |                           |
| 4.1                                                       | Introduction .                                                                             | 1                         |
| 4.2                                                       | Copyrights, Copyrights vs Patents debate                                                   | 1                         |
| 4.3                                                       | Authorship and Assignment Issues                                                           | 1                         |
| 4.4                                                       | Copyright in Internet                                                                      | 1                         |

|     |                                                       |   |
|-----|-------------------------------------------------------|---|
| 4.5 | Multimedia and Copyright issues                       | 1 |
| 4.6 | Software Piracy - Trademarks                          | 1 |
| 4.7 | Trademarks in Internet, Copyright and Trademark cases | 1 |

**Module 5 (Patents and Legal aspects) (7 hrs)**

|     |                                                                       |   |
|-----|-----------------------------------------------------------------------|---|
| 5.1 | Understanding Patents - European Position on Computer related Patents | 1 |
| 5.2 | Legal position on Computer related Patents                            | 1 |
| 5.3 | Indian Position on Patents                                            | 1 |
| 5.4 | Case Law, Domain names                                                | 1 |
| 5.5 | Domain name registration, Domain Name Disputes                        | 1 |
| 5.6 | Cyber Squatting                                                       | 1 |
| 5.7 | IPR cases                                                             | 1 |



|         |                   |          |   |   |   |        |                      |
|---------|-------------------|----------|---|---|---|--------|----------------------|
| CCT 456 | BIG DATA SECURITY | CATEGORY | L | T | P | CREDIT | YEAR OF INTRODUCTION |
|         |                   | PEC      | 2 | 1 | 0 | 3      | 2019                 |

**Preamble:**

The course explores the foundations of big data, including its foundations in computing technology and statistics. The course also gives an understanding of the nature of underlying technical challenges and statistical assumptions used to understand relationships in a variety of applied fields, with a focus on the fields of fraud detection and communication monitoring.

**Course Outcomes:** After the completion of the course, the student will be able to

| CO# | Course Outcomes                                                                                                              |
|-----|------------------------------------------------------------------------------------------------------------------------------|
| CO1 | Explain the basics of Big Data and their challenges. <b>(Cognitive knowledge level: Understand)</b>                          |
| CO2 | Explain the difference between predictive analytics and descriptive analytics <b>(Cognitive knowledge level: Understand)</b> |
| CO3 | Trace out the role played by authentication in security <b>(Cognitive knowledge level: Apply)</b>                            |
| CO4 | Describe the security concerns of big-data. <b>(Cognitive knowledge level: Understand)</b>                                   |
| CO5 | Escalate the applications of security analytics. <b>(Cognitive knowledge level: Apply)</b>                                   |

**Mapping of course outcomes with program outcomes**

|     | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | P10 | P11 | P12 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| CO1 | ✓   | ✓   | ✓   |     |     |     |     |     |     |     |     | ✓   |
| CO2 | ✓   | ✓   | ✓   |     |     |     |     |     |     |     |     | ✓   |
| CO3 | ✓   | ✓   | ✓   |     | ✓   |     |     |     |     |     |     | ✓   |

|     |   |   |   |  |   |  |  |  |  |  |  |   |
|-----|---|---|---|--|---|--|--|--|--|--|--|---|
| CO4 | ✓ | ✓ | ✓ |  | ✓ |  |  |  |  |  |  | ✓ |
| CO5 | ✓ | ✓ | ✓ |  | ✓ |  |  |  |  |  |  | ✓ |

| Abstract POs defined by National Board of Accreditation |                                            |      |                                |
|---------------------------------------------------------|--------------------------------------------|------|--------------------------------|
| PO#                                                     | Broad PO                                   | PO#  | Broad PO                       |
| PO1                                                     | Engineering Knowledge                      | PO7  | Environment and Sustainability |
| PO2                                                     | Problem Analysis                           | PO8  | Ethics                         |
| PO3                                                     | Design/Development of solutions            | PO9  | Individual and teamwork        |
| PO4                                                     | Conduct investigations of complex problems | PO10 | Communication                  |
| PO5                                                     | Modern tool usage                          | PO11 | Project Management and Finance |
| PO6                                                     | The Engineer and Society                   | PO12 | Lifelong learning              |

### Assessment Pattern

| Bloom's Category | Test 1 (Marks in percentage) | Test 2 (Marks in percentage) | End Semester Examination (Marks in percentage) |
|------------------|------------------------------|------------------------------|------------------------------------------------|
| Remember         | 30                           | 30                           | 30                                             |
| Understand       | 30                           | 30                           | 30                                             |
| Apply            | 40                           | 40                           | 40                                             |
| Analyze          |                              |                              |                                                |
| Evaluate         |                              |                              |                                                |
| Create           |                              |                              |                                                |

### Mark Distribution

| Total Marks | CIE Marks | ESE Marks | ESE Duration |
|-------------|-----------|-----------|--------------|
| 150         | 50        | 100       | 3            |



**Continuous Internal Evaluation Pattern:**Attendance : **10 marks**Continuous Assessment Test : **25 marks**Continuous Assessment Assignment : **15 marks**

**Internal Examination Pattern:** Each of the two internal examinations has to be conducted out of 50 marks. The first series test shall be preferably conducted after completing the first half of the syllabus. The second series test shall be preferably conducted after completing the remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly completed module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly completed module), each with 7 marks. Out of the 7 questions, a student should answer any 5.

**End Semester Examination Pattern:** There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which a student should answer anyone. Each question can have a maximum 2 subdivisions and carries 14 marks.

## Syllabus

**Module 1 (Introduction to Big Data)**

Introduction to Big Data, Evolution of Big data, Characteristics. Big Data Analytics, Big Data framework - fundamental concepts of Big Data management and analytics - Current challenges and trends in Big Data Acquisition.

**Module 2 (Data Analytics)**

Predictive Analytics: Regression, Decision Tree, Neural Networks - Descriptive Analytics: Association Rules, Sequence Rules, Survival Analysis: Survival Analysis Measurements, Kaplan Meir Analysis, Parametric Survival Analysis - Social Network Analytics: Social Network Learning Relational Neighbor Classification

**Module 3 (Introduction to Security Analytics)**

Introduction to Security Analytics – Techniques in Analytics – Analysis in everyday life – Challenges in Intrusion and Incident Identification – Simulation and Security Process, Analytical Software's and tools, Malware Analysis – static and dynamic analysis - Security Intelligence – Security Breaches

#### **Module 4(Applications of Security Analytics)**

Access Analytics – Analysis of Log file -Security analysis with text mining –Machine Learning and data mining applications for security: Intrusion detection and network anomaly detection. Big data analytics for security: Analyzing DDOS – Distributed Denial of Service attack: counter based method, and access pattern based method – Machine learning for Ransomware detection and prevention.

#### **Module 5 (Big Data Privacy and Applications)**

Data Masking – Privately Identified Information (PII) -Privacy preservation in Big Data- Popular Big Data Techniques and tools- Map Reduce paradigm and the Hadoop system – Applications- Social Media Analytics- Recommender Systems- Fraud Detection.

#### **Text Books**

1. Bart Baesens, "Analytics in a Big Data World: The Essential Guide to Data Science and its Applications", John Wiley & Sons, 2014
2. Min Chen, Shiwen Mao, Yin Zhang, Victor CM Leung, “Big Data: Related Technologies, Challenges and Future Prospects” , Springer, 2014.
3. Michael Minelli, Michele Chambers, AmbigaDhiraj ,“Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends”, John Wiley & Sons, 2013.

#### **References**

1. Raj, Pethuru, “Handbook of Research on Cloud Infrastructures for Big Data Analytics”, IGI Global.
2. Douglas R. Stinson ,“Cryptography Theory and Practice ”, Chapman & Hall/CRC, 3rd Edition, 2006.
3. Mark Talabis, Robert McPherson, I Miyamoto and Jason Martin, “Information Security Analytics: Finding Security Insights, Patterns, and Anomalies in Big Data”, Syngress Media, U.S., 2014.

**Sample Course Level Assessment Questions**

**Course Outcome 1 (CO1):**

1. Explain the Evolution of Big Data and their characteristics
2. Describe any five characteristics of Big Data.

**Course Outcome 2 (CO2):**

1. Describe the prediction error and regression techniques
2. Explain the three categories of Prediction methodologies.

**Course Outcome 3 (CO3):**

1. Identify the various challenges in Intrusion and Incident Identification.

**Course Outcome 4 (CO4):**

1. How machine learning helps in Ransom ware detection and prevention.

**Course Outcome 5 (CO5):**

1. What is Privacy preservation? Discuss its importance in Big Data.

**Model Question Paper**

**QP CODE:**

**Reg No:** \_\_\_\_\_

**Name :** \_\_\_\_\_

**PAGES : 3**

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY**

**EIGHTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR**

**Course Code: CCT 456**

**Course Name: BIG DATA SECURITY**

**Max.Marks:100**

**Duration: 3 Hours**

**PART A**

**Answer all Questions. Each question carries 3 Marks**

1. Explain the Evolution of Big Data.

2. Describe any five characteristics of Big Data
3. How decision trees aid in big data analytics.
4. What is regression analysis? How is it done?
5. Why data Analytics is needed?
6. How is security analytics done?
7. Explain DDOS attack.
8. How does analysis of log files assist in security analytics?
9. Define Data masking.
10. How map reduce is performed in hadoop?

### PART B

**Answer any one Question from each module.**

**Each question carries 14 Marks**

11. a) Illustrate the various phases involved in Big Data Analytics with a neat diagram. (7)  
 b) Explain the trends in big data acquisition. (7)
- OR**
12. a) Describe the challenges in big data acquisition (7)  
 b) Explain Big data framework. (7)
13. a) Illustrate Kaplan Meir Analysis with an example (8)  
 b) Describe Social network Analytics (6)
- OR**
14. a) Compare predictive and descriptive analysis. (7)  
 b) Describe Parametric Survival Analysis. (7)
15. a) Compare and contrast static and dynamic malware analysis. (7)  
 b) Describe the various security breaches possibilities in big data scenarios. (7)
- OR**
16. a) Summarize various challenges in Intrusion and Incident Identification. (8)  
 b) Briefly explain various methods used in security analytics. (6)
17. a) Differentiate between counter based method and access pattern based method. (8)

b) Describe how network anomaly detection is done (6)

**OR**

18. a) How machine learning helps in Ransomware detection and prevention. (8)

b) Explain the scope of Security analysis with text mining. (6)

19. a) Describe Popular Big Data Techniques and tools. (8)

b) Explain the significance of Privately Identified Information. (6)

**OR**

20.a) How is Privacy preservation in Big Data achieved (8)

b) Describe the role of Recommender Systems (6)

### TEACHING PLAN

| Sl.No.                                             | Contents                                                  | No of Lecture Hrs (35) |
|----------------------------------------------------|-----------------------------------------------------------|------------------------|
| <b>Module 1 (Introduction to Big Data) (6 hrs)</b> |                                                           |                        |
| 1.1                                                | Introduction to Big Data                                  | 1 hour                 |
| 1.2                                                | Evolution of Big data, Characteristics                    | 1 hour                 |
| 1.3                                                | Big Data Analytics, Big Data framework                    | 1 hour                 |
| 1.4                                                | Fundamental concepts of Big Data management and analytics | 1 hour                 |
| 1.5                                                | Current challenges in Big Data Acquisition                | 1 hour                 |
| 1.6                                                | Trends in Big Data Acquisition                            | 1 hour                 |
| <b>Module 2 (Data Analytics) (8 hrs)</b>           |                                                           |                        |
| 2.1                                                | Predictive Analytics: Regression, Decision Tree           | 1 hour                 |

|                                                              |                                                            |        |
|--------------------------------------------------------------|------------------------------------------------------------|--------|
| 2.2                                                          | Neural Networks                                            | 1 hour |
| 2.3                                                          | Descriptive Analytics: Association Rules, Sequence Rules.  | 1 hour |
| 2.4                                                          | Survival Analysis: Survival Analysis Measurements          | 1 hour |
| 2.5                                                          | Kaplan Meir Analysis                                       | 1 hour |
| 2.6                                                          | Parametric Survival Analysis                               | 1 hour |
| 2.7                                                          | Social Network Analytics                                   | 1 hour |
| 2.8                                                          | Social Network Learning Relational Neighbor Classification | 1 hour |
| <b>Module 3 (Introduction to Security Analytics) (8 hrs)</b> |                                                            |        |
| 3.1                                                          | Introduction to Security Analytics                         | 1 hour |
| 3.2                                                          | Techniques in Analytics – Analysis in everyday life        | 1 hour |
| 3.3                                                          | Challenges in Intrusion and Incident Identification        | 1 hour |
| 3.4                                                          | Simulation and Security Process                            | 1 hour |
| 3.5                                                          | Analytical Softwares and tools                             | 1 hour |
| 3.6                                                          | Malware Analysis                                           | 1 hour |
| 3.7                                                          | Static and dynamic analysis                                | 1 hour |
| 3.8                                                          | Security Intelligence – Security Breaches                  | 1 hour |
| <b>Module 4(Applications of Security Analytics) (7 hrs)</b>  |                                                            |        |
| 4.1                                                          | Access Analytics – Analysis of Log file                    | 1 hour |
| 4.2                                                          | Security analysis with text mining.                        | 1 hour |

|                                                             |                                                                                             |        |
|-------------------------------------------------------------|---------------------------------------------------------------------------------------------|--------|
| 4.3                                                         | Machine Learning and data mining applications for security:                                 | 1 hour |
| 4.4                                                         | Intrusion detection and network anomaly detection.                                          | 1 hour |
| 4.5                                                         | Big data analytics for security: Analyzing DDOS –                                           | 1 hour |
| 4.6                                                         | Distributed Denial of Service attack: counter based method, and access pattern based method | 1 hour |
| 4.7                                                         | Machine learning for Ransom ware detection and prevention.                                  | 1 hour |
| <b>Module 5 (Big Data Privacy and Applications) (6 hrs)</b> |                                                                                             |        |
| 5.1                                                         | Data Masking – Privately Identified Information (PII).                                      | 1 hour |
| 5.2                                                         | Privacy preservation in Big Data.                                                           | 1 hour |
| 5.3                                                         | Popular Big Data Techniques and tools- Map Reduce paradigm                                  | 1 hour |
| 5.4                                                         | Hadoop system.                                                                              | 1 hour |
| 5.5                                                         | Applications- Social Media Analytics                                                        | 1 hour |
| 5.6                                                         | Recommender Systems- Fraud Detection.                                                       | 1 hour |



|        |                            |          |   |   |   |        |                      |
|--------|----------------------------|----------|---|---|---|--------|----------------------|
| CST426 | CLIENT SERVER ARCHITECTURE | CATEGORY | L | T | P | CREDIT | YEAR OF INTRODUCTION |
|        |                            | PEC      | 2 | 1 | 0 | 3      | 2019                 |

**Preamble:** The syllabus is prepared with the view of preparing the Engineering Graduates to build effective Client/Server applications. This course aims at providing a foundation in decentralized computer systems, using the client/server model. The course content is decided to cover the essential fundamentals which can be taught within the given slots in the curriculum.

**Prerequisite:** Computer Networks

**Course Outcomes:** After the completion of the course the student will be able to

|             |                                                                                                                                                                  |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>CO 1</b> | Explain the basics of client/server systems and the driving force behind the development of client/server systems <b>(Cognitive Knowledge Level: Understand)</b> |
| <b>CO 2</b> | Outline the architecture and classifications of client/server systems <b>(Cognitive Knowledge Level: Understand)</b>                                             |
| <b>CO 3</b> | Choose the appropriate client/server network services for a typical application <b>(Cognitive Knowledge Level: Understand)</b>                                   |
| <b>CO 4</b> | Describe management services and issues in network <b>(Cognitive Knowledge Level: Understand)</b>                                                                |
| <b>CO 5</b> | Compare and summarize the web extensions and choose appropriate web services standards for an application <b>(Cognitive Knowledge Level: Understand)</b>         |

## Mapping of course outcomes with program outcomes

|     | PO1                                                                                 | PO2                                                                                 | PO3                                                                                 | PO4 | PO5                                                                                 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12                                                                                  |
|-----|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-----|-------------------------------------------------------------------------------------|-----|-----|-----|-----|------|------|---------------------------------------------------------------------------------------|
| CO1 |  |  |                                                                                     |     |  |     |     |     |     |      |      |  |
| CO2 |  |  |                                                                                     |     |                                                                                     |     |     |     |     |      |      |  |
| CO3 |  |  |                                                                                     |     |  |     |     |     |     |      |      |  |
| CO4 |  |                                                                                     |                                                                                     |     |                                                                                     |     |     |     |     |      |      |  |
| CO5 |  |  |  |     |                                                                                     |     |     |     |     |      |      |  |

| Abstract POs defined by National Board of Accreditation |                                            |      |                                |
|---------------------------------------------------------|--------------------------------------------|------|--------------------------------|
| PO#                                                     | Broad PO                                   | PO#  | Broad PO                       |
| PO1                                                     | Engineering Knowledge                      | PO7  | Environment and Sustainability |
| PO2                                                     | Problem Analysis                           | PO8  | Ethics                         |
| PO3                                                     | Design/Development of solutions            | PO9  | Individual and team work       |
| PO4                                                     | Conduct investigations of complex problems | PO10 | Communication                  |
| PO5                                                     | Modern tool usage                          | PO11 | Project Management and Finance |
| PO6                                                     | The Engineer and Society                   | PO12 | Life long learning             |

### Assessment Pattern

| Bloom's Category | Continuous Assessment Tests |                | End Semester Examination Marks |
|------------------|-----------------------------|----------------|--------------------------------|
|                  | Test 1 (Marks)              | Test 2 (Marks) |                                |
| Remember         | 30                          | 30             | 30                             |
| Understand       | 70                          | 70             | 50                             |
| Apply            |                             |                |                                |
| Analyse          |                             |                |                                |
| Evaluate         |                             |                |                                |
| Create           |                             |                |                                |

### Mark distribution

| Total Marks | CIE Marks | ESE Marks | ESE Duration |
|-------------|-----------|-----------|--------------|
| 150         | 50        | 100       | 3 hours      |

### Continuous Internal Evaluation Pattern:

|                                                                        |            |
|------------------------------------------------------------------------|------------|
| Attendance                                                             | : 10 marks |
| Continuous Assessment Test 1 (for theory, for 2 hrs)                   | : 20 marks |
| Continuous Assessment Test 2 (for lab, internal examination, for 2hrs) | : 20 marks |

**Internal Examination Pattern:** There will be two parts; Part A and Part B. Part A contains 5 questions with 2 questions from each module ( $2.5 \text{ modules} \times 2 = 5$ ), having 3 marks for each question. Students should answer all questions. Part B also contains 5 questions with 2 questions from each module ( $2.5 \text{ modules} \times 2 = 5$ ), of which a student should answer any one. The questions should not have sub- divisions and each one carries 7 marks.

**End Semester Examination Pattern:** There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which a student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

### Sample Course Level Assessment Questions

#### Course Outcome 1 (CO1):

1. Explain the driving forces behind the development of Client/ Server system from different perspectives.

#### Course Outcome 2 (CO2):

1. How two-tier computing and three-tier computing improves the performance of Client/Server system.

#### Course Outcome 3(CO3):

1. Explain the role of client in Client/Server computing and also explain the various services provided by client.
2. What is the primary motivation behind the RPC facility ? How does a RC facility makes the job of distributed application programmers simpler?
3. Implement RPC concept using suitable language/tool(Assignment)

#### Course Outcome 4 (CO4):

1. Explain Connectivity and Communication Interface Technology in Client/Server application. How does transmission protocol work in Client/Server application?

#### Course Outcome 5 (CO5):

1. Discuss the role of web browser for providing web service in Client/Server environment.
2. Identify and explain the social relevance of web services (Assignment)

## Syllabus

### Module – 1 (Introduction)

Introduction to Client/Server computing - Driving forces behind Client/ Server, Client/ Server development tools, Development of client/server systems, Client/Server security, Organizational Expectations, Improving performance of client/server applications, Single system image, Downsizing and Rightsizing, Advantages of client server computing, Applications of Client/Server.

### Module -2 (Client/Server Application Components)

Classification of Client/Server Systems- Two-Tier Computing, Middleware, Three-Tier Computing- Model View Controller (MVC), Principles behind Client/Server Systems. Client/Server Topologies. Existing Client/Server Architecture. Architecture for Business Information System.

### Module -3 (Client/Server Network)

Client- Services, Request for services, RPC, Windows services, Print services, Remote boot services, other remote services, Utility Services. Dynamic Data Exchange (DDE). Object Linking and Embedding (OLE). Common Object Request Broker Architecture (CORBA).

Server- Detailed server functionality, Network operating system, Available platforms, Server operating system.

### Module -4 (Client/ Server Systems Development)

Services and Support- System administration, Availability, Reliability, Scalability, Observability, Agility, Serviceability. Software Distribution, Performance, Network management. Remote Systems Management- RDP, Telnet, SSH, Security. LAN and Network Management issues, Training, Connectivity, Communication interface technology, Interprocess communication, Wide area network technologies, Network Acquisition, PC-level processing unit, X-terminals, Server hardware.

### Module -5 (Client/Server Technology and Web Services)

Web Services History. Web Server Technology- Web Server, Web Server Communication, Role of Java for Client/Server on Web. Web Services- MicroServices, APIs, API Gateway, Authentication of users/clients, Tokens/Keys for Authentication, Service Mesh, Message Queues, SaaS, Web Sockets.

Client/Server/Browser – Server Technology, Client/Server Technology and Web Applications, Balanced Computing and the Server's Changing Role. Thin client computing - Computing models-Comparison-Computing Environment.

Future of client/ server Computing Enabling Technologies, Transformational system.

### Text Books

1. Patrick Smith & Steave Guengerich, "Client / Server Computing", PHI
2. Dawna Travis Dewire, "Client/Server Computing", TMH

### Reference Books

1. Jeffrey D.Schank, "Novell's Guide to Client-Server Application & Architecture" Novell Press
2. Robert Orfali, Dan Harkey, Jeri Edwards, Client/Server Survival Guide, Wiley-India Edition, Third Edition
3. W. H. Inman, Developing Client Server Applications, BPB

### Model Question Paper

**QP CODE:**

**Reg No:** \_\_\_\_\_

**Name:** \_\_\_\_\_

**PAGES : 4**

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY**

**EIGHTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR**

**Course Code: CST426**

**Course Name : Client Server Architecture**

**Max. Marks : 100**

**Duration: 3 Hours**

**PART A**

**Answer All Questions. Each Question Carries 3 Marks**

1. How client/server computing environment is different from mainframe based computing environment?
2. Write short notes on single system image and downsizing.
3. Discuss the topologies of Clients/Server system with suitable examples.
4. Discuss the relevance of Clients/Server system in adopting open system standards. Justify your answer.

5. Enumerate the services provided in a client/server system.
6. List out the features of network operating system.
7. How interposes communication is established?.
8. Write short note on x-terminals.
9. Explain the history of web services.
10. With an example, explain the role of java for client/server on web (10x3=30)

**Part B**

**(Answer any one question from each module. Each question carries 14 Marks)**

11. (a) Explain the driving forces behind the development of Client/ Server system from different perspectives. (10)  
(b) Explain the various Clients/Server system development tools. (4)
- OR**
12. (a) Explain Client/Server System development methodology and explain various phases and their activities involved in System Integration Life Cycle. (10)  
(b) Write short notes on the following. (a) Single system image. (b) Downsizing and Client/Server computing. (4)
13. (a) How two-tier computing and three-tier computing improves the performance of Client/Server system. (10)  
(b) List out the principles behind client/server systems . (4)
- OR**
14. (a) Explain the architecture of Business Information System. (10)  
(b) Explain different ways to improve performance in Client/Server developed applications. (4)
15. (a) In Client/Server computing, explain the following with example in detail (a) Dynamic Data Exchange (b) RPC (c) Remote Boot Service (d) Object-linking and embedding. (10)

- (b) Explain the role of client in Client/Server computing and also explain the various services provide by client. (4)

**OR**

16. (a) Explain the architecture of CORBA. (10)

- (b) Explain the server functionality in detail, for Client/Server computing. (4)

17. (a) Explain Connectivity and Communication Interface Technology in Client/Server application. How does transmission protocol work in Client/Server application? (10)

- (b) Comment on the network service acquisition mechanism for the client/service model. (4)

**OR**

18. (a) In client server architecture, what do you mean by Availability, Reliability, Serviceability and Security? Explain with examples (10)

- (b) How remote systems management security is ensured in a Client/Server application. (4)

19. (a) What is the future of Client/Server computing in the following technologies (i) Electronic Document Management. (ii) Full Text Retrieval. (iii) Geographic Information System. (10)

- (b) Discuss the role of web browser for providing web service in Client/Server environment. (4)

**OR**

20. (a) Explain end-to-end working of Client/Server web model. (10)

- (b) Explain the architecture of Transformational system. (4)



## Teaching Plan

| Sl No                                                            | Contents                                                                          | No. of Lecture Hours (35) |
|------------------------------------------------------------------|-----------------------------------------------------------------------------------|---------------------------|
| <b>Module- 1( Introduction) (7 hours)</b>                        |                                                                                   |                           |
| 1.1                                                              | Driving forces behind Client/ Server                                              | 1 hour                    |
| 1.2                                                              | Client Server development tools                                                   | 1 hour                    |
| 1.3                                                              | Development of client/server systems                                              | 1 hour                    |
| 1.4                                                              | Client/Server security, Organizational Expectations                               | 1 hour                    |
| 1.5                                                              | Improving performance of client/server applications                               | 1 hour                    |
| 1.6                                                              | Single system image, Downsizing and Rightsizing                                   | 1 hour                    |
| 1.7                                                              | Advantages and Applications of client server computing                            | 1 hour                    |
| <b>Module- 2(Client/Server Application Components) (8 hours)</b> |                                                                                   |                           |
| 2.1                                                              | Classification of Client/Server Systems                                           | 1 hour                    |
| 2.2                                                              | Open System Standards                                                             | 1 hour                    |
| 2.3                                                              | Two-Tier Computing                                                                | 1 hour                    |
| 2.4                                                              | Three-Tier Computing, Middleware                                                  | 1 hour                    |
| 2.5                                                              | Principles behind Client/Server Systems                                           | 1 hour                    |
| 2.6                                                              | Client/Server Topologies                                                          | 1 hour                    |
| 2.7                                                              | Existing Client/Server Architecture                                               | 1 hour                    |
| 2.8                                                              | Architecture for Business Information System                                      | 1 hour                    |
| <b>Module- 3(Client/Server Network) (6 hours)</b>                |                                                                                   |                           |
| 3.1                                                              | The client: Services, Request for services, RPC, Windows services, Print services | 1 hour                    |
| 3.2                                                              | Remote boot services, Utility Services & Other Services                           | 1 hour                    |
| 3.3                                                              | Dynamic Data Exchange (DDE), Object Linking and Embedding (OLE)                   | 1 hour                    |
| 3.4                                                              | Common Object Request Broker Architecture (CORBA)                                 | 1 hour                    |

|                                                                       |                                                                                                                    |        |
|-----------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------|--------|
| 3.5                                                                   | The server: Detailed server functionality, the network operating system                                            | 1 hour |
| 3.6                                                                   | Available platforms, the server operating system                                                                   | 1 hour |
| <b>Module- 4( Client Server Systems Development) (7 hours)</b>        |                                                                                                                    |        |
| 4.1                                                                   | Services and Support, System administration                                                                        | 1 hour |
| 4.2                                                                   | Availability, Reliability, Scalability, Observability, Agility Serviceability, Software Distribution, Performance  | 1 hour |
| 4.3                                                                   | Network management, Remote Systems Management, RDP,Telnet,SSH                                                      | 1 hour |
| 4.4                                                                   | Security ,LAN and Network Management issues                                                                        | 1 hour |
| 4.4                                                                   | Training, Connectivity, Communication interface technology                                                         | 1 hour |
| 4.5                                                                   | Interposes communication, wide area network technologies                                                           | 1 hour |
| 4.6                                                                   | Network Acquisition, PC-level processing unit, x-terminals, server Hardware                                        | 1 hour |
| <b>Module -5(Client/Server Technology And Web Services) (7 hours)</b> |                                                                                                                    |        |
| 5.1                                                                   | Web Services History , Web Server Technology , Web Server                                                          | 1 hour |
| 5.2                                                                   | Web Server Communication , Role of Java for Client/Server on Web                                                   | 1 hour |
| 5.3                                                                   | Web Services , MicroServices, APIs, API Gateway, Authentication of users/clients                                   | 1 hour |
| 5.4                                                                   | Tokens/Keys for Authentication ,Service Mesh, Message Queues                                                       | 1 hour |
| 5.5                                                                   | SaaS, Web Sockets ,Client/Server Technology and Web Applications                                                   | 1 hour |
| 5.6                                                                   | Balanced Computing and the Server's Changing Role ,Thin client computing , Computing models, Computing Environment | 1 hour |
| 5.7                                                                   | Future of client/ server Computing Enabling Technologies, Transformational system                                  | 1 hour |

| CST436 | PARALLEL COMPUTING | CATEGORY | L | T | P | CREDIT | YEAR OF INTRODUCTION |
|--------|--------------------|----------|---|---|---|--------|----------------------|
|        |                    | PEC      | 2 | 1 | 0 |        |                      |

**Preamble:** This course helps the learners to understand basic and advanced concepts of parallel computing. It covers Principles of Parallel Algorithm Design, Communication operations, Programming Using the Message Passing Paradigm, Programming Shared Address Space Platforms Thread Basics, and GPU Programming. This course enables a learner to design solutions to complex real world problems using parallel computing paradigms including thread parallelism, shared memory program, message passing interfaces, and vector processing.

**Prerequisite:** Knowledge in Computer Organization and Architecture.

**Course Outcomes:** After the completion of the course the students will be able to

|     |                                                                                                                          |
|-----|--------------------------------------------------------------------------------------------------------------------------|
| CO1 | Summarize the key parallel computational models ( <b>Cognitive Knowledge Level : Understand</b> )                        |
| CO2 | Appreciate and apply parallel and distributed algorithms in problem Solving ( <b>Cognitive Knowledge Level : Apply</b> ) |
| CO3 | Appreciate the communication models for parallel algorithm development ( <b>Cognitive Knowledge Level : Understand</b> ) |
| CO4 | Develop parallel algorithms using message passing paradigm ( <b>Cognitive Knowledge Level : Apply</b> )                  |
| CO5 | Formulate parallel algorithms for shared memory architectures. ( <b>Cognitive Knowledge Level : Apply</b> )              |
| CO6 | Demonstrate the fundamental skills of heterogeneous computing with GPUs( <b>Cognitive Knowledge Level : Apply</b> )      |

**Mapping of course outcomes with program outcomes**

|     | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|
| CO1 |     |     |     |     |     |     |     |     |     |      |      |      |
| CO2 |     |     |     |     |     |     |     |     |     |      |      |      |
| CO3 |     |     |     |     |     |     |     |     |     |      |      |      |
| CO4 |     |     |     |     |     |     |     |     |     |      |      |      |

|     |  |  |  |  |  |  |  |  |  |  |  |  |
|-----|--|--|--|--|--|--|--|--|--|--|--|--|
| CO5 |  |  |  |  |  |  |  |  |  |  |  |  |
| CO6 |  |  |  |  |  |  |  |  |  |  |  |  |

| Abstract POs Defined by National Board of Accreditation |                                            |      |                                |
|---------------------------------------------------------|--------------------------------------------|------|--------------------------------|
| PO#                                                     | Broad PO                                   | PO#  | Broad PO                       |
| PO1                                                     | Engineering Knowledge                      | PO7  | Environment and Sustainability |
| PO2                                                     | Problem Analysis                           | PO8  | Ethics                         |
| PO3                                                     | Design/Development of solutions            | PO9  | Individual and teamwork        |
| PO4                                                     | Conduct investigations of complex problems | PO10 | Communication                  |
| PO5                                                     | Modern tool usage                          | PO11 | Project Management and Finance |
| PO6                                                     | The Engineer and Society                   | PO12 | Lifelong learning              |

#### Assessment Pattern

| Blooms Category | Continuous Assessment Tests |                     | End Semester Examination Marks |
|-----------------|-----------------------------|---------------------|--------------------------------|
|                 | Test 1 (Percentage)         | Test 2 (Percentage) |                                |
| Remember        | 30                          | 20                  | 20                             |
| Understand      | 50                          | 40                  | 40                             |
| Apply           | 20                          | 40                  | 40                             |

|          |  |  |  |
|----------|--|--|--|
| Analyze  |  |  |  |
| Evaluate |  |  |  |
| Create   |  |  |  |

**Mark Distribution**

| Total Marks | CIE Marks | ESE Marks | ESE Duration |
|-------------|-----------|-----------|--------------|
| 150         | 50        | 100       | 3 Hours      |

**Continuous Internal Evaluation Pattern:**

|                                  |          |
|----------------------------------|----------|
| Attendance                       | 10 marks |
| Continuous Assessment Tests      | 25 marks |
| Continuous Assessment Assignment | 15 marks |

**Internal Examination Pattern:**

Each of the two internal examinations has to be conducted out of 50 marks. First Internal Examination shall be preferably conducted after completing the first half of the syllabus, and the Second Internal Examination shall be preferably conducted after completing the remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly covered module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly covered module), each with 7 marks. Out of the 7 questions in Part B, a student should answer any 5.

**End Semester Examination Pattern:**

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which a student should answer anyone. Each question can have a maximum 2 subdivisions and carries 14 marks.

## Syllabus

### Module- 1 (Principles of Parallel Algorithm Design)

Basic Introduction to Parallel Processing platforms. Preliminaries, Decomposition Techniques, Characteristics of Tasks and Interactions, Mapping Techniques for Load Balancing, Methods for Containing Interaction Overheads, Parallel Algorithm Models.

### Module- 2 (Communication Operations)

Basic Communication Operations - One-to-All Broadcast and All-to-One Reduction, All-to-All Broadcast and Reduction, All-Reduce and Prefix-Sum Operations, Scatter and Gather, All-to-All Personalized Communication, Circular Shift, Improving the Speed of Some Communication Operation

### Module-3 (Programming Using the Message Passing Paradigm)

Principles of Message-Passing Programming, The Building Blocks: Send and Receive Operations, MPI: The Message Passing Interface, Overlapping Communication with Computation, Collective Communication and Computation Operations, Groups and Communicators.

### Module 4 (Programming Shared Address Space Platforms Thread Basics)

Thread Basics, Why Threads? The POSIX Thread Application Programme Interface, Synchronization Primitives in POSIX, Controlling Thread and Synchronization Attributes, Thread Cancellation, Composite Synchronization Constructs, OpenMP: a Standard for Directive Based Parallel Programming, Specifying Concurrent Tasks in OpenMP, Synchronization Constructs in OpenMP, Data Handling in OpenMP, OpenMP Library Functions, OpenMP Applications: Parallel algorithm development for Matrix multiplication

### Module 5 (GPU Programming)

Heterogeneous Parallel Computing, Architecture of a Modern GPU, Speeding up Real Applications, Data parallel computing, CUDA C Program Structure, A Vector Addition Kernel, Device Global Memory and Data Transfer, Kernel Functions and Threading, Kernel Launch, CUDA Thread Organization, Mapping Threads to Multidimensional Data, Synchronization and Transparent Scalability, Resource Assignment, Querying Device Properties, Thread Scheduling and Latency Tolerance, Importance of Memory Access Efficiency, Cuda Memory Types, Tiling for Reduced Memory Traffic, Tiled Matrix Multiplication Kernel, Boundary Checks

**Text Books**

1. Ananth Grama, Anshul Gupta, George Karypis, Vipin Kumar, Introduction to Parallel Computing, 2nd Ed, Addison-Wesley, 2003
2. David B. Kirk, Wen-mei W. Hwu, Programming Massively Parallel Processors: A Hands-on Approach, 3rd Ed., Morgan Kaufman, 2016.

**References**

1. Steven Brawer, Introduction to Parallel Computing, Academic Press, (1989)
2. Barbara Chapman, Gabriele Jost, Ruud van der Pas, Using OpenMP: Portable Shared Memory Parallel Programming, MIT Press, 2008.
3. William Gropp, Ewing Lusk, Anthony Skjellum Using MPI: Portable Parallel Programming with the Message-Passing Interface, 3rd Ed, MIT Press, 2014.
4. Thomas Rauber, Gudula Rünger, Parallel Programming for Multicore and Cluster Systems, Springer, 2010

**Sample Course Level Assessment Questions****Course Outcome 1 (CO1):**

1. Differentiate between static and dynamic task mapping
2. Explain partitioning of data with an example

**Course Outcome 2 (CO2):**

1. Explain the handshaking sequence of Blocking Non-Buffered Send/Receive operation with a neat diagram.
2. In the algorithm, assume a decomposition such that each execution of Line 7 is a task. Draw a task-dependency graph and a task-interaction graph.

```
1.procedure FFT_like_pattern(A, n)
```

```
2.begin
```

```
3.m := $\log_2 n$;
```

```
4.for j := 0 to m - 1 do
```

```
5.k := 2j;
```

```
6.for i := 0 to n - 1 do
```

```
7.A[i] := A[i] + A[i XOR 2j];
```

```
8.end // for
```

```
9.end // FFT_like_pattern
```



**Course Outcome 3 (CO3):**

1. Write a procedure for performing all-to-all reduction on a mesh
2. Give a hypercube algorithm to compute prefix sums of  $n$  numbers if  $p$  is the number of nodes and  $n/p$  is an integer greater than 1. Assuming that it takes time  $t_{add}$  to add two numbers and time  $t_s$  to send a message of unit length between two directly-connected nodes, give an exact expression for the total time taken by the algorithm.

**Course Outcome 4(CO4):**

1. Show how the two-dimensional matrix-vector multiplication program needs to be changed so that it will work correctly for a matrix of size  $n \times m$  on a  $q \times r$  process grid
2. One of the advantages of non-blocking communication operations is that they allow the transmission of the data to be done concurrently with computations. Discuss the type of restructuring that needs to be performed on a program to allow for the maximal overlap of computation with communication. Is the sending process in a better position to benefit from this overlap than the receiving process

**Course Outcome 5(CO5):**

1. Implement a multi-access threaded queue with multiple threads inserting and multiple threads extracting from the queue. Use mutex-locks to synchronize access to the queue. Document the time for 1000 insertions and 1000 extractions each by 64 insertion threads (producers) and 64 extraction threads (consumers).
2. Implement a producer-consumer framework in OpenMP using sections to create a single producer task and a single consumer task. Ensure appropriate synchronization using locks.

**Course Outcome 6 (CO6):**

1. Consider a hypothetical block with 8 threads executing a section of code before reaching a barrier. The threads require the following amount of time (in microseconds) to execute the sections: 2.0, 2.3, 3.0, 2.8, 2.4, 1.9, 2.6, and 2.9 and to spend the rest of their time waiting for the barrier. What percentage of the total execution time of the thread is spent waiting for the barrier?
2. Write and explain the CUDA program for vector addition.

## Model Question Paper

QP CODE: \_\_\_\_\_

PAGES :3

Reg No: \_\_\_\_\_

Name: \_\_\_\_\_

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY**  
**EIGHTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR**

**Course Code: CST436**

**Course Name: PARALLEL COMPUTING**

**Max.Marks:100**

**Duration: 3 Hours**

### **PART A**

**Answer All Questions. Each Question Carries 3 Marks**

1. Explain partitioning of data with an example
2. Which are the characteristics of tasks influencing the selection of mapping scheme?
3. Describe the scatter - gather communication.
4. Explain the Circular Shift operation.
5. Explain the handshaking sequence of Blocking Non-Buffered Send/Receive operation with a neat diagram.
6. Describe the six fundamental routines of MPI.
7. Explain thread cancellation.
8. Explain how concurrent tasks are specified in openMP
9. Explain the architecture of modern GPU with a diagram.
10. Describe how the data transfer between GPU device and the host memories are managed. **(10x3=30)**

### **Part B**

**(Answer any one question from each module. Each question carries 14 Marks)**

11. (a) Describe recursive decomposition with an example.

**(8)**

- (b) Compare various parallel algorithm models (6)

OR

12. (a) Differentiate between static and dynamic task mapping (8)

- (b) In the algorithm, assume a decomposition such that each execution of Line 7 is a task. Draw a task-dependency graph and a task-interaction graph. (6)

```
1. procedure FFT_like_pattern(A, n)
2. begin
3. m := log2 n;
4. for j := 0 to m - 1 do
5. k := 2j;
6. for i := 0 to n - 1 do
7. A[i] := A[i] + A[i XOR 2j];
8. end // for
9. end // FFT_like_pattern
```

13. (a) Illustrate the All-to-All Broadcast and Reduction with an example (8)

- (b) Explain any three techniques to improve the speed of communication operations (6)

OR

14. (a) Explain the One-to-All Broadcast and All-to-One Reduction with an example (8)

- (b) Explain the Ring and Mesh techniques of All-to-All Personalized communication. (6)

15. (a) Explain Collective Communication and Computation Operations in MPI (9)

- (b) Show the impact of finite buffers in message passing. (5)

OR

16. (a) Write algorithm for Collective Communication and Computation Operations (9)

using MPI.

- (b) How is deadlock avoided in *MPI\_Send* and *MPI\_Recv* (5)
- 17. (a) Explain how mutual exclusion for shared variables are accomplished in threads. (6)
- (b) Explain the nesting of parallel directives with a suitable example. (8)

OR

- 18. (a) Explain the compilation operations of an example openMP program along with its *pThread* translations. (4)
- (b) Explain the parallel matrix multiplication using openMP (10)
- 19. (a) Describe the CUDA Kernel functions. (6)
- (b) How is synchronization between CUDA threads achieved? (8)

OR

- 20. (a) Explain the two-level hierarchical organization of CUDA threads. (10)
- (b) Write and explain the CUDA program for vector addition. (4)

Estd.



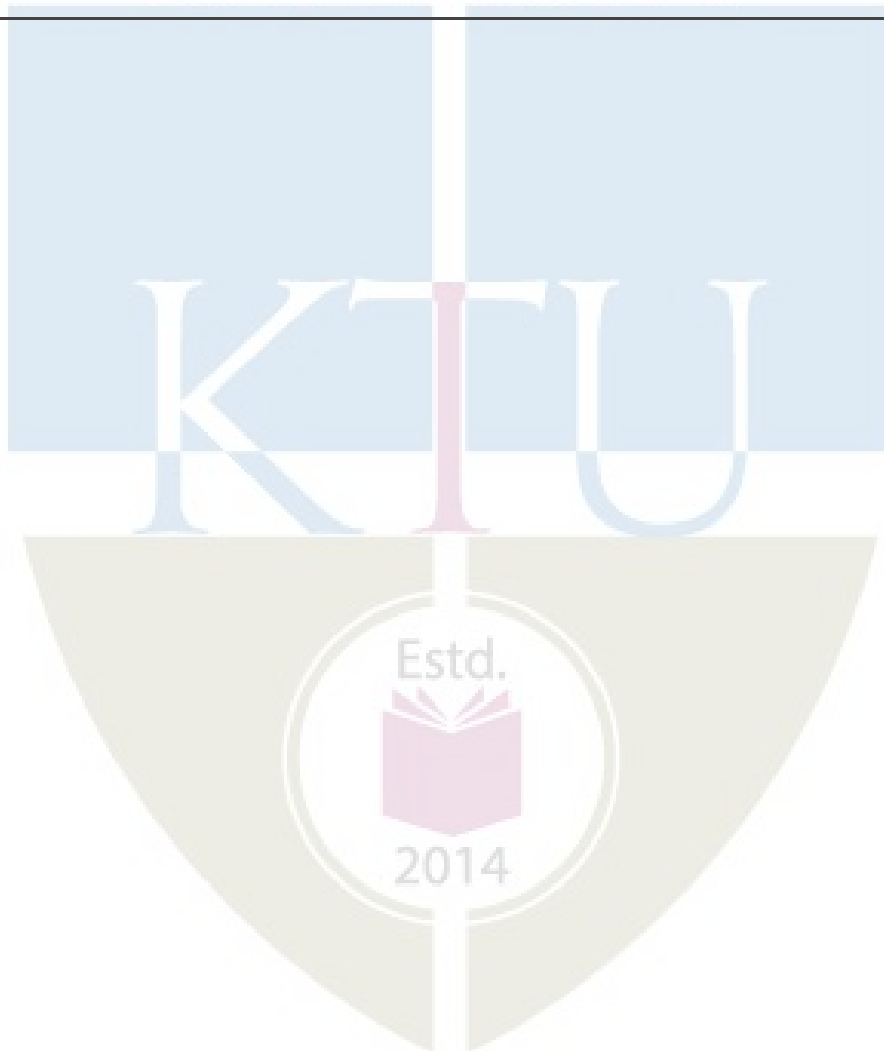
2014

**TEACHING PLAN**

| No                                                                                        | Contents                                                                                    | No of Lecture Hrs (37) |
|-------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------|------------------------|
| <b>Module – 1 (Basic Introduction to Parallel Processing ) (TB-1, Ch. 3) (7 hrs)</b>      |                                                                                             |                        |
| 1.1                                                                                       | Basic Introduction to Parallel Processing platforms. Preliminaries                          | 1                      |
| 1.2                                                                                       | Decomposition Techniques – Recursive, Data                                                  | 1                      |
| 1.3                                                                                       | Decomposition Techniques – Exploratory, Speculative, Hybrid                                 | 1                      |
| 1.4                                                                                       | Characteristics of Tasks and Interactions                                                   | 1                      |
| 1.5                                                                                       | Mapping Techniques for Load Balancing -Static                                               | 1                      |
| 1.6                                                                                       | Mapping Techniques for Load Balancing - Dynamic                                             | 1                      |
| 1.7                                                                                       | Methods for Containing Interaction Overheads, Parallel Algorithm Models.                    | 1                      |
| <b>Module- 2 (Basic Communication Operations ) (TB-1, Ch. 4) (6hrs)</b>                   |                                                                                             |                        |
| 2.1                                                                                       | One-to-All Broadcast and All-to-One Reduction                                               | 1                      |
| 2.2                                                                                       | All-to-All Broadcast and Reduction                                                          | 1                      |
| 2.3                                                                                       | All-Reduce and Prefix-Sum Operations, Scatter Gather                                        | 1                      |
| 2.4                                                                                       | All-to-All Personalized Communication                                                       | 1                      |
| 2.5                                                                                       | Circular Shift                                                                              | 1                      |
| 2.6                                                                                       | Improving the Speed of Some Communication Operation                                         | 1                      |
| <b>Module- 3 ( Programming Using the Message Passing Paradigm) (TB-1, Ch. 6 ) (7 hrs)</b> |                                                                                             |                        |
| 3.1                                                                                       | Principles of Message-Passing Programming, The Building Blocks: Send and Receive Operations | 1                      |
| 3.2                                                                                       | MPI: The Message Passing Interface                                                          | 1                      |
| 3.3                                                                                       | MPI: The Message Passing Interface : Illustration                                           | 1                      |

|                                                                                       |                                                                                               |   |
|---------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------|---|
| 3.4                                                                                   | Overlapping Communication with Computation                                                    | 1 |
| 3.5                                                                                   | Overlapping Communication with Computation : Illustration                                     | 1 |
| 3.6                                                                                   | Collective Communication and Computation Operations                                           | 1 |
| 3.7                                                                                   | Collective Communication and Computation Operations : Illustration                            | 1 |
| <b>Module 4 (Programming Shared Address Space Platforms) (TB-1, Ch. 7, 8 ) (8hrs)</b> |                                                                                               |   |
| 4.1                                                                                   | Thread Basics, Why Threads? The POSIX Thread API                                              | 1 |
| 4.2                                                                                   | Synchronization Primitives in POSIX                                                           | 1 |
| 4.3                                                                                   | Controlling Thread and Synchronization Attributes                                             | 1 |
| 4.4                                                                                   | Thread Cancellation, Composite Synchronization Constructs,                                    | 1 |
| 4.5                                                                                   | OpenMP: a Standard for Directive Based Parallel Programming                                   | 1 |
| 4.6                                                                                   | Specifying Concurrent Tasks in OpenMP, Synchronization Constructs in OpenMP                   | 1 |
| 4.7                                                                                   | Data Handling in OpenMP, OpenMP Library Functions                                             | 1 |
| 4.8                                                                                   | OpenMP Applications: Parallel algorithm development for Matrix multiplication                 | 1 |
| <b>Module 5 (GPU Programming) (TB-2, Ch. 1, 2 ) (9 hrs)</b>                           |                                                                                               |   |
| 5.1                                                                                   | Heterogeneous Parallel Computing, Architecture of a Modern GPU, Speeding up Real Applications | 1 |
| 5.2                                                                                   | Data parallel computing – CUDA C Program Structure                                            | 1 |
| 5.3                                                                                   | Vector Addition Kernel, Device Global Memory and Data Transfer                                | 1 |
| 5.4                                                                                   | Kernel Functions and Threading, Kernel Launch                                                 | 1 |

|     |                                                                                                                                       |   |
|-----|---------------------------------------------------------------------------------------------------------------------------------------|---|
| 5.5 | CUDA Thread Organization, Mapping Threads to Multidimensional Data                                                                    | 1 |
| 5.6 | Synchronization and Transparent Scalability, Resource Assignment, Querying Device Properties, Thread Scheduling and Latency Tolerance | 1 |
| 5.7 | Importance of Memory Access Efficiency, Cuda Memory Types                                                                             | 1 |
| 5.8 | Tiling for Reduced Memory Traffic                                                                                                     | 1 |
| 5.9 | Tiled Matrix Multiplication Kernel, Boundary Checks                                                                                   | 1 |





| CST446 | DATA COMPRESSION TECHNIQUES | CATEGORY | L | T | P | CREDIT | YEAR OF INTRODUCTION |
|--------|-----------------------------|----------|---|---|---|--------|----------------------|
|        |                             | PEC      | 2 | 1 | 0 | 3      | 2019                 |

**Preamble:** This course helps the learners to understand compression techniques on text, image, audio and video data. It covers lossy & lossless compression, RLE, JPEG, MPEG and its variants. This course enables the students to develop and implement compression algorithms on different domains.

**Prerequisite:** Knowledge of probability theory, computation on matrices, basic topics in data structures, storage and efficiency

**Course Outcomes:** After the completion of the course the student will be able to

| CO# | CO                                                                                                                                       |
|-----|------------------------------------------------------------------------------------------------------------------------------------------|
| CO1 | Describe the fundamental principles of data compression( <b>Cognitive Knowledge level: Understand</b> )                                  |
| CO2 | Make use of statistical and dictionary based compression techniques for various applications ( <b>Cognitive Knowledge level: Apply</b> ) |
| CO3 | Illustrate various image compression standards. ( <b>Cognitive Knowledge level: Apply</b> )                                              |
| CO4 | Summarize video compression mechanisms to reduce the redundancy in video.( <b>Cognitive Knowledge level: Understand</b> )                |
| CO5 | Use the fundamental properties of digital audio to compress audio data.( <b>Cognitive Knowledge level: Understand</b> )                  |

**Mapping of course outcomes with program outcomes**

|     | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|
| CO1 |     |     |     |     |     |     |     |     |     |      |      |      |
| CO2 |     |     |     |     |     |     |     |     |     |      |      |      |
| CO3 |     |     |     |     |     |     |     |     |     |      |      |      |
| CO4 |     |     |     |     |     |     |     |     |     |      |      |      |
| CO5 |     |     |     |     |     |     |     |     |     |      |      |      |

| Abstract POs defined by National Board of Accreditation |                                            |      |                                |
|---------------------------------------------------------|--------------------------------------------|------|--------------------------------|
| PO#                                                     | Broad PO                                   | PO#  | Broad PO                       |
| PO1                                                     | Engineering Knowledge                      | PO7  | Environment and Sustainability |
| PO2                                                     | Problem Analysis                           | PO8  | Ethics                         |
| PO3                                                     | Design/Development of solutions            | PO9  | Individual and team work       |
| PO4                                                     | Conduct investigations of complex problems | PO10 | Communication                  |
| PO5                                                     | Modern tool usage                          | PO11 | Project Management and Finance |
| PO6                                                     | The Engineer and Society                   | PO12 | Life long learning             |

#### Assessment Pattern

| Bloom's Category | Continuous Assessment Tests |            | End Semester Examination Marks (%) |
|------------------|-----------------------------|------------|------------------------------------|
|                  | Test 1 (%)                  | Test 2 (%) |                                    |
| Remember         | 30                          | 30         | 30                                 |
| Understand       | 40                          | 40         | 40                                 |
| Apply            | 30                          | 30         | 30                                 |
| Analyze          |                             |            |                                    |
| Evaluate         |                             |            |                                    |
| Create           |                             |            |                                    |

#### Mark Distribution

| Total Marks | CIE Marks | ESE Marks | ESE Duration |
|-------------|-----------|-----------|--------------|
| 150         | 50        | 100       | 3            |

#### Continuous Internal Evaluation Pattern:

|                                                            |          |
|------------------------------------------------------------|----------|
| Attendance                                                 | 10 marks |
| Continuous Assessment Tests(Average of Series Tests 1 & 2) | 25 marks |
| Continuous Assessment Assignment                           | 15 marks |

### **Internal Examination Pattern:**

Each of the two internal examinations has to be conducted out of 50 marks. First series test shall be preferably conducted after completing the first half of the syllabus and the second series test shall be preferably conducted after completing remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly completed module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly completed module), each with 7 marks. Out of the 7 questions, a student should answer any 5.

### **End Semester Examination Pattern:**

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 full questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carries 14 marks.

## **Syllabus**

### **Module-1 (Modelling and types of compression)) 1**

Introduction to Compression Techniques- Lossy compression & Lossless compression, Measures of Performance, Modeling and coding. Mathematical modelling for Lossless and lossy compression - Physical models and probability models.

### **Module – 2 (Basic Compression Methods)**

Basic Compression Technique- Run length encoding, RLE Text compression. Statistical Methods- Prefix Codes, Binary Huffman coding, non-binary Huffman Algorithms, Arithmetic Coding.

### **Module - 3 (Text & Image Compression)**

Dictionary based Coding- LZ77, LZ78 and LZW compression. Image Compression- Image standards, JPEG image Compression- Baseline JPEG, JPEG-LS.

### **Module - 4 (Video Compression)**

Video Compression- Analog video, Digital Video, Motion Compensation. MPEG standards- MPEG 1, MPEG 4

### **Module - 5 (Audio Compression)**

Audio Compression- Basics of Digital Audio, Basic Audio Compression Techniques, MPEG Audio Compression-Layer 1 coding, Layer 2 coding and Layer 3 coding.

### Text Book

1. David Solomon, Data compression: the complete reference, 4/e, Springer, January 2007
2. Khalid Sayood, Introduction to data compression, Morgan Kaufmann Publishers, 2003.

### References

- 1) Stephen Welstead, Fractal and wavelet Image Compression techniques, PHI, 1999.
- 2) Sleinreitz, Multimedia System, Addison Wesley.
- 3) Mark Nelson and Jean-loup Gailly, The Data Compression Book, M&T Books.

### Course Level Assessment Questions

#### Course Outcome 1 (CO1):

1. Discuss different types of compression performance metrics
2. Explain mathematical model for lossless compression

#### Course Outcome 2 (CO2):

1. Explain RLE based text compression and identify a example with compression ratio of 2.
2. Given the eight symbols A, B, C, D, E, F, G, and H with probabilities  $\frac{1}{30}$ ,  $\frac{1}{30}$ ,  $\frac{1}{30}$ ,  $\frac{2}{30}$ ,  $\frac{3}{30}$ ,  $\frac{5}{30}$ ,  $\frac{5}{30}$ , and  $\frac{12}{30}$ , draw three different Huffman trees with heights 5 and 6 for these symbols and calculate the average code size for each tree.

#### Course Outcome 3 (CO3):

1. Differentiate the LZ77 and LZ78 performance with the input given as 'sirsideastmaneasilyteasesseasickseals'
2. Explain why the continuous-tone images is required for JPEG and the main steps used in image compression.

#### Course Outcome 4 (CO4):

1. Briefly explain MPEG-4 video compression standard
2. How H.261 video compression is completed.

#### Course Outcome 5 (CO5):

1. Explain critical bands, thresholding and masking related to audio compression
2. Explain the working of -law encoder and decoder with an example

## Model Question Paper

**QP CODE:**

**Reg No:** \_\_\_\_\_

**Name:** \_\_\_\_\_

**PAGES : 2**

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY**

**EIGHTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR**

**Course Code: CST446**

**Course Name: Data Compression Techniques**

**Max.Marks:100**

**Duration: 3 Hours**

### **PART A**

**Answer All Questions. Each Question Carries 3 Marks**

1. Specify different quantities used to measure the performance of a data compression technique
2. Explain mathematical model for lossless compression
3. State and prove Kraft-McMillan inequality
4. Compare Huffman and Arithmetic coding
5. Describe LZ77 approach of encoding a string with the help of an example
6. Compare and contrast JPEG and JPEG-LS differences in working.
7. Discuss different components of video
8. Identify the advantage of MPEG-4 over MPEG
9. Explain critical bands, thresholding and masking related to audio compression
10. Explain the working of -law encoder and decoder with an example

**(10x3=30)**

**Part B**

**(Answer any one question from each module. Each question carries 14 Marks)**

11. (a) Explain mathematical model for lossy compression and lossless compression (10)  
(b) Define compression ratio with an example (4)

**OR**

12. (a) Discuss any probability model and identify the shortcoming of the solution. (7)  
(b) Identify the mathematical preliminaries for Lossless Compression (7)
13. (a) With a help of flowchart discuss the RLE text compression for text data given below (10)  
`'ABBBBBBBBCDEEEF'`  
(b) calculate the compression ratio for the example while taking repetitions = 4 (4)

**OR**

14. (a) Illustrate with a example why Huffman coding is preferred than Shannon Fano Algorithm for compression (10)  
(b) How Huffman coding is handling the unpredictability of input data stream (4)
15. (a) Explain in detail the working of LZ78 with example and dictionary Tree (10)  
(b) Illustrate with example, how the compression factor LZW differ from the LZ78 (4)

**OR**

16. (a) How quantization and coding helps in compression and their role in JPEG. (6)  
(b) With the help of the given example illustrate the compression ratio of JPEG and JPEG-LS (8)
17. (a) With the help of equations discuss Composite and Components Video (7)  
(b) Differentiate the major changes in MPEG - 2 and MPEG-4 Video (7)

**OR**

18. (a) Describe in details about functionalities for MPEG-4 (8)  
(b) How Motion Compensation help in video compression (6)
19. (a) How The Human Auditory System limitations can be taken in audio (7)

compressions

- (b) Discuss the complexity of Layer III compared to others in MPEG Audio Coding (7)

**OR**

20. (a) Discuss Format of Compressed Data and encoding in layer I and II (9)
- (b) Differentiate Spectral and Temporal Masking (5)

### TEACHING PLAN

| No                                                             | Contents                                                                                                  | No of Lecture Hrs (36 Hours) |
|----------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------|------------------------------|
| <b>Module – 1 (Modelling and types of compression) (7 hrs)</b> |                                                                                                           |                              |
| 1.1                                                            | Introduction to Compression Techniques- Lossy compression & Lossless compression, Measures of Performance | 2                            |
| 1.2                                                            | Modelling and coding.                                                                                     | 1                            |
| 1.3                                                            | Physical model for lossless compression                                                                   | 1                            |
| 1.4                                                            | Physical model for lossy compression                                                                      | 1                            |
| 1.5                                                            | Probability model for lossless compression                                                                | 1                            |
| 1.6                                                            | Probability model for lossy compression                                                                   | 1                            |
| <b>Module - 2 (Basic Compression Methods) (8 hrs)</b>          |                                                                                                           |                              |
| 2.1                                                            | Run length encoding, RLE Text compression                                                                 | 1                            |
| 2.2                                                            | Statistical methods-Prefix Codes                                                                          | 1                            |
| 2.3                                                            | Binary Huffman coding                                                                                     | 1                            |
| 2.4                                                            | Illustration of Binary Huffman coding                                                                     | 1                            |
| 2.5                                                            | Non-binary Huffman Algorithms                                                                             | 1                            |
| 2.6                                                            | Arithmetic Coding algorithm                                                                               | 1                            |
| 2.7                                                            | Illustration of Arithmetic Coding algorithm                                                               | 2                            |



| <b>Module - 3 (Text &amp; Image Compression) (8 hrs)</b> |                                                              |   |
|----------------------------------------------------------|--------------------------------------------------------------|---|
| 3.1                                                      | LZ77 compression                                             | 2 |
| 3.2                                                      | LZ78 Compression                                             | 1 |
| 3.3                                                      | LZW Compression                                              | 1 |
| 3.4                                                      | Basics of Image compression and Image standards              | 1 |
| 3.5                                                      | Baseline JPEG Image compression                              | 1 |
| 3.6                                                      | JPEG-LS Image compression                                    | 1 |
| <b>Module - 4 (Video Compression) (7 hrs)</b>            |                                                              |   |
| 4.1                                                      | Basics of Video Compression- Analog video and Digital Video. | 2 |
| 4.2                                                      | Motion Compensation                                          | 1 |
| 4.3                                                      | MPEG-1 standard and Video Syntax                             | 1 |
| 4.4                                                      | MPEG-1 Pel Reconstruction                                    | 1 |
| 4.5                                                      | MPEG-4 standard                                              | 1 |
| 4.6                                                      | Functionalities for MPEG-4                                   | 1 |
| <b>Module - 5 (Audio Compression) ( 6 hrs)</b>           |                                                              |   |
| 5.1                                                      | Basics of Audio Compression, Digital Audio                   | 1 |
| 5.2                                                      | Basic Audio Compression Techniques                           | 1 |
| 5.3                                                      | MPEG Audio Compression basics- Frequency Domain Coding       | 1 |
| 5.4                                                      | Encoding: Layers I and II                                    | 1 |
| 5.5                                                      | Encoding: Layer II -Psychoacoustic Models                    | 1 |
| 5.6                                                      | Psychoacoustic Models - Encoding: Layer III                  | 1 |

| CST466 | DATA MINING | CATEGORY | L | T | P | CREDIT | YEAR OF INTRODUCTION |
|--------|-------------|----------|---|---|---|--------|----------------------|
|        |             | PEC      | 2 | 1 | 0 | 3      | 2019                 |

**Preamble:** This course helps the learner to understand the concepts of data mining and data warehousing. It covers the key processes of data mining, data preprocessing techniques, fundamentals and advanced concepts of classification, clustering, association rule mining, web mining and text mining. It enables the learners to develop new data mining algorithms and apply the existing algorithms in real-world scenarios.

**Prerequisite:** NIL

**Course Outcomes:** After the completion of the course the student will be able to

| CO# | CO                                                                                                                                                                    |
|-----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| CO1 | Employ the key process of data mining and data warehousing concepts in application domains. ( <b>Cognitive Knowledge Level: Understand</b> )                          |
| CO2 | Make use of appropriate preprocessing techniques to convert raw data into suitable format for practical data mining tasks ( <b>Cognitive Knowledge Level: Apply</b> ) |
| CO3 | Illustrate the use of classification and clustering algorithms in various application domains ( <b>Cognitive Knowledge Level: Apply</b> )                             |
| CO4 | Comprehend the use of association rule mining techniques. ( <b>Cognitive Knowledge Level: Apply</b> )                                                                 |
| CO5 | Explain advanced data mining concepts and their applications in emerging domains ( <b>Cognitive Knowledge Level: Understand</b> )                                     |

**Mapping of course outcomes with program outcomes**

|     | PO 1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|-----|------|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|
| CO1 |      |     |     |     |     |     |     |     |     |      |      |      |
| CO2 |      |     |     |     |     |     |     |     |     |      |      |      |
| CO3 |      |     |     |     |     |     |     |     |     |      |      |      |

|     |  |  |  |  |  |  |  |  |  |  |  |  |
|-----|--|--|--|--|--|--|--|--|--|--|--|--|
| CO4 |  |  |  |  |  |  |  |  |  |  |  |  |
| CO5 |  |  |  |  |  |  |  |  |  |  |  |  |

| Abstract POs defined by National Board of Accreditation |                                            |      |                                |
|---------------------------------------------------------|--------------------------------------------|------|--------------------------------|
| PO#                                                     | Broad PO                                   | PO#  | Broad PO                       |
| PO1                                                     | Engineering Knowledge                      | PO7  | Environment and Sustainability |
| PO2                                                     | Problem Analysis                           | PO8  | Ethics                         |
| PO3                                                     | Design/Development of solutions            | PO9  | Individual and team work       |
| PO4                                                     | Conduct investigations of complex problems | PO10 | Communication                  |
| PO5                                                     | Modern tool usage                          | PO11 | Project Management and Finance |
| PO6                                                     | The Engineer and Society                   | PO12 | Lifelong learning              |

### Assessment Pattern

| Bloom's Category | Continuous Assessment Tests |            | End Semester Examination Marks (%) |
|------------------|-----------------------------|------------|------------------------------------|
|                  | Test 1 (%)                  | Test 2 (%) |                                    |
| Remember         | 20                          | 20         | 20                                 |
| Understand       | 30                          | 30         | 30                                 |
| Apply            | 50                          | 50         | 50                                 |
| Analyze          |                             |            |                                    |
| Evaluate         |                             |            |                                    |
| Create           |                             |            |                                    |

### Mark Distribution

| Total Marks | CIE Marks | ESE Marks | ESE Duration |
|-------------|-----------|-----------|--------------|
| 150         | 50        | 100       | 3            |

**Continuous Internal Evaluation Pattern:**

|                                                         |          |
|---------------------------------------------------------|----------|
| Attendance                                              | 10 marks |
| Continuous Assessment Test(Average of Internal Test1&2) | 25 marks |
| Continuous Assessment Assignment                        | 15 marks |

**Internal Examination Pattern**

Each of the two internal examinations has to be conducted out of 50 marks. First series test shall be preferably conducted after completing the first half of the syllabus and the second series test shall be preferably conducted after completing the remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly completed module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly completed module), each with 7 marks. Out of the seven questions, a student should answer any five.

**End Semester Examination Pattern:**

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 full questions from each module of which student should answer any one. Each question can have a maximum 2 subdivisions and carries 14 marks.

**Syllabus****Module – 1 (Introduction to Data Mining and Data Warehousing)**

Data warehouse-Differences between Operational Database Systems and Data Warehouses, Multidimensional data model- Warehouse schema, OLAP Operations, Data Warehouse Architecture, Data Warehousing to Data Mining, Data Mining Concepts and Applications, Knowledge Discovery in Database Vs Data mining, Architecture of typical data mining system, Data Mining Functionalities, Data Mining Issues.

**Module - 2 (Data Preprocessing)**

Data Preprocessing-Need of data preprocessing, Data Cleaning- Missing values, Noisy data, Data Integration and Transformation, Data Reduction-Data cube aggregation, Attribute subset selection, Dimensionality reduction, Numerosity reduction, Discretization and concept hierarchy generation.

**Module - 3 (Advanced classification and Cluster analysis)**

Classification- Introduction, Decision tree construction principle, Splitting indices -Information Gain, Gini index Decision tree construction algorithms-ID3, Decision tree construction with presorting-SLIQ, Classification Accuracy-Precision, Recall.

Introduction to clustering-Clustering Paradigms, Partitioning Algorithm- PAM, Hierarchical Clustering-DBSCAN, Categorical Clustering-ROCK

**Module 4: (Association Rule Analysis)**

Association Rules-Introduction, Methods to discover Association rules, Apriori(Level-wise algorithm), Partition Algorithm, Pincer Search Algorithm, Dynamic Itemset Counting Algorithm, FP-tree Growth Algorithm.

**Module 5 (Advanced Data Mining Techniques)**

Web Mining - Web Content Mining, Web Structure Mining- Page Rank, Clever, Web Usage Mining- Preprocessing, Data structures, Pattern Discovery, Pattern Analysis. Text Mining-Text Data Analysis and information Retrieval, Basic measures for Text retrieval, Text Retrieval methods, Text Indexing Techniques, Query Processing Techniques.

**Text Books**

1. Dunham M H, "Data Mining: Introductory and Advanced Topics", Pearson Education, New Delhi, 2003.
2. Arun K Pujari, "Data Mining Techniques", Universities Press Private Limited, 2008.
3. Jaiwei Han and Micheline Kamber, "Data Mining Concepts and Techniques", Elsevier, 2006

**Reference Books**

1. M Sudeep Elayidom, "Data Mining and Warehousing", 1st Edition, 2015, Cengage Learning India Pvt. Ltd.
2. Mehmed Kantardzic, "Data Mining Concepts, Methods and Algorithms", John Wiley and Sons, USA, 2003.
3. Pang-Ning Tan and Michael Steinbach, "Introduction to Data Mining", Addison Wesley, 2006.

## Course Level Assessment Questions

### Course Outcome 1 (CO1):

- Explain the OLAP operations in a multidimensional model.
  - Compare the techniques used in ROLAP, MOLAP and HOLAP
- Explain the various data mining issues with respect to mining methodology, user interaction and diversity of data types.
- Suppose that a data warehouse consists of the three dimensions time, doctor, and patient, and the two measures count and charge, where charge is the fee that a doctor charges a patient for a visit.
  - Draw star and snowflake schema diagrams for the data warehouse.
  - Starting with the base cuboid [day; doctor; patient], what specific OLAP operations should be performed in order to list the total fee collected by each doctor in 2004?

### Course Outcome 2 (CO2):

- Use the methods below to normalize the following group of data: 100, 200, 300, 400, 550, 600, 680, 850, 1000
  - min-max normalization by setting min = 0 and max = 1
  - z-score normalization
  - Normalization by decimal scaling

Comment on which method you would prefer to use for the given data, giving reasons as to why.

- Identify a suitable dataset from any available resources and apply different preprocessing steps that you have learned. Observe and analyze the output obtained. (Assignment)

### Course Outcome 3 (CO3):

- Illustrate the working of ID3 algorithm with the following example

| MOTOR | WHEELS | DOORS | SIZE   | TYPE       | CLASS      |
|-------|--------|-------|--------|------------|------------|
| NO    | 2      | 0     | small  | cycle      | bicycle    |
| NO    | 3      | 0     | small  | cycle      | tricycle   |
| YES   | 2      | 0     | small  | cycle      | motorcycle |
| YES   | 4      | 2     | small  | automobile | Sports car |
| YES   | 4      | 3     | medium | automobile | minivan    |
| YES   | 4      | 4     | medium | automobile | sedan      |
| YES   | 4      | 4     | large  | automobile | sumo       |

- Illustrate the working of K medoid algorithm for the given dataset.  $A_1=(3,9)$ ,  $A_2=(2,5)$ ,  $A_3=(8,4)$ ,  $A_4=(5,8)$ ,  $A_5=(7,5)$ ,  $A_6=(6,4)$ ,  $A_7=(1,2)$ ,  $A_8=(4,9)$ .



- Take a suitable dataset from available resources and apply all the classification and clustering algorithms that you have studied on original and preprocessed datasets. Analyze the performance variation in terms of different quality metrics. Give a detailed report based on the analysis. (Assignment)

#### Course Outcome 4 (CO4):

- A database has five transactions. Let min sup = 60% and min con f = 80%.

| <i>TID</i> | <i>items_bought</i> |
|------------|---------------------|
| T100       | {M, O, N, K, E, Y}  |
| T200       | {D, O, N, K, E, Y}  |
| T300       | {M, A, K, E}        |
| T400       | {M, U, C, K, Y}     |
| T500       | {C, O, O, K, I, E}  |

- Find all frequent item sets using Apriori and FP-growth, respectively. Compare the efficiency of the two mining processes.
  - List all of the strong association rules (with support  $s$  and confidence  $c$ ) matching the following metarule, where  $X$  is a variable representing customers, and  $item_i$  denotes variables representing items (e.g., "A", "B", etc.)  

$$\forall x \in transaction, buys(X, item_1) \wedge buys(X, item_2) \Rightarrow buys(X, item_3) \quad [s, c]$$
- Identify and list some scenarios in which association rule mining can be used, and then use at least two appropriate association rule mining techniques in one of the two scenarios. (Assignment)

#### Course Outcome 5 (CO5):

- Consider an e-mail database that stores a large number of electronic mail (e-mail) messages. It can be viewed as a semi structured database consisting mainly of text data. Discuss the following.
  - How can such an e-mail database be structured so as to facilitate multidimensional search, such as by sender, by receiver, by subject, and by time?
  - What can be mined from such an e-mail database?
  - Suppose you have roughly classified a set of your previous e-mail messages as junk, unimportant, normal, or important. Describe how a data mining system may take this as the training set to automatically classify new e-mail messages or unclassified ones.
- Precision and recall are two essential quality measures of an information retrieval system.
  - Explain why it is the usual practice to trade one measure for the other.
  - Explain why the F-score is a good measure for this purpose.



- (c) Illustrate the methods that may effectively improve the F-score in an information retrieval system.
3. Explain HITS algorithm with an example.

**Model Question Paper**

**QP CODE:**

**Reg No:** \_\_\_\_\_

**Name:** \_\_\_\_\_

**PAGES : 4**

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY**

**EIGHTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR**

**Course Code: CST466**

**Course Name: Data Mining**

**Max.Marks:100**

**Duration: 3 Hours**

**PART A**

**Answer All Questions. Each Question Carries 3 Marks**

1. Differentiate between OLTP and OLAP.
2. Compare the techniques of ROLAP, MOLAP and HOLAP
3. Explain Concept hierarchy with an example.
4. Explain heuristic methods of attribute subset selection techniques.
5. Consider a two-class classification problem of predicting whether a photograph contains a man or a woman. Suppose we have a test dataset of 10 records with expected outcomes and a set of predictions from our classification algorithm.

|    | Expected | Predicted |
|----|----------|-----------|
| 1  | man      | woman     |
| 2  | man      | man       |
| 3  | woman    | woman     |
| 4  | man      | man       |
| 5  | woman    | man       |
| 6  | woman    | woman     |
| 7  | woman    | woman     |
| 8  | man      | man       |
| 9  | man      | woman     |
| 10 | woman    | woman     |

Calculate precision, recall of the data.

6. Given two objects represented by the tuples (22,1,42,10) and (20,0, 36,8). Compute the Euclidean and Manhattan distance between the two objects.
7. The pincer search algorithm is a bi-directional search, whereas the level wise algorithm is a unidirectional search. Express your opinion about the statement.
8. Define support, confidence and frequent set in association data mining context.
9. Distinguish between focused crawling and regular crawling.
10. Describe any two-text retrieval indexing techniques. (10x3=30)

### Part B

(Answer any one question from each module. Each question carries 14 Marks)

11. (a) Suppose a data warehouse consists of three measures: customer, account and branch and two measures count (number of customers in the branch) and balance. Draw the schema diagram using snowflake schema and star schema. (7)
- (b) Explain three- tier data warehouse architecture with a neat diagram. (7)

**OR**

- 12 (a) Illustrate different OLAP operations in multidimensional data model (7)
- (b) Describe different issues in data mining (7)
- 13 (a) Suppose that the data for analysis includes the attribute age. The age values for the data tuples are (in increasing order) 13, 15, 16, 16, 19, 20, 20, 21, 22, 22, 25, 25, 25, 25, 30, 33, 33, 35, 35, 35, 35, 36, 40, 45, 46, 52, 70. (8)
- (a) Use min-max normalization to transform the value 35 for age onto

the  
range [0-1].

- (b) Use z-score normalization to transform the value 35 for age, where the standard deviation of age is 12.94 years.
- (c) Use normalization by decimal scaling to transform the value 35 for age.
- (d) Use smoothing by bin means to smooth the above data, using a bin depth of 3. Illustrate your steps. Comment on the effect of this technique for the given data.

- (b) With proper illustration, explain how PCA can be used for dimensionality reduction? Explain (6)

**OR**

- 14 (a) Suppose a group of 12 sales price records has been sorted as follows: 5, 10, 11, 13, 15, 35, 50, 55, 72, 92, 204, 215. Sketch examples of each of the following sampling techniques: SRSWOR, SRSWR, cluster sampling, stratified sampling. Use samples of size 5 and the strata “youth,” “middle-aged,” and “senior.” (8)
- (b) Partition the above data into three bins by each of the following methods: (6)
  - (i) equal-frequency (equi-depth) partitioning
  - (ii) equal-width partitioning
- 15 (a) Explain the concept of a cluster as used in ROCK. Illustrate with examples (9)
- (b) Consider the following dataset for a binary classification problem. (5)

| A | B | Class Label |
|---|---|-------------|
| T | F | +           |
| T | T | +           |
| T | T | +           |
| T | F | -           |
| T | T | +           |
| F | F | -           |
| F | F | -           |
| F | F | -           |
| T | T | -           |
| T | F | -           |

Calculate the gain in Gini index when splitting on A and B respectively. Which attribute would the decision tree induction algorithm choose?

OR

- 16 (a) For a sunburn dataset given below, find the first splitting attribute for the decision tree by using the ID3 algorithm. (10)

| Name  | Hair   | Height  | Weight  | Lotion | Class   |
|-------|--------|---------|---------|--------|---------|
| Sarah | Blonde | Average | Light   | No     | Sunburn |
| Dana  | Blonde | Tall    | Average | Yes    | None    |
| Alex  | Brown  | Tall    | Average | Yes    | None    |
| Annie | Blonde | Short   | Average | No     | Sunburn |
| Emily | Red    | Average | Heavy   | No     | Sunburn |
| Pete  | Brown  | Tall    | Heavy   | No     | None    |
| John  | Brown  | Average | Heavy   | No     | None    |
| Katie | Blonde | Short   | Light   | Yes    | None    |

- (b) Explain the working of SLIQ algorithm. (4)
- 17 (a) Illustrate the working of Pincer Search Algorithm with an example. (7)
- (b) Describe the working of dynamic itemset counting technique? Specify when to move an itemset from dashed structures to solid structures? (7)

OR

- 18 (a) A database has six transactions. Let min\_sup be 60% and min\_conf be 80%. (9)

| TID | items_bought   |
|-----|----------------|
| T1  | I1, I2, I3     |
| T2  | I2, I3, I4     |
| T3  | I4, I5         |
| T4  | I1, I2, I4     |
| T5  | I1, I2, I3, I5 |
| T6  | I1, I2, I3, I4 |

Find frequent itemsets using FP Growth algorithm and generate strong association rules from a three item dataset.

- (b) Write partitioning algorithm for finding large itemset and compare its efficiency with apriori algorithm (5)

- 19 (a) Describe web content mining techniques. (7)
- (b) Write an algorithm to find maximal frequent forward sequences to mine log traversal patterns. Illustrate the working of this algorithm. (7)

OR

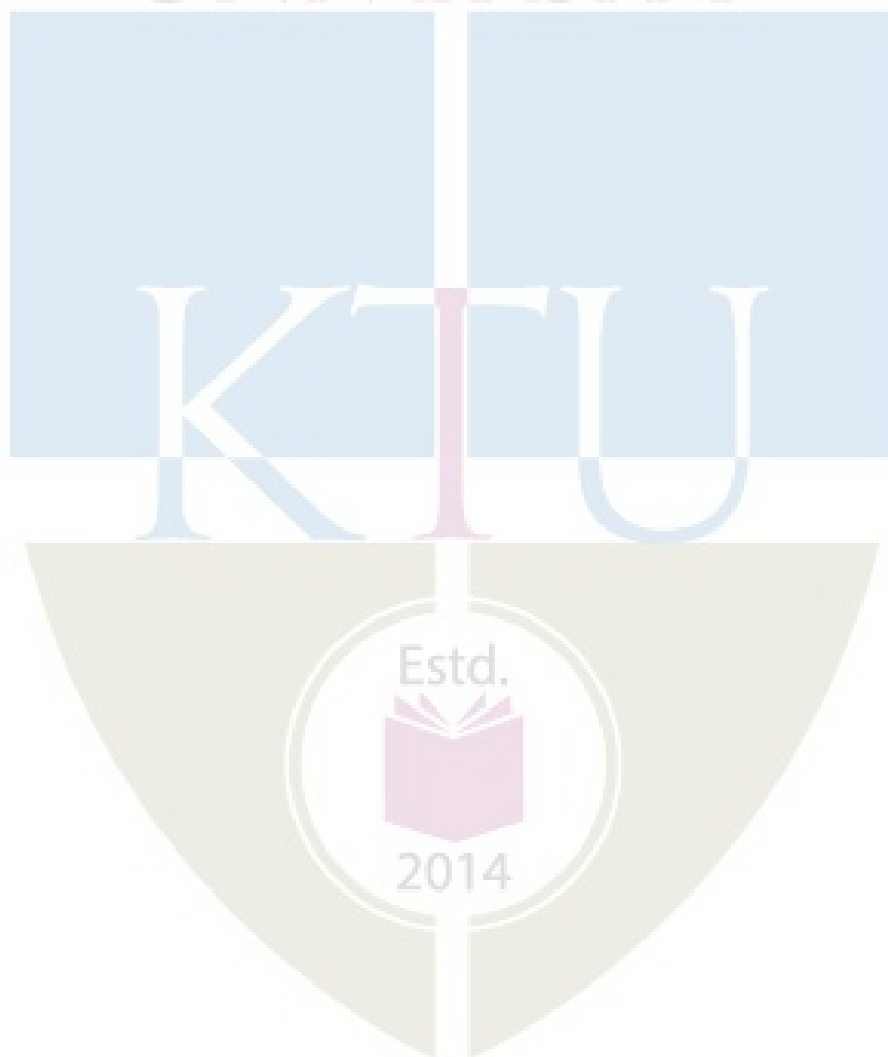
- 20 (a) Explain how web structure mining is different from web usage mining and web content mining? Write a CLEVER algorithm for web structure mining. (7)
- (b) Describe different Text retrieval methods. Explain the relationship between text mining and information retrieval and information extraction. (7)

### Teaching Plan

| No                                                                                  | Contents                                                                                                                           | No. of lecture hours (36 Hrs) |
|-------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------|-------------------------------|
| <b>Module 1(Introduction to Data Mining and Data Warehousing) (Text3) (6 hours)</b> |                                                                                                                                    |                               |
| 1.1                                                                                 | Data warehouse-Differences between Operational Database Systems and Data Warehouses, Multidimensional data model- Warehouse schema | 1                             |
| 1.2                                                                                 | OLAP Operations                                                                                                                    | 1                             |
| 1.3                                                                                 | DataWarehouse Architecture, Data Warehousing to Data Mining                                                                        | 1                             |
| 1.4                                                                                 | Datamining Concepts and Applications, Knowledge Discovery in Database Vs Data mining                                               | 1                             |
| 1.5                                                                                 | Architecture of typical data mining system,Data Mining Functionalities                                                             | 1                             |
| 1.6                                                                                 | Data Mining Functionalities, Data Mining Issues                                                                                    | 1                             |
| <b>Module 2(Data Preprocessing) (6 hours) (Text3)</b>                               |                                                                                                                                    |                               |
| 2.1                                                                                 | Data Preprocessing: Need of Data Preprocessing, Data Cleaning- Missing values, Noisy data.                                         | 1                             |
| 2.2                                                                                 | Data integration                                                                                                                   | 1                             |
| 2.3                                                                                 | Data transformation                                                                                                                | 1                             |
| 2.4                                                                                 | Data Reduction-Data cube aggregation, Attribute subset selection                                                                   | 1                             |
| 2.5                                                                                 | Data Reduction-Dimensionality reduction                                                                                            | 1                             |

|                                                                                     |                                                                                                                    |   |
|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------|---|
| 2.6                                                                                 | Numerosity reduction, Discretization and concept hierarchy generation                                              | 1 |
| <b>Module 3(Advanced classification and Cluster analysis)(9 hours)(Text2,Text3)</b> |                                                                                                                    |   |
| 3.1                                                                                 | Classification- Introduction, Decision tree construction principle, Splitting indices-Information Gain, Gini index | 1 |
| 3.2                                                                                 | Decision Tree- ID3                                                                                                 | 1 |
| 3.3                                                                                 | Decision Tree- ID3                                                                                                 | 1 |
| 3.4                                                                                 | Decision tree construction with presorting- SLIQ                                                                   | 1 |
| 3.5                                                                                 | Accuracy and error measures, evaluation                                                                            | 1 |
| 3.6                                                                                 | Introduction to clustering, Clustering Paradigms                                                                   | 1 |
| 3.7                                                                                 | Partitioning Algorithm- PAM                                                                                        | 1 |
| 3.8                                                                                 | Hierarchical Clustering-DBSCAN                                                                                     | 1 |
| 3.9                                                                                 | Categorical Clustering-ROCK                                                                                        | 1 |
| <b>Module 4(Association Rule Analysis) (8 hours) (Text2,Text3,Text1)</b>            |                                                                                                                    |   |
| 4.1                                                                                 | Association Rules: Introduction, Methods to discover association rules                                             | 1 |
| 4.2                                                                                 | A priori algorithm (Level-wise algorithm)                                                                          | 1 |
| 4.3                                                                                 | A priori algorithm (Level-wise algorithm)                                                                          | 1 |
| 4.4                                                                                 | Partition Algorithm                                                                                                | 1 |
| 4.5                                                                                 | Pincer Search Algorithm                                                                                            | 1 |
| 4.6                                                                                 | Pincer Search Algorithm                                                                                            | 1 |
| 4.7                                                                                 | Dynamic Itemset Counting Algorithm                                                                                 | 1 |
| 4.8                                                                                 | FP-tree Growth Algorithm                                                                                           | 1 |
| <b>Module 5(Advanced Data Mining Techniques) (7 hours) (Text1, Text3)</b>           |                                                                                                                    |   |
| 5.1                                                                                 | Web Mining - Web Content Mining                                                                                    | 1 |
| 5.2                                                                                 | Web Structure Mining- Page Rank                                                                                    | 1 |
| 5.3                                                                                 | Web Structure Mining –Clever algorithm                                                                             | 1 |
| 5.4                                                                                 | Web Usage Mining- Preprocessing, Data structures                                                                   | 1 |

|     |                                                                                             |   |
|-----|---------------------------------------------------------------------------------------------|---|
| 5.5 | Web Usage Mining -Pattern Discovery, Pattern Analysis                                       | 1 |
| 5.6 | Text Mining-Text Data Analysis and information Retrieval, Basic measures for Text retrieval | 1 |
| 5.7 | Text Retrieval methods, Text Indexing Techniques<br>Query Processing Techniques             | 1 |





| CST476 | MOBILE COMPUTING | CATEGORY | L | T | P | CREDIT | YEAR OF INTRODUCTION |
|--------|------------------|----------|---|---|---|--------|----------------------|
|        |                  | PEC      | 2 | 1 | 0 | 3      | 2019                 |

**Preamble:** The course is designed with the view of preparing the engineering students capable of understanding the communication protocols, various architectures and security features used in mobile computing. This course covers basics of mobile computing, architecture of wireless transmission systems and next generation networks. This course enables the learners to acquire advanced concepts on wireless communication systems and mobile ad-hoc networks.

**Prerequisite:** A sound knowledge of computer networks.

**Course Outcomes:** After the completion of the course the student will be able to

| CO# | Course Outcomes                                                                                                                                                                |
|-----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| CO1 | Explain the various mobile computing applications, services, design considerations and architectures ( <b>Cognitive knowledge: Understand</b> )                                |
| CO2 | Describe the various technology trends for next generation cellular wireless networks and use the spreading concept on data transmission ( <b>Cognitive knowledge: Apply</b> ) |
| CO3 | Summarize the architecture of various wireless LAN technologies ( <b>Cognitive knowledge: Understand</b> )                                                                     |
| CO4 | Identify the functionalities of mobile network layer and transport layer ( <b>Cognitive knowledge: Understand</b> )                                                            |
| CO5 | Explain the features of Wireless Application Protocol ( <b>Cognitive knowledge: Understand</b> )                                                                               |
| CO6 | Interpret the security issues in mobile computing and next generation technologies ( <b>Cognitive knowledge: Understand</b> )                                                  |

**Mapping of course outcomes with program outcomes**

|     | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|
| CO1 |     |     |     |     |     |     |     |     |     |      |      |      |
| CO2 |     |     |     |     |     |     |     |     |     |      |      |      |
| CO3 |     |     |     |     |     |     |     |     |     |      |      |      |
| CO4 |     |     |     |     |     |     |     |     |     |      |      |      |

|     |                                                                                   |                                                                                   |                                                                                   |  |  |  |  |  |  |  |                                                                                     |
|-----|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|--|--|--|--|--|--|--|-------------------------------------------------------------------------------------|
| CO5 |  |  |  |  |  |  |  |  |  |  |  |
| CO6 |  |  |  |  |  |  |  |  |  |  |  |

| Abstract POs defined by National Board of Accreditation |                                            |      |                                |
|---------------------------------------------------------|--------------------------------------------|------|--------------------------------|
| PO#                                                     | Broad PO                                   | PO#  | Broad PO                       |
| PO1                                                     | Engineering Knowledge                      | PO7  | Environment and Sustainability |
| PO2                                                     | Problem Analysis                           | PO8  | Ethics                         |
| PO3                                                     | Design/Development of solutions            | PO9  | Individual and team work       |
| PO4                                                     | Conduct investigations of complex problems | PO10 | Communication                  |
| PO5                                                     | Modern tool usage                          | PO11 | Project Management and Finance |
| PO6                                                     | The Engineer and Society                   | PO12 | Life long learning             |

### Assessment Pattern

| Bloom's Category | Test 1 (%) | Test 2 (%) | End Semester Examination (%) |
|------------------|------------|------------|------------------------------|
| Remember         | 30         | 30         | 30                           |
| Understand       | 50         | 50         | 50                           |
| Apply            | 20         | 20         | 20                           |
| Analyse          |            |            |                              |
| Evaluate         |            |            |                              |
| Create           |            |            |                              |

### Mark Distribution

| Total Marks | CIE Marks | ESE Marks | ESE Duration |
|-------------|-----------|-----------|--------------|
| 150         | 50        | 100       | 3            |

**Continuous Internal Evaluation Pattern:**

Attendance : **10 marks**

Continuous Assessment Test : **25 marks**

Continuous Assessment Assignment : **15 marks**

**Internal Examination Pattern:**

Each of the two internal examinations has to be conducted out of 50 marks. First series test shall be preferably conducted after completing the first half of the syllabus and the second series test shall be preferably conducted after completing remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly completed module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly completed module), each with 7 marks. Out of the 7 questions, a student should answer any 5.

**End Semester Examination Pattern:**

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which a student should answer any one. Each question can have maximum 2 sub-divisions and carries 14 marks.

**Syllabus****Module - 1 (Mobile Computing Basics)**

Introduction to mobile computing – Functions, Middleware and Gateways, Application and services. Mobile computing architecture – Internet: The Ubiquitous network, Three-tier architecture for Mobile Computing, Design considerations for mobile computing.

**Module – 2 (Wireless Transmission and Communication Systems)**

Spread spectrum – Direct sequence, Frequency hopping. Medium Access Control – Space Division Multiple Access (SDMA), Frequency Division Multiple Access (FDMA), Time Division Multiple Access (TDMA), Code Division Multiple Access (CDMA). Satellite Systems – Basics, Applications, Geostationary Earth Orbit (GEO), Low Earth Orbit (LEO), Medium Earth Orbit (MEO), Routing, Localization, Handover. Telecommunication Systems - Global System for Mobile Communication (GSM)

services, Architecture, Handover, Security.

### **Module – 3 (Wireless LANs)**

Wireless LAN - Advantages, Design goals, Applications, Infrastructure Vs Ad-hoc mode, IEEE 802.11 System Architecture, Protocol Architecture, Physical layer, Medium Access Control layer, HIPERLAN-1, Bluetooth.

### **Module – 4 (Mobile Network and Transport Layer)**

Mobile network layer – Mobile Internet Protocol (IP), Dynamic Host Configuration Protocol (DHCP), Mobile ad-hoc networks – Routing, Dynamic Source Routing (DSR), Destination Sequence Distance Vector (DSDV), Ad-hoc routing protocols. Mobile transport layer – Traditional Transmission Control Protocol (TCP), Improvements in Classical TCP. Wireless Application Protocol (WAP) - Architecture, Wireless Datagram Protocol (WDP), Wireless Transport Layer Security (WTLS), Wireless Transaction Protocol (WTP), Wireless Session Protocol (WSP).

### **Module – 5 (Mobile Security and Next Generation Networks)**

Security issues in mobile computing - Information security, Security techniques and algorithms, Security models. Next generation networks - Orthogonal Frequency Division Multiplexing (OFDM), Wireless Asynchronous Transfer Mode (WATM), Multi Protocol Label Switching (MPLS), 10 pillars of 5G, Security for 5G communication.

### **Text Books**

1. Asoke K. Talukder, Hasan Ahmad, Roopa R Yavagal, Mobile Computing Technology- Application and Service Creation, 2/e, McGraw Hill Education.
2. Jochen Schiller, Mobile Communications, Pearson Education Asia, 2008.
3. Jonathan Rodriguez, Fundamentals of 5G Mobile Networks, Wiley Publishers, 2015.

### **Reference Books**

1. Raj Kamal, Mobile Computing, 2/e, Oxford University Press.
2. Andrew S. Tanenbaum, Computer Networks, PHI, 3/e, 2003
3. Theodore S. Rappaport, Wireless Communications Principles and Practice, 2/e, PHI, New Delhi, 2004.
4. Curt M. White, Fundamentals of Networking and Communication 7/e, Cengage learning.

## **Course Level Assessment Questions**

### **Course Outcome 1 (CO1):**

1. Give examples for five mobile computing applications.
2. Identify any three differences between middleware and gateways.

### **Course Outcome 2 (CO2):**

1. There are four stations sending data 1,1,1,0 respectively. Station 3 receives station 1's

- data. Show the encoding, decoding and channel sharing mechanisms using CDMA.
2. Compare the influence of near/far effect and its countermeasures in TDMA and CDMA systems.

**Course Outcome 3 (CO3):**

1. Compare IEEE 802.11 and Bluetooth with respect to their ad-hoc capabilities.
2. Describe with neat sketch the major baseband states of a Bluetooth device.

**Course Outcome 4 (CO4):**

1. With the help of an example, show how routing process is handled by Dynamic Source Routing protocol.
2. Describe the major differences between AODV and the standard Distance Vector Routing algorithm. Why are extensions needed?
3. Simulate routing protocols using NS2.

**Course Outcome 5 (CO5):**

1. How does WAP push operation differ from pull operation?
2. With the help of a neat sketch explain the secure session establishment using WTLS.

**Course Outcome 6 (CO6):**

1. Explain the 3GPP security framework for mobile security.
2. Explain the features of policy-based security model.

**Model Question Paper**

**QP CODE:**

**PAGES: 3**

**Reg No:** \_\_\_\_\_

**Name:** \_\_\_\_\_

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY  
EIGHTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR**

**Course Code: CST476**

**Course Name : Mobile Computing**

**Max Marks: 100**

**Duration: 3 Hours**

**PART-A**

**(Answer All Questions. Each question carries 3 marks)**

1. Explain the different types of middleware and gateways in the architecture of mobile computing.
2. Explain the major segments to support mobile computing functions.

3. Compare and contrast the satellite systems – GEO, LEO and MEO.
4. Assume all stations can hear all other stations. One station wants to transmit and senses the carrier idle. Why can a collision still occur after the start of transmission?
5. List any three advantages and disadvantages of wireless LANs.
6. Compare the features of infrastructure and ad-hoc networks.
7. Mention the basic purpose of DHCP. Also list the entities of DHCP.
8. Identify the benefits of location information for routing in ad-hoc networks.
9. List any six pillars of 5G.
10. How does multifactor security model provide security in a mobile network?

(10x3=30)

### Part B

(Answer any one question from each module. Each question carries 14 Marks)

11. (a) Describe the design considerations of three tier architecture of mobile computing. (6)
- (b) Explain any four functions and applications of mobile computing. (8)

OR

12. (a) Explain Internet-Ubiquitous networks mentioning the significance and functions of core, edge and access network. (6)
- (b) With the help of a neat sketch explain the three-tier architecture of mobile computing. (8)
13. (a) Check to see if the following set of chips can belong to an orthogonal system.  
[+1, +1, +1, +1], [+1, -1, -1, +1], [-1, +1, +1, -1], [+1, -1, -1, +1] (6)
- (b) Summarize the routing and localization process in satellite systems. (8)

OR

14. (a) Apply Direct Sequence Spread Spectrum to the data 101 using Barker sequence 10110111000. Show the encoding and decoding steps. (6)
- (b) Describe the system architecture of GSM networks. (8)
15. (a) How is Quality-of-Service provided in Bluetooth? (6)

- (b) Explain the phases in Elimination-yield non-preemptive priority multiple access of HIPERLAN-1. (8)

**OR**

16. (a) Describe the protocol architecture of IEEE 802.11. (6)
- (b) Explain the Medium Access Control management features provided in an IEEE 802.11 station. (8)
17. (a) With the help of an example, show the routing table creation using Destination Sequence Distance Vector Routing protocol in mobile ad-hoc networks. (7)
- (b) Describe the router discovery methods used in mobile IP. (7)

**OR**

18. (a) Compare the features of flat routing and hierarchical routing. (6)
- (b) List the entities of a mobile IP. With the help of an example, explain how packet delivery is done to and from a fixed node. (8)
19. (a) How is orthogonality helpful in Orthogonal Frequency Division Multiplexing? (4)
- (b) Explain the functioning of Multi Protocol Label Switching technology. (10)

**OR**

20. (a) Describe the services of Wireless Asynchronous Transfer Mode. (6)
- (b) Explain the different security models in mobile computing. (8)

### TEACHING PLAN

| No                                                  | Contents                                     | No.of Lecture Hrs (35 hrs) |
|-----------------------------------------------------|----------------------------------------------|----------------------------|
| <b>Module – 1 (Mobile Computing Basics) (6 hrs)</b> |                                              |                            |
| 1.1                                                 | Introduction to mobile computing – Functions | 1                          |
| 1.2                                                 | Middleware and Gateways                      | 1                          |
| 1.3                                                 | Application and services                     | 1                          |
| 1.4                                                 | Internet: The Ubiquitous network             | 1                          |



|                                                                             |                                                                                                                          |   |
|-----------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------|---|
| 1.5                                                                         | Three-tier architecture for Mobile Computing                                                                             | 1 |
| 1.6                                                                         | Design considerations for mobile computing                                                                               | 1 |
| <b>Module – 2 (Wireless Transmission and Communication Systems) (8 hrs)</b> |                                                                                                                          |   |
| 2.1                                                                         | Direct sequence spread spectrum, Frequency hopping spread spectrum                                                       | 1 |
| 2.2                                                                         | Space Division Multiple Access (SDMA), Frequency Division Multiple Access (FDMA)                                         | 1 |
| 2.3                                                                         | Time Division Multiple Access (TDMA)                                                                                     | 1 |
| 2.4                                                                         | Code Division Multiple Access (CDMA)                                                                                     | 1 |
| 2.5                                                                         | Satellite Systems Basics, Applications, Geostationary Earth Orbit (GEO), Low Earth Orbit (LEO), Medium Earth Orbit (MEO) | 1 |
| 2.6                                                                         | Routing, Localization, Handover                                                                                          | 1 |
| 2.7                                                                         | Global System for Mobile Communication (GSM) services, Architecture                                                      | 1 |
| 2.8                                                                         | Handover, Security                                                                                                       | 1 |
| <b>Module - 3 (Wireless LANs) (7 hrs)</b>                                   |                                                                                                                          |   |
| 3.1                                                                         | Wireless LAN - Advantages, Design goals, Applications, Infrastructure Vs Ad-hoc mode                                     | 1 |
| 3.2                                                                         | IEEE 802.11 System Architecture                                                                                          | 1 |
| 3.3                                                                         | Protocol Architecture                                                                                                    | 1 |
| 3.4                                                                         | Physical layer                                                                                                           | 1 |
| 3.5                                                                         | Medium Access Control layer                                                                                              | 1 |
| 3.6                                                                         | HIPERLAN-1                                                                                                               | 1 |
| 3.7                                                                         | Bluetooth                                                                                                                | 1 |
| <b>Module - 4 (Mobile Network and Transport Layer) (8 hrs)</b>              |                                                                                                                          |   |
| 4.1                                                                         | Mobile Internet Protocol (IP), Dynamic Host Configuration Protocol (DHCP)                                                | 1 |
| 4.2                                                                         | Mobile ad-hoc networks – Routing, Dynamic Source Routing (DSR)                                                           | 1 |

|                                                                          |                                                                                             |   |
|--------------------------------------------------------------------------|---------------------------------------------------------------------------------------------|---|
| 4.3                                                                      | Destination Sequence Distance Vector (DSDV)                                                 | 1 |
| 4.4                                                                      | Ad-hoc routing protocols                                                                    | 1 |
| 4.5                                                                      | Traditional Transmission Control Protocol (TCP), Improvements in Classical TCP              | 1 |
| 4.6                                                                      | Wireless Application Protocol (WAP) – Architecture, Wireless Datagram Protocol (WDP)        | 1 |
| 4.7                                                                      | Wireless Transport Layer Security (WTLS)                                                    | 1 |
| 4.8                                                                      | Wireless Transaction Protocol (WTP), Wireless Session Protocol (WSP)                        | 1 |
| <b>Module - 5 (Mobile Security and Next Generation Networks) (6 hrs)</b> |                                                                                             |   |
| 5.1                                                                      | Information security, Security techniques                                                   | 1 |
| 5.2                                                                      | Security algorithms, Security models                                                        | 1 |
| 5.3                                                                      | Introduction to Next generation networks, Orthogonal Frequency Division Multiplexing (OFDM) | 1 |
| 5.4                                                                      | Wireless Asynchronous Transfer Mode (WATM)                                                  | 1 |
| 5.5                                                                      | Multi Protocol Label Switching (MPLS)                                                       | 1 |
| 5.6                                                                      | 10 pillars of 5G, Security for 5G communication                                             | 1 |

Estd.



2014

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# **SEMESTER VIII**

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## **PROGRAM ELECTIVE V**

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| CST418 | HIGH PERFORMANCE COMPUTING | CATEGORY | L | T | P | CREDIT | YEAR OF INTRODUCTION |
|--------|----------------------------|----------|---|---|---|--------|----------------------|
|        |                            | PEC      | 2 | 1 | 0 | 3      | 2019                 |

**Preamble:** This course helps the learners to understand the different architectural features of high-end processors. This course discusses the Basics of high-end processors Architecture, Instruction-Level Parallelism, Data-Level Parallelism, Thread Level Parallelism, and GPU Architectures. This course enables the students to provide solutions to real-world problems making use of the capabilities of HPC systems.

**Prerequisite:** Basic knowledge in Computer System architecture, Microprocessors, Operating systems, and System software.

**Course Outcomes:** After the completion of the course the student will be able to

|     |                                                                                                                                             |
|-----|---------------------------------------------------------------------------------------------------------------------------------------------|
| CO1 | Describe different types of modern processing environments and parallel computing hardware ( <b>Cognitive Knowledge Level: Understand</b> ) |
| CO2 | Summarize the concepts of Instruction Level Parallelism ( <b>Cognitive Knowledge Level: Understand</b> )                                    |
| CO3 | Appreciate the idea of Data Level Parallelism ( <b>Cognitive Knowledge Level: Apply</b> )                                                   |
| CO4 | Demonstrate the concept of Thread Level Parallelism ( <b>Cognitive Knowledge Level: Apply</b> )                                             |
| CO5 | Describe the basics of GPU architecture. ( <b>Cognitive Knowledge Level: Understand</b> )                                                   |

#### Mapping of course outcomes with program outcomes

|     | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|
| CO1 |     |     |     |     |     |     |     |     |     |      |      |      |
| CO2 |     |     |     |     |     |     |     |     |     |      |      |      |
| CO3 |     |     |     |     |     |     |     |     |     |      |      |      |
| CO4 |     |     |     |     |     |     |     |     |     |      |      |      |
| CO5 |     |     |     |     |     |     |     |     |     |      |      |      |

| Abstract POs defined by National Board of Accreditation |                                            |      |                                |
|---------------------------------------------------------|--------------------------------------------|------|--------------------------------|
| PO#                                                     | Broad PO                                   | PO#  | Broad PO                       |
| PO1                                                     | Engineering Knowledge                      | PO7  | Environment and Sustainability |
| PO2                                                     | Problem Analysis                           | PO8  | Ethics                         |
| PO3                                                     | Design/Development of solutions            | PO9  | Individual and teamwork        |
| PO4                                                     | Conduct investigations of complex problems | PO10 | Communication                  |
| PO5                                                     | Modern tool usage                          | PO11 | Project Management and Finance |
| PO6                                                     | The Engineer and Society                   | PO12 | Life long learning             |

### Assessment Pattern

| Bloom's Category | Continuous Assessment Tests |            | End Semester Examination Marks (%) |
|------------------|-----------------------------|------------|------------------------------------|
|                  | Test 1 (%)                  | Test 2 (%) |                                    |
| Remember         | 20                          | 20         | 20                                 |
| Understand       | 50                          | 50         | 50                                 |
| Apply            | 30                          | 30         | 30                                 |
| Analyze          |                             |            |                                    |
| Evaluate         |                             |            |                                    |
| Create           |                             |            |                                    |

### Mark Distribution

| Total Marks | CIE Marks | ESE Marks. | ESE Duration |
|-------------|-----------|------------|--------------|
| 150         | 50        | 100        | 3            |

**Continuous Internal Evaluation Pattern:**

|                                                               |          |
|---------------------------------------------------------------|----------|
| Attendance                                                    | 10 marks |
| Continuous Assessment Tests (Average of Internal Tests 1 & 2) | 25 marks |
| Continuous Assessment Assignment                              | 15 marks |

**Internal Examination Pattern**

Each of the two internal examinations have to be conducted out of 50 marks. The first series test shall be preferably conducted after completing the first half of the syllabus and the second series test shall be preferably conducted after completing the remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly completed module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly completed module), each with 7 marks. Out of the 7 questions, a student should answer any 5.

**End Semester Examination Pattern:**

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 full questions from each module of which students should answer anyone. Each question can have a maximum of 2 sub-divisions and carries 14 marks.

**Syllabus****Module-1 ( Basics of Architecture )**

Classes of Computers - Classes of Parallelism and Parallel Architectures – Defining Computer Architecture – Dependability – Quantitative Principles of Computer Design – Basics of Memory Hierarchies – Virtual Memory and Virtual Machines – Pipelining

**Module-2 ( Instruction-Level Parallelism)**

Instruction-Level Parallelism: Concepts and Challenges – Basic Compiler Techniques for Exposing ILP – Reducing Branch Costs With Advanced Branch Prediction – Hardware-Based Speculation – Multithreading: Exploiting Thread-Level Parallelism to Improve Uniprocessor Throughput

**Module-3 (Data-Level Parallelism)**

Vector Architecture – SIMD Instruction Set Extensions for Multimedia – Graphics Processing Units – Detecting and Enhancing Loop-Level Parallelism

**Module-4 ( Thread Level Parallelism)**

Multiprocessor Architecture: Issues and Approach – Centralized Shared-Memory Architectures – Performance of Symmetric Shared-Memory Multiprocessors– Distributed Shared-Memory and Directory-Based Coherence – Synchronization: The Basics – Introduction to Memory Consistency

**Module-5 (GPU Architectures)**

The CPU-GPU system as an accelerated computational platform – The GPU and the thread engine – Characteristics of GPU memory spaces – The PCI bus: CPU to GPU data transfer overhead – Multi-GPU platforms – Potential benefits of GPU – accelerated platforms

**Text Books**

1. John L. Hennessy, David A. Patterson Computer Architecture, Sixth Edition A Quantitative Approach, Morgan Kaufman, Fifth Edition, 2012.
2. Robert Robey, Yuliana Zamora, Parallel and High-Performance Computing, Manning Publications, First Edition, 2021.

**Reference Books**

1. Thomas Sterling, Matthew Anderson, and MaciejBrodowicz, High-Performance Computing – Modern Systems and Practices, First Edition, 2017.
2. Charles Severance, Kevin Dowd,High-Performance Computing, O'Reilly Media, Second Edition, 1998.
3. Kai Hwang, Faye Alaye Briggs, Computer Architecture and Parallel Processing, McGraw-Hill, 1984.

**Course Level Assessment Questions****Course Outcome 1 (CO1):**

1. Differentiate different classes of computer-based on features like microprocessor cost, system cost, and system design issues.
2. Explain the different methods by which computer hardware exploits application-level parallelism.
3. Explain in detail the instruction set architecture
4. Describe the encoding scheme specified as part of ISA



**Course Outcome 2 (CO2):**

1. Differentiate data, name, and control dependencies with suitable examples.
2. Explain loop unrolling with suitable coding demonstration
3. Explain in detail about Tournament Predictors.
4. Describe the unique features of very long instruction word processors.

**Course Outcome 3 (CO3):**

1. What are the three things conveyed through a data dependence? Explain the Data Dependencies of the following code:

```

Loop: fld f0,0(x1) //f0=array element
 fadd.d f4,f0,f2 //add scalar in f2
 fsd f4,0(x1) //store result
 addi x1,x1,-8 //decrement pointer 8 bytes
 bne x1,x2,Loop //branch x1≠x2

```

2. Assume a single-issue pipeline. Unroll the loop as many times as necessary to schedule it without any stalls, collapsing the loop overhead instructions. How many times must the loop be unrolled? Show the instruction schedule. What is the execution time per element of the result?
3. Explain the SIMD Instruction Set Extensions for Multimedia.

**Course Outcome 4 (CO4):**

1. With the help of a neat diagram illustrate a single-chip multicore with a distributed cache.
2. Demonstrate the Implementation of cache coherence in a distributed-memory multiprocessor by adding a directory to each node with a suitable diagram.
3. Consider the following code segments running on two processors P1 and P2. Assume A, and B, are initially 0. Explain how an optimizing compiler might make it impossible for B to be ever set to 2 in a sequentially consistent execution model.

| P1:             | P2:             |
|-----------------|-----------------|
| A=1;            | B=1;            |
| A=2;            | While (A <> 1); |
| While (B == 0); | B= 2;           |

**Course Outcome 5 (CO5):**

1. Explain the benefits of potential GPU.
2. Illustrate GPU system as an accelerated computational platform.
3. Discuss CPU to GPU data transfer overhead.

## Model Question Paper

**QP CODE:**

**Reg No:** \_\_\_\_\_

**Name:** \_\_\_\_\_

**PAGES : 4**

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY**

**EIGHTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR**

**Course Code: CST418**

**Course Name: High Performance Computing**

**Max. Marks : 100**

**Duration: 3 Hours**

### **PART A**

**Answer All Questions. Each Question Carries 3 Marks**

1. Differentiate between Data level parallelism and Task level parallelism
2. Explain the principle of locality
3. Define Instruction Level Parallelism with an example.
4. Devise the importance of loop unrolling with an example.
5. What is the equation of CPI (cycles per instruction) for a pipelined processor? How can we set the ideal pipeline CPI?
6. Explain the two types of name dependencies between an instruction  $i$  that precedes instruction  $j$  in program order.
7. Differentiate between module reliability and module availability measures with suitable examples.
8. Why SMP architectures are called UMA multiprocessors and DSM multiprocessors as NUMA processors.

9. Explain the need for GPU.
10. List the characteristics of GPU memory spaces.

**3x10=30****Part B****(Answer any one question from each module. Each question carries 14 Marks)**

11. (a) Describe the quantitative principle of computer design with Amdahl's law. (8)
- (b) Discuss in detail the importance of considering processor performance for the design of an efficient computer system. (6)

**OR**

12. (a) Illustrate how processes are protected with the help of virtual memory. (7)
- (b) Discuss the role played by virtual machines in providing protection for processes. (7)
13. (a) Explain in detail data dependence and hazards. (8)
- (b) With neat sketches explain how data-level parallelism is achieved in vector, and SIMD architectures. (6)

**OR**

14. (a) Describe the unique features of very long instruction word processors. (8)
- (b) Consider a three-way superscalar machine renaming these three instructions concurrently: (6)

```
addi x1, x1, x1
addi x1, x1, x1
addi x1, x1, x1
```

If the value of x1 starts at 5, then what will be its value when after this sequence is executed?

15. (a) The following loop has multiple types of dependences. Find all the true dependences, output dependencies, and anti-dependencies, and eliminate the output dependencies and anti-dependencies by renaming. (8)

```
for (i=0; i<100; i=i+1) {
 Y[i] = X[i] / c; /* S1 */
 X[i] = X[i] + c; /* S2 */
 Z[i] = Y[i] + c; /* S3 */
 Y[i] = c - Y[i]; /* S4 */
}
```

- (b) Describe the limitations of Symmetric Shared-Memory Multiprocessors and Snooping Protocols (6)

**OR**

16. (a) Demonstrate the different types of hardware approaches required for the working of multithreading. (8)

- (b) Consider the following loop: (6)

```
for (i=0; i<100; i++) {
 A[i] = A[i] + B[i]; /* S1 */
 B[i+1] = C[i] + D[i]; /* S2 */
}
```

Are there exist dependencies between S1 and S2? Determine whether the above loop is parallel? If not, show how to make it parallel.

17. (a) Consider an 8-processor multicore where each processor has its own L1 and L2 caches. Here snooping is performed on a shared bus among the L2 caches. Assume that the average L2 request is 15 cycles for a coherence miss or other miss and a clock rate of 3.0 GHz, a CPI of 0.7, and a load/store frequency of 40%. If the goal set is that no more than 50% of the L2 bandwidth is consumed by coherence traffic, then what is the maximum coherence miss rate per processor? (8)

- (b) Explain the basic structure of a centralized shared-memory multiprocessor (6)

based on a multicore chip.

**OR**

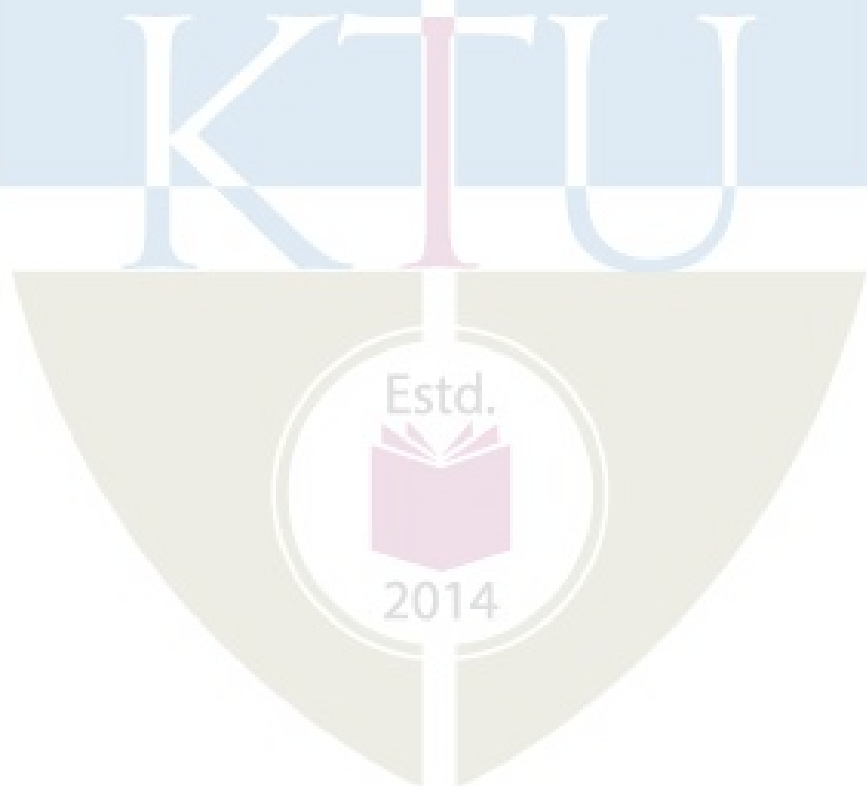
18. (a) Suppose an application running on a 100-processor multiprocessor use 1, 50, or 100 processors. If for 95% of the time all 100 processors are used, illustrate how the remaining 5% of the execution time employs 50 processors for a speedup of 80? (6)
- (b) With a neat diagram, demonstrate invalidate cache coherence protocol for a private write-back cache, showing the states and state transitions for each block in the cache. (8)
19. (a) Explain the multi-GPU platform. (8)
- (b) Explain some of the benefits of GPU. (6)
- OR**
20. (a) Discuss in detail the characteristics of GPU memory spaces. (8)
- (b) Explain about GPU thread engine. (6)

**Teaching Plan**

| No                                                 | Contents                                          | No. of Lecture Hours (36 hrs) |
|----------------------------------------------------|---------------------------------------------------|-------------------------------|
| <b>Module 1 - Basics of Architecture (7 hours)</b> |                                                   |                               |
| 1.1                                                | Classes of Computers                              | 1 hour                        |
| 1.2                                                | Classes of Parallelism and Parallel Architectures | 1 hour                        |
| 1.3                                                | Dependability                                     | 1 hour                        |
| 1.4                                                | Quantitative Principles of Computer Design.       | 1 hour                        |

|                                                              |                                                                                     |        |
|--------------------------------------------------------------|-------------------------------------------------------------------------------------|--------|
| 1.5                                                          | Basics of Memory Hierarchies                                                        | 1 hour |
| 1.6                                                          | Virtual Memory and Virtual Machines                                                 | 1 hour |
| 1.7                                                          | Pipelining                                                                          | 1 hour |
| <b>Module -2 (Introduction to Syntax Analysis) (7 hours)</b> |                                                                                     |        |
| 2.1                                                          | Instruction-Level Parallelism: Concepts and Challenges                              | 1 hour |
| 2.2                                                          | Basic Compiler Techniques for Exposing ILP                                          | 1 hour |
| 2.3                                                          | Reducing Branch Costs With Advanced Branch Prediction                               | 1 hour |
| 2.4                                                          | Hardware-Based Speculation                                                          | 1 hour |
| 2.5                                                          | Multithreading                                                                      | 1 hour |
| 2.6                                                          | Exploiting Thread-Level Parallelism to Improve Uniprocessor Throughput – Lecture 1. | 1 hour |
| 2.7                                                          | Exploiting Thread-Level Parallelism to Improve Uniprocessor Throughput – Lecture 2. | 1 hour |
| <b>Module- 3 - Data-Level Parallelism (7 hours)</b>          |                                                                                     |        |
| 3.1                                                          | Vector Architecture -Lecture 1                                                      | 1 hour |
| 3.2                                                          | Vector Architecture -Lecture 2                                                      | 1 hour |
| 3.3                                                          | SIMD Instruction Set Extensions for Multimedia – Lecture 1                          | 1 hour |
| 3.4                                                          | SIMD Instruction Set Extensions for Multimedia – Lecture 2                          | 1 hour |
| 3.5                                                          | Graphics Processing Units                                                           | 1 hour |
| 3.6                                                          | Detecting and Enhancing Loop-Level Parallelism – Lecture 1                          | 1 hour |
| 3.7                                                          | Detecting and Enhancing Loop-Level Parallelism – Lecture 2                          | 1 hour |
| <b>Module 4– Thread Level Parallelism (8 hours)</b>          |                                                                                     |        |
| 4.1                                                          | Multiprocessor Architecture: Issues and Approach                                    | 1 hour |
| 4.2                                                          | Centralized Shared-Memory Architectures – Lecture 1                                 | 1hour  |
| 4.3                                                          | Centralized Shared-Memory Architectures – Lecture 2                                 | 1hour  |
| 4.4                                                          | Performance of Symmetric Shared-Memory Multiprocessors                              | 1hour  |
| 4.5                                                          | Distributed Shared-Memory                                                           | 1hour  |
| 4.6                                                          | Directory-Based Coherence                                                           | 1hour  |
| 4.7                                                          | Synchronization                                                                     | 1hour  |

|                                               |                                                             |        |
|-----------------------------------------------|-------------------------------------------------------------|--------|
| 4.8                                           | Introduction to Memory Consistency                          | 1hour  |
| <b>Module 5 – GPU Architectures (7 hours)</b> |                                                             |        |
| 5.1                                           | The CPU-GPU system as an accelerated computational platform | 1 hour |
| 5.2                                           | The GPU and the thread engine – Lecture 1                   | 1 hour |
| 5.3                                           | The GPU and the thread engine – Lecture 2                   | 1 hour |
| 5.4                                           | Characteristics of GPU memory spaces                        | 1hour  |
| 5.5                                           | PCI bus: CPU to GPU data transfer overhead                  | 1hour  |
| 5.6                                           | Multi-GPU platforms                                         | 1hour  |
| 5.7                                           | Potential benefits of GPU-accelerated platforms             | 1hour  |





| CST428 | BLOCKCHAIN TECHNOLOGIES | CATEGORY | L | T | P | CREDIT | YEAR OF INTRODUCTION |
|--------|-------------------------|----------|---|---|---|--------|----------------------|
|        |                         | PEC      | 2 | 1 | 0 | 3      | 2019                 |

**Preamble:** The purpose of this course is to create awareness and understanding among students on the foundation of blockchain technology. The course introduces the cryptographic principles behind blockchain and helps the students understand concepts like consensus, crypto-currency, smart contracts, use cases etc. The course enables students to develop simple decentralized applications using blockchain networks such as Ethereum.

**Prerequisite:** Basic knowledge in data structures and operating systems.

**Course Outcomes:** After the completion of the course the student will be able to

|     |                                                                                                                |
|-----|----------------------------------------------------------------------------------------------------------------|
| CO1 | Illustrate the cryptographic building blocks of blockchain technology. (Cognitive Knowledge Level: Understand) |
| CO2 | Explain the fundamental concepts of blockchain technology. (Cognitive Knowledge Level: Understand)             |
| CO3 | Summarize the classification of consensus algorithms. (Cognitive Knowledge Level: Understand)                  |
| CO4 | Explain the concepts of first decentralized cryptocurrency bitcoin. (Cognitive Knowledge Level: Understand)    |
| CO5 | Explain the use of smart contracts and its use cases. (Cognitive Knowledge Level: Understand)                  |
| CO6 | Develop simple applications using Solidity language on Ethereum platform. (Cognitive Knowledge Level: Apply)   |

**Mapping of course outcomes with program outcomes**

|     | PO1                                                                                 | PO2                                                                                 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12                                                                                  |
|-----|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-----|-----|-----|-----|-----|-----|-----|------|------|---------------------------------------------------------------------------------------|
| CO1 |  |  |     |     |     |     |     |     |     |      |      |  |
| CO2 |  |  |     |     |     |     |     |     |     |      |      |  |

|     |  |  |  |  |  |  |  |  |  |  |  |  |
|-----|--|--|--|--|--|--|--|--|--|--|--|--|
| C03 |  |  |  |  |  |  |  |  |  |  |  |  |
| C04 |  |  |  |  |  |  |  |  |  |  |  |  |
| C05 |  |  |  |  |  |  |  |  |  |  |  |  |
| C06 |  |  |  |  |  |  |  |  |  |  |  |  |

| Abstract POs defined by National Board of Accreditation |                                            |      |                                |
|---------------------------------------------------------|--------------------------------------------|------|--------------------------------|
| PO#                                                     | Broad PO                                   | PO#  | Broad PO                       |
| PO1                                                     | Engineering Knowledge                      | PO7  | Environment and Sustainability |
| PO2                                                     | Problem Analysis                           | PO8  | Ethics                         |
| PO3                                                     | Design/Development of solutions            | PO9  | Individual and team work       |
| PO4                                                     | Conduct investigations of complex problems | PO10 | Communication                  |
| PO5                                                     | Modern tool usage                          | PO11 | Project Management and Finance |
| PO6                                                     | The Engineer and Society                   | PO12 | Life long learning             |

### Assessment Pattern

| Bloom's Category | Continuous Assessment Tests |            | End Semester Examination Marks (%) |
|------------------|-----------------------------|------------|------------------------------------|
|                  | Test 1 (%)                  | Test 2 (%) |                                    |
| Remember         | 30                          | 30         | 30                                 |
| Understand       | 50                          | 50         | 50                                 |
| Apply            | 20                          | 20         | 20                                 |
| Analyze          |                             |            |                                    |
| Evaluate         |                             |            |                                    |
| Create           |                             |            |                                    |

**Mark Distribution**

| Total Marks | CIE Marks | ESE Marks | ESE Duration |
|-------------|-----------|-----------|--------------|
| 150         | 50        | 100       | 3            |

**Continuous Internal Evaluation Pattern:**

|                                                              |          |
|--------------------------------------------------------------|----------|
| Attendance                                                   | 10 marks |
| Continuous Assessment Tests(Average of Internal Tests 1 & 2) | 25 marks |
| Continuous Assessment Assignment                             | 15 marks |

**Internal Examination Pattern**

Each of the two internal examinations has to be conducted out of 50 marks. First series test shall be preferably conducted after completing the first half of the syllabus and the second series test shall be preferably conducted after completing remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly completed module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly completed module), each with 7 marks. Out of the 7 questions, a student should answer any 5.

**End Semester Examination Pattern:**

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 full questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carries 14 marks.

**Syllabus****Module – 1 (Fundamentals of Cryptography)**

Introduction to Cryptography, Symmetric cryptography – AES. Asymmetric cryptography – RSA. Elliptic curve cryptography, Digital signatures – RSA digital signature algorithms. Secure Hash Algorithms – SHA-256. Applications of cryptographic hash functions – Merkle trees, Distributed hash tables.

**Module – 2 (Fundamentals of Blockchain Technology)**

Blockchain – Definition, architecture, elements of blockchain, benefits and limitations, types of blockchain. Consensus – definition, types, consensus in blockchain.

Decentralization – Decentralization using blockchain, Methods of decentralization, Routes to decentralization, Blockchain and full ecosystem decentralization.

### **Module - 3 (Consensus Algorithms and Bitcoin)**

Consensus Algorithms, Crash fault-tolerance (CFT) algorithms – Paxos, Raft. Byzantine fault-tolerance (BFT) algorithms – Practical Byzantine Fault Tolerance (PBFT), Proof of work (PoW), Proof of stake (PoS), Types of PoS.

Bitcoin – Definition, Cryptographic keys – Private keys, public keys, addresses. Transactions – Lifecycle, coinbase transactions, transaction validation. Blockchain – The genesis block.

Mining – Tasks of miners, mining algorithm, hash rate. Wallets – Types of wallets.

### **Module - 4 (Smart Contracts and Use cases)**

Smart Contracts – Definition, Smart contract templates, Oracles, Types of oracles, Deploying smart contracts. Decentralization terminology – Decentralized applications, Decentralized Autonomous Organizations.

Use cases of Blockchain technology – Government, Health care, Finance, Supply chain management.

Blockchain and allied technologies – Blockchain and Cloud Computing, Blockchain and Artificial Intelligence.

### **Module - 5 (Ethereum and Solidity)**

Ethereum – The Ethereum network. Components of the Ethereum ecosystem – Keys and addresses, Accounts, Transactions and messages. The Ethereum Virtual Machine, Blocks and blockchain.

The Solidity language – The layout of a Solidity source code, Structure of a smart contract, variables, data types, control structures, events, inheritance, libraries, functions, error handling.

Smart contracts Case study: Voting, Auction.

### **Text Book**

1. Imran Bashir, Mastering Blockchain: A deep dive into distributed ledgers, consensus protocols, smart contracts, DApps, cryptocurrencies, Ethereum, and more, Packt Publishing, Third edition, 2020.

### **References**

2. Ritesh Modi, Solidity Programming Essentials: A beginner's guide to build smart contracts for Ethereum and blockchain, Packt Publishing, First edition, 2018.
3. Kumar Saurabh, Ashutosh Saxena, Blockchain Technology: Concepts and Applications, First Edition, Wiley Publications, First edition, 2020.
4. Chandramouli Subramanian, Asha A George, et al, Blockchain Technology, Universities Press (India) Pvt. Ltd, First edition, August 2020.

5. Lorne Lantz, Daniel Cawrey, Mastering Blockchain: Unlocking the Power of Cryptocurrencies, Smart Contracts, and Decentralized Applications, O'Reilly Media, First edition, 2020.
6. Andreas M. Antonopoulos, Gavin Wood, Mastering Ethereum: Building Smart Contracts and DApps, O'Reilly Media, First edition, 2018.

### **Course Level Assessment Questions**

#### **Course Outcome 1 (CO1):**

1. Distinguish between Symmetric cryptography and asymmetric cryptography.
2. Explain the working of AES algorithm.

#### **Course Outcome 2 (CO2):**

1. Categorize consensus mechanism used in blockchain.
2. Define Blockchain. Explain how decentralization of computing or processing power is achieved by a blockchain.

#### **Course Outcome 3 (CO3):**

1. Explain how Proof of Stake can achieve consensus among peers.
2. Explain the working of Raft protocol.

#### **Course Outcome 4 (CO4):**

1. Describe the use of genesis block.
2. Explain the mining algorithm used in bitcoin.

#### **Course Outcome 5 (CO5):**

1. Illustrate how blockchain technology can be used in supply chain management.
2. What are oracles in a blockchain ecosystem? Explain the generic data flow from a smart contract to an oracle.

#### **Course Outcome 6 (CO6):**

1. Develop a smart contract for voting process. In this application, delegated voting is allowed and the counting is automatic and completely transparent at the same time.
2. Develop a smart contract for auction process. The contract should be a blind auction where it is not possible to see the actual bid until the bidding period ends.

## Model Question Paper

**QP CODE:**

**Reg No:** \_\_\_\_\_

**Name:** \_\_\_\_\_

**PAGES : 2**

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY**

**EIGHTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR**

**Course Code: CST428**

**Course Name: BLOCK CHAIN TECHNOLOGIES**

**Max. Marks : 100**

**Duration: 3 Hours**

### **PART A**

**Answer All Questions. Each Question Carries 3 Marks**

1. Discuss the role of secure hash functions in blockchain.
2. List out the properties of digital signatures.
3. Illustrate the blockchain based decentralized system.
4. Explain how Proof of Stake can achieve consensus among peers.
5. If your blockchain network has 5 Byzantine nodes, what is the minimum number of nodes that are required to ensure Byzantine fault tolerance using PBFT protocol?
6. How are transactions verified in a Bitcoin network?
7. Explain how smart contracts can be used for enforcing agreements between parties in the form of business logic.
8. Explain the concept of blockchain-based digital identity cards.
9. Explain error handling in Solidity language.

10. With the help of a figure show the relationship between the transaction, transaction trie, and block header in Ethereum. (10x3=30)

**Part B**

**(Answer any one question from each module. Each question carries 14 Marks)**

11. (a) Explain the design of SHA-256 and its compression function using a diagram. (9)

- (b) Explain how hash functions are used to build Merkle trees in blockchain. (5)

**OR**

12. (a) Explain public and private keys. Perform encryption and decryption using RSA for  $p=3$ ,  $q=11$ ,  $e=7$  and  $M=5$ . (7)

- (b) Explain elliptic curve digital signature algorithm. (7)

13. (a) Illustrate and explain how blockchain works using a neat diagram. (7)

- (b) Explain the benefits, features and limitations of blockchain. (7)

**OR**

14. (a) Explain consensus mechanisms used in blockchain. List out any six consensus algorithms used in the context of blockchain. (7)

- (b) Define blockchain. Explain how decentralization of computing or processing power is achieved by a blockchain. (7)

15. (a) Explain and illustrate how Paxos protocol can be used to achieve consensus. (7)

- (b) Show how Practical Byzantine Fault Tolerance can achieve consensus in the presence of Byzantine faults. (7)

**OR**

16. (a) Describe the various fields that make up a transaction in Bitcoin. (7)

- (b) What is the role of a Bitcoin miner? Explain the mining algorithm used in (7)



Bitcoin with the help of a flowchart.

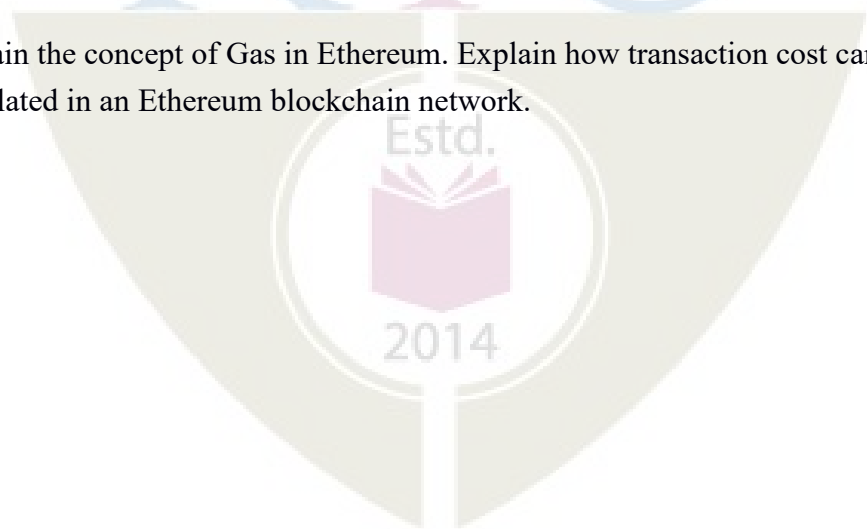
17. (a) Illustrate how blockchain technology can be implemented in finance sector. (7)
- (b) Discuss oracles in a blockchain ecosystem. Explain the generic data flow from a smart contract to an oracle. (7)

**OR**

18. (a) Explain the design process of decentralized applications with diagrams. (7)
- (b) Explain the use of blockchain technology in supply chain management. (7)
19. (a) Using Solidity language, create a simple bank contract that allows a user to deposit, withdraw and view balance. (7)
- (b) Define block difficulty. Explain how block difficulty is adjusted in Ethereum blockchain network. (7)

**OR**

20. (a) Using Solidity language, create a simple voting smart contract where a chairperson will give the right to vote to each address individually. (7)
- (b) Explain the concept of Gas in Ethereum. Explain how transaction cost can be calculated in an Ethereum blockchain network. (7)



**Teaching Plan**

| No                                                                | Contents                                                                                                       | No. of Lecture Hours<br>(35 hours) |
|-------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------|------------------------------------|
| <b>Module-1 (Fundamentals of Cryptography) (7 hours)</b>          |                                                                                                                |                                    |
| 1.1                                                               | Introduction to cryptography                                                                                   | 1 hour                             |
| 1.2                                                               | Symmetric cryptography, AES                                                                                    | 1 hour                             |
| 1.3                                                               | Asymmetric cryptography, RSA                                                                                   | 1 hour                             |
| 1.4                                                               | Elliptic curve cryptography                                                                                    | 1 hour                             |
| 1.5                                                               | Digital signatures – RSA digital signature algorithm                                                           | 1 hour                             |
| 1.6                                                               | Secure Hash Algorithms – SHA-256                                                                               | 1 hour                             |
| 1.7                                                               | Applications of cryptographic hash functions – Merkle trees, Distributed hash tables                           | 1 hour                             |
| <b>Module-2 (Fundamentals of Blockchain Technology) (6 hours)</b> |                                                                                                                |                                    |
| 2.1                                                               | Blockchain – definition and architecture                                                                       | 1 hour                             |
| 2.2                                                               | Elements of blockchain.                                                                                        | 1 hour                             |
| 2.3                                                               | Blockchain – benefits and limitations, types.                                                                  | 1 hour                             |
| 2.4                                                               | Consensus – definition, types, consensus in blockchain                                                         | 1 hour                             |
| 2.5                                                               | Decentralization using blockchain, Methods of decentralization                                                 | 1 hour                             |
| 2.6                                                               | Routes to decentralization, Blockchain and full ecosystem decentralization                                     | 1 hour                             |
| <b>Module-3 (Consensus Algorithms and Bitcoin) (7 hours)</b>      |                                                                                                                |                                    |
| 3.1                                                               | Consensus Algorithms – Crash fault-tolerance (CFT) algorithms – Paxos, Raft (working is expected).             | 1 hour                             |
| 3.2                                                               | Byzantine fault-tolerance (BFT) algorithms – Practical Byzantine Fault Tolerance (PBFT) (working is expected). | 1 hour                             |
| 3.3                                                               | Proof of work (PoW), Proof of stake (PoS), Types of PoS                                                        | 1 hour                             |
| 3.4                                                               | Bitcoin – Definition, Cryptographic keys – Private keys, public keys, addresses.                               | 1 hour                             |
| 3.5                                                               | Transactions – Lifecycle, coinbase transactions, transaction validation                                        | 1 hour                             |

|                                                           |                                                                                                                    |        |
|-----------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------|--------|
| 3.6                                                       | Blockchain – The genesis block. Mining – Tasks of miners                                                           | 1 hour |
| 3.7                                                       | Mining – mining algorithm, hash rate. Wallets – Types of wallets.                                                  | 1 hour |
| <b>Module-4 (Smart Contracts and Use cases) (6 hours)</b> |                                                                                                                    |        |
| 4.1                                                       | Smart Contracts – Definition, Smart contract templates                                                             | 1 hour |
| 4.2                                                       | Oracles, Types of oracles, Deploying smart contracts.                                                              | 1 hour |
| 4.3                                                       | Decentralization terminology –Decentralized applications, Decentralized Autonomous Organizations.                  | 1 hour |
| 4.4                                                       | Use cases of Blockchain technology – Government, Health care.                                                      | 1 hour |
| 4.5                                                       | Use cases of Blockchain technology – Finance, Supply chain management.                                             | 1 hour |
| 4.6                                                       | Blockchain and Allied Technologies – Blockchain and Cloud Computing, Blockchain and Artificial Intelligence.       | 1 hour |
| <b>Module-5 (Ethereum and Solidity) (9 hours)</b>         |                                                                                                                    |        |
| 5.1                                                       | Ethereum - The Ethereum network,<br>Components of the Ethereum ecosystem – Keys and addresses, Accounts            | 1 hour |
| 5.2                                                       | Components of the Ethereum ecosystem – Transactions and messages                                                   | 1 hour |
| 5.3                                                       | The Ethereum Virtual Machine                                                                                       | 1 hour |
| 5.4                                                       | Ethereum Blocks and blockchain                                                                                     | 1 hour |
| 5.5                                                       | The Solidity language – The layout of a Solidity source code, Structure of a smart contract, variables, data types | 1 hour |
| 5.6                                                       | The Solidity language – control structures, events, inheritance, libraries                                         | 1 hour |
| 5.7                                                       | The Solidity language – functions, error handling.                                                                 | 1 hour |
| 5.8                                                       | Smart contracts Case study: Voting.                                                                                | 1 hour |
| 5.9                                                       | Smart contracts Case study: Auction.                                                                               | 1 hour |

**Prerequisite:** A basic knowledge of Computer Graphics and Image representation

|     |                                                                                                                                                  |
|-----|--------------------------------------------------------------------------------------------------------------------------------------------------|
| CO1 | Explain the concepts of image formation and the basis of digital image processing. <b>(Cognitive Knowledge Level: Understand)</b>                |
| CO2 | Demonstrate the role of image transforms in representing, highlighting, and modifying image features. <b>(Cognitive Knowledge Level: Apply)</b>  |
| CO3 | Solve image enhancement problems using spatial and frequency domain techniques. <b>(Cognitive Knowledge Level: Apply)</b>                        |
| CO4 | Make use of the concept of image restoration and image segmentation techniques in real-world problems. <b>(Cognitive Knowledge Level: Apply)</b> |
| CO5 | Interpret morphological operations, image representation, and description techniques. <b>(Cognitive Knowledge Level: Understand)</b>             |

|     | PO1                                 | PO2                                 | PO3                                 | PO4                                 | PO5                                 | PO6                                 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12                                |
|-----|-------------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|-----|-----|-----|------|------|-------------------------------------|
| CO1 | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |                                     |                                     |                                     |                                     |     |     |     |      |      | <input checked="" type="checkbox"/> |
| CO2 | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |                                     |                                     | <input checked="" type="checkbox"/> |                                     |     |     |     |      |      | <input checked="" type="checkbox"/> |
| CO3 | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |                                     |                                     |                                     |     |     |     |      |      | <input checked="" type="checkbox"/> |
| CO4 | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |     |     |     |      |      | <input checked="" type="checkbox"/> |
| CO5 | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |                                     |                                     |                                     |                                     |     |     |     |      |      | <input checked="" type="checkbox"/> |

| Abstract POs defined by National Board of Accreditation |                                            |      |                                |
|---------------------------------------------------------|--------------------------------------------|------|--------------------------------|
| PO#                                                     | Broad PO                                   | PO#  | Broad PO                       |
| PO1                                                     | Engineering Knowledge                      | PO7  | Environment and Sustainability |
| PO2                                                     | Problem Analysis                           | PO8  | Ethics                         |
| PO3                                                     | Design/Development of solutions            | PO9  | Individual and teamwork        |
| PO4                                                     | Conduct investigations of complex problems | PO10 | Communication                  |
| PO5                                                     | Modern tool usage                          | PO11 | Project Management and Finance |
| PO6                                                     | The Engineer and Society                   | PO12 | Life long learning             |

### Assessment Pattern

| Bloom's Category | Continuous Assessment Tests |            | End Semester Examination Marks (%) |
|------------------|-----------------------------|------------|------------------------------------|
|                  | Test 1 (%)                  | Test 2 (%) |                                    |
| Remember         | 30                          | 30         | 30                                 |
| Understand       | 40                          | 40         | 40                                 |
| Apply            | 30                          | 30         | 30                                 |
| Analyze          |                             |            |                                    |
| Evaluate         |                             |            |                                    |
| Create           |                             |            |                                    |

### Mark Distribution

| Total Marks | CIE Marks | ESE Marks | ESE Duration |
|-------------|-----------|-----------|--------------|
| 150         | 50        | 100       | 3            |

**Continuous Internal Evaluation Pattern:**

|                                                               |          |
|---------------------------------------------------------------|----------|
| Attendance                                                    | 10 marks |
| Continuous Assessment Tests (Average of Internal Tests 1 & 2) | 25 marks |
| Continuous Assessment Assignment                              | 15 marks |

**Internal Examination Pattern**

Each of the two internal examinations has to be conducted out of 50 marks. The first series test shall be preferably conducted after completing the first half of the syllabus and the second series test shall be preferably conducted after completing the remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly completed module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly completed module), each with 7 marks. Out of the 7 questions, a student should answer any 5.

**End Semester Examination Pattern:**

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 full questions from each module of which students should answer anyone. Each question can have a maximum 2 subdivisions and carries 14 marks.

**Syllabus****Module – 1 (Digital Image Fundamentals)**

Elements of Visual Perception, A Simple Image Formation Model. Spatial and Intensity Resolution. Image Interpolation. Classification of Digital Images. Image Types. Image Storage Mechanisms. Arithmetic and Logical Operations. Geometric Spatial Transformations and Image Registration. Image File Formats. Colour Fundamentals and Colour Models.

**Module - 2 (Image Transforms)**

Basic concept of spatial domain and frequency domain, Unitary transform, Discrete Fourier Transform- 2D DFT, 4 order DFT Transform coefficients, Forward and inverse transform, Discrete Cosine Transform- 2D DCT, 4 order DCT Transform Coefficients(No derivation needed), Forward and Inverse DCT, Hadamard Transform.

**Module - 3 (Image Enhancement in Spatial and Frequency Domain)**

Point operations- Clipping and Thresholding, Digital Negative, Intensity Level Slicing, Bit Extraction, Range Compression. Spatial Operations- Fundamentals of spatial convolution and

correlation, Spatial averaging and spatial Low pass filtering, Directional Smoothing, Median Filtering, Unsharp masking and Crispening.

Basics of Filtering in Frequency Domain, Filters, Smoothing Frequency Domain Filters- Sharpening Frequency Domain Filters

#### **Module - 4 (Image Restoration & Image Segmentation)**

Image degradation model, Noise models, Mean Filters, Order Statistic filter, Adaptive filters. Edge Detection, gradient operators, Laplace operators and zero crossings. Thresholding, Basic Global Thresholding, Optimum global thresholding using Otsu method, Multiple thresholds, Variable thresholding, Multivariable thresholding. Region-Based Approach to Segmentation.

#### **Module - 5 (Morphological Operations & Representation and Description)**

Structuring Element, Dilation and Erosion, Opening and Closing, Hit or Miss Transformation.

Boundary Following. Chain Codes. Polygonal Approximation. Boundary Descriptors. Regional Descriptors. Relational Descriptors.

#### **Text Books**

1. Rafael C. Gonzalez, Richard E. Woods, Digital Image Processing (English) 3rd Edition, Pearson India, 2013
2. A K. Jain, Fundamentals of digital image processing, Prentice Hall of India, 1989.

#### **Reference Books**

1. Al Bovik, The Essential Guide to Image Processing, Academic Press, 2009.
2. Milan Sonka, Vaclav Hlavac and Roger Boyle, Image Processing, Analysis, and Machine Vision, Thomson Learning, 2008.
3. S Jayaraman, S Esakkirajan and T Veerakumar, Digital Image Processing, McGraw Hill Education, 2009.

### **Course Level Assessment Questions**

#### **Course Outcome1 (CO1) :**

1. Find the number of bits required to store a 256 X 256 image with 32 gray levels.
2. Explain the reasons for blocking artifacts and false contours in an image.

#### **Course Outcome 2 (CO2) :**

1. Compare different image transforms based on their roles, properties and applications.
2. Compute the inverse 2D DFT of the transform coefficients  $F(k,l)$  given below.



$$F(k, l) = \begin{pmatrix} 64 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \end{pmatrix}$$

3. Use Discrete Fourier transform to construct 2D DFT for a 4x4 image given below. Assume that indices start from (0,0)

|   |   |   |   |
|---|---|---|---|
| 6 | 6 | 6 | 6 |
| 6 | 6 | 6 | 6 |
| 6 | 6 | 6 | 6 |
| 6 | 6 | 6 | 6 |

### Course Outcome 3 (CO3) :

1. Perform intensity level slicing on the 3 BPP (Bit Per Pixel) image. Let  $r_1=3$  and  $r_2=5$ . Draw the modified image with/without background transformations.

|   |   |   |   |   |
|---|---|---|---|---|
| 2 | 1 | 2 | 2 | 1 |
| 2 | 3 | 4 | 5 | 2 |
| 6 | 2 | 7 | 6 | 0 |
| 2 | 6 | 6 | 5 | 1 |
| 0 | 3 | 2 | 2 | 1 |

2. Let  $y(m) = \{2,3,8,4,2\}$ . Obtain the median filter output for the window  $W = [-1,0,1,2]$  and show how salt and pepper noise is reduced.
3. Consider a 3\*3 spatial mask that averages the four closest neighbors of a point(x,y), but excludes the point itself from the average.
  - (a) Find the equivalent filter  $H(u,v)$  in the frequency domain.
  - (b) Show that  $H(u,v)$  is a lowpass filter (ASSIGNMENT)

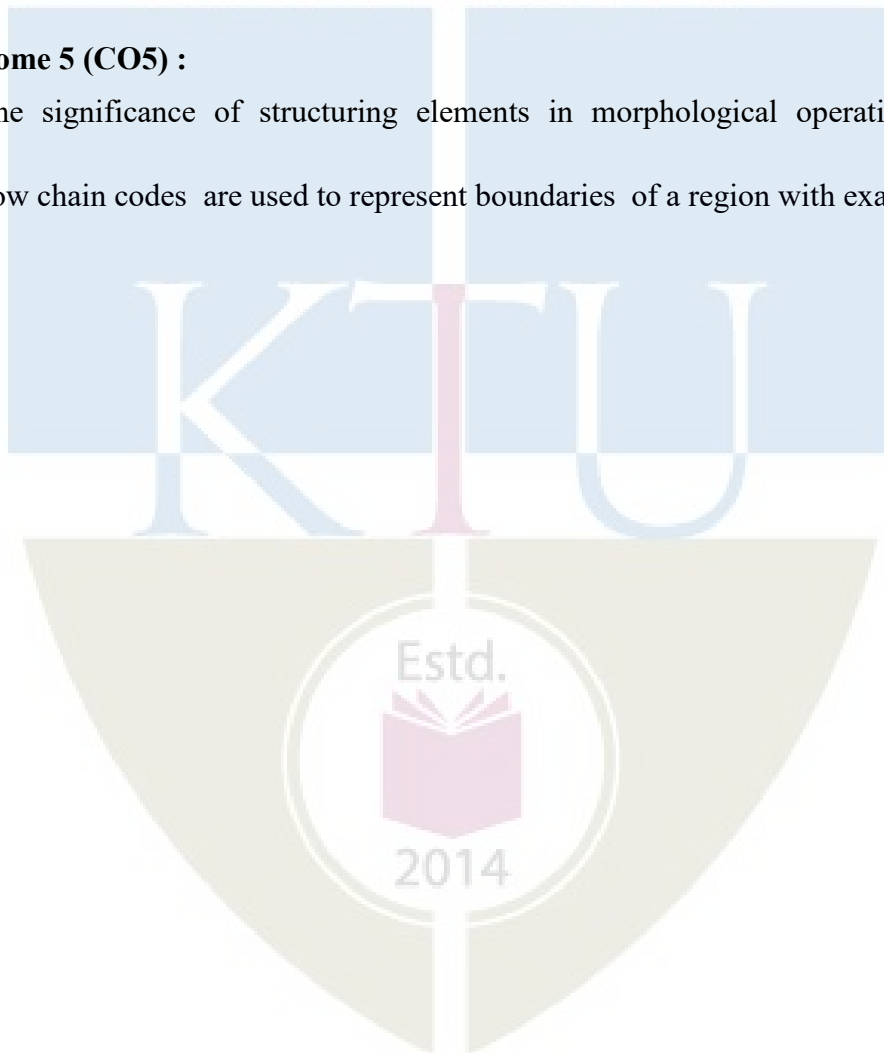
### Course Outcome 4 (CO4) :

1. Compare Region and Edge-based techniques in segmentation.

2. Consider a noisy image that is restored using arithmetic mean filter of size  $3 \times 3$  and using the geometric mean filter of the same size. Which image will be less blurred and why?
3. Suppose that you want to help a radiologist to extract the tumor portion from an MRI image for volumetric analysis. This volumetric analysis determines the effect of treatment on the patient, which can be judged from the extracted size and shape of the abnormal portion. Manual tracing of the tumor regions is very difficult since the tumor portion on the MRI image is inhomogeneous, with complex shapes and ambiguous boundaries. Suggest a sequence of steps that you may use to automate this process as an image processing student. (ASSIGNMENT)

**Course Outcome 5 (CO5) :**

4. Explain the significance of structuring elements in morphological operations with example.
5. Explain how chain codes are used to represent boundaries of a region with examples.



## Model Question Paper

QP CODE:

Reg No: \_\_\_\_\_

Name: \_\_\_\_\_

PAGES : 4

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY**  
**EIGHTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR**

**Course Code: CST438**

**Course Name: IMAGE PROCESSING TECHNIQUE**

**Max. Marks : 100**

**Duration: 3 Hours**

### PART A

**Answer All Questions. Each Question Carries 3 Marks**

1. Give an image representation model and describe how the representation changes in different types of images.
2. Describe any three types of color models.
3. Obtain the HADAMARD basis matrix for  $N=8$ .
4. Prove that DFT is a unitary transform.
5. Sketch perspective plot of a 2-D ideal low pass filter transfer function and filter cross-section. List its usefulness in Image enhancement.
6. Explain the significance of directional smoothing technique.
7. Specify the significance of the Zero crossing detector.
8. Describe region growing technique for image segmentation.
9. Define 'Structuring Element' used in morphological operations. Give samples for Structuring Elements.
10. Explain image boundary representation using polygonal approximation.

**(10x3=30)**

### Part B

**(Answer any one question from each module. Each question carries 14 Marks)**

11. (a) Explain a Simple Image Formation Model with the help of a neat diagram. (7)  
(b) Explain the relationship between image size, spatial resolution, and image quality. Compare gray level and intensity resolution. (7)

**OR**

12. (a) Describe arithmetic, logical and geometrical operations on Image. (7)

- (b) Explain the significance of image interpolation and describe its various types. (7)
13. (a) State the advantages of Discrete Cosine Transform over Discrete Fourier Transform. (4)
- (b) You are given a 4 X 4 image patch. Compute 2D DCT for the image patch. Reconstruct the original image patch by neglecting the last four coefficients in 2D DCT. Comment on the observed result. (10)

|    |    |    |    |
|----|----|----|----|
| 12 | 4  | 2  | 6  |
| 5  | 10 | 12 | 24 |
| 6  | 8  | 10 | 12 |
| 14 | 12 | 8  | 10 |

OR

14. (a) Discuss the concept of sequency in Hadamard transform. (4)
- (b) Find the 2D forward DFT of the image segment (10)
- |   |   |   |   |
|---|---|---|---|
| 1 | 1 | 1 | 1 |
| 1 | 1 | 1 | 1 |
| 1 | 1 | 1 | 1 |

Prove the unitary property of the given image segment.

15. (a) Explain the output and application of the following point processing techniques (9)
- (i) Range Compression (ii) Bit Extraction (iii) Thresholding
- (b) State and explain the features of median filtering. Compute the output of the median filtering for  $Y(m) = \{2, 4, 8, 3, 2\}$ ,  $w = \{-1, 0, 1, 2\}$  where  $Y(m)$  is an array and  $w$  is a window. (5)

OR

16. (a) Describe the role of Unsharp masking with its applications (4)
- (b) Explain and compare the basic frequency domain filters for image sharpening (10)
17. (a) A 4×4 image is given by (8)

|    |    |   |   |
|----|----|---|---|
| 2  | 4  | 8 | 7 |
| 12 | 6  | 9 | 8 |
| 13 | 7  | 4 | 3 |
| 8  | 12 | 4 | 9 |

Filter the above image using

(a) MIN filter (b) MAX filter using the filter mask

0 1 0

1 1 1

0 1 0

(Assume replicate padding of the input image)

- (b) Explain any two types of thresholding techniques. Describe the threshold detection algorithm using Otsu's method. (6)

OR

18. (a) Explain Image degradation model with the help of a neat diagram. (8)

- (b) Illustrate the split and merge algorithm for image segmentation using neat sketches. (6)

19. (a) Explain the purpose of morphological operations in digital image? Describe the opening and closing operations with examples. (7)

- (b) Illustrate Hit or Miss Transformation. (7)

OR

20. (a) Explain the concept of the chain coding scheme with its applications. (6)

- (b) Describe in detail any two boundary representation schemes and illustrate with examples. (8)

### Teaching Plan

| No                                                     | Contents                                                                                | No. of Lecture Hours<br>(36 hrs) |
|--------------------------------------------------------|-----------------------------------------------------------------------------------------|----------------------------------|
| <b>Module-1 (Digital Image Fundamentals) (7 hours)</b> |                                                                                         |                                  |
| 1.1                                                    | Elements of Visual Perception, A Simple Image Formation Model                           | 1                                |
| 1.2                                                    | Spatial and Intensity Resolution, Image Interpolation, Classification of Digital Image. | 1                                |
| 1.3                                                    | Image Types, Image Storage Mechanisms.                                                  | 1                                |
| 1.4                                                    | Arithmetic and Logical Operations.                                                      | 1                                |
| 1.5                                                    | Geometric Spatial Transformations and Image Registration.                               | 1                                |
| 1.6                                                    | Image File Formats.                                                                     | 1                                |

|                                                                               |                                                                                                                       |   |
|-------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------|---|
| 1.7                                                                           | Colour Fundamentals and Colour Models.                                                                                | 1 |
| <b>Module-2 (Image Transforms) (8 hours)</b>                                  |                                                                                                                       |   |
| 2.1                                                                           | Basic concept of spatial domain and frequency domain.                                                                 | 1 |
| 2.2                                                                           | Need of Image Transform, Basic properties of unitary transform.                                                       | 1 |
| 2.3                                                                           | Discrete Fourier transform, Proof DFT is Unitary.                                                                     | 1 |
| 2.4                                                                           | 4 order DFT Transform coefficients (Derivation).                                                                      | 1 |
| 2.5                                                                           | Problems ( 4 order DFT).                                                                                              | 1 |
| 2.6                                                                           | Discrete Cosine Transform- 2D DCT.                                                                                    | 1 |
| 2.7                                                                           | 4 order DCT Transform Coefficients(No derivation needed).                                                             | 1 |
| 2.8                                                                           | Hadamard Transform.                                                                                                   | 1 |
| <b>Module-3 (Image Enhancement in spatial and frequency domain) (8 hours)</b> |                                                                                                                       |   |
| 3.1                                                                           | Point operations- Clipping and Thresholding, Digital Negative. Intensity Level Slicing.                               | 1 |
| 3.2                                                                           | Bit Extraction, Range Compression + (Work out problems).                                                              | 1 |
| 3.3                                                                           | Spatial Operations-Fundamentals of spatial convolution and correlation.                                               | 1 |
| 3.4                                                                           | Spatial averaging and spatial Low pass filtering, Directional Smoothing.                                              | 1 |
| 3.5                                                                           | Median Filtering, Unsharp masking and Crispening.                                                                     | 1 |
| 3.6                                                                           | Basics of Filtering in Frequency Domain.                                                                              | 1 |
| 3.7                                                                           | Smoothing Frequency Domain Filters : Ideal Low Pass Filter; Gaussian Low Pass Filter; Butterworth Low Pass Filter;    | 1 |
| 3.8                                                                           | Sharpening Frequency Domain Filters: Ideal High Pass Filter; Gaussian High Pass Filter; Butterworth High Pass filter. | 1 |
| <b>Module-4 (Image Restoration &amp; Image Segmentation) ( 6 hours)</b>       |                                                                                                                       |   |
| 4.1                                                                           | Image degradation model, Noise models.                                                                                | 1 |
| 4.2                                                                           | Mean Filters – Order Statistic filter – Adaptive filters.                                                             | 1 |
| 4.3                                                                           | Edge Detection, Gradient operators, Laplace operators and zero crossings.                                             | 1 |

|                                                                                           |                                                                                         |   |
|-------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------|---|
| 4.4                                                                                       | Thresholding- Basic Global Thresholding, Optimum global thresholding using Otsu method. | 1 |
| 4.5                                                                                       | Multiple thresholds, Variable thresholding, Multivariable thresholding.                 | 1 |
| 4.6                                                                                       | Region-Based Approach to Segmentation.                                                  | 1 |
| <b>Module-5 (Morphological Operations &amp; Representation and Description) (7 hours)</b> |                                                                                         |   |
| 5.1                                                                                       | Structuring Element. Dilation and Erosion,                                              | 1 |
| 5.2                                                                                       | Morphological Opening, Closing.                                                         | 1 |
| 5.3                                                                                       | Hit or Miss Transformation.                                                             | 1 |
| 5.4                                                                                       | Boundary Following. Chain Codes, Polygonal Approximation.                               | 1 |
| 5.5                                                                                       | Boundary Descriptors.                                                                   | 1 |
| 5.6                                                                                       | Regional Descriptors.                                                                   | 1 |
| 5.7                                                                                       | Relational Descriptors.                                                                 | 1 |





| CST448 | INTERNET OF THINGS | CATEGORY | L | T | P | CREDIT | YEAR OF INTRODUCTION |
|--------|--------------------|----------|---|---|---|--------|----------------------|
|        |                    | PEC      | 2 | 1 | 0 | 3      | 2019                 |

**Preamble:** This course equips the learners with fundamental of the Internet of Things(IoT) and the IoT ecosystem. It covers the architecture of IoT, communication mechanisms, protocols, hardware, software, data analytics, and the cloud platforms for IoT. This course enables the students to design smart IoT applications for real world problems using Raspberry Pi.

**Prerequisite:** Basic knowledge in Data Communication, Computer Networks and Programming in Python

**Course Outcomes:** After the completion of the course the students will be able to

|     |                                                                                                                                      |
|-----|--------------------------------------------------------------------------------------------------------------------------------------|
| CO1 | Outline the fundamentals of IoT and its underlying physical and logical architecture( <b>Cognitive Knowledge Level: Understand</b> ) |
| CO2 | Explain the hardware architectures for IoT ( <b>Cognitive Knowledge Level : Understand</b> )                                         |
| CO3 | Outline the Network architectures for IoT( <b>Cognitive Knowledge Level : Understand</b> )                                           |
| CO4 | Implement data analytics on the IoT platforms ( <b>Cognitive Knowledge Level : Apply</b> )                                           |
| CO5 | Appreciate the security considerations in IoT ( <b>Cognitive Knowledge Level : Understand</b> )                                      |
| CO6 | Implement IoT applications using the available hardware and software. ( <b>Cognitive Knowledge Level : Apply</b> )                   |

**Mapping of course outcomes with program outcomes**

|     | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|
| CO1 |     |     |     |     |     |     |     |     |     |      |      |      |
| CO2 |     |     |     |     |     |     |     |     |     |      |      |      |
| CO3 |     |     |     |     |     |     |     |     |     |      |      |      |
| CO4 |     |     |     |     |     |     |     |     |     |      |      |      |

|     |  |  |  |  |  |  |  |  |  |  |  |  |
|-----|--|--|--|--|--|--|--|--|--|--|--|--|
| CO5 |  |  |  |  |  |  |  |  |  |  |  |  |
| CO6 |  |  |  |  |  |  |  |  |  |  |  |  |

| Abstract POs Defined by National Board of Accreditation |                                            |      |                                |
|---------------------------------------------------------|--------------------------------------------|------|--------------------------------|
| PO#                                                     | Broad PO                                   | PO#  | Broad PO                       |
| PO1                                                     | Engineering Knowledge                      | PO7  | Environment and Sustainability |
| PO2                                                     | Problem Analysis                           | PO8  | Ethics                         |
| PO3                                                     | Design/Development of solutions            | PO9  | Individual and teamwork        |
| PO4                                                     | Conduct investigations of complex problems | PO10 | Communication                  |
| PO5                                                     | Modern tool usage                          | PO11 | Project Management and Finance |
| PO6                                                     | The Engineer and Society                   | PO12 | Lifelong learning              |

#### Assessment Pattern

| Blooms Category | Continuous Assessment Tests |                     | End Semester Examination Marks |
|-----------------|-----------------------------|---------------------|--------------------------------|
|                 | Test 1 (Percentage)         | Test 2 (Percentage) |                                |
| Remember        | 30                          | 20                  | 30                             |
| Understand      | 60                          | 50                  | 40                             |
| Apply           | 10                          | 30                  | 30                             |
| Analyze         |                             |                     |                                |

|          |  |  |  |
|----------|--|--|--|
| Evaluate |  |  |  |
| Create   |  |  |  |

**Mark Distribution**

| Total Marks | CIE Marks | ESE Marks | ESE Duration |
|-------------|-----------|-----------|--------------|
| 150         | 50        | 100       | 3 Hours      |

**Continuous Internal Evaluation Pattern:**

|                                  |          |
|----------------------------------|----------|
| Attendance                       | 10 marks |
| Continuous Assessment Tests      | 25 marks |
| Continuous Assessment Assignment | 15 marks |

**Internal Examination Pattern:**

Each of the two internal examinations has to be conducted out of 50 marks. First Internal Examination shall be preferably conducted after completing the first half of the syllabus, and the Second Internal Examination shall be preferably conducted after completing the remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly covered module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly covered module), each with 7 marks. Out of the 7 questions in Part B, a student should answer any 5.

**End Semester Examination Pattern:**

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which a student should answer anyone. Each question can have a maximum 2 subdivisions and carries 14 marks.

## Syllabus

### Module- 1 ( IoT Architecture)

What is IoT, Genesis of IoT, IoT and Digitization, IoT Impact, Convergence of IT and IoT, IoT Challenges, IoT Network Architecture and Design, Drivers Behind New Network Architectures, Comparing IoT Architectures, A Simplified IoT Architecture, The Core IoT Functional Stack, IoT Data Management and Compute Stack.

### Module- 2 (Engineering IoT Networks)

Smart Objects: The “Things” in IoT, Sensors, Actuators, and Smart Objects, Sensor Networks, Connecting Smart Objects, Communications Criteria, IoT Access Technologies

### Module- 3 (IoT Network Layer)

IP as the IoT Network Layer, The Business Case for IP, The need for Optimization, Optimizing IP for IoT, Profiles and Compliances, Application Protocols for IoT, The Transport Layer, IoT Application Transport Methods

### Module 4 (Data Analytics for IoT)

Data and Analytics for IoT, An Introduction to Data Analytics for IoT, Machine Learning, Big Data Analytics Tools and Technology, Edge Streaming Analytics, Network Analytics, Securing IoT, A Brief History of OT Security, Common Challenges in OT Security, Differences between IT and OT Security Practices and Systems, Formal Risk Analysis Structures: OCTAVE and FAIR.

### Module 5 ( Developing IoT Systems)

IoT Logical Design using Python, IoT Physical Devices and Endpoints - Raspberry Pi interfaces, Programming Raspberry Pi using Python, Other IoT devices, IoT Physical devices and Cloud offerings, Cloud Storage Models, WAMP - Autobahn for IoT, Django, Designing RESTful Web API, Cloud Web Services for IoT.

### Textbooks

1. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry, "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", 1st Edition, Pearson Education (Cisco Press Indian Reprint)

2. Arshadeep Bahga, Vijay Madiseti, “Internet of Things: A hands-on approach”, University Press, 2015 (First edition)

### References

1. Rajkamal, “Internet of Things: Architecture and Design Principles”, McGraw Hill (India) Private Limited
2. Dieter Uckelmann, Mark Harrison, Michahelles Florian (Ed.), Architecting the internet of things, Springer, 2011
3. Dr. Ovidiu Vermesan, Dr. Peter Friess, Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems, River Publishers, 2013
4. Simon Monk, “Programming Arduino: Getting Started with Sketches”, McGraw Hill Publications

### Sample Course Level Assessment Questions

#### Course Outcome 1 (CO1):

1. Write a short note on the impact of IoT in the real world
2. Explain the challenges of IoT.
3. Compare OT and IT Technology.
4. Describe the elements of one M2M architecture of IoT

#### Course Outcome 2 (CO2):

1. Mention any four wireless technologies and its architectural characteristics
2. Comment things in IoT
3. Compare biosensors and biodegradable sensors used in IoT
4. Explain the term NBIoT(Narrow Band IoT)

#### Course Outcome 3 (CO3):

1. Discuss the need for optimization
2. Compare MQTT and COAP
3. Explain different schedule management and packet forwarding models of 6TiSCH

#### Course Outcome 4(CO4):

1. Compare Bigdata and edge analytics
2. Compare structured and unstructured data
3. Describe the components of FNF

**Course Outcome 5(CO5):**

1. What are the major challenges in IoT security?
2. Explain the impact of OT Network Characteristics on IoT Security.

**Course Outcome 6(CO6):**

1. Implement LDR interfacing with Raspberry Pi
2. Explain the development of a RESTful web API.

**Model Question Paper**

QP CODE: \_\_\_\_\_

PAGES :3

Reg No: \_\_\_\_\_

Name: \_\_\_\_\_

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY**

**EIGHTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR**

**Course Code: CST448**

**Course Name: Internet of Things**

**Max.Marks : 100**

**Duration: 3 Hours**

**PART A**

**Answer All Questions. Each Question Carries 3 Marks**

1. Explain the role of IoT in connected roadways,
2. Describe the functions of the various layers of simplified IoT Architecture Model.
3. Explain the communication protocols employed in Wireless Sensor Networks
4. What are the essential performance considerations of constrained-node networks?
5. Explain the parameters to be considered while choosing between IP adaptation / adoption for last mile communication.
6. With neat diagrams compare the IoT protocol stacks using 6LoWPAN and IP.
7. Differentiate the types of IoT data analytics results.

8. How can the insecure operational protocols be characterized?
9. Write a program to interface an LED and a switch with Raspberry Pi
10. List down the Raspberry Pi interfaces and explain. (10x3=30)

**Part B**

(Answer any one question from each module. Each question carries 14 Marks)

11. (a) Illustrate the impact of IoT in at least 2 domains of normal human life. (9)  
(b) Describe the Application and Analytics sublayer of IoT Architecture (6)
- OR**
12. (a) Describe the Standardized IoT architectures. (8)  
(b) Explain the functions of Access Network Sublayer of IoT Architecture (6)
13. (a) Describe the LoRaWAN technology as an IoT communication paradigm. (10)  
(b) Describe various types of sensors. (4)
- OR**
14. (a) Define actuators. Describe the roles of actuators in IoT systems. (6)  
(b) Explain the IEEE 802.15.4 standard for wireless communication. (8)
15. (a) Explain Message Queuing Telemetry Transport framework and message format. (8)  
(b) Explain tunneling of legacy SCADA over IP Networks with a neat diagram. (6)
- OR**
16. (a) Explain SCADA Transport over LLNs with MAP-T. (7)  
(b) Explain RPL encryption and authentication on constrained nodes. (7)



17. (a) Explain the Hadoop ecosystem with a neat diagram. (7)

(b) Explain the Flexible NetFlow Architecture. (7)

**OR**

18. (a) Explain the “The Purdue Model for Control Hierarchy” and OT network characteristics. (8)

(b) Explain any two formal risk analysis structures (6)

19. (a) Explain the working of WAMP protocol. (8)

(b) Describe how AWS supports IoT development (6)

**OR**

20. (a) Demonstrate an example of Raspberry Pi applications for Industrial IoT. (8)

(b) Explain the Django Architecture (6)

### TEACHING PLAN

| No                                                                | Contents                                                              | No of Lecture Hrs (35 Hrs) |
|-------------------------------------------------------------------|-----------------------------------------------------------------------|----------------------------|
| <b>Module – 1 ( IoT Architecture) (6 hrs) (TB-1, Chapter 1,2)</b> |                                                                       |                            |
| 1.1                                                               | What is IoT, Genesis of IoT, IoT and Digitization,                    | 1                          |
| 1.2                                                               | IoT Impact, Convergence of IT and IoT, IoT Challenges                 | 1                          |
| 1.3                                                               | IoT Network Architecture and Design                                   | 1                          |
| 1.4                                                               | Drivers Behind New Network Architectures, Comparing IoT Architectures | 1                          |
| 1.5                                                               | A Simplified IoT Architecture,                                        | 1                          |

|                                                                       |                                                                       |   |
|-----------------------------------------------------------------------|-----------------------------------------------------------------------|---|
| 1.6                                                                   | The Core IoT Functional Stack, IoT Data Management and Compute Stack. | 1 |
| <b>Module- 2 (Engineering IoT Networks) (7hrs)(TB-1, Chapter 3,4)</b> |                                                                       |   |
| 2.1                                                                   | Smart Objects: The “Things” in IoT,                                   | 1 |
| 2.2                                                                   | Sensors, Actuators, and Smart Objects                                 | 1 |
| 2.3                                                                   | Sensor Networks                                                       | 1 |
| 2.4                                                                   | Connecting Smart Objects                                              | 1 |
| 2.5                                                                   | IoT Access Technologies –IEEE 802.15.4 (g/e), 1901.2a                 | 1 |
| 2.6                                                                   | IoT Access Technologies - 802.11ah, LoRaWAN                           | 1 |
| 2.7                                                                   | IoT Access Technologies – LoRaWAN, NBIoT, LTE                         | 1 |
| <b>Module- 3 (IoT Network Layer) (7 hrs)(TB-1, Chapter 5,6)</b>       |                                                                       |   |
| 3.1                                                                   | IP as the IoT Network Layer, The Business Case for IP                 | 1 |
| 3.2                                                                   | The need for Optimizing IP for IoT                                    | 1 |
| 3.3                                                                   | Optimizing IP for IoT, Profiles, and Compliance                       | 1 |
| 3.4                                                                   | Application Protocols for IoT - CoAP                                  | 1 |
| 3.5                                                                   | Application Protocols for IoT - MQTT                                  | 1 |
| 3.6                                                                   | The Transport Layer, IoT Application Transport Methods                | 1 |
| 3.7                                                                   | The Transport Layer, IoT Application Transport Methods                | 1 |
| <b>Module 4 ( Data Analytics for IoT) (6hrs)(TB-1, Chapter 7,8)</b>   |                                                                       |   |
| 4.1                                                                   | An Introduction to Data Analytics for IoT, Machine Learning           | 1 |
| 4.2                                                                   | Big Data Analytics Tools and Technology                               | 1 |
| 4.3                                                                   | Edge Streaming Analytics, Network Analytics                           | 1 |

|                                                                        |                                                                  |   |
|------------------------------------------------------------------------|------------------------------------------------------------------|---|
| 4.4                                                                    | A Brief History of OT Security, Common Challenges in OT Security | 1 |
| 4.5                                                                    | Differences between IT and OT Security Practices and Systems     | 1 |
| 4.6                                                                    | Formal Risk Analysis Structures: OCTAVE and FAIR                 | 1 |
| <b>Module 5 ( Developing IoT Systems)(9 hrs) (TB-2, Chapter 6,7,8)</b> |                                                                  |   |
| 5.1                                                                    | IoT Logical Design using Python,                                 | 1 |
| 5.2                                                                    | IoT Physical Devices and Endpoints                               | 1 |
| 5.3                                                                    | Raspberry Pi interfaces, Programming Raspberry Pi using Python   | 1 |
| 5.4                                                                    | Other IoT devices                                                | 1 |
| 5.5                                                                    | Cloud Storage Models                                             | 1 |
| 5.6                                                                    | WAMP-Autobahn for IoT                                            | 1 |
| 5.7                                                                    | Django                                                           | 1 |
| 5.8                                                                    | Designing RESTful Web API                                        | 1 |
| 5.9                                                                    | Cloud Web Services for IoT.                                      | 1 |

| CST458 | SOFTWARE TESTING | CATEGORY | L | T | P | CREDIT | YEAR OF INTRODUCTION |
|--------|------------------|----------|---|---|---|--------|----------------------|
|        |                  | PEC      | 2 | 1 | 0 | 3      | 2019                 |

**Preamble:** This is a course in theoretical computer science that introduces the concepts and methods in software testing. It covers various techniques for test case design used to test software artifacts, including requirements, design, and code, the different techniques for test case design based on graphs, programming language syntaxes and symbolic execution using PEX tool. It enables the learners to follow a systematic software testing approaches while developing applications.

**Prerequisite:** Nil

**Course Outcomes:** After the completion of the course the student will be able to:-

|     |                                                                                                                                                                                                           |
|-----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| CO1 | List a range of different software testing techniques and be able to apply specific unit testing method to the projects using Junit.(Cognitive Knowledge Level: Understand)                               |
| CO2 | Illustrate using appropriate tools the mutation testing method for a given piece of code to identify hidden defects that can't be detected using other testing methods.(Cognitive Knowledge Level: Apply) |
| CO3 | Explain graph coverage criteria in terms of control flow graph and data flow graph for a given program.(Cognitive Knowledge Level: Understand)                                                            |
| CO4 | Demonstrate the importance of black-box approaches in terms of domain and functional testing.(Cognitive Knowledge Level: Apply)                                                                           |
| CO5 | Illustrate the use of PEX tool with symbolic execution.(Cognitive Knowledge Level: Apply)                                                                                                                 |

**Mapping of course outcomes with program outcomes**

|     | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO 9 | PO10 | PO11 | PO12 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| CO1 |     |     |     |     |     |     |     |     |      |      |      |      |
| CO2 |     |     |     |     |     |     |     |     |      |      |      |      |
| CO3 |     |     |     |     |     |     |     |     |      |      |      |      |
| CO4 |     |     |     |     |     |     |     |     |      |      |      |      |

|     |  |  |  |  |  |  |  |  |  |  |  |  |
|-----|--|--|--|--|--|--|--|--|--|--|--|--|
| CO5 |  |  |  |  |  |  |  |  |  |  |  |  |
|-----|--|--|--|--|--|--|--|--|--|--|--|--|

| Abstract POs defined by National Board of Accreditation |                                            |      |                                |
|---------------------------------------------------------|--------------------------------------------|------|--------------------------------|
| PO#                                                     | Broad PO                                   | PO#  | Broad PO                       |
| PO1                                                     | Engineering Knowledge                      | PO7  | Environment and Sustainability |
| PO2                                                     | Problem Analysis                           | PO8  | Ethics                         |
| PO3                                                     | Design/Development of solutions            | PO9  | Individual and team work       |
| PO4                                                     | Conduct investigations of complex problems | PO10 | Communication                  |
| PO5                                                     | Modern tool usage                          | PO11 | Project Management and Finance |
| PO6                                                     | The Engineer and Society                   | PO12 | Life long learning             |

### Assessment Pattern

| Bloom's Category | Continuous Assessment Tests |                | End Semester Examination |
|------------------|-----------------------------|----------------|--------------------------|
|                  | Test 1 (Marks)              | Test 2 (Marks) | Marks                    |
| Remember         | 30                          | 30             | 30                       |
| Understand       | 40                          | 40             | 40                       |
| Apply            | 30                          | 30             | 30                       |
| Analyze          |                             |                |                          |
| Evaluate         |                             |                |                          |
| Create           |                             |                |                          |

### Mark Distribution

| Total Marks | CIE Marks | ESE Marks | ESE Duration |
|-------------|-----------|-----------|--------------|
| 150         | 50        | 100       | 3 hours      |

**Continuous Internal Evaluation Pattern:**

|                                                            |          |
|------------------------------------------------------------|----------|
| Attendance                                                 | 10 marks |
| Continuous Assessment Tests(Average of Series Tests 1 & 2) | 25 marks |
| Continuous Assessment Assignment                           | 15 marks |

**Internal Examination Pattern:**

Each of the two internal examinations has to be conducted out of 50 marks. First series test shall be preferably conducted after completing the first half of the syllabus and the second series test shall be preferably conducted after completing remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly completed module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly completed module), each with 7 marks. Out of the 7 questions, a student should answer any 5.

**End Semester Examination Pattern:**

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which a student should answer any one. Each question can have maximum 2 sub-divisions and carries 14 marks.

## Syllabus

### Module - 1 (Introduction to Software Testing)

Some Popular Errors – Ariane 5, Therac 25, Intel Pentium Bug. What is Software testing? Why should it be tested? Software Quality, Role of Testing. Testing Process - Level 0 thinking, Level 1 thinking, Level 2 thinking, Level 3 thinking, Level 4 thinking. Software Testing Terminologies - Verification, Validation and Testing, Faults, Error and Bug, Test cases, Coverage Criteria. Types of Testing- Unit testing, integration testing, System testing, Acceptance testing, Beta testing, Functional testing, Stress testing, Performance testing, Usability testing and Regression testing. Testing Methods - Black Box testing, White Box testing, Grey Box testing.

### Module - 2 (Unit Testing)

Concept of Unit testing. Static Unit testing. Dynamic Unit testing - Control Flow testing, Data Flow testing, Domain testing, Functional Program testing. Mutation testing - Mutation and Mutants, Mutation operators, Mutation score. Junit - Framework for Unit testing. Case Study - Mutation testing using Junit and Muclipse.

### Module - 3 (Unit Testing - White Box Approaches)

Overview of Graph Coverage Criteria. Structural Graph Coverage Criteria - Node/vertex coverage, Edge coverage, Edge pair coverage, Path coverage, Complete path coverage, Prime path coverage, Complete round trip coverage, Simple round trip coverage. Data Flow Criteria - du paths, du pairs. Subsumption Relationships among Graph Coverage Criteria. Graph Coverage for Source Code - Control flow graphs for code, CFG: If statement, CFG: If statement with return, CFG: Switch-case, CFG: Loops, CFG: Exceptions (try-catch). Example program – Statistics. Graph Coverage for Design Elements - Call graphs and classes, Class inheritance testing: Coverage criteria, Coverage criteria on inheritance graph, Data flow at the design level, Inter-procedural DU pairs, Coupling du-pairs example. Example - Quadratic Root. Case Study - Graph Based testing using JUnit Framework.

### Module - 4 (Unit Testing - Black Box Approaches)

Domain Testing / Input Space Partitioning - Partitions of a set. Input domain modelling - Interface-based approach, Functionality-based approach. Identifying values. Multiple partitions of the input domain - All Combinations Coverage (ACoC), Each Choice Coverage (ECC), Pair-wise Coverage, T-wise Coverage, Base Choice Coverage, Multiple Base Choices Coverage. TriTyp example. Functional Testing - Functional Testing Concepts of Howden. Functional testing - Important Steps. Types of Functional testing - Equivalence Class Partitioning, Boundary Value Analysis, Decision Tables, Random Testing. Case Study - Black Box testing approaches using JUnit.



**Module - 5 (Grey Box Testing Approaches)**

Introduction to Grey Box testing - Why Grey Box testing, Gray Box Methodology, Advantages and Disadvantages. Techniques of Grey Box Testing - Matrix Testing, Regression Testing, Orthogonal Array Testing or OAT, Pattern Testing. An Introduction to PEX - Parameterized Unit Testing, The Testing Problem. Symbolic Execution – Example, Symbolic execution tree. PEX application Case Study – PEX.

**Text Books**

1. Paul Ammann and Jeff Offutt, Introduction to Software Testing, Cambridge University Press
2. Kshirasagar Naik and Priyadarshi Tripathy, Software Testing And Quality Assurance: Theory And Practice, Wiley.

**Reference Materials**

1. King, James C, “Symbolic Execution and Program Testing”, Association for Computing Machinery, July 1976.

**Sample Course Level Assessment Questions****Course Outcome 1 (CO1):**

Explain the following types of testing methods with examples.

- (i) Black-box testing.
- (ii) White-box testing.
- (iii) Grey-box testing.

**Course Outcome 2 (CO2):**

Define 12 mutants for the following method *power()* using effective mutation operators. Try to use each mutation operator at least once. Approximately, how many mutants do you think there would be, if all mutants for *power()* were created?

```
public static int power (int left, int right)
{
//*****
// Raises Left to the power of Right
// precondition : Right >= 0
// postcondition: Returns Left**Right
//*****
```

```
intrslt;
rslt = Left;
if (Right == 0)
{
 rslt = 1;
}
else
{
 for (int i = 2; i <= Right; i++)
 rslt = rslt * Left;
}
return (rslt);
}
```

**Course Outcome 3 (CO3):**

Draw the control flow graph and data flow graph of given piece of code.

```
public static double ReturnAverage(int value[],int AS, int MIN, int MAX){
/*
```

Function: ReturnAverageComputes the averageof all those numbers in the input array in the positive range [MIN, MAX]. The maximum size of the array is AS. But, the array size could be smaller than AS in which case the end of input is represented by -999.

```
*/
int i, ti, tv, sum;
doubleav;
i = 0; ti = 0; tv = 0; sum = 0;
while (ti< AS && value[i] != -999) {
 ti++;
 if (value[i] >= MIN && value[i] <= MAX) {
 tv++;
 sum = sum + value[i];
 }
 i++;
}
```

```

if (tv > 0)
av = (double)sum/tv;
else
av = (double) -999;
return (av);
}

```

**Course Outcome 4 (CO4):**

Explain the following with examples.

1. Input domain modelling.
2. All Combinations Coverage (ACoC)
3. Each Choice Coverage (ECC)
4. Pair-wise Coverage
5. T-wise Coverage
6. Base Choice Coverage
7. Multiple Base Choices Coverage.

**Course Outcome 5 (CO5):**

Draw the symbolic execution tree for the following program code and explain the symbolic execution of testme ( $\alpha_1$ ,  $\alpha_2$ ).

```

int twice (int v) {
 return 2 * v;
}

void testme (int x, int y) {
 z = twice (y);
 if (z == x){
 if (x > y + 10)
 ERROR;
 }
}

int main() {
 x = sym input();
 y = sym input();
 testme (x , y);
}

```

return(0);

**Model Question Paper**

**QP CODE:**

**PAGES: 3**

**Reg No:** \_\_\_\_\_

**Name :** \_\_\_\_\_

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY**

**EIGHTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR**

**Course Code: CST458**

**Course Name: Software Testing**

**Max.Marks:100**

**Duration: 3 Hours**

**PART A**

**Answer all Questions. Each question carries 3 Marks**

1. Explain the differences between Validation and Verification?
2. Explain the differences between Fault, Error, and Bug?
3. Define Ground string, Mutation score, and Mutants?
4. What are the functions of Test driver and Test stubs in dynamic unit testing?
5. Define Node coverage, Edge coverage and Prime path coverage in a control flow graph?
6. What are du paths and du pairs in a data flow graph?
7. Explain the two approaches in input domain modelling?
8. Explain the difference between Equivalence Class Partitioning and Boundary Value Analysis?
9. Briefly explain three techniques of Grey box testing?
10. Explain the concept of symbolic execution with the help of a toy example?

**(10x3=30)**

**Part B**

**(Answer any one question from each module. Each question carries 14 Marks)**

11. (a) Explain the following types of testing

- (i) Black Box testing (ii) White Box testing (iii) GreyBox testing (14)  
(iv) Unit testing (v) Integration testing (vi) System testing (vii) Acceptance testing

OR

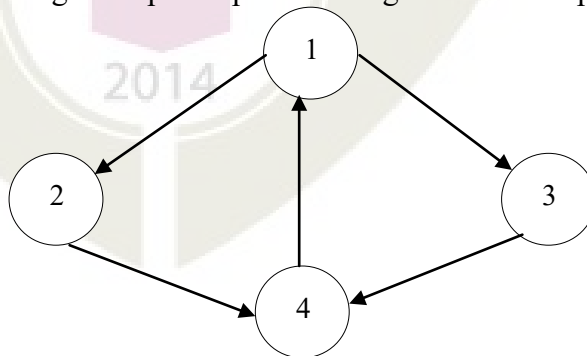
12. (a) Explain the following coverage criterias based on the code fragment given below? (i) Functional coverage (ii) Statement coverage (iii) Conditional coverage (iv) Branch coverage (8)

```
int foo (int x, int y){
 int z = 0;
 if ((x > 0) && (y > 0)){
 z = x;}
 return z;
}
```

- (b) Write positive and negative test cases for an ATM Machine? (6)
13. (a) Explain Dynamic unit test environment with a neat figure. (8)
- (b) Explain the major difference between control flow testing and data flow testing. (6)

OR

14. (a) Explain seven types of mutation operators with neat examples? (14)
15. (a) Explain touring, side trips and detours with a neat example (7)
- (b) Explain simple path coverage and prime path coverage with the help of CFG given below? (7)



OR

16. (a) Draw CFG fragment for (7)  
(i) Simple *if* (ii) Simple *while* loop (iii) Simple *for* loop
- (b) Explain the following concepts with examples? (7)  
(i) Call graph (ii) Inheritance graph (iii) Coupling du-pairs
17. (a) What are the four important steps in functional testing? (7)
- (b) Briefly explain input domain modelling approaches? (7)

**OR**

18. (a) Consider the triangle classification program with a specification: (6)  
The program reads floating values from the standard input. The three values  $A$ ,  $B$ , and  $C$  are interpreted as representing the lengths of the sides of triangle. The program then prints a message to the standard output that states whether the triangle, if it can be formed, is scalene, isosceles, equilateral, or right angled. Determine the following for the above program:
- (i) For the boundary condition  $A + B > C$  case (scalene triangle), identify test cases to verify the boundary.
- (ii) For the boundary condition  $A = C$  case (isosceles triangle), identify test cases to verify the boundary.
- (iii) For the boundary condition  $A = B = C$  case (equilateral triangle), identify test cases to verify the boundary.
- (b) Develop a decision table to generate test cases for this specification. (8)
19. (a) Explain the importance of grey box testing, its advantages and disadvantages? (9)
- (b) Explain the concept of symbolic execution tree? (5)

**OR**

20. (a) Consider the code fragment given below: - (7)
1. POWER: PROCEDURE(X, Y);
  2.  $Z \leftarrow 1$ ;

```

3. J ← 1;
4. LAB: IF Y ≥ J THEN
5. DO; Z ← Z * X;
6. J ← J + 1;
7. GO TO LAB; END;
8. RETURN (Z) ;
9. END;

```

a) Explain Symbolic execution of POWER ( $\alpha_1$ ,  $\alpha_2$ ).

(b) Explain Execution tree for POWER ( $\alpha_1$ ,  $\alpha_2$ ).

(7)

### TEACHING PLAN

| No                                                            | Contents                                                                                                                    | No of Lecture Hrs (35 hrs) |
|---------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------|----------------------------|
| <b>Module 1 (Introduction to Software Testing) -(7 Hours)</b> |                                                                                                                             |                            |
| 1.1                                                           | Some Popular Errors– Ariane 5, Therac 25, Intel Pentium Bug.                                                                | 1 Hour                     |
| 1.2                                                           | What is Software testing? Why should it be tested? Software Quality, Role of Testing.                                       | 1 Hour                     |
| 1.3                                                           | Testing Process - Level 0 thinking, Level 1 thinking, Level 2 thinking, Level 3 thinking, Level 4 thinking.                 | 1 Hour                     |
| 1.4                                                           | Software Testing Terminologies- Verification, Validation and Testing, Faults, Error and Bug, Test cases, Coverage Criteria. | 1 Hour                     |
| 1.5                                                           | Types of Testing- Unit testing, integration testing, System testing, Acceptance testing, Beta testing                       | 1 Hour                     |
| 1.6                                                           | Functional testing, Stress testing, Performance testing, Usability testing and Regression testing.                          | 1 Hour                     |
| 1.7                                                           | Testing Methods - Black Box testing, White Box testing, Grey Box testing.                                                   | 1 Hour                     |
| <b>Module 2 (Unit testing)- (6 Hours)</b>                     |                                                                                                                             |                            |
| 2.1                                                           | Concept of Unit testing, Static Unit Testing                                                                                | 1 Hour                     |



|                                                                  |                                                                                                                                                                                                                |        |
|------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|
| 2.2                                                              | Dynamic Unit testing - Control Flow testing, Data Flow testing, Domain testing, Functional Program testing.                                                                                                    | 1 Hour |
| 2.3                                                              | Mutation testing - Mutation and Mutants, Mutation operators, Mutation score.                                                                                                                                   | 1 Hour |
| 2.4                                                              | Junit - Framework for Unit testing.                                                                                                                                                                            | 1 Hour |
| 2.5                                                              | Case Study - Mutation testing using Junit                                                                                                                                                                      | 1 Hour |
| 2.6                                                              | Case Study - Mutation testing using Muclipse                                                                                                                                                                   | 1 Hour |
| <b>Module 3 (Unit Testing:- White Box Approaches)- (8 Hours)</b> |                                                                                                                                                                                                                |        |
| 3.1                                                              | Structural Graph Coverage Criteria - Node/vertex coverage, Edge coverage, Edge pair coverage, Path coverage                                                                                                    | 1 Hour |
| 3.2                                                              | Complete path coverage, Prime path coverage, Complete round trip coverage, Simple round trip coverage.                                                                                                         | 1 Hour |
| 3.3                                                              | Data Flow Criteria - du paths, du pairs                                                                                                                                                                        | 1 Hour |
| 3.4                                                              | Subsumption Relationships among Graph Coverage Criteria                                                                                                                                                        | 1 Hour |
| 3.5                                                              | Graph Coverage for Source Code – Control Flow Graphs (CFG) for code, CFG: If statement, CFG: If statement with return, CFG: Switch-case, CFG: Loops, CFG: Exceptions (try-catch). Example program - Statistics | 1 Hour |
| 3.6                                                              | Graph Coverage for Design Elements – Structural graph coverage and data flow graph coverage for design elements                                                                                                | 1 Hour |
| 3.7                                                              | Case Study - Graph Based testing using JUnit Framework. (Lecture 1)                                                                                                                                            | 1 Hour |
| 3.8                                                              | Case Study - Graph Based testing using JUnit Framework. (Lecture 2)                                                                                                                                            | 1 Hour |
| <b>Module 4 (Unit Testing:- Black Box Approaches) -(7 Hours)</b> |                                                                                                                                                                                                                |        |
| 4.1                                                              | Domain Testing / Input Space Partitioning - Partitions of a set.                                                                                                                                               | 1 Hour |
| 4.2                                                              | Input domain modelling - Interface-based approach, Functionality-based approach.                                                                                                                               | 1 Hour |

|                                                          |                                                                                                                                                                                                    |        |
|----------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|
| 4.3                                                      | Multiple partitions of the input domain - All Combinations Coverage (ACoC), Each Choice Coverage (ECC), Pair-wise Coverage, T-wise Coverage, Base Choice Coverage, Multiple Base Choices Coverage. | 1 Hour |
| 4.4                                                      | Functional Testing - Functional Testing Concepts of Howden. Important Steps.                                                                                                                       | 1 Hour |
| 4.5                                                      | Types of Functional testing - Equivalence Class Partitioning, Boundary Value Analysis                                                                                                              | 1 Hour |
| 4.6                                                      | Decision Tables, Random Testing.                                                                                                                                                                   | 1 Hour |
| 4.7                                                      | Case Study - Black Box testing approaches using JUnit.                                                                                                                                             | 1 Hour |
| <b>Module 5 (Grey Box Testing Approaches)- (7 Hours)</b> |                                                                                                                                                                                                    |        |
| 5.1                                                      | Introduction to Grey Box testing - Why Grey Box testing, Gray Box Methodology, Advantages and Disadvantages.                                                                                       | 1 Hour |
| 5.2                                                      | Techniques of Grey Box Testing - Matrix Testing, Regression Testing, Orthogonal Array Testing or OAT, Pattern Testing.                                                                             | 1 Hour |
| 5.3                                                      | An Introduction to Pex - Parameterized Unit Testing, The Testing Problem.                                                                                                                          | 1 Hour |
| 5.4                                                      | Symbolic Execution – Example, Symbolic execution tree.                                                                                                                                             | 1 Hour |
| 5.5                                                      | Case Study – PEX (Lecture 1)                                                                                                                                                                       | 1 Hour |
| 5.6                                                      | Case Study – PEX (Lecture 2)                                                                                                                                                                       | 1 Hour |
| 5.7                                                      | Case Study – PEX (Lecture 3)                                                                                                                                                                       | 1 Hour |

| CST468 | BIOINFORMATICS | CATEGORY | L | T | P | CREDIT | YEAR OF INTRODUCTION |
|--------|----------------|----------|---|---|---|--------|----------------------|
|        |                | PEC      | 2 | 1 | 0 | 3      | 2019                 |

**Preamble:** This course helps the learners to understand the fundamental concepts in Molecular Biology, Genomics, Proteomics and Modelling. This course introduces bio macromolecules such as genes and proteins, different biological databases, and tools and algorithms for biological data processing, analysis and interpretation, and the elements of the systems approach to Molecular Biology. This course enables the learners to contribute towards drug discovery and computational analysis and modelling of biological process.

**Prerequisite:** Basic background in higher secondary biology

**Course Outcomes:** After the completion of the course, the student will be able to

|             |                                                                                                                                                                                   |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>CO 1</b> | Describe the basic concepts of Bioinformatics with an emphasis on structure, function and synthesis of biomolecules ( <b>Cognitive knowledge level : Understand</b> )             |
| <b>CO 2</b> | Identify biological data formats and databases, retrieve bio-sequences, and align bio-sequences to identify similarity ( <b>Cognitive knowledge level : Apply</b> )               |
| <b>CO 3</b> | Employ similarity searching tools and algorithms to align sequences to highlight the similarity, and describe the structure of genes ( <b>Cognitive knowledge level : Apply</b> ) |
| <b>CO 4</b> | Demonstrate Protein Structure, visualize protein structure using tools, and explain how proteins interact ( <b>Cognitive knowledge level : Apply</b> )                            |
| <b>CO 5</b> | Explain the fundamental aspects of Systems Biology, Computational Modeling and properties of models ( <b>Cognitive knowledge level : Understand</b> )                             |

**Mapping of course outcomes with program outcomes**

|            | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|
| <b>CO1</b> |     |     |     |     |     |     |     |     |     |      |      |      |
| <b>CO2</b> |     |     |     |     |     |     |     |     |     |      |      |      |
| <b>CO3</b> |     |     |     |     |     |     |     |     |     |      |      |      |

|     |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                   |  |  |  |  |  |  |                                                                                     |
|-----|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|--|--|--|--|--|--|-------------------------------------------------------------------------------------|
| CO4 |  |  |  |  |                                                                                   |  |  |  |  |  |  |  |
| CO5 |  |  |                                                                                   |                                                                                   |  |  |  |  |  |  |  |  |

| PO# | Broad PO                                   | PO#  | Broad PO                       |
|-----|--------------------------------------------|------|--------------------------------|
| PO1 | Engineering Knowledge                      | PO7  | Environment and Sustainability |
| PO2 | Problem Analysis                           | PO8  | Ethics                         |
| PO3 | Design/Development of solutions            | PO9  | Individual and team work       |
| PO4 | Conduct investigations of complex problems | PO10 | Communication                  |
| PO5 | Modern tool usage                          | PO11 | Project Management and Finance |
| PO6 | The Engineer and Society                   | PO12 | Life long learning             |

### Assessment Pattern

| Bloom's Category | Continuous Assessment Tests |           | End Semester Examination |
|------------------|-----------------------------|-----------|--------------------------|
|                  | Test1 (%)                   | Test2 (%) |                          |
| Remember         | 30                          | 30        | 30                       |
| Understand       | 50                          | 50        | 50                       |
| Apply            | 20                          | 20        | 20                       |
| Analyse          |                             |           |                          |
| Evaluate         |                             |           |                          |
| Create           |                             |           |                          |

### Mark Distribution

| Total Marks | CIE Marks | ESE Marks | ESE Duration |
|-------------|-----------|-----------|--------------|
| 150         | 50        | 100       | 3            |

**Continuous Internal Evaluation Pattern:**

|                                                            |          |
|------------------------------------------------------------|----------|
| Attendance                                                 | 10 marks |
| Continuous Assessment Tests (Average of Series Tests 1& 2) | 25 marks |
| Continuous Assessment Assignment                           | 15 marks |

**Internal Examination Pattern:**

Each of the two internal examinations has to be conducted out of 50 marks. First series test shall be preferably conducted after completing the first half of the syllabus and the second series test shall be preferably conducted after completing remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly completed module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly completed module), each with 7 marks. Out of the 7 questions, a student should answer any 5.

**End Semester Examination Pattern:**

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 full questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carries 14 marks.

## Syllabus

### Module-1 (Introduction to bioinformatics)

Introduction to bioinformatics, Nature & Scope of Bioinformatics, DNA, RNA, and Protein: The Central Dogma, Messenger RNA, tRNA, rRNA, Genetic code, Gene Structure and Control, Transcription, translation

### Module-2 (Introduction to bio sequences and analysis)

Introduction to Biological Databases, NCBI, Genbank, Bio sequence formats- FASTA, Sequence alignment- Global Alignment and Local Alignment, Dot Matrix Method, Dynamic Programming Method, Gap Penalties, Amino Acid Scoring Matrices - PAM and BLOSUM

### Module-3 (Database Similarity Searching and genomics)

Database Similarity Searching, BLAST – Variants -BLASTN, BLASTP, BLASTX, Statistical Significance, Needleman and Wunsch and Smith–Waterman Method, Multiple Sequence Alignment, scoring function, Clustal, introduction to structure of prokaryotic and eukaryote gene

### Module-4 (Proteomics)

Protein Structure, Ramachandran Plot, Hierarchies of Protein Structure, Determination of Protein three-dimensional structure, protein structure database-PDB, Protein structure visualization, introduction to Protein protein interaction, STRING database

### Module-5 (Systems Biology)

Introduction to Systems Biology, Models and Modelling, Properties of models, Systems state and steady state, Variables, Parameters, and Constants in modelling, Purpose and Adequateness of Models, Advantages of Computational Modelling, Model Development, Network Versus Elements, Modularity, Robustness and Sensitivity, Data Integration

### Text books

1. Zvelebil, Marketa J., and Jeremy O. Baum. *Understanding bioinformatics*. Garland Science, 2007.
2. Xiong, Jin. *Essential bioinformatics*. Cambridge University Press, 2006.
3. Klipp, E., Herwig, R., Kowald, A., Wierling, C., &Lehrach, H. *Systems biology in practice: concepts, implementation and application*. John Wiley & Sons. 2005

### References

1. Baxevanis, Andreas D., Gary D. Bader, and David S. Wishart, eds. *Bioinformatics*. John Wiley & Sons, 2020.
2. Shaik, Noor Ahmad, et al. *Essentials of Bioinformatics, Volume I*. Springer, 2019

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4. S C Rastogi, N Mendiratta and PRastogi, *Bioinformatics: Methods and Applications* , PHI Learning Private Limited, New Delhi, 2015.
5. D E Krane and M L Raymer, *Fundamental Concepts of Bioinformatics*, Pearson Education, 2006.
6. Andreas D.Baxevanis, B F Francis Ouellette, *Bioinformatics - A Practical Guide to the Analysis of Genes and Proteins*, Third Edition, John Wiley & Sons INC. , U.K. 2006
7. Neil C Jones and Pavel A Pevzner, *An Introduction to Bioinformatics Algorithms*, MIT press, 2004.

### Course Level Assessment Questions

#### Course Outcome 1 (CO1):

1. Compare and contrast the DNA and RNA on the basis of structure and functions.
2. Demonstrate with the help of a flow diagram the generation of protein using the transcription and translation process.

#### Course Outcome 2 (CO2):

1. Download DNA sequence of human insulin form NCBI
2. Identify the following qualifiers for GenBank and give their definitions: [ACCN], [ALL], [AUTH], [ECNO], [FKEY], [GENE], [JOUR], [KYWD]
3. Construct a dot plot and find the sequence alignment between the following two sequences:  
Sequence1: GATTCTATCTAACTA, Sequence2: GTTCTATTCTAAC

#### Course Outcome 3 (CO3):

1. Apply Needleman-Wunsch Algorithm to perform sequence alignment for the following sequences: CGTGAATTCAT (sequence #1), GACTTAC (sequence #2)
2. Construct a BLAST procedure for sequence alignment(HSP) if a sequence and its corresponding database sequence are given. Assume the necessary data and demonstrate the procedure.

#### Course Outcome 4 (CO4):

1. Differentiate between the different protein molecular structure visualizations. Also mention the advantages and uses of each visualization technique.
2. Make use of an example and demonstrate the steps in protein comparison. Show how root mean square deviation is calculated while comparing two proteins.

#### Course Outcome 5 (CO5):

1. Explain how systems biology is used in data integration.
2. Explain the process of model development



## Model Question Paper

**QP CODE:**

**Reg No:** \_\_\_\_\_

**Name:** \_\_\_\_\_

**PAGES : 3**

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY**  
**EIGHTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR**

**Course Code: CST468**

**Course Name: Bioinformatics**

**Max. Marks : 100**

**Duration: 3 Hours**

### **PART A**

**Answer All Questions. Each Question Carries 3 Marks**

1. Differentiate DNA, Gene, genome and chromosome.
2. What are the functions of mRNA, tRNA and rRNA?
3. What do you mean by Gene expression?
4. Write difference between local and global alignment.
5. Write short note on Gap penalties and its usage in comparing Biological sequences.
6. List any three types of BLAST and make short description on each.
7. What are the principle underlying the formation of Ramachandran plot?.
8. What are the experimental methods for determining protein structure?
9. What do you mean by steady state in a biological system.
10. Justify the statement - systems are modular.

**(10x3=30)**

### **Part B**

**(Answer any one question from each module. Each question carries 14 Marks)**

11. (a) What is the central dogma of molecular biology? **(6)**  
(b) Explain the steps involved in the process of transcription. How is the primary transcript produced by a prokaryote different from that produced by a eukaryotic cell? **(8)**

**OR**

12. (a) Discuss translation process in protein synthesis. (6)
- (b) Explain bio-molecules involved in central dogma, its structure and types. (8)
13. (a) Explain the importance of Primary and secondary databases in Bioinformatics (6)
- (b) Illustrate the methods of pairwise sequence alignment. What is the use of assigning gap penalties in alignment? (8)

**OR**

14. (a) Illustrate sequence alignment. What are the applications of sequence alignment in Bioinformatics? (7)
- (b) What is the use of scoring matrices? Differentiate between PAM and BLOSUM matrices and its usage in alignment. (7)
15. (a) Using Needleman and Wunsch dynamic programming method, construct the partial alignment score table for the following two sequences, using the scoring parameters: match score: +5, mismatch score: -1, gap penalty: -2. (9)
- CCATGCU**  
**GATTACA**  
Also write down the optimal global alignment between these sequences along with the optimal score.
- (b) Interpret the blast result and statistical significance of the alignment by analyzing the results. (5)

**OR**

16. (a) Using Smith Waterman method construct the partial alignment scoring table and obtain the optimal local alignment of the following two sequences: (9)
- ACGTATCGCGTATA**  
**GATGCTCTCGGAJAA**
- (b) Illustrate multiple sequence alignment. (5)
17. (a) Discuss hierarchies of protein structure. (6)
- (b) Explain how the protein structure is determined by using experimental techniques. (8)

**OR**

18. (a) Discuss protein interaction. How it contributes to the complexity of an organism? (9)
- (b) Discuss on Protein Structure Database. (5)

19. (a) Discuss systems biology approach of understanding complex biological systems. (6)
- (b) Explain on Variables, Parameters, and Constants in modeling biological systems. (8)

OR

20. (a) Explain on advantages of Computational Modeling of biological system. (7)
- (b) What are the properties of models in biological system? (7)

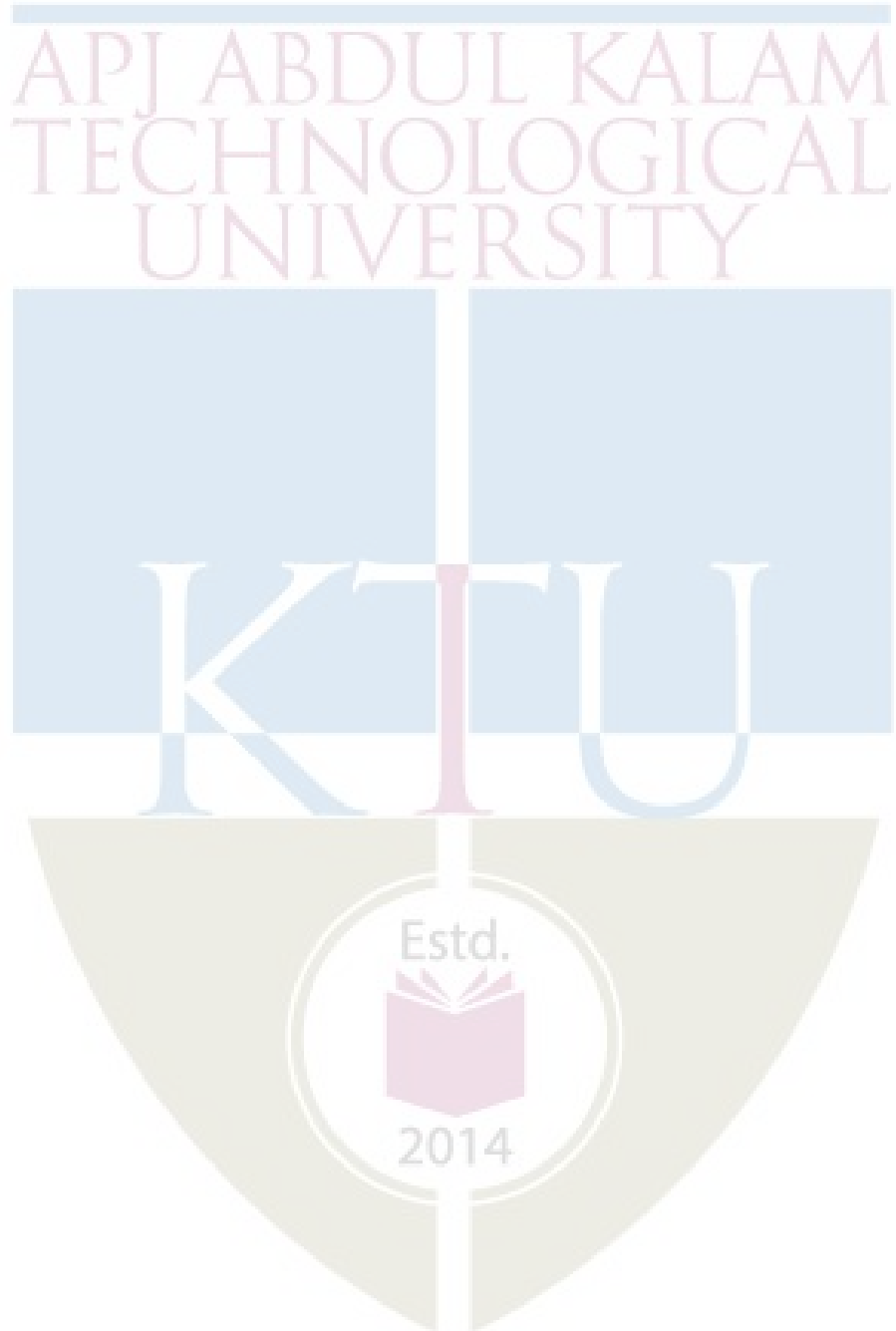
## TEACHING PLAN

| No                                                                                                                 | Contents                                                 | No of Lecture (36 Hrs) |
|--------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------|------------------------|
| <b>Module-1 (Introduction to bioinformatics)(8 hrs)</b><br>Text 1 (Relevant topics from chapter 1.1, 1.2, 1.3)     |                                                          |                        |
| 1.1                                                                                                                | Introduction to bioinformatics                           | 1                      |
| 1.2                                                                                                                | Nature & Scope of Bioinformatics                         | 1                      |
| 1.3                                                                                                                | DNA, RNA, and Protein                                    | 1                      |
| 1.4                                                                                                                | The Central Dogma introduction                           | 1                      |
| 1.5                                                                                                                | Messenger RNA, tRNA, rRNA,                               | 1                      |
| 1.6                                                                                                                | Genetic code,                                            | 1                      |
| 1.7                                                                                                                | Gene Structure and Control                               | 1                      |
| 1.8                                                                                                                | Transcription, Translation                               | 1                      |
| <b>Module-2 (Introduction to bio sequences and analysis) (7 hrs)</b><br>Text 2 (Relevant topics from chapter 2, 3) |                                                          |                        |
| 2.1                                                                                                                | Introduction to Biological Databases                     | 1                      |
| 2.2                                                                                                                | NCBI Sequence retrieval                                  | 1                      |
| 2.3                                                                                                                | Genbank, Bio sequence formats- FASTA                     | 1                      |
| 2.4                                                                                                                | Sequence alignment- Global Alignment and Local Alignment | 1                      |
| 2.5                                                                                                                | Dot Matrix Method, Dynamic Programming Method            | 1                      |

|                                                                                                                         |                                                                                  |   |
|-------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------|---|
| 2.6                                                                                                                     | Gap Penalties                                                                    | 1 |
| 2.7                                                                                                                     | Amino Acid Scoring Matrices – PAM, BLOSUM                                        | 1 |
| <b>Module-3 (Database Similarity Searching and genomics) (7 hrs)</b><br>Text 2 (Relevant topics from chapter 4 5 and 8) |                                                                                  |   |
| 3.1                                                                                                                     | Database Similarity Searching, BLAST, Variants of BLAST - BLASTN, BLASTP, BLASTX | 1 |
| 3.2                                                                                                                     | BLAST Analysis - Statistical Significance                                        | 1 |
| 3.3                                                                                                                     | Needleman and Wunsch Method                                                      | 1 |
| 3.4                                                                                                                     | Smith–Waterman Method                                                            | 1 |
| 3.5                                                                                                                     | Multiple Sequence Alignment, scoring function                                    | 1 |
| 3.6                                                                                                                     | Clustal tool                                                                     | 1 |
| 3.7                                                                                                                     | Gene Structure of prokaryotic, eukaryote                                         | 1 |

|                                                                                             |                                                                              |   |
|---------------------------------------------------------------------------------------------|------------------------------------------------------------------------------|---|
| <b>Module-4 (Proteomics) (7 hrs)</b><br>Text 2 (Relevant topics from chapter 12, 13 and 19) |                                                                              |   |
| 4.1                                                                                         | Protein Structure, Ramachandran Plot                                         | 1 |
| 4.2                                                                                         | Hierarchies of Protein Structure                                             | 1 |
| 4.3                                                                                         | Determination of Protein three-dimensional structure                         | 1 |
| 4.4                                                                                         | protein structure database-PDB                                               | 1 |
| 4.5                                                                                         | Protein structure visualization                                              | 1 |
| 4.6                                                                                         | Protein protein interaction                                                  | 1 |
| 4.7                                                                                         | Protein protein interaction networks, STRING database                        | 1 |
| <b>Module-5 (Systems Biology) (7 hrs)</b><br>Text 3 (Relevant topics from Section 1.1-1.4)  |                                                                              |   |
| 5.1                                                                                         | Introduction to Systems Biology, Properties of models                        | 1 |
| 5.2                                                                                         | Systems state and steady state                                               | 1 |
| 5.3                                                                                         | Variables, Parameters, and Constants in modelling                            | 1 |
| 5.4                                                                                         | Purpose and Adequateness of Models                                           | 1 |
| 5.5                                                                                         | Advantages of Computational Modelling ,Model Development (introduction only) | 1 |
| 5.6                                                                                         | Network Versus Elements, Modularity,                                         | 1 |

|     |                                              |   |
|-----|----------------------------------------------|---|
| 5.7 | Robustness and Sensitivity, Data Integration | 1 |
|-----|----------------------------------------------|---|



| CST478 | COMPUTATIONAL LINGUISTICS | CATEGORY | L | T | P | CREDIT | YEAR OF INTRODUCTION |
|--------|---------------------------|----------|---|---|---|--------|----------------------|
|        |                           | PEC      | 2 | 1 | 0 | 3      | 2019                 |

**Preamble:** The course aims to teach the basics of Computational Linguistics to the students viewing language phenomena from a computational/statistical standpoint. This involves ideas about statistical and computational models and how these could be linked with various language processing tasks. The course helps the learner to appreciate the complexities involved in language processing tasks using a machine, in contrast with the ease with which human beings handle them. Some practical aspects are also discussed using the Python and NLTK framework to equip the student with the capability to design solutions to linguistic problems.

**Prerequisite:** Nil

**Course Outcomes:** After the completion of the course the student will be able to

| CO# | CO                                                                                                                                                                   |
|-----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| CO1 | Explain the fundamental concepts of language processing ( <b>Cognitive Knowledge Level: Understand</b> )                                                             |
| CO2 | Demonstrate the concepts of probability, statistical inference and hidden Markov model. ( <b>Cognitive Knowledge Level: Apply</b> )                                  |
| CO3 | Compare and summarize the various methods of word sense disambiguation, lexical acquisition and selectional preferences. ( <b>Cognitive Knowledge Level: Apply</b> ) |
| CO4 | Make use of different Part-of-Speech Tagging methods for language modelling. ( <b>Cognitive Knowledge Level: Apply</b> )                                             |
| CO5 | Examine Probabilistic Context Free Grammars and various probabilistic parsing methods ( <b>Cognitive Knowledge Level: Apply</b> )                                    |
| CO6 | Develop simple systems for linguistic tasks using Python and NLTK. ( <b>Cognitive Knowledge Level: Apply</b> )                                                       |

### Mapping of course outcomes with program outcomes

|     | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|
| CO1 |     |     |     |     |     |     |     |     |     |      |      |      |
| CO2 |     |     |     |     |     |     |     |     |     |      |      |      |
| CO3 |     |     |     |     |     |     |     |     |     |      |      |      |
| CO4 |     |     |     |     |     |     |     |     |     |      |      |      |
| CO5 |     |     |     |     |     |     |     |     |     |      |      |      |
| CO6 |     |     |     |     |     |     |     |     |     |      |      |      |

| Abstract POs defined by National Board of Accreditation |                                            |      |                                |
|---------------------------------------------------------|--------------------------------------------|------|--------------------------------|
| PO#                                                     | Broad PO                                   | PO#  | Broad PO                       |
| PO1                                                     | Engineering Knowledge                      | PO7  | Environment and Sustainability |
| PO2                                                     | Problem Analysis                           | PO8  | Ethics                         |
| PO3                                                     | Design/Development of solutions            | PO9  | Individual and team work       |
| PO4                                                     | Conduct investigations of complex problems | PO10 | Communication                  |
| PO5                                                     | Modern tool usage                          | PO11 | Project Management and Finance |
| PO6                                                     | The Engineer and Society                   | PO12 | Life long learning             |

### Assessment Pattern

| Bloom's Category | Continuous Assessment Tests |            | End Semester Examination Marks (%) |
|------------------|-----------------------------|------------|------------------------------------|
|                  | Test 1 (%)                  | Test 2 (%) |                                    |
| Remember         | 30                          | 30         | 30                                 |
| Understand       | 30                          | 30         | 30                                 |
| Apply            | 40                          | 40         | 40                                 |
| Analyze          |                             |            |                                    |
| Evaluate         |                             |            |                                    |



|        |  |  |  |
|--------|--|--|--|
| Create |  |  |  |
|--------|--|--|--|

### Mark Distribution

| Total Marks | CIE Marks | ESE Marks | ESE Duration |
|-------------|-----------|-----------|--------------|
| 150         | 50        | 100       | 3Hrs         |

### Continuous Internal Evaluation Pattern:

|                                                            |          |
|------------------------------------------------------------|----------|
| Attendance                                                 | 10 marks |
| Continuous Assessment Tests(Average of Series Tests 1 & 2) | 25 marks |
| Continuous Assessment Assignment                           | 15 marks |

### Internal Examination Pattern:

Each of the two internal examinations has to be conducted out of 50 marks. First series test shall be preferably conducted after completing the first half of the syllabus and the second series test shall be preferably conducted after completing remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly completed module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly completed module), each with 7 marks. Out of the 7 questions, a student should answer any 5.

### End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 full questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carries 14 marks.

## Syllabus

### Module- 1 (Preliminaries)

Introduction: Rationalist and Empiricist Approaches to Language-Questions that linguistics should answer-Noncategorical phenomena in language-Language and cognition as probabilistic phenomena

The Ambiguity of Language: Why natural language processing is difficult-Lexical resources-Word counts-Zipf's laws-Collocations-Concordances

Linguistic Essentials:

Parts of Speech and Morphology -Nouns and pronouns-Words that accompany nouns: Determiners and adjectives-Verbs-Other parts of speech-Phrase Structure-Phrase structure grammars -Semantics and Pragmatics-Corpus Based Work

### Module -2 (Mathematical Essentials:)

Probability Theory-Probability spaces-Conditional probability and independence-Bayes' theorem-Random variables-Expectation and variance-Notation-Joint and conditional distributions-Standard distributions-Bayesian statistics

Statistical Inference: n-gram Models over Sparse Data-Bins: Forming Equivalence Classes-Reliability vs discrimination-n gram models

Markov Models-Hidden Markov Models-Why use HMMs?-General form of an HMM-Finding the probability of an observation-Finding the best state sequence

### Module -3 (Word Sense Disambiguation)

Methodological Preliminaries- Supervised and unsupervised learning-Pseudowords-Upper and lower bounds on performance-Supervised Disambiguation-Bayesian classification-Dictionary based Disambiguation-Disambiguation based on sense definitions-Thesaurus based disambiguation

Lexical Acquisition-Evaluation Measures-Verb Subcategorization -Attachment

Ambiguity-PP attachment- Selectional Preferences

Semantic Similarity: Vector space measures-Probabilistic measures

### Module -4 (Grammar)

Part-of-Speech Tagging-The Information Sources in Tagging-Markov Model Taggers-Hidden Markov Model Taggers-Appling HMMs to POS tagging-The effect of initialization on HMM training-Transformation Based Learning of Tags

Probabilistic Context Free Grammars-Some Features of PCFGs-Questions for PCFGs -The Probability of a String -Using inside probabilities-Using outside probabilities-Finding the most likely parse for a sentence-parsing for disambiguation-parsing model versus language model

### **Module -5 (Language Processing with Python)**

Introduction to NLTK, Text Wrangling and Text cleansing : Sentence Splitter, Tokenization, Stemming, Lemmatization, Stop word removal , Rare word Removal, Spell Correction. Part of Speech Tagging and NER. Parsing Structure in Text: Shallow versus deep parsing, different types of parsers and dependency parsing.

#### **Text Books :**

1. C.D. Manning and H. Schutze. Foundations of Statistical Natural Language Processing. MIT Press.
2. Steven Bird, Ewan Klein, Edward Loper, Natural Language Processing with Python and NLTK. O'reilly Pub.

#### **References:**

1. D. Jurafsky and J.H. Martin: Speech and Language Processing: Introduction to Natural Language Processing, Computational Linguistics and Speech Recognition, PHI.
2. James Allen: Natural Language Understanding. Pearson Pub.
3. Nitin Hardeniya, Jacob Perkins, Deepti Chopra, Nisheeth Joshi, ItiMathur: Natural Language Processing: Python and NLTK., 1<sup>st</sup> Edition. Packt Publishing

### **Course Level Assessment Questions**

#### **Course Outcome 1 (CO1):**

1. What do you understand by the term *collocations*? List their properties.
2. Define the term phrase structure grammar formally.

#### **Course Outcome 2 (CO2):**

1. State Bayes' theorem and explain briefly. Comment on its usefulness in NLP.
2. How can n-grams be used to model natural language statistically?

#### **Course Outcome 3 (CO3):**

1. What is meant by attachment ambiguity? Show it using English sentences
2. What is meant by Word Sense Disambiguation (WSD)? Outline any one WSD algorithm

#### **Course Outcome 4 (CO4):**

1. How can HMM be used for Parts of speech tagging?
2. Outline an implementation procedure for HMM

#### **Course Outcome 5 (CO5):**

1. Show with an example how can probabilistic grammars be used to model human preferences in parsing.
2. Give the technique of Transformation-Based Learning of Tags

#### **Course Outcome 6 (CO6):**

1. Implement a python program for stop word removal in a simple paragraph.
2. Write a code to access a weather site and extract the forecast top temperature for your town or city today.

## Model Question Paper

**QP CODE:**

**Reg No:** \_\_\_\_\_

**Name:** \_\_\_\_\_

**PAGES : 3**

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY**  
**EIGHTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR**

**Course Code: CST478**

**Course Name: Computational Linguistics**

**Max. Marks : 100**

**Duration: 3 Hours**

### **PART A**

**Answer All Questions. Each Question Carries 3 Marks**

1. Define Zipf's law.
2. List the uses of a corpus in language processing?
3. What is a Hidden Markov Model?
4. State Bayes' theorem and explain briefly. Comment on its usefulness in NLP.
5. What is meant by supervised disambiguation? What are its prerequisites ?
6. Consider the sentence: "the children ate the cake with a spoon". Construct the parse tree for it and explain the attachment ambiguity.
7. Discuss the properties of Markov chain useful in POS tagging.
8. Explain the features of PCFG.
9. What is NLTK? How is it useful in text processing ?
10. Write a Python program to extract different date formats from a text document.

**(10x3=30)**

**Part B**

**(Answer any one question from each module. Each question carries 14 Marks)**

11. (a) Write a note on the following terms with example: (9)  
(i) Collocations (ii) Concordances (iii) Phrase structure grammars

- (b) Differentiate stemming and lemmatization with examples. (5)

**OR**

12. (a) Write a note on all parts of speech tags of English language (9)

- (b) What are the differences between Rationalist and Empiricist to Language approaches (5)

13. (a) What do you mean by a probability distribution? (5)  
What are the approaches used in SNLP to estimate probability distribution of linguistic events?

- (b) Give a formal definition of Hidden Markov Model (HMM) and state the relevant assumption while using HMM for language modeling (9)

**OR**

14. (a) Assume that a particular type of syntactic error detected by a system A occurs once in 1,00,000 sentences on an average. This system detects an error correctly with a probability 0.05. Suppose the system reports an error in a test sentence. What is the probability that this is true? (5)

- (b) List some of the problems associated with sparse data in SNLP. (9)  
Write a note on n-gram Models over Sparse Data

15. (a) What do you understand by Disambiguation based on sense definitions. (9)  
Write and explain any one algorithm for this.

- (b) With the help of Bayes' rule, explain the Bayesian disambiguation algorithm. (5)

**OR**

16. (a) Write a note on selectional preferences with an example (5)

- (b) What is meant by attachment ambiguity? List different attachment issues. (9)

17. (a) Write a note on Transformation-Based Learning of tags. Give it's algorithm (9)
- (b) How can HMM be used for parts of speech tagging (5)

OR

18. (a) Write the formal definition of PCFG. (5)

Apply probabilistic parsing on the following sentence and find the correct parsing using the given grammar

Sentence: Astronomers saw stars with ears.

Probabilistic grammar:

|                               |     |                                       |      |
|-------------------------------|-----|---------------------------------------|------|
| $S \rightarrow NP VP$         | 1.0 | $NP \rightarrow NP PP$                | 0.4  |
| $PP \rightarrow P NP$         | 1.0 | $NP \rightarrow \textit{astronomers}$ | 0.1  |
| $VP \rightarrow V NP$         | 0.7 | $NP \rightarrow \textit{ears}$        | 0.18 |
| $VP \rightarrow VP PP$        | 0.3 | $NP \rightarrow \textit{saw}$         | 0.04 |
| $P \rightarrow \textit{with}$ | 1.0 | $NP \rightarrow \textit{stars}$       | 0.18 |
| $V \rightarrow \textit{saw}$  | 1.0 | $NP \rightarrow \textit{telescopes}$  | 0.1  |

- (b) How do you find the probability of a string using inside and outside probabilities ? (9)
19. (a) Write a Python program for PoS tagging using the necessary Python packages. (9)
- (b) Explain the process of Named Entity Recognition. (5)  
List its uses and challenges involved.

OR

20. (a) Write a regular expression for removing punctuations, numbers and white spaces in a piece of text. (9)
- (b) Write a Python program to count the number of sentences, words and line numbers in a given piece of text. Display each sentence along with that. (5)



### TEACHING PLAN

| No                                                    | Contents                                                                                                  | No of Lecture Hrs (36 hrs) |
|-------------------------------------------------------|-----------------------------------------------------------------------------------------------------------|----------------------------|
| <b>Module - 1 (Preliminaries) (9 hrs)</b>             |                                                                                                           |                            |
| 1.1                                                   | Introduction: Rationalist and Empiricist Approaches to Language-Questions that linguistics should answer- | 1                          |
| 1.2                                                   | Non-categorical phenomena in language-Language and cognition as probabilistic phenomena                   | 1                          |
| 1.3                                                   | The Ambiguity of Language: Why natural language processing is difficult                                   | 1                          |
| 1.4                                                   | Lexical resources-Word counts                                                                             | 1                          |
| 1.5                                                   | Zipf's laws-Collocations-Concordances                                                                     | 1                          |
| 1.6                                                   | Linguistic Essentials: Parts of Speech and Morphology -Nouns and pronouns                                 | 1                          |
| 1.7                                                   | Words that accompany nouns: Determiners and adjectives-Verbs-Other parts of speech                        | 1                          |
| 1.8                                                   | Phrase Structure-Phrase structure grammars                                                                | 1                          |
| 1.9                                                   | Semantics and Pragmatics-Corpus Based Work                                                                | 1                          |
| <b>Module – 2 (Mathematical Essentials) (7 hrs)</b>   |                                                                                                           |                            |
| 2.1                                                   | Probability Theory-Probability spaces                                                                     | 1                          |
| 2.2                                                   | Conditional probability and independence-Bayes' theorem                                                   | 1                          |
| 2.3                                                   | Random variables-Expectation and variance-Notation                                                        | 1                          |
| 2.4                                                   | Joint and conditional distributions-Standard distributions-Bayesian statistics                            | 1                          |
| 2.5                                                   | Statistical Inference: n-gram Models over Sparse Data-Bins: Forming Equivalence Classes                   | 1                          |
| 2.6                                                   | Markov Models-Hidden Markov Models: Why use HMMs?                                                         | 1                          |
| 2.7                                                   | General form of an HMM-Finding the probability of an observation-Finding the best state sequence          | 1                          |
| <b>Module – 3 (Word Sense Disambiguation) (7 hrs)</b> |                                                                                                           |                            |
| 3.1                                                   | Methodological Preliminaries-Supervised and unsupervised learning                                         | 1                          |
| 3.2                                                   | Upper and lower bounds on performance-Supervised Disambiguation                                           | 1                          |
| 3.3                                                   | Bayesian classification-Dictionary based Disambiguation-                                                  | 1                          |
| 3.4                                                   | Disambiguation based on sense definitions-Thesaurus based disambiguation                                  | 1                          |
| 3.5                                                   | Lexical Acquisition-Evaluation Measures                                                                   | 1                          |



|     |                                                                                    |   |
|-----|------------------------------------------------------------------------------------|---|
| 3.6 | Verb Subcategorization-Attachment Ambiguity, PP attachment-Selectional Preferences | 1 |
| 3.7 | Semantic Similarity:Vector space measures-Probabilistic measures                   | 1 |

| <b>Module – 4 (Grammar) (8 hrs)</b>                          |                                                                                                           |   |
|--------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------|---|
| 4.1                                                          | Part-of-Speech Tagging-The Information Sources in Tagging                                                 | 1 |
| 4.2                                                          | Markov Model Taggers-Hidden Markov Model Taggers-                                                         | 1 |
| 4.3                                                          | Applying HMMs to POS tagging-The effect of initialization on HMM training-                                | 1 |
| 4.4                                                          | Transformation-Based Learning of Tags                                                                     | 1 |
| 4.5                                                          | Probabilistic Context Free Grammars-Some Features of PCFGs                                                | 1 |
| 4.6                                                          | Questions for PCFGs                                                                                       | 1 |
| 4.7                                                          | The Probability of a String -Using inside probabilities<br>Using outside probabilities                    | 1 |
| 4.8                                                          | Finding the most likely parse for a sentence-parsing for disambiguation, parsing model vs. language model | 1 |
| <b>Module - 5 (Language Processing with Python) ( 5 hrs)</b> |                                                                                                           |   |
| 5.1                                                          | Introduction to NLTK                                                                                      | 1 |
| 5.2                                                          | Text Wrangling and Text cleansing : Sentence Splitter, Tokenization, Stemming,                            | 1 |
| 5.3                                                          | Lemmatization, Stop word removal , Rare word Removal, Spell Correction.                                   | 1 |
| 5.4                                                          | Part of Speech Tagging and NER.                                                                           | 1 |
| 5.5                                                          | Parsing Structure in Text: Shallow versus deep parsing, types of parsers                                  | 1 |

APJ ABDUL KALAM  
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UNIVERSITY

**SEMESTER VIII**

**MINOR**



| CSD482 | MINI PROJECT | CATEGORY | L | T | P | CREDIT | YEAR OF INTRODUCTION |
|--------|--------------|----------|---|---|---|--------|----------------------|
|        |              | PWS      | 0 | 0 | 3 | 4      | 2019                 |

**Preamble:** The objective of this course is to apply the fundamental concepts of different courses learned in respective Minor Streams: Software Engineering, Machine Learning and Networking. This course helps the learners to get an exposure to the development of application software/hardware solutions/ software simulations in the field of Computer Science and Engineering. It enables the learners to understand the different steps to be followed such as literature review and problem identification, preparation of requirement specification & design document, testing, development and deployment. Mini project enables the students to boost their skills, widen the horizon of thinking and their ability to resolve real life problems.

**Prerequisite:** A sound knowledge in courses studied in respective minor stream.

**Course Outcomes:** After the completion of the course the student will be able to

| CO# | CO                                                                                                                                                                                                                               |
|-----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| CO1 | Identify technically and economically feasible problems ( <b>Cognitive Knowledge Level: Apply</b> )                                                                                                                              |
| CO2 | Identify and survey the relevant literature for getting exposed to related solutions. ( <b>Cognitive Knowledge Level: Apply</b> )                                                                                                |
| CO3 | Perform requirement analysis, identify design methodologies and develop adaptable & reusable solutions of minimal complexity by using modern tools & advanced programming techniques ( <b>Cognitive Knowledge Level: Apply</b> ) |
| CO4 | Prepare technical report and deliver presentation ( <b>Cognitive Knowledge Level: Apply</b> )                                                                                                                                    |
| CO5 | Apply engineering and management principles to achieve the goal of the project ( <b>Cognitive Knowledge Level: Apply</b> )                                                                                                       |

#### Mapping of course outcomes with program outcomes

|     | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|
| CO1 |     |     |     |     |     |     |     |     |     |      |      |      |
| CO2 |     |     |     |     |     |     |     |     |     |      |      |      |
| CO3 |     |     |     |     |     |     |     |     |     |      |      |      |
| CO4 |     |     |     |     |     |     |     |     |     |      |      |      |
| CO5 |     |     |     |     |     |     |     |     |     |      |      |      |

| Abstract POs defined by National Board of Accreditation |                                            |      |                                |
|---------------------------------------------------------|--------------------------------------------|------|--------------------------------|
| PO#                                                     | Broad PO                                   | PO#  | Broad PO                       |
| PO1                                                     | Engineering Knowledge                      | PO7  | Environment and Sustainability |
| PO2                                                     | Problem Analysis                           | PO8  | Ethics                         |
| PO3                                                     | Design/Development of solutions            | PO9  | Individual and team work       |
| PO4                                                     | Conduct investigations of complex problems | PO10 | Communication                  |
| PO5                                                     | Modern tool usage                          | PO11 | Project Management and Finance |
| PO6                                                     | The Engineer and Society                   | PO12 | Lifelong learning              |

#### Assessment Pattern

#### Mark Distribution

| Total Marks | CIE Marks | ESE Marks |
|-------------|-----------|-----------|
| 150         | 75        | 75        |

#### Continuous Internal Evaluation Pattern:

|                                                                                                                                                                                            |            |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|
| Attendance                                                                                                                                                                                 | 10 marks   |
| Project Guide                                                                                                                                                                              | 15 marks   |
| Project Report                                                                                                                                                                             | 10 marks   |
| Evaluation by the Committee (will be evaluating the level of completion and demonstration of functionality/specifications, presentation, oral examination, work knowledge and involvement) | : 40 marks |

Student Groups with 4 or 5 members should identify a topic of interest in consultation with a Faculty Advisor/Project Coordinator/Guide. Review the literature and gather information pertaining to the chosen topic. State the objectives and develop a methodology to achieve the objectives. Carryout the design/fabrication or develop codes/programs to achieve the objectives by strictly following steps specified in the teaching plan. Innovative design concepts, performance, scalability, reliability considerations, aesthetics/ergonomic, user experience and security aspects taken care of in the project shall be given due weight.

The progress of the mini project is evaluated based on a minimum of two reviews. The review committee may be constituted by a senior faculty member, Mini Project coordinator and project guide. The internal evaluation shall be made based on the progress/outcome of the project, reports and a viva-voce examination, conducted internally by a 3-member committee. A project report is required at the end of the semester. The project has to be demonstrated for its full design specifications.

### End Semester Examination Pattern:

The marks will be distributed as

|              |             |
|--------------|-------------|
| Presentation | : 30 marks  |
| Demo         | : 20 marks  |
| Viva         | : 25 marks. |
| Total        | : 75 marks. |

### TEACHING PLAN

Students are expected to follow the following steps.

1. Review of Literature and Identification of a problem
2. Create an abstract with a problem statement, solution approach, technology stack, team, etc.
3. Create Requirements Specification
4. Create Design Document . This may include designs like,
  - a. System Architecture Design
  - b. Application Architecture Design
  - c. GUI Design
  - d. API Design
  - e. Database Design
  - f. Technology Stack
5. Deployment, Test Run & Get Results
6. Prepare Project Report

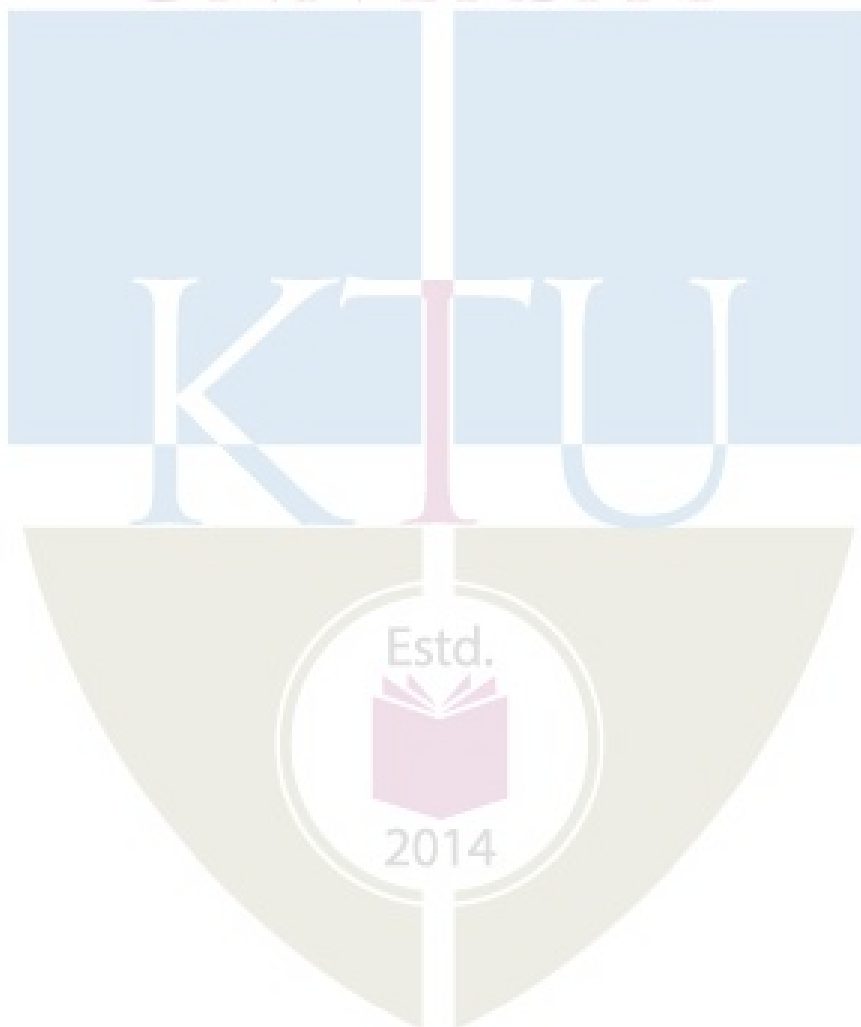
### Guidelines for the Report preparation

A bonafide report on the mini project shall be submitted within one week after the final presentation. Minimum number of pages should be 40.

- Use Times New Roman font for the entire report – Chapter/Section Title – Times New Roman 18, Bold; Heading 2 – Times New Roman 16, Bold; Heading 3 – Times New Roman 14, Bold; Body- Times New Roman 12, Normal.
- Line Spacing – Between Heading 2 – 3 lines, between lines in paragraph 1.5 lines.
- Alignments – Chapter/Section Title – Center, Heading 2 & 3 should be Left Aligned. Ensure that all body text is paragraph justified.
- Figures & Tables – Ensure that all Figures and Tables are suitably numbered and given proper names/headings. Write figure title under the figure and table title above the table.

- **Suggestive order of documentation:**

- i. Top Cover
- ii. Title page
- iii. Certification page
- iv. Acknowledgement
- v. Abstract
- vi. Table of Contents
- vii. List of Figures and Tables
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- ix. Appendices, if any
- x. References/Bibliography



APJ ABDUL KALAM  
TECHNOLOGICAL  
UNIVERSITY

# **SEMESTER VIII**

## **HONOURS**





| CSD496 | MINI PROJECT | CATEGORY | L | T | P | CREDIT | YEAR OF INTRODUCTION |
|--------|--------------|----------|---|---|---|--------|----------------------|
|        |              | PWS      | 0 | 0 | 3 | 2      | 2019                 |

**Preamble:** The objective of this course is to apply the fundamental concepts of courses learned in respective Honors Streams: Security in Computing, Machine Learning and Formal Methods. This course helps the learners to get an exposure to the development of application software/hardware solutions/ software simulations in the field of Computer Science and Engineering. It enables the learners to understand the different steps to be followed such as literature review and problem identification, preparation of requirement specification & design document, testing, development and deployment. Mini project enables the students to boost their skills, widen the horizon of thinking and their ability to resolve real life problems.

**Prerequisite:** A sound knowledge in courses studied in respective honor stream.

**Course Outcomes:** After the completion of the course the student will be able to

| CO# | CO                                                                                                                                                                                                                               |
|-----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| CO1 | Identify technically and economically feasible problems ( <b>Cognitive Knowledge Level: Apply</b> )                                                                                                                              |
| CO2 | Identify and survey the relevant literature for getting exposed to related solutions. ( <b>Cognitive Knowledge Level: Apply</b> )                                                                                                |
| CO3 | Perform requirement analysis, identify design methodologies and develop adaptable & reusable solutions of minimal complexity by using modern tools & advanced programming techniques ( <b>Cognitive Knowledge Level: Apply</b> ) |
| CO4 | Prepare technical report and deliver presentation ( <b>Cognitive Knowledge Level: Apply</b> )                                                                                                                                    |
| CO5 | Apply engineering and management principles to achieve the goal of the project ( <b>Cognitive Knowledge Level: Apply</b> )                                                                                                       |

#### Mapping of course outcomes with program outcomes

|     | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|
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**Assessment Pattern**  
**Mark Distribution**

| Total Marks | CIE Marks | ESE Marks |
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| 150         | 75        | 75        |

**Continuous Internal Evaluation Pattern:**

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|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|
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| Project Guide                                                                                                                                                                              | 15 marks   |
| Project Report                                                                                                                                                                             | 10 marks   |
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|--------------|-------------|
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