B.TECH IN COMPUTER SCIENCE AND DESIGN

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	MNC	--
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: Maths, 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,

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 Projects, 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 in 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

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**

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	HUN 102	PROFESSIONAL COMMUNICATION	2-0-2	4	--
F	EST 102	PROGRAMMING IN C	2-1-2	5	4
S 1/2	PHL 120	ENGINEERING PHYSICSLAB	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**

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, CSD, 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.

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.					

SEMESTER IV

SLOT	COURSE NO.	COURSES	L-T-P	HOURS	CREDIT
A	MAT 206	GRAPH THEORY	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	CSL 202	DIGITAL LAB	0-0-3	3	2
T	CSL204	OPERATING SYSTEMS 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.

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	CXT 305	WEB PROGRAMMING	3-1-0	4	4
D	CXT 307	VIRTUAL REALITY	3-1-0	4	4
E	CXT 309	OBJECT ORIENTED MODELING AND DESIGN	3-0-0	3	3
F	MCN 301	DISASTER MANAGEMENT	2-0-0	2	--
S	CXL 331	WEB PROGRAMMING LAB	0-0-3	3	2
T	CXL 333	VR LAB	0-0-3	3	2
R/M/H	VAC	Remedial/Minor/Honours course*	3-1-0	4	4
TOTAL				**27***	**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

SEMESTER VI

SLOT	COURSE NO.	COURSES	L-T-P	HOURS	CREDIT
A	CST 302	COMPILER DESIGN	3-1-0	4	4
B	CST 304	COMPUTER GRAPHICS AND IMAGE PROCESSING	3-1-0	4	4
C	CST 306	ALGORITHM ANALYSIS AND DESIGN	3-1-0	4	4
D	CXT---	PROGRAM ELECTIVE I	2-1-0	3	3
E	HUT 300	INDUSTRIAL ECONOMICS & FOREIGN TRADE	3-0-0	3	3
F	CXT 308	COMPREHENSIVE COURSE WORK	1-0-0	1	1
S	CXL 332	COMPUTER AIDED SOFTWARE ENGINEERING LAB (CASE LAB)	0-0-3	3	2
T	CXD 334	MINI PROJECT	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 six trending areas in Computer Science and Design, namely Machine Learning, Data Science, Formal Methods in Software Engineering, Multimedia, Design Technologies and Architecture & Design. 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 Machine Learning area may opt to take the elective courses - Foundations of Machine Learning from Elective-I in S6, Machine Learning from Elective-II in S7 and Fuzzy systems and Genetic Algorithms from Elective-III 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

Different Specializations introduced through various Elective Buckets				
Bucket	**Specialization**	**Semester**		
		S6	**S7**	**S8**
1	MACHINE LEARNING	FOUNDATIONS OF MACHINE LEARNING (E-I)	MACHINE LEARNING (E-II)	FUZZY SYSTEMS AND GENETIC ALGORITHMS (E-III)
2	DATA SCIENCE	DATA MINING (E-I)	CLOUD COMPUTING (E-II)	BIG DATA ANALYTICS(E-III)
3	FORMAL METHODS IN SOFTWARE ENGINEERING	AUTOMATED VERIFICATION (E-I)	MODEL BASED SOFTWARE DEVELOPMENT (E-II)	SOFTWARE TESTING AND QUALITY ASSURANCE (E-III)
4	MULTIMEDIA	MULTIMEDIA TECHNOLOGIES (E-I)	VIDEO EDITING (E-II)	MULTIMEDIA COMPRESSION (E-III)
5	DESIGN TECHNOLOGIES	VISUAL DESIGN AND COMMUNICATION (E-I)	DESIGN PROCESS ANDPERSPECTIVE (E-II)	PROTOTYPING INTERACTIVE SYSTEMS (E-III)
6	ARCHITECTURE AND DESIGN	COMPUTER ARCHITECTURE (E-I)	HIGH PERFORMANCE ARCHITECTURE (E-II)	PARALLEL PROGRAMMING (E-III)

PROGRAM ELECTIVE I

SLOT	COURSE NO.	COURSES	L-T-P	HOURS	CREDIT
D	CST 312	i FOUNDATIONS OF MACHINE LEARNING	2-1-0	3	3
	CXT 322	ii DATA MINING	2-1-0		
	CST 342	iii. AUTOMATED VERIFICATION	2-1-0		
	CXT 332	iv MULTIMEDIA TECHNOLOGIES	2-1-0		
	CXT 352	v. VISUAL DESIGN AND COMMUNICATION	2-1-0		
	CXT 362	vi. COMPUTER ARCHITECTURE	2-1-0		

COURSES TO BE CONSIDERED FOR COMPREHENSIVE COURSE WORK

i DATA STRUCTURES
ii OPERATING SYSTEMS
iii. COMPUTER ORGANIZATION AND ARCHITECTURE
iv WEB PROGRAMMING
v. VIRTUAL REALITY

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 the 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

demonstrated for its full design specifications. Innovative design concepts, reliability considerations, aesthetics/ergonomics 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 the 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

SEMESTER VII

SLOT	COURSE NO.	COURSES	L-T-P	HOURS	CREDIT
A	CXT 401	USER INTERFACE SOFTWARE AND TECHNOLOGY (UIST)	2-1-0	3	3
B	CXT---	PROGRAM ELECTIVE II	2-1-0	3	3
C	CST---	OPEN ELECTIVE	2-1-0	3	3
D	MCN 401	INDUSTRIAL SAFETY ENGINEERING	2-1-0	3	---
S	CXL 411	COMPUTER GRAPHICS LAB	0-0-3	3	2
T	CXQ 413	SEMINAR	0-0-3	3	2
U	CXD 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	i .MACHINE LEARNING	2-1-0	3	3
	CST 423	ii. CLOUD COMPUTING	2-1-0		
	CST 443	iii. MODEL BASED SOFTWARE DEVELOPMENT	2-1-0		
	CXT 433	iv. VIDEO EDITING	2-1-0		
	CXT 453	v. DESIGN PROCESS AND PERSPECTIVE	2-1-0		
	CXT 463	vi. HIGH PERFORMANCE COMPUTING	2-1-0		

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 Computer Science & Engineering, Computer Science & Design and Information Technology, offered in the colleges under KTU.

SLOT	COURSE NO.	COURSES	L-T-P	HOURS	CREDIT
B	CST 415	i INTRODUCTION TO MOBILE COMPUTING	2-1-0	3	3
	CST 425	ii INTRODUCTION TO DEEP LEARNING	2-1-0		
	CST 435	iii 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.

SEMESTER VIII

SLOT	COURSE NO.	COURSES	L-T-P	HOURS	CREDIT
A	CXT 402	ADVANCED COMPUTER GRAPHICS	2-1-0	3	3
B	CXT ---	PROGRAM ELECTIVE III	2-1-0	3	3
C	CXT ---	PROGRAM ELECTIVE IV	2-1-0	3	3
D	CXT ---	PROGRAM ELECTIVE V	2-1-0	3	3
T	CXT 404	COMPREHENSIVE COURSE VIVA	1-0-0	1	1
U	CXD 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	CXT 414	i FUZZY SYSTEMS AND GENETIC ALGORITHMS	2-1-0	3	3
	CXT 424	ii BIG DATA ANALYTICS	2-1-0		
	CXT 434	iii SOFTWARE TESTING AND QUALITY ASSURANCE	2-1-0		
	CXT 444	iv. MULTIMEDIA COMPRESSION	2-1-0		
	CXT 454	v. PROTOTYPING INTERACTIVE SYSTEMS	2-1-0		
	CXT 464	vi. PARALLEL PROGRAMMING	2-1-0		

PROGRAM ELECTIVE IV

SLOT	COURSE NO.	COURSES	L-T-P	HOURS	CREDIT
C	CXT 416	i. DATA AND COMPUTER COMMUNICATION	2-1-0	3	3
	CST 426	i i. CLIENT SERVER ARCHITECTURE	2-1-0		
	CXT 436	iii. PROCESSOR AND SYSTEM DESIGN	2-1-0		
	CXT 446	iv. COMPUTER GAME DESIGN AND PROGRAMMING	2-1-0		
	CXT 456	v. OPTIMIZATION TECHNIQUES	2-1-0		
	CST 476	vi. MOBILE COMPUTING	2-1-0		

PROGRAM ELECTIVE V

SLOT	COURSE NO.	COURSES	L-T-P	HOURS	CREDIT
D	CXT 418	i. DESIGNING HUMAN CENTERED SYSTEMS	2-1-0	3	3
	CXT 428	ii. EVOLUTIONARY COMPUTING	2-1-0		
	CST 448	iii. INTERNET OF THINGS	2-1-0		
	CXT 438	iv. ADVANCED DATABASESYSTEMS	2-1-0		
	CST 468	v. BIOINFORMATICS	2-1-0		
	CST 478	vi. COMPUTATIONAL LINGUISTICS	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 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 under Phase I;
- Review and finalization of the Approach to the Problem relating to the assigned topic;
- Detailed Analysis/Modelling/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 a 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, ofwhich 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 form the minor courses.

(vi) The registration for the minor program will commence from semester 3 and all the academic units offering minors in their discipline should prescribe a set of such courses. The courses shall be grouped into a 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 an 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 in Computer Science & Design** can opt to study the courses listed below:

MINOR BUCKETS											
SEMESTER	**BUCKET-1** SPECIALIZATION **SOFTWARE ENGINEERING**				**BUCKET-2** SPECIALIZATION **MACHINE LEARNING**				**BUCKET-3** SPECIALIZATION **COMPUTER GRAPHICS**			
	COURSE NO	**COURSE NAME**	**HOURS**	**CREDIT**	**COURSE NO**	**COURSE NAME**	**HOURS**	**CREDIT**	**COURSE NO**	**COURSE NAME**	**HOURS**	**CREDIT**
S3	CST 281	OBJECT ORIENTED PROGRAMMING	4	4	CST 283	PYTHON FOR MACHINE LEARNING	4	4	CXT 285	INTRODUCTION TO COMPUTER GRAPHICS	4	4
S4	CST 282	PROGRAMMING METHODOLOGIES	4	4	CST 284	MATHEMATICS FOR MACHINE LEARNING	4	4	CXT 286	COMPUTER GRAPHICS AND IMAGE PROCESSING	4	4
S5	CST 381	CONCEPTS IN SOFTWARE ENGINEERING	4	4	CST 383	CONCEPTS IN MACHINE LEARNING	4	4	CXT 385	COMPUTER GAME DESIGN AND PROGRAMMING	4	4
S6	CST 382	INTRODUCTION TO SOFTWARE TESTING	4	4	CST 384	CONCEPTS IN DEEP LEARNING	4	4	CXT 386	WEB PROGRAMMING FOR GRAPHICS AND GAMING	4	4
S7	CXD 481	MINIPROJECT	4	4	CXD 481	MINIPROJECT	4	4	CXD 481	MINIPROJECT	4	4
S8	CXD 482	MINIPROJECT	4	4	CXD 482	MINIPROJECT	4	4	CXD 482	MINIPROJECT	4	4
Note-1: Name of the specialization shall be mentioned in the Minor Degree to be awarded												
Note-2: Any B.Tech students from non-Computer Science/non-IT streams can register for the courses in the minor buckets.												

HONOURS

Honours is an additional credential a student may earn if he/she opts for the extra 20 credits needed for this in his/her 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 ofengineering. 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 courses 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 a maximum of 3 buckets, each bucket representing a particular specialization in the branch. The students shall select only the courses from the 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 withregular 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 Programme.

(vi) The registration for Honours program will commence from semester 4 and all academic units offering Honours in their discipline should prescribe a set of such courses. The courses shall be grouped into a maximum of 5 buckets, each bucket representing a particular specialization in the branch. The students shall select only the courses from the same bucket in all semesters. It means that the specialization is to be fixed by the student and cannot be changed subsequently. There is an option to skip any two courses listed here if required, 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 8th semester. For example: Students who have registered for **B.Tech in Computer Science and Design with Honours** can opt to study the courses listed in one of the buckets shown below:

HONOURS BUCKETS												
SEMESTER	**BUCKET-1**				**BUCKET-2**				**BUCKET-3**			
	SPECIALIZATION **SECURITY IN COMPUTING**				SPECIALIZATION **MACHINELEARNING**				SPECIALIZATION **IOT SPECIALIZATION**			
	CODE	**COURSE NAME**	**HOURS**	**CREDIT**	**CODE**	**COURSE NAME**	**HOURS**	**CREDIT**	**CODE**	**COURSE NAME**	**HOURS**	**CREDIT**
S4	CST 292	NUMBER THEORY	4	4	CST 294	COMPUTATIONAL FUNDAMENTALS FOR MACHINE LEARNING	4	4	CXT 296	IOT ARCHITECTURE AND ITS PROTOCOLS	4	4
S5	CST 393	CRYPTOGRAPHIC ALGORITHMS	4	4	CST 395	NEURAL NETWORKS AND DEEP LEARNING	4	4	CXT 397	DEVICES AND SENSORS FOR IOT-PROGRAMMING FOR IOT BOARDS	4	4
S6	CST 394	NETWORK SECURITY	4	4	CST 396	ADVANCED TOPICS IN MACHINE LEARNING	4	4	CXT 398	DATA VISUALIZATION AND OPEN SOURCE PROGRAMMING FOR IOT	4	4
S7	CST 495	CYBER FORENSICS	4	4	CST 497	ADVANCED TOPICS IN ARTIFICIAL INTELLIGENCE	4	4	CXT 499	CLOUD, MULTIMEDIA AND IOT	4	4
S8	CXD 496	MINI PROJECT	4	4	CXD 496	MINI PROJECT	4	4	CXD 496	MINI PROJECT	4	4
Note: Name of the specialization shall be mentioned in the Honours Degree to be awarded												

INDUCTION PROGRAM

There will be a 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.

CXT 401	USER INTERFACE SOFTWARE & TECHNOLOGY	Category	L	T	P	Credit	Year of Introduction
		PCC	2	1	0	3	2021

Preamble: This is a core course in computer science and design. The main objective of this course is to learn how to use user interface software and technologies in designing human-computer interaction, user experience, and ultimately, how we navigate and interact with the digital world. Recognizing the ever-evolving landscape of technology, characterized by rapid innovation and constant refinement, we endeavor to delve into the principles, methodologies, and advancements that drive the design, development, and implementation of user interfaces.

Prerequisite: Basic programming skills, Web Programming

NB- Students are not expected to write Bootstrap code for the exam.

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

CO1	Summarize interaction design principles and user behaviour patterns to organize content effectively. **[Cognitive knowledge level: Understand]**
CO2	Explain navigational models, layout patterns, and interactive elements to design intuitive navigation systems and responsive user interfaces. **[Cognitive knowledge level: Understand]**
CO3	Apply design patterns, layout structures, and components in Bootstrap5 to create optimized user interactive systems. **[Cognitive knowledge level: Apply]**
CO4	Develop practical skills in designing and prototyping user interfaces using Bootstrap5,considering factors such as page layout, interactive elements and visual aesthetics.**[Cognitive knowledge level: Apply]**
CO5	Analyze the effectiveness of user interface designs and iterate to enhance user experience and satisfaction. **[Cognitive knowledge level: Analyze]**

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO1 0	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 internal evaluation test is to be conducted based on the first two modules of the Syllabus. The second internal evaluation test is to be conducted based on the third and fourth modules of the Syllabus. There will be two parts: Part A and Part B. Students should answer all questions from Part A. Part B contains 7 questions each with 7 marks. Out of the 7 questions, a student should answer any 5. An assignment/quiz/open book test is to be given based on the fifth module of the Syllabus. The time duration for each internal evaluation test is 1 hour and 30 minutes.

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 (Understanding User Behavior and Research)

Introduction to user research and its importance in interface design, Exploring user motivations and behavior patterns -Analyzing common user behaviors - safe exploration, instant gratification, satisficing, habituation, and streamlined repetition. Introduction to Bootstrap 5-layout structures- grid system, containers, and spacing utilities.

Module- 2 (Organizing Content and Information Architecture)

Introduction to information architecture and application structure - Exploring patterns for feature organization, search, and browsing. Organizing content in Bootstrap 5- images, cards, lists, and tables.

Module - 3 (Navigation and Wayfinding)

Introduction to navigation design and signposts - Navigational models, Design conventions for websites, Patterns - clear entry points, menus, and breadcrumbs. Bootstrap 5's navigation components- navbar, dropdowns, and pagination.

Module - 4 (Organizing Page Layout)

Introduction to page layout principles and visual frameworks - Basics of page layout, Layout patterns -centerstage, grid of equals, module tabs, accordion, collapsible panels, diagonal balance, and liquid layout. Creation of responsive and flexible page layouts-Usage of containers, rows, and columns to structure content on different devices using Bootstrap 5.

Module - 5 (Interactivity, Forms, and Control)

Introduction to interactive elements: Actions and Commands - Exploring patterns- buttons, hover tools, action panels, progress indicators. Bootstrap 5's form components -form controls, input groups, and custom form elements.

NB- Students are not expected to write Bootstrap code for the exam.

Text Book

1. Designing Interfaces: Patterns for Effective Interaction Design - Jenifer Tidwell, Second edition, O'Reilly Media, Inc.
2. https://getbootstrap.com/docs/5.0/getting-started/

Reference Books

1. The Design of Everyday Things. Donald A. Norman. Basic Books; 1st Basic edition (September 2002), ISBN: 0-465- 06710-7 (paperback)
2. Human-Computer Interaction by Alan Dix, Janet E. Finlay, Gregory D. Abowd, and Russell Beale
3. About Face: The Essentials of Interaction Design- Alan Cooper, Robert Reimann, David Cronin, and Christopher Noessel

4. The Elements of User Experience: User-Centered Design for the Web and Beyond- Jesse James Garrett
5. Sketching User Experiences: Getting the Design Right and the Right Design (Interactive Technologies). Bill Buxton. Morgan Kaufmann, 1st edition (March 30, 2007), ISBN- 10: 0123740371

Sample Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Define user research in the context of interaction design.
2. Explain instant gratification.
3. Explain the spacing utilities in Bootstrap5.

Course Outcome 2 (CO2):

1. How do different navigational models influence user comprehension and task completion rates?
2. Write notes on clear entry points.
3. Explain input groups in Bootstrap5.

Course Outcome 3 (CO3):

1. Illustrate the use of grid system to design a responsive layout using Bootstrap5.
2. Explain how the component Table is used to organize content in Bootstrap5.
3. Compare the various layout structures used in designing a user interface.

Course Outcome 4 (CO4):

1. Illustrate how form control can be used to design interactive user interfaces.
2. Sketch a page layout applying diagonal balance.
3. Discuss best practices for implementing accordion panels in interface design.

Course Outcome 5 (CO5):

1. Analyze the effectiveness of sign-in tools in interface navigation design, considering their impact on user authentication processes and overall user experience.
2. Analyze the principles of visual hierarchy in page layout design and their influence on user attention and comprehension. How can designers create effective visual hierarchies to guide users through content?

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: CXT401

Course Name: User Interface Software & Technology

Max.Marks:100 **Duration: 3 Hours**

PART A

Answer all Questions. Each question carries 3 Marks

1. Define user research in the context of interaction design. Provide two examples of user research methods commonly used in interface design.

2. Explain the concept of "satisficing" in user behavior. How can designers address satisficing tendencies in interface design?

3. Discuss the significance of information architecture in interface design. Provide two principles of effective information architecture.

4. How can lists be used to organize contents in Bootstrap5?

5. Explain the importance of clear entry points in interface design. Provide two examples of interfaces that effectively utilize clear entry points.

6. Explain navbar with its subcomponents.

7. Discuss about grid of equals in page layout design.

8. Explain the concept of module tabs in page layout. How do module tabs help organize content on a webpage?
9. Explain the concept of "responsive design" in interface development. How does responsive design enhance user experience across different devices?
10. Explain form control in Bootstrap5.

Part B

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

11. a) Discuss the significance of user research in interaction design, considering its impact on product development and user satisfaction. Provide examples to illustrate the importance of user research in real-world interface design projects. (7 marks)

    b) Explain the concept of "instant gratification" in user behavior and its implications for interface design. How can designers balance the need for instant gratification with other design considerations such as usability and accessibility? (7 marks)

OR

12. a)Discuss the concept of "streamlined repetition" in interface design and its relationship to user efficiency and productivity. How can designers leverage streamlined repetition to improve user workflows and task completion rates? (7 marks)

b) Assess the role of habituation in user behavior and its effects on interface engagement over time. Provide strategies for designing interfaces that mitigate habituation and maintain user engagement (7 marks)

13. a) Explain the effectiveness of different information architecture models in organizing complex content structures. Provide examples of interfaces that demonstrate the successful implementation of each model. (7 marks)

    b) Explain how the component Table is used to organize content in Bootstap5. (7 marks)

OR

14. a) Discuss the role of alternative views in content organization and navigation design. How do alternative views enhance user comprehension and exploration of diverse content types? (7 marks)

    b) Explain the effectiveness of the canvas plus palette pattern in organizing and presenting content within digital interfaces. (7 marks)

15. a)How do different navigational models influence user comprehension and task completion rates? (7 marks)

    b) Discuss the advantages and limitations of modal panels and provide recommendations for their appropriate use in interface design. (7 marks)

OR

16. a) Discuss the concept of "escape hatch" in navigation design and its role in facilitating user exploration and recovery from navigational errors. (7 marks)

    b) Explain the effectiveness of sign-in tools in interface navigation design, considering their impact on user authentication processes and overall user experience. (7 marks)

17. a) Explain the principles of visual hierarchy in page layout design and their influence on user

attention and comprehension. (7 marks)

b) Discuss the best practices for implementing accordion panels in interface design. (7 marks)

OR

18. a) How can designers leverage liquid layouts to optimize user experience across different devices and screen sizes? (7 marks)

b) Explain the effectiveness of diagonal balance in page layout design, considering its impact on visual aesthetics and user engagement. (7 marks)

19. a) How can designers implement progressive disclosure techniques to enhance user understanding and engagement? (7 marks)

b) Discuss the best practices for designing intuitive and accessible hover interactions. (7 marks)

OR

20. a) How can designers implement multi-level undo functionality effectively while maintaining interface consistency and performance? (7 marks)

b) Discuss the best practices for designing and implementing macros in interfaces to support user workflows and task automation. (7 marks)

Teaching Plan

Sl. No	Topic	No. of Hours (36 hrs.)
Module - 1 (Understanding User Behavior and Research) 7 Hours		
1.1	Introduction to user research and its importance in interface design	1 Hour
1.2	Exploring user motivations and behavior patterns	1 Hour
1.3	Safe exploration, instant gratification	1 Hour
1.4	Satisficing, habituation, and streamlined repetition.	1 Hour
1.5	Introduction to Bootstrap 5-layout structures-	1 Hour
1.6	Grid system, containers	1 Hour
1.7	Spacing utilities.	1 Hour
Module - 2 (Organizing Content and Information Architecture) 7 Hours		
2.1	Introduction to information architecture and application structure	1 Hour
2.2	Exploring patterns for feature organization.	1 Hour
2.3	Exploring patterns for search, and browsing.	1 Hour
2.4	Organizing content in Bootstrap 5- images	1 Hour
2.5	Cards	1 Hour
2.6	Lists	1 Hour
2.7	Tables	1 Hour
Module - 3 (Navigation and Wayfinding) 7 Hours		
3.1	Introduction to navigation design and signposts	1 Hour
3.2	Navigational models	1 Hour
3.3	Design conventions for websites	1 Hour
3.4	Patterns - clear entry points	1 Hour
3.5	Menus, and breadcrumbs.	1 Hour
3.6	Bootstrap 5's navigation components- navbar	1 Hour

3.7	Dropdowns, pagination	1 Hour
Module - 4 (Organizing Page Layout) 8 Hours		
4.1	Introduction to page layout principles and visual frameworks	1 Hour
4.2	Basics of page layout	1 Hour
4.3	Layout patterns -centerstage	1 Hour
4.4	Grid of equals, module tabs	1 Hour
4.5	Accordion, collapsible panels	1 Hour
4.6	Diagonal balance, liquid layout.	1 Hour
4.7	Creation of responsive and flexible page layouts	1 Hour
4.8	Usage of containers, rows, and columns to structure content on different devices using Bootstrap 5	1 Hour
Module - 5 (Interactivity, Forms, and Control) 7 Hours		
5.1	Introduction to interactive elements	1 Hour
5.2	Actions and Commands	1 Hour
5.3	Exploring patterns- buttons	1 Hour
5.4	Hover tools, action panels	1 Hour
5.5	Progress indicators	1 Hour
5.6	Bootstrap 5's form components -form controls, input groups	1 Hour
5.7	Custom form elements	1 Hour

CXT 433	Video Editing	Category	L	T	P	Credit	Year of Introduction
		PEC	2	1	0	3	2021

Preamble: This is an elective course in computer science and design. The course gives a comprehensive understanding of video editing, techniques, tools and principles. It covers the concept of basic and advanced editing techniques, audio manipulation, linear and nonlinear editing and also the concepts of AVID XPRESS DV 4.

Prerequisite: Basic Knowledge of Multimedia

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

CO1	Explain the broad perspective of linear and nonlinear editing concepts. **(Cognitive Knowledge Level: Understand)**
CO2	Articulate the concept of Storytelling styles. **(Cognitive Knowledge Level: Understand)**
CO3	Apply basic editing techniques, including transitions, titles, color correction and audio manipulation **(Cognitive Knowledge Level: Apply)**
CO4	Discuss the advanced editing techniques, **(Cognitive Knowledge Level: Understand)**
CO5	Explain the concepts of AVID XPRESS DV 4.**(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	PO8	PO 9	PO 10	PO 11	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 Tests**		**End Semester Examination Marks**
	Test 1 (Marks)	**Test 2 (Marks)**	
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 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 internal evaluation test is to be conducted based on the first two modules of the Syllabus. The second internal evaluation test is to be conducted based on the third and fourth modules of the Syllabus. There will be two parts: Part A and Part B. Students should answer all questions from Part A. Part B contains 7 questions each with 7 marks. Out of the 7 questions, a student should answer any 5. An assignment/quiz/open book test is to be given based on the fifth module of the Syllabus. The time duration for each internal evaluation test is 1 hour and 30 minutes.

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 editing)

Evolution of filmmaking - Introducing Digital Video - Getting Your Digital Video Gear -linear editing - non-linear digital video - Economy of Expression - risks associated with altering reality through editing.

Module - 2 (Story telling)

Storytelling styles in a digital world through jump cuts, L-cuts, match cuts, cutaways, dissolves, split edits - Consumer and pro NLE systems - digitizing images - managing resolutions - mechanics of digital editing - pointer files - media management

.

Module - 3 (Using audio and video)

Capturing digital and analog video - importing audio - Working with Clips - Turning Your Clips into a Movie - Fixing Color and Light Issues - Using Transitions and Titles - Working with Audio.

Module 4 (Advanced Video Editing)

Using Video Effects in iMovie - Working with Still Photos and Graphics- Previewing video - Exporting Movies for the Online World - Exporting Digital Video to Tape - Recording CDs and DVDs – Tools for

digital video production.

Module 5 (Working with AVID XPRESS DV 4 6)

Starting Projects and Working with Project Window - Using Basic Tools and Logging - Preparing to Record and Recording - Importing Files - Organizing with Bins - Viewing and Making Footage - Using Timeline and Working in Trim Mode - Working with Audio - Output Options.

Text Books

1. Keith Underdahl, “Digital Video for Dummies”, Third Edition, Dummy Series, 2001.
2. Avid Xpress DV 4 User Guide, 2007.
3. Ken Dancyger, "The Technique of Film and Video Editing: History, Theory, and Practice", 5th Edition.

Reference Books

1. Robert M. Goodman and Partick McGarth, “Editing Digital Video: The Complete Creative and Technical Guide”, Digital Video and Audio, McGraw – Hill 2003.
2. Walter Murch, “In the Blink of An Eye: 2nd Edition.

Sample Course Level Assessment Questions:

Course Outcome 1 (CO1):

1. Write Notes on evolution of film making.
2. Explain video editing process with various stages.
3. Demonstrate linear video editing techniques with its advantages and disadvantages.
4. Differentiate linear and nonlinear editing. Mention the application of both techniques in detail.
5. What are the prerequisites for video creation and editing? Explain in detail.
6. Examine the commercial requirements of video editing. How to attain those requirements?
7. What is meant by economy of expression? Identify the ways to achieve video editing.
8. Explain the risks associated with altering reality through editing.

Course Outcome 2 (CO2):

1. Explain the purpose of story board in digital video editing with suitable diagrams.
2. Discuss about various story telling techniques.
3. Demonstrate various cuts used in video editing with applications.
4. Which software is best for NLE? Justify with pros and cons.
5. Write about digitization process of images with necessary steps.
6. Describe different types of resolutions. Mention advantages and disadvantages of higher video resolution.
7. Explain the terms i) pixel, ii) video resolution iii)P and I in resolution iv) Aspect ratio.

8. Summarize the uses media management in video editing.
9. Analyze in detail about five phases of video editing.

Course Outcome 3 (CO3):

1. Explain audio compression techniques in detail.
2. How to store files on CD and VCD? Compare its performance.
3. Discuss the ways to record audio files. Demonstrate any one method in detail.
4. Compare various video compression techniques.
5. Write about various video file formats supported by android phone. List the steps to convert video files to different formats.
6. Examine the method to import and export video files from laptop to mobile phone.
7. Identify various video storage devices. Analyze its performance in various aspects.
8. Enumerate the difficulties faced by editors with audio and video files.
9. With an example explain how basic editing techniques, transitions, titles, color correction are applied in editing.

Course Outcome 4 (CO4):

1. Compare various video editing software's.
2. Write notes on evolution of Final cut pro editing tool.
3. Explain about animation effects created by Final cut pro editing tool.
4. Discuss about built in effects associated with Final cut pro editing to improve video quality.
5. Compare Final cut pro vs Adobe premiere pro video editing tools.
6. Describe the steps to use final cut pro for video editing.
7. Explain the tools used in final cut pro software.
8. Explain the features, pros and cons of final cut pro software.

Course Outcome 5 (CO5):

1. Write about the features and uses of Avid Xpress DV 4 video editing software.
2. Explain the starting of a new project in Avid Xpress DV 4 video editing tool.
3. Compare Avid Xpress dv 4 video editing software with adobe premiere Pro.
4. Explain the importance of Bins display in Avid Xpress dv 4 and explain working with Bin in detail.
5. Demonstrate i) Setting up the record tool ii) Preparing for audio tool.
6. Discuss the following terms with respect to Avid Xpress dv 4.

i) Text view ii) Frame view iii) Script view iv) Custom bin view.

7. Explain about script integration in detail in Avid Xpress dv 4.
8. How are media files managed by Avid Xpress dv 4?
9. Write Notes on viewing and managing footage in Avid Xpress dv 4.
10. Illustrate with an example the use of timeline in Avid Xpress dv 4.

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: CXT 433
Course Name: Video Editing

Max.Marks:100 **Duration: 3 Hours**

PART A
Answer All Questions. Each Question Carries 3 Marks

1. What are the ways to study film history?
2. Define video editing.
3. Mention the storytelling techniques.
4. Differentiate cross cut and cutaway.
5. What are the best practices for video storage?
6. How to store digital video files?
7. What is purpose of canvas in final cut pro?
8. List down the audio files supported by final cut pro.
9. Express the purpose of Avid Xpress Pro editing tool.
10. Identify the options for backing up media files.

(10x3= 30)

Part B

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

11 (a) Demonstrate linear video editing techniques with its advantages and disadvantages. (**7 marks)**

(b)What is meant by economy of expression? Identify the ways to achieve video editing. (**7 marks)**

OR

12 (a) Explain video editing process with various stages. (**7 marks)**

(b) Discuss the risks associated with altering reality through editing. **(7 marks)**

13 (a) Explain the purpose of story board in digital video editing with suitable diagrams. **(7 marks)**

(b) Describe different types of resolutions. Mention advantages and disadvantages of higher video resolution. **(7 marks)**

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OR

14(a) Illustrate the various cuts used in video editing with applications. **(7 marks)**

(b)Write about digitization process of images with necessary steps. **(7 marks)**

15 (a) Write about various video file formats supported by android phone.

List the steps to convert video files to different formats. **(7 marks)**

(b)Enumerate the difficulties faced by editors with audio and video files. **(7 marks)**

OR

16 (a) Explain audio compression techniques in detail. **(7 marks)**

(b)Describe and compare various video compression techniques. **(7 marks)**

17 (a) Explain about animation effects created by Final cut pro editing tool. **(7 marks)**

(b)Describe the steps to use final cut pro for video editing. **(7 marks)**

OR

18 (a) Illustrate the effects associated with Final cut pro editing to improve video quality. **(8 marks)**

(b) Explain the tools used in final cut pro. **(6 marks)**

19 (a) Describe the starting of a new project in Avid Xpress DV 4 video editing tool. **(7 marks)**

(b) Explicate the viewing and managing footage in Avid Xpress dv4. **(7 marks)**

OR

20 (a) Define the following terms related to respect to Avid Xpress dv 4 **(8 marks)**

i) Text view.
ii) Frame view.
iii) Script view
iv) Custom bin view

(b) Illustrate the use of timeline in Avid Xpress dv 4**.** **(6 marks)**

	Lesson Plan	**No. of lecture hours (36 Hrs.)**
No	**Contents**	
Module 1(Introduction to editing) (7 hours)		
1.1	Evolution of filmmaking	1
1.2	Introducing Digital Video	1
1.3	Getting Your Digital Video Gear	1
1.4	Linear editing	1
1.5	Non-linear digital video	1
1.6	Economy of Expression	1
1.7	Risks associated with altering reality through editing	1
Module 2(Story telling) (8 hours)		
2.1	Storytelling styles in a digital world through jump cuts.	1
2.2	L-cuts, match cuts	1
2.3	Cutaways, dissolves, split edits	1
2.4	Consumer and pro NLE systems	1
2.5	Digitizing images	1

2.6	Managing resolutions	1
2.7	Mechanics of digital editing, Pointer files	1
2.8	Media management	1

	Module 3 (Using audio and video) (7 hours)	
3.1	Capturing digital and analog video	1
3.2	Importing audio	1
3.3	Working with Clips	1
3.4	Turning Your Clips into a Movie	1
3.5	Fixing Color and Light Issues	1
3.6	Using Transitions and Titles	1
3.7	Working with Audio	1
	Module 4(Advanced Video Editing) (7 hours)	
4.1	Using Video Effects in iMovie	1
4.2	Working with Still Photos and Graphics	1
4.3	Previewing video	1
4.4	Exporting Movies for the Online World	1
4.5	Exporting Digital Video to Tape	1
4.6	Recording CDs and DVDs	1
4.7	Tools for digital video production	1

Module 5(Working with Avid Xpress DV 4 6) (7 hours)		
5.1	Starting Projects and Working with Project Window	1
5.2	Using Basic Tools and Logging	1
5.3	Preparing to Record and Recording	1
5.4	Importing Files	1
5.5	Organizing with Bins	1
5.6	Viewing and Making Footage.	1
5.7	Using Timeline and Working in Trim Mode, Working with Audio - Output Options	1

CXT 453	DESIGN PROCESS AND PERSPECTIVES	Category	L	T	P	Credit	Year of Introduction
		PEC	2	1	0	3	2021

Preamble: This course helps the learner to understand the stages involved in the design process, the methods used by the designers to generate and refine creative ideas, the key considerations that help shape them and the feedback and review elements that allow design teams to learn from each job and contribute to future commissions. It covers varied skills a learner needs to strategically and creatively interpret good design and write for advertising across multiple media platforms.

Prerequisite: NIL

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

CO1	Discuss the fundamentals of the graphic design process. **(Cognitive Knowledge Level: Understand)**
CO2	Make use of various graphic design thinking process and phases. **(Cognitive Knowledge Level: Apply)**
CO3	Learn the concepts of design and development for Interactive Media. **(Cognitive Knowledge Level: Understand)**
CO4	Illustrate embedding of media content, aesthetics and authoring interactive digital media. **(Cognitive Knowledge Level: Understand)**
CO5	Create a website using different design concepts. **(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 - 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 internal evaluation test is to be conducted based on the first two modules of the Syllabus. The second internal evaluation test is to be conducted based on the third and fourth modules of the Syllabus. There will be two parts: Part A and Part B. Students should answer all questions from Part A. Part B contains 7 questions each with 7 marks. Out of the 7 questions, a student should answer any 5. An assignment/quiz/open book test is to be given based on the fifth module of the Syllabus. The time duration for each internal evaluation test is 1 hour and 30 minutes.

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 carries 14 marks.

Syllabus

Module – 1 (Graphic design process)

Graphic design, Group structures and working methods, Industrialization, Technology, Typography, Consumerism, Identity and branding, Social responsibility, Modernism and post- modernism, Nostalgia and rhetoric, Semiotics, Vernacular, Design as problem solving, Creative thinking.

Module - 2 (Elements of design thinking)

Define the problem – Research the problem: Identifying drivers - Information gathering - Target groups – Idea Generation for the problem - Basic design directions - Questions and answers - Themes of thinking - Brainstorming- Deciding elements to design - Sketching and Drawing - Lines, shapes, Negative space/white space, Volumes, Value, Color, Texture- Color: Colors Theories-Color wheel - Color Harmonies or Color Schemes- Color Symbolism – Font - Layout.

Module - 3 (Refinement and prototyping design)

Refinement of Design : Thinking in images - Thinking in signs - Appropriation - Humor- Personification -

Visual metaphors - Modification - Thinking in words- Thinking in technology – Prototyping - Developing designs - 'Types' of prototype- Vocabulary – Risk management – Implementation: Format - Materials- Finishing – Case study.

Module - 4 (Introduction to Interactive digital media)

Introduction - Interactive Digital Media, Forms of Interactive Digital Media, Developing Interactive Digital Media, Essential Skills for the Interactive Digital Media Developer, The Impact of Interactive Digital Media, The Interactive Digital Media Development Process and Team, Fundamental Components of Interactive Digital Media - Analog vs. Digital Media, Bits and Bytes, File Formats, Analog to Digital, The Pros of Digital Media, Compression, Description vs. Command-Based Encoding of Media, Color on the Screen.

Module - 5 (Media content, aesthetics and authoring in Interactive Digital Media)

Media content - Graphics, Pixel-based Images, Vector-based Images, 2D Animation, 3D Graphics and Animation, Audio, Video in Interactive Digital Media, Text.
Aesthetics - Typography, Color, Layout Principles.
Authoring - Multimedia Authoring, Making Video Games: Casual and Console, Building Apps, Building Interactive Media for Performance and Public Spaces, Building Websites.

Text Books

1. Gavin Ambrose and Paul Harris, "The Fundamentals of Graphics Design", 1st Edition, 2008, Bloomsbury Publishing.
2. Design Thinking for Visual Communication, Gavin Ambrose, Edition 1, 2017, Bloomsbury Publishing.
3. Juliya V Griffey, "Introduction to Interactive Digital Media: Concept and Practice", 1st Edition, 2019, Taylor & Francis.

Reference Books

1. David Raizman; History of Modern Design, Prentice Hall, 2004
2. Jamie Steane, The Principles and Processes of Interactive Design, 2015, Bloomsbury Publishing

Sample Course Level Assessment Questions:

Course Outcome 1 (CO1):

1. Explain the Hierarchy of group structures.
2. What are the roles of account handlers and project managers?
3. What is glyph switching?
4. Differentiate between modernism and postmodernism views.
5. Explain Typography.

Course Outcome 2 (CO2):

1. How does color contribute to the visual impact of a design?
2. Discuss the role of texture in design thinking.
3. How does color contribute to the visual impact of a design?
4. Imagine you're tasked with creating a promotional video for a new product using 3D graphics and animation. Describe the steps you would take to plan, design, and execute the production process, ensuring that the final video effectively showcases the product's features and benefits to the target audience.
5. Imagine you're redesigning the branding and website for a high-end fashion brand. Describe how you would approach selecting and incorporating typography to reflect the brand's identity, convey its values, and enhance the overall user experience for potential customers browsing the website.

Course Outcome 3 (CO3):

1. What is Interactive Digital Media?
2. What are the different forms of Interactive Digital Media?
3. Compare description-based encoding and command-based encoding of media.
4. Explain analog to digital conversion in Interactive Digital Media.
5. What are wireframes?

Course Outcome 4 (CO4):

1. What is sampling?
2. Find an example of a visual hierarchy. Why is it effective?
3. Explain the components of Unity.
4. Differentiate Pixel based images and vector-based images
5. Find an example of a visual hierarchy. Why is it effective?

Course Outcome 5 (CO5):

1. Develop an UI for a social media website and chat.
2. Develop a publication that tells comic stories
3. Develop a Blog that publishes educational posts.

4. Develop an advertisement for electronic products
5. Develop an interactive website for the hospital management system**.**

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: CXT 453
Course Name: Design Process and Perspective

Max.Marks:100 **Duration: 3 Hours**

PART A
Answer All Questions. Each Question Carries 3 Marks

1. Explain Consumerism.
2. Differentiate between Identity and Branding.
3. Who are the target groups in the research stage?
4. "Asking questions and answers help in identifying the true needs". Justify.
5. What is Refinement of Design?
6. Explain different developing designs used for developing an idea
7. What are the phases in interactive digital media development?
8. Explain the pros of digital media.
9. Explain different file formats of pixel-based images.
10. Why do you think video has become increasingly integrated into interactive digital media applications?

(10x3= 30)

Part B

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

11 (a) What is the role of semiotics in the Graphics Design Process? (7)

(b) Explain vernacular design principles and their applications. (7)

OR

12 (a) What are the various approaches adopted by a designer to solve a problem. (7)

(b) Nostalgia and Rhetoric play an instrumental role in the design of a product. Justify your answer. (7)

13 (a) What is Brainstorming? List out the rules of brainstorming. (7)

(b) What are the seven elements of design? Explain. (7)

OR

14 (a) Explain the significance of negative space in design thinking. (7)

(b) What are the basic design directions in design thinking? (7)

15 (a) Explain different types of prototyping? (7)

(b) Explain Thinking in signs and its categories. (7)

OR

16 (a) Explain appropriation and its key forms. (7)

(b)Explain different vocabularies or styles used for design development. (7)

17 (a) Explain the compression in Interactive Digital Media. (6)

(b) Explain the Interactive Digital Media Development Team members. (8)

OR

18 (a) Explain the process of interactive digital media development and its team. (8)

(b) Explain Color on the Screen in Interactive Digital Media. (6)

19 (a) Explain distinct phases of 3D production that can be accomplished in a 3D animation program. (7)

(b) Explain different types of writings needed for interactive documents. (7)

OR

20 (a) Explain basic layout principles which creates an interactive media (6)

(b) Explain the process involved in developing a website. (8)

Teaching Plan

No	Contents	No. of lecture hours. 36
Module 1(Graphic Design Process) (7 hours)		
1.1	Introduction to Graphic design	1
1.2	Group structures and working methods	1
1.3	Industrialization, Technology, Typography, Consumerism	1
1.4	Identity and branding, social responsibility	1
1.5	Modernism and post- modernism	1
1.6	Nostalgia and rhetoric, Semiotics, Vernacular	1
1.7	Design as problem solving, Creative thinking	1
Module 2 (Elements of design thinking) (7 hours)		
2.1	Define the problem – Research the problem: Identifying drivers	1
2.2	Information gathering - Target groups – Idea Generation for the problem	1
2.3	Basic design directions - Questions and answers	1
2.4	Themes of thinking - Brainstorming- Deciding elements to design	1
2.5	Sketching and Drawing - Lines, shapes, Negative space/white space, Volumes, Value	1
2.6	Color, Texture- Color: Colors Theories-Color wheel - Color Harmonies or Color Schemes- Color Symbolism	1
2.7	Font - Layout	1

Module 3 (Refinement and prototyping design) (8 hours)		
3.1	Refinement of Design: Thinking in images	1
3.2	Thinking in signs - Appropriation	1

3.3	Humor- Personification - Visual metaphors	1
3.4	Modification - Thinking in words, Thinking in technology – Prototyping, Developing designs	1
3.5	Types of prototypes- Vocabulary	1
3.6	Risk management	1
3.7	Implementation: Format - Materials- Finishing	1
3.8	Case study	1
Module 4 (Introduction to Interactive Digital Media) (7 hours)		
4.1	Introduction - Interactive Digital Media, Forms of Interactive Digital Media	1
4.2	Developing Interactive Digital Media, Essential Skills	1
4.3	The Impact of Interactive Digital Media	1
4.4	The Interactive Digital Media Development Process and Team	1
4.5	Fundamental Components of Interactive Digital Media - Analog vs. Digital	1
4.6	Analog to Digital, The Pros of Digital Media, Compression	1
4.7	Description vs. Command-Based Encoding of Media, Color on the Screen.	1

Module 5 (Media content, aesthetics and authoring in Interactive Digital Media) (7 hours)		
5.1	Media content - Graphics, Pixel-based Images	1
5.2	Vector-based Images, 2D Animation, 3D Graphics and Animation	1
5.3	Audio, Video in Interactive Digital Media, Text, Aesthetics - Typography	1
5.4	Color, Layout Principles	1
5.5	Authoring - Multimedia Authoring	1
5.6	Making Video Games: Casual and Console	1

5.7	Building Apps, Interactive Media for Performance and Public Spaces and websites	1

CXT463	HIGH PERFORMANCE COMPUTING	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		PEC	2	1	0	3	2021

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 (**Cognitive Knowledge Level: Understand**)
CO2	Summarize the concepts of Instruction Level Parallelism (**Cognitive Knowledge Level: Understand**)
CO3	Use the idea of Data Level Parallelism (**Cognitive Knowledge Level: Apply**)
CO4	Demonstrate the concept of Thread Level Parallelism(**Cognitive Knowledge Level: Apply**)
CO5	Describe the basics of GPU 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	✓	✓	✓									✓
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**	Life long learning

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination Marks(%)
	Test1 (%)	Test2 (%)	
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. The first internal evaluation test is to be conducted based on the first two modules of the Syllabus. The second internal evaluation test is to be conducted based on the third and fourth modules of the Syllabus. There will be two parts: Part A and Part B. Students should answer all questions from Part A. Part B contains 7 questions each with 7 marks. Out of the 7 questions, a student should answer any 5. An assignment/quiz/open book test is to be given based on the fifth module of the Syllabus. The time duration for each internal evaluation test is 1 hour and 30 minutes.

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 over head–Multi-GPU platforms–Potential benefits of GPU–accelerated platforms

Text Books

1. JohnL.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 Maciej Brodowicz, 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 Outcome1 (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 Outcome2(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 Outcome3 (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 Outcome4(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 Outcome5 (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

QPCODE:

Reg No:_____

Name:_____ **PAGES:4**

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SEVENTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: CXT463

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 carries14 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 L2bandwidth 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 speed up 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 (36hrs)
	Module1-Basics of Architecture (7hours)	
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
Module-2 (Instruction Level Parallelism) (7hours)		
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 – Lecture1.	1 hour
2.7	Exploiting Thread-Level Parallelism to Improve Uniprocessor Throughput – Lecture2.	1 hour
Module-3-Data-Level Parallelism (7hours)		
3.1	Vector Architecture- Lecture1	1 hour
3.2	Vector Architecture- Lecture2	1 hour
3.3	SIMD Instruction Set Extensions for Multimedia– Lecture1	1 hour
3.4	SIMD Instruction Set Extensions for Multimedia– Lecture2	1 hour
3.5	Graphics Processing Units	1 hour
3.6	Detecting and Enhancing Loop-Level Parallelism– Lecture1	1 hour
3.7	Detecting and Enhancing Loop-Level Parallelism– Lecture2	1 hour
Module4–Thread Level Parallelism (8hours)		
4.1	Multiprocessor Architecture: Issues and Approach	1 hour
4.2	Centralized Shared-Memory Architectures– Lecture1	1hour
4.3	Centralized Shared-Memory Architectures– Lecture2	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
Module5–GPU Architectures (7hours)		
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

CXL 411	COMPUTER GRAPHICS LAB	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		PCC	0	0	3	2	2021

Preamble:
This laboratory course encourages students to explore and implement different CG concepts. Students can develop animation programs using the CG concepts. This course also encourages students to do different image processing operations

Prerequisite: Basic understanding of computer programming, Computer Graphics and Image Processing.

CO1	Implement computer graphics algorithms for drawing Line and circle **(Cognitive Knowledge Level: Apply)**
CO2	Apply Polygon filling and clipping concepts in CG **(Cognitive Knowledge Level: Apply)**
CO3	Implementation of geometric transformations of 2D and 3D objects. **(Cognitive Knowledge Level: Apply)**
CO4	Develop animation programs using CG concepts. **(Cognitive Knowledge Level: Apply)**
CO5	Implement different image Processing operations **(CognitiveKnowledge 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 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	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 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.

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, 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. Introduction To 2D graphics:Line drawing algorithms- DDA, Bresenham's algorithm. Circle drawing algorithms- Midpoint Circle generation algorithm, Bresenham's algorithm.

2. Polygon filling and 2D transformations: Polygon filling algorithms,flood fill and boundary fill algorithms,2d transformations-translation,rotation,scaling, composite transformations

3. 3D transformations: Basic 3 D transformations-translation,rotation,scaling

4. Clipping algorithms: Line clipping,Polygon clipping

5. Image Enhancement operations:Basic gray level transformation functions in images, contrast stretching-Histogram equalisation,Smoothing,Sharpening
6. Fundamentals of image Segmentation: Thresholding,Region based approaches

List of Lab Experiments/Exercises

1. Implementation of DDA Line drawing algorithm. *
2. Implementation of Bresenham's Line drawing algorithm*
3. Implementation of Bresenham's circle drawing algorithm.
4. Implementation of Midpoint circle drawing algorithm.*
5. Implementation of boundary filling algorithm .*
6. Implementation of 2D transformations.*
7. Implementation of 3D transformations
8. Implementation of Line clipping algorithm. *
9. Implementation of Polygon clipping algorithm.*
10. Implementation of animation programs using CG concepts*
11. Implementation of relationship between pixels in an image
12. Implementation of transformations on images.*
13. Implementation of contrast stretching and histogram equalisation.*
14. Implementation of Image Smoothing Filters.*
15. Implementation of image Sharpening filters and Edge Detection using Gradient Filters.*
16. Implementation of segmentation operations.*

Note: *Students can be given a group micro project, so that they learn to work in a team environment. They can also be trained on project management tools.*

*All programs are mandatory and should be completed in the lab.

Reference Books

1. Donald Hearn and M. Pauline Baker, Computer Graphics, PHI, 2e, 1996
2. Rafael C. Gonzalez and Richard E. Woods, Digital Image Processing. Pearson, 4e, 2017
3. William M. Newman and Robert F. Sproull, Principles of Interactive Computer Graphics. McGraw Hill, 2001
4. M. Sonka, V. Hlavac, and R. Boyle, Image Processing, Analysis, and Machine Vision, Thomson India Edition, 4e, 2017

CXT499	CLOUD, MULTIMEDIA AND IOT	Category	L	T	P	Credit	Year of Introduction
		T	3	1	0	4	2021

Preamble:

This is the foundational course for awarding B. Tech. Honors in Computer Science and Design with specialization in Internet of Things. The purpose of this course is to introduce IoT protocols for communication and to implement various cloud deployment models necessary for developing applications for IoT devices. Concepts in this course help the learners to understand internet technologies and protocols for multimedia transmission and interaction.

Prerequisite: IOT ARCHITECTURE AND ITS PROTOCOLS

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

CO 1	Identify the impacts of embedded systems, IOT, cloud computing and multimedia. (**Knowledge Level: Understand**)
CO 2	Use IoT protocols for communication and to implement various cloud deployment models necessary for developing applications for IoT devices. (**Knowledge Level: Apply**)
CO 3	Gain the necessary knowledge to construct IoT systems and use cloud services for processing and storage of the data. (**Knowledge Level: Apply**)
CO 4	Explain basics of multimedia, various Image Data Representations and Color models in image and video (**Knowledge Level: Understand**)
CO 5	Articulate internet technologies and protocols for multimedia transmission and interaction. (**Knowledge Level: Understand**)
CO6	**Explain multimedia cloud computing and internet of things in the cloud. (Knowledge Level: Understand)**

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO5	PO 6	PO7	PO8	PO9	PO 10	PO1 1	PO1 2
CO 1	✓	✓	✓									✓
CO 2	✓	✓	✓	✓								✓
CO 3	✓	✓	✓	✓								✓
CO 4	✓	✓	✓		✓							✓
CO 5	✓	✓	✓		✓							✓
CO 6	✓	✓	✓									✓

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	**PO 10**	Communication
PO5	Modern tool usage	**PO 11**	Project Management and Finance
PO6	The Engineer and Society	**PO 12**	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%
Analyses			
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. The first internal evaluation test is to be conducted based on the first two modules of the Syllabus. The second internal evaluation test is to be conducted based on the third and fourth modules of the syllabus. There will be two parts: Part A and Part B. Students should answer all questions from Part A. Part B contains 7 questions each with 7 marks. Out of the 7 questions, a student should answer any 5. An assignment/quiz/open book test is to be given based on the fifth module of the Syllabus. The time duration for each internal evaluation test is 1 hour and 30 minutes.

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 a maximum of 2 subdivisions and carries 14 marks.

Syllabus

Module 1 9 hours

Cloud Computing: Definition, roots of cloud computing, characteristics, cloud architecture and cloud Service Models: IaaS, PaaS, SaaS**.** Cloud Deployment Models: Public, Private, Hybrid**,** Virtualization: Benefits & drawbacks of virtualization, server virtualization, virtualization of - operating system, platform, CPU, network, application, memory and I/O devices, Cloud security: issues, threats, data security and information security.

Module 2 9 hours

Internet of Thing (IoT): Overview, conceptual framework, architecture, major components, IOT definitions and framework, Basic nodal capabilities, Physical design of IOT, IOT protocols – Link layer protocols, network layer protocols, application layer protocols, Logical design of IOT, IOT functional blocks, IOT enabling technologies, Embedded systems, Applications of embedded systems.

Module 3 8 hours

Architectural Models for IoT and Cloud Convergence - Cloud Platforms and Services for IoT - Deploying IoT Applications on Cloud - Data Management and Analytics in IoT using Cloud - Security Aspects of IoT in Cloud Environments - IoT and Cloud Interoperability Challenges Real-time Processing and Edge Computing in IoT and Cloud - IoT Cloud Case Studies: Healthcare, Smart Cities, Industrial IoT - Future Trends in IoT and Cloud Integration

Module 4 10 hours

Introduction to Multimedia-Definition-Components of Multimedia. Multimedia and Hypermedia, World Wide Web. Overview of Multimedia Software Tools -Music Sequencing and Notation -Digital Audio -Graphics and Image Editing-Video Editing-Animation-Multimedia Authoring-Some useful editing and authoring tools- VMRL- Graphics and Image Data Representations-Graphics image Data Types-Popular File Formats **-**Color in Image and Video-Color Science-Color Models in Images-Color Models in Video-Fundamental Concepts in Video-Basics of Digital Audio

Module 5 **9** Hours

Multimedia Communications and Networking: Internet Technologies and Protocols-Multicast Extension-Quality-of-Service for Multimedia Communications-Protocols for Multimedia Transmission and Interaction.

Cloud Computing for Multimedia Services- Multimedia Cloud Computing-Cloud-Assisted Media Sharing-Computation Offloading for Multimedia Services-Interactive Cloud Gaming. The internet of things in the cloud: Cloud Middleware-NIST's SPI Architecture and Cloud Standards-Cloud Providers and Systems-The Cloud of Things.

Text book:

1. Kayla Little and Ron Pascuzzi,A Reference Guide to the Internet of Things', Bridgera LLC, 500 West Peace Street, Raleigh, NC 27603.
2. Arshdeep Bahga and Vijay Madisetti , Integration of "Internet of Things (A Hands-on Approach)" for IoT components
3. Rajkumar Buyyaet ,"Cloud Computing: Principles and Paradigms" for cloud components.(Module 3)
4. Ze-Nian Li and Mark S. Drew, Fundamentals of Multimedia, Pearson Education
5. Zhou H. The internet of things in the cloud. Boca Raton, FL: CRC press; 2012

Reference books:

1. Raj Kamal, Internet of things, Architecture and design principles', McGraw Hill Education
2. Douglas Comer, The Cloud Computing Book',
3. Jitendra Kumar Verma, Deepak Saxena, Vicente González-Prida, 'IoT and Cloud Computing for Societal Good',

Sample Course Level Assessment Questions.

Course Outcome 1 (CO1):

1. Describe the Characteristics of Cloud Computing.
2. Define the architectural view of IoT and functional blocks.

Course Outcome 2 (CO2):

1. What are the protocols that are used in IoT?
2. Explain the advantages of next generation IP based protocols used in IoT.
3. Design a smart home automation system using IoT devices such as sensors and actuators. Utilize MQTT (Message Queuing Telemetry Transport) as the communication protocol between these devices and a cloud-based platform. Discuss how you would implement a hybrid cloud deployment model to ensure both local processing for real-time responses and cloud storage for long-term data analysis.

Course Outcome 3 (CO3):

1. Explain the advantages and disadvantages of deploying IoT applications on cloud platforms compared to on-premises solutions, considering factors such as scalability, cost, and security.
2. Explore the challenges of achieving interoperability between IoT devices and cloud platforms. How can standardization efforts address these challenges effectively?
3. Develop a mobile health monitoring application that collects data from wearable IoT devices like fitness trackers and heart rate monitors. Employ CoAP (Constrained Application Protocol) as the communication protocol to transmit sensor data to a cloud infrastructure. Evaluate the suitability of various cloud deployment models (public, private, hybrid) for hosting the backend services of the application, considering factors such as data privacy, scalability, and cost-effectiveness.

Course Outcome 4 (CO4):

1. Explain the components of Multimedia.
2. Explore the basics of digital audio, including sampling, quantization, and compression techniques. How do these concepts contribute to the efficient storage and transmission of audio data?

Course Outcome 5 (CO5):

1. Describe the role of multimedia in modern communication?
2. Explain the functionality and significance of real-time control protocol?

Course Outcome 6 (CO6):

1. Explain the role of cloud computing in multimedia services?
2. Discuss the Integration of Internet of Things (IoT) devices with cloud computing.

Model Question paper

	QP Code:	**CLOUD, MULTIMEDIA AND IOT**	**Total Pages:3**
Reg No.:			**Name:**

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
VII SEMESTER B. TECH (HONOURS) DEGREE EXAMINATION, MONTH and YEAR

Course Code: CXT 499

Course Name: CLOUD, MULTIMEDIA AND IOT

Max. Marks: 100		**Duration: 3 Hours**

PART A

	Answer all questions, each carries 3 marks.	Marks
1	What is cloud computing.	(3)
2	What are the different cloud deployment models?	(3)
3	Specify any three real world design constraints for IOT applications	(3)
4	What are the components of physical design of IOT?	(3)
5	What are the primary security considerations for IoT devices and data when operating within cloud environments?	(3)
6	How do IoT and cloud technologies collaborate to address specific industry needs.	(3)
7	Define multimedia.	(3)
8	Explain various graphics/image Data Types.	(3)
9	Which of the following is a key feature of quality of service for multimedia communications?	(3)
10	What does NIST's SPI architecture primarily focus on in the context of the cloud of	(3)

	things?	

PART B			
Answer any one Question from each module. Each question carries 14 Marks			
11	a)	Describe the essential characteristics of cloud computing. How do these characteristics differentiate cloud computing from traditional computing?	(8)
	b)	Differentiate between the three primary service models of cloud computing: Infrastructure as a Service (IaaS), Platform as a Service (PaaS), and Software as a Service (SaaS).	(6)
		OR	
12	a)	Discuss the benefits and drawbacks of virtualization in the context of cloud computing.	(7)
	b)	Identify the main security issues and threats in cloud computing and suggest strategies to mitigate these risks, focusing on data security and information security.	(7)
13	a)	Explain various IOT protocols.	(8)
	b)	Write a short note on the major components of IOT?	(6)
		OR	
14	a)	Describe the simplified IoT Architecture. Also describe about application layer protocols: (a) CoAP (b) MQTT.	(6)
	b)	Explain about IOT functional blocks.	(8)
15	a)	How do architectural models facilitate the convergence of IoT and cloud technologies?	(8)
	b)	What are some key cloud platforms and services commonly utilized for IoT deployments, and how do they support IoT applications?	(6)
		OR	
16	a)	How does real-time processing and edge computing enhance IoT	(8)

		functionality within cloud environments?	
	b)	What are the advantages and challenges associated with deploying IoT applications on cloud infrastructure?	(6)
17	a)	Explain the components of multimedia.	(6)
	b)	Describe the different multimedia software tools.	(8)
		OR	
18	a)	Describe the role of VRML (Virtual Reality Modeling Language) in creating immersive multimedia experiences. Provide examples of applications where VRML is commonly used and discuss its potential impact on multimedia development.	(6)
	b)	Explain the different MIDI messages.	(8)
19	a)	Describe the role of network layer protocols such as IP in packet addressing and forwarding, and compare circuit switching and packet switching techniques in terms of their suitability for different data transmission requirements.	(8)
	b)	Discuss how routing tables and protocols contribute to guiding packet forwarding across various network segments.	(6)
		OR	
20	a)	Discuss the challenges and solutions in implementing cloud gaming, focusing on interaction delay, video streaming, and real-world deployment and evaluate the trade-offs between interaction delay and video quality?	(6)
	b)	Examine the essential requirements for effective computation offloading and illustrate various approaches employed to enhance energy efficiency and performance in mobile computing.	(8)

Teaching Plan		
No	**Topic**	**No. of Lectures (45 Hrs.)**
	Module-1	**9 hrs.**
1.1	Cloud Computing: Definition, roots of cloud computing, characteristics.	1
1.2	Cloud architecture and cloud Service Models: IaaS, PaaS **.**	1
1.3	Cloud Service Models-Saas.	1
1.4	Cloud Deployment Models: Public, Private, Hybrid.	1
1.5	Virtualization: Benefits & drawbacks of virtualization.	1
1.6	Server virtualization, virtualization of - operating system, platform, CPU, network, application.	1
1.7	Virtualization of memory and I/O devices.	1
1.8	Cloud security: issues, threats.	1
1.9	Data security and information security.	1
	Module-2	**9 hrs.**
2.1	Internet of Thing (IoT): Overview.	1
2.2	Conceptual framework, architecture, major components.	1
2.3	IOT definitions and framework, Basic nodal capabilities.	1
2.4	Physical design of IOT, IOT protocols – Link layer protocols, network layer protocols.	1

2.5	Application layer protocols.	1
2.6	Logical design of IOT.	1
2.7	IOT functional blocks.	1
2.8	IOT enabling technologies, Embedded systems.	1
2.9	Applications of embedded systems.	1
	Module-3	**8 hrs.**
3.1	Architectural Models for IoT and Cloud Convergence.	1
3.2	Cloud Platforms and Services for IoT - Deploying IoT Applications on Cloud.	1
3.3	Data Management and Analytics in IoT using Cloud.	1
3.4	Security Aspects of IoT in Cloud Environments.	1
3.5	IoT and Cloud Interoperability Challenges.	1
3.6	Real-time Processing and Edge Computing in IoT and Cloud.	1
3.7	IoT Cloud Case Studies: Healthcare, Smart Cities, Industrial IoT.	1
3.8	Future Trends in IoT and Cloud Integration.	1
	Module-4	**10 hrs.**
4.1	Introduction to Multimedia: Definition, Components of Multimedia.	1

4.2	Multimedia and Hypermedia, World Wide Web.	1
4.3	Overview of Multimedia Software Tools: Music Sequencing and Notation, Digital Audio, Graphics and Image Editing, Video Editing, Animation, Multimedia Authoring.	1
4.4	Some useful editing and authoring tools, VMRL.	1
4.5	Graphics and Image Data Representations, Graphics image Data Types.	1
4.6	Popular File Formats.	1
4.7	Color in Image and Video-Color Science.	1
4.8	Color Models in Images, Color Models in Video.	1
4.9	Fundamental Concepts in Video.	1
4.10	Basics of Digital Audio.	1
	Module-5	**9 hrs.**
5.1	Internet Technologies and Protocols, Multicast Extension.	1
5.2	Quality-of-Service for Multimedia Communications.	1
5.3	Protocols for Multimedia Transmission and Interaction.	1
5.4	Multimedia Cloud Computing.	1
5.5	Cloud Assisted Media Sharing.	1

5.6	Computation Offloading for Multimedia Services-Interactive Cloud Gaming.	1
5.7	The internet of things in the cloud: Cloud Middleware, NIST's SPI Architecture and Cloud Standards. (Lecture -1)	1
5.8	The internet of things in the cloud: Cloud Middleware, NIST's SPI Architecture and Cloud Standards. (Lecture -2)	1
5.9	Cloud Providers and Systems-The Cloud of Things.	1

CXQ 413	SEMINAR	CATEGORY	L	T	P	CREDIT
		PWS	0	0	3	2

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 literate and to give a presentation about it.
- To prepare a technical report.

Course Outcomes [COs]: After successful completion of the course, the students will be able to:

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	Life long 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.).

CXD415	PROJECT PHASE I	CATEGORY	L	T	P	CREDIT
		PWS	0	0	6	2

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 [COs] : After successful completion of the course, the students will be able to:

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): 20 Marks.

(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 I: Interim Evaluation						
No.	**Parameters**	**Marks**	**Poor**	**Fair**	**Very Good**	**Outstanding**
1-a	Topic identification, selection, formulation of objectives and/or literature survey. (Group assessment) [CO1]	10	The team has failed to come with a relevant topic in time. Needed full assistance to find a topic from the guide. They do not respond to suggestions from the evaluation committee and/or the guide. No literature review was conducted. The team tried to gather easy information without verifying the authenticity. No objectives formed yet.	The team has identified a topic. The originally selected topic lacks substance and needs to be revised. There were suggestions given to improve the relevance and quality of the project topic. Only a few relevant references were consulted/ studied and there is no clear evidence to show the team's understanding on the same. Some objectives identified, but not clear enough.	Good evidence of the group thinking and brainstorming on what they are going to build. The results of the brainstorming are documented and the selection of topic is relevant. The review of related references was good, but there is scope of improvement. Objectives formed with good clarity, however some objectives are not realistic enough.	The group has brainstormed in an excellent manner on what they were going to build. The topic selected is highly relevant, real world problem and is potentially innovative. The group shows extreme interest in the topic and has conducted extensive literature survey in connection with the topic. The team has come up with clear objectives which are feasible.
			(0 – 3 Marks)	(4 – 6 Marks)	(7 - 9 Marks)	(10 Marks)
1-b	Project Planning, Scheduling and Resource/ Tasks Identification and allocation. (Group assessment) [CO4]	10	No evidence of planning or scheduling of the project. The students did not plan what they were going to build or plan on what materials / resources to use in the project. The students do not have any idea on the budget required. The team has not yet decided on who does what. No project journal kept.	Some evidence of a primary plan. 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 details. Some evidence on task allocation among the team members.	Good evidence of planning done. Materials were listed and thought out, but the plan wasn't quite complete. Schedules were prepared, but not detailed, and needs improvement. Project journal is presented but it is not complete in all respect / detailed. There is better task allocation and individual members understand about their tasks. There is room for improvement.	Excellent evidence of enterprising and extensive project planning. Gantt charts were used to depict detailed project scheduling. A project management/version control tool is used to track the project, which shows familiarity with modern tools. All materials / resources were identified and listed and anticipation of procuring time is done. Detailed budgeting is done. All tasks were identified and incorporated in the schedule. A well-kept project journal shows evidence for all the above, in addition to the interaction with the project guide. Each member knows well about their individual tasks.
			(0 – 3 Marks)	(4 – 6 Marks)	(7 - 9 Marks)	(10 Marks)
Phase 1 Interim Evaluation Total Marks: 20						

EVALUATION RUBRICS for PROJECT Phase I: Final Evaluation						
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. The 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/desig n/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						

CXD481	MINI PROJECT	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		PWS	0	0	4	4	2021

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 Computer graphics. 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 Design. 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 Roman18, Bold; Heading 2 – Times New Roman16, Bold; Heading 3 – Times New Roman14, 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

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CXT 402	Advanced Computer Graphics	Category	L	T	P	Credit	Year of Introduction
		PCC	2	1	0	3	2021

Preamble: This is a core course in computer science and design. The main objective of this course is to learn advanced computer graphic and animation concepts and its implementation.

Prerequisite: Basic knowledge about the course Computer Graphics

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

CO1	Explain the concepts of 3D display methods and 3D object representations **[Cognitive knowledge level: Understand]**
CO2	Illustrate the concept of 3D transformation and 3D viewing **[Cognitive knowledge level: Apply]**
CO3	Explain the concept of illumination models in computer Graphics. **[Cognitive knowledge level: Understand]**
CO4	Illustrate the significance of color models in Computer Graphics. [**Cognitive knowledge level: Understand]**
CO5	Apply computer animation methods for solving problems. **[Cognitive knowledge level: Apply]**

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO1 0	PO11	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**	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 internal evaluation test is to be conducted based on the first two modules of the Syllabus. The second internal evaluation test is to be conducted based on the third and fourth modules of the Syllabus. There will be two parts: Part A and Part B. Students should answer all questions from Part A. Part B contains 7 questions each with 7 marks. Out of the 7 questions, a student should answer any 5. An assignment/quiz/open book test is to be given based on the fifth module of the Syllabus. The time duration for each internal evaluation test is 1 hour and 30 minutes.

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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

CXT 402 ADVANCED COMPUTER GRAPHICS

Module - 1 (3D object representations)

3D Display methods,3D Object Representations – Polygon Surfaces – Curved lines and surfaces- Quadric surfaces, Super quadrics– Spline Representations – Bezier Curves and Surfaces, Sweep representation, Octrees.

Module- 2 (3D Transformations and viewing)

3D transformations- basic transformations, reflection, shear, composite transformations, Modelling and coordinate transformations.
3D viewing- viewing pipeline, viewing coordinate, projections, clipping, View Volumes and General Projection Transformations, General Parallel-Projection Transformations.

Module - 3 (Illumination models)
Light sources, basic illumination models, polygon rendering methods - Constant-Intensity Shading Gouraud Shading, Phong Shading, fast Phong Shading ,ray tracing methods.

Module - 4 (Color models and Color applications)
Properties of light, Standard Primaries and the Chromaticity Diagram, Colour models- RGB, YIQ,CMY, HSV, Conversion between HSV and RGB models, HLS model.

Module - 5 (Computer Animation)
Design of animation sequences, General computer animation functions, raster animations, key frame systems, motion specifications. Conventional Animation, Computer Assisted animation, Interpolation, Simple Animation Effects.

Text Book

1. Donald Hearn and M. Pauline Baker, Computer Graphics, PHI, 2e, 1996
2. James D. Foley, Andries van Dam, Computer Graphics: Principles and Practice 2e, Addison–Wesley

Reference Books

1. Foley, vanDam, Feiner Hughes Addision Wesley, Computer Graphics: Principals and Practices, Third Edition.
2. David F. Roges, Mathematical Elements of Graphics Tata McGrow Hill.
3. David Rogers, Procedural Elements-Computer Graphics, TMH.
4. Shalini Govil-pal, Principals of Computer Graphics, Springer.

Sample Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Describe 3D display methods.
2. Describe polygon surface representations.
3. Describe spline representations.

Course Outcome 2 (CO2):

1. Describe 3 D viewing examples.
2. Explain the concept of clipping with an example.
3. Illustrate with an example the transformation of an object description from one coordinate system to another.
4. Explain in detail basic 3D transformations. Given a 3D object with coordinate points A(0, 3, 1), B(3, 3, 2), C(3, 0, 0), D(0, 0, 0). Apply the translation with the distance 1 towards X axis, 1 towards Y axis and 2 towards Z axis and obtain the new coordinates of the object.

Course Outcome 3 (CO3):

1. Describe various light source.
2. Explain basic illustration models.
3. Explain polygon rendering methods.

Course Outcome 4 (CO4):

1. Explain properties of light.
2. Explain different color models.
3. Conversion between different color models.
4. Derive expressions for converting HSV color values to RCB values.
5. Derive expressions for converting RCB color parameters to HSV values.

Course Outcome 5 (CO5):

1. Explain design of animation sequence.
2. Explain different animation functions.
3. Explain direct motion specification.
4. Illustrate with an example simulating accelerations.
5. Illustrate with an example how morphing methods can he applied to any motion or transition involving a change in shape.

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: CXT 402

Course Name: Advanced Computer Graphics

Max.Marks:100 **Duration: 3 Hours**

PART A

Answer all Questions. Each question carries 3 Marks

1. Explain how polygon surfaces are specified
2. Write properties of Bezier curves.
3. Explain scaling transformation.
4. What is normalized view volume?
5. What is an illumination model?
6. Explain the ray tracing method.
7. What is chromaticity? Write the use of a chromaticity diagram.
8. Explain HLS color model?
9. Explain raster animation.
10. Describe how morphing is performed.

Part B

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

11. Write the different methods that can be used to calculate positions over the range of a alpine curve or surface

OR

12. Write notes on (a)sweep representation (b)Octrees.

13. Explain in detail basic 3D transformations. Given a 3D object with coordinate points A(0, 3, 1), B(3, 3, 2), C(3, 0, 0), D(0, 0, 0). Apply the translation with the distance 1 towards X axis, 1 towards Y axis and 2 towards Z axis and obtain the new coordinates of the object

OR

14. Explain reflections, shears and composite transformation.

15. Explain different polygon rendering methods.

OR

16. Describe basic illumination models.

17. Explain YIQ and CMY color models. Also derive expressions for converting RCB color parameters to HSV values.

OR

18. Explain with mapping algorithm, conversion between HSV and RGB models.

19. Explain different ways to specify motion in animation systems.

OR

20. Illustrate with an example how morphing methods can he applied to any motion or transition involving a change in shape.

Teaching Plan

Sl. No	Topic	No. of Hours (36 hrs.)
Module - 1 (3D object representations) 8 Hours		
1.1	3D Display methods,3D Object Representations	1 Hour
1.2	Polygon Surfaces – Curved lines and surfaces	1 Hour
1.3	Quadric surfaces, Super quadrics	1 Hour
1.4	Curved lines and surfaces	1 Hour
1.5	Spline Representations	1 Hour
1.6	Bezier Curves and Surfaces	1 Hour
1.7	Sweep representation	1 Hour
1.8	Octrees	
Module - 2 (3D Transformations and viewing) 7 Hours		
2.1	3D transformations- basic transformations, Modelling and coordinate transformations.	1 Hour
2.2	reflection, shear	1 Hour
2.3	composite transformations	1 Hour
2.4	3D viewing- viewing pipeline, viewing coordinate,	1 Hour
2.5	clipping	1 Hour
2.6	View Volumes and General Projection Transformations	1 Hour
2.7	General Parallel-Projection Transformations	1 Hour
Module - 3 (Illumination models) 7 Hours		
3.1	Light sources, basic illumination models, -	1 Hour
3.2	polygon rendering methods	1 Hour
3.3	Constant-Intensity Shading	1 Hour

3.4	Gouraud Shading	1 Hour
3.5	Phong Shading	1 Hour
3.6	fast Phong Shading	1 Hour
3.7	ray tracing methods.	1 Hour
Module - 4 (Color models and Color applications) 7 Hours		
4.1	Properties of light,	1 Hour
4.2	Standard Primaries and the Chromaticity Diagram,	1 Hour
4.3	Color models- RGB, YIQ	1 Hour
4.4	CMY, HSV	1 Hour
4.5	Conversion between HSV and RGB models	1 Hour
4.6	HLS model.(lecture-1	1 Hour
4.7	HLS model. (Lecture-2)	1 Hour
Module - 5 (Computer Animations**) 7 Hours**		
5.1	Design of animation sequences	1 Hour
5.2	General computer animation functions,	1 Hour
5.3	raster animations	1 Hour
5.4	key frame systems, motion specifications	1 Hour
5.5	Conventional Animation, Computer Assisted animation	1 Hour
5.6	Interpolation	1 Hour
5.7	Simple Animation Effects	1 Hour

CXT 414	FUZZY SYSTEMS AND GENETIC ALGORITHMS	Category	L	T	P	Credit	Year of Introduction
		PEC	2	1	0	3	2021

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, building of fuzzy approximation-based solutions and use of genetic algorithms. It helps students to design and develop fuzzy and genetic algorithm-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 **(Cognitive Knowledge Level: Understand)**
CO2	**Summarize** the concepts of crisp sets, crisp relations, crisp logic with fuzzy sets, fuzzy relations and fuzzy logic. **(Cognitive Knowledge Level: Apply)**
CO3	**Develop** fuzzy systems by selecting appropriate membership functions, fuzzification and defuzzification methods. **(Cognitive Knowledge Level: Apply)**
CO4	**Make** use of fuzzy logic inference to solve real world problems. **(Cognitive Knowledge Level: Apply)**
CO5	**Illustrate** the concepts of Genetic Algorithm. **(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 (Marks)	**Test 2 (Marks)**	
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 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 internal evaluation test is to be conducted based on the first two modules of the Syllabus. The second internal evaluation test is to be conducted based on the third and fourth modules of the Syllabus. There will be two parts: Part A and Part B. Students should answer all questions from Part A. Part B contains 7 questions each with 7 marks. Out of the 7 questions, a student should answer any 5. An assignment/quiz/open book test is to be given based on the fifth module of the Syllabus. The time duration for each internal evaluation test is 1 hour and 30 minutes.

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 Fuzzy Set Theory)

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, λ-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. Fuzzy Inference Systems - Mamdani and Sugeno types. Fuzzy Logic Controller.

Module - 5 (Genetic Algorithms)

Concepts of genetic algorithm. Operators in genetic algorithm - coding, selection, cross over-single point, Two-point, uniform cross over, mutation- Gaussian, Uniform, Zigzag, Scramble, Insertion, Inversion, Swap. Stopping condition for genetic algorithm.

Text Books

1. Timothy J. Ross, Fuzzy Logic with Engineering Applications – Third Edition, John Wiley and Sons, 2010

2. George J. Klir and Bo Yuan, Fuzzy Sets and Fuzzy Logic: Theory and Applications - Prentice Hall, 1995.

3. S.N.Sivanandam and S.N. Deepa, Principles of Soft Computing , 2ndEdition, John Wiley & Sons.

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.

Sample Course Level Assessment Questions:

Course Outcome 1 (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, {s1, s2, s3}, and B, defined on a universe of three discrete weights, {w1,w2,w3}. Suppose A and B represent a "high- strength steel" and a "near-optimum weight," respectively, as shown below.

$$A = \left\{\frac{1}{s_1} + \frac{0.5}{s_2} + \frac{0.2}{s_3}\right\}$$

$$B = \left\{\frac{1}{w_1} + \frac{0.5}{w_2} + \frac{0.2}{w_3}\right\}$$

a) Find the fuzzy relation for the Cartesian product, R, of A and B

b) Introducing another fuzzy set, C, which represents a set of "moderately good" steel strengths.

$$C = \left\{\frac{0.1}{s_1} + \frac{0.6}{s_2} + \frac{1}{s_3}\right\}$$

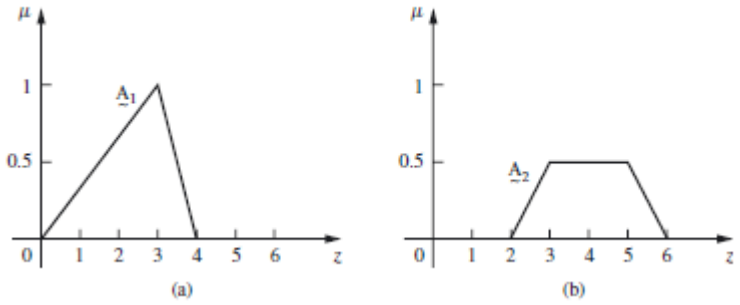
Find C◦R using max–min composition

Course Outcome 3 (CO3):

1. Using your own intuition and your own definitions of the universe of discourse,plot fuzzy membership functions for "age of people" who are:
   (i) very young
   (ii) young
   (iii) middle-aged
   (iv) old
2. a) Define membership functions for approximately isosceles triangle, approximately equilateral and approximately right-angled triangles.

b) Find the membership value for the triangle represented by the angles 80◦, 75◦, 25◦, in the above triangles.

3. 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. Using the Genetic algorithm with Roulette wheel selection method, maximize the function f(x)=x2 over {0, 1, 2, ..., 31} with initial x values of (13, 24, 8, 19). Show one crossover and mutation.
2. Explain the stopping conditions for genetic algorithms.

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: CXT 414
Course Name: FUZZY SYSTEMS AND GENETIC ALGORITHMS

Max.Marks:100 **Duration: 3 Hours**

PART A
Answer All Questions. Each Question Carries 3 Marks

1. Compare and contrast crisp and fuzzy systems.

2. Illustrate where a fuzzy logic based application is suitable.

3. 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.

4. Define fuzzy tolerance and equivalence relations.

5. The discretized membership functions for a transistor and a resistor are given below.

   μT= {(0,0), (1,0.2), (2,0.7), (3,0.8), (4,0.9), (5,1)} &

   μR= {(0,0), (1,0.1), (2,0.3), (3,0.2), (4,0.4), (5,0.5)}

   Calculate

   (a) Algebraic sum

   (b) Algebraic product

   (c) Bounded Sum

   (d) Bounded difference

6. Consider two fuzzy sets.

A = {(0.2,0), (0.4,0.8), (0.6,1)}

B = {(0.2,0.9), (0.4,0.7), (0.6,0.3)}

Using Zadeh's notations, express the fuzzy sets into λ-cut sets for λ = 0.4 for the following operations.

i) A'

ii) B'

iii) A'∨ B'

iv) A'∧ B'

7. Compare and contrast the two types of fuzzy inference systems.

8. Write a brief note on Fuzzy Logic Controller.

9. Explain any two mutation methods.

10. Explain stochastic universal sampling with an example.

(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 { s1, s2, s3 } and B, defined on the universe of discrete weights { w1, w2, w3}. Suppose A represents a "high-strength steel" and B a "near-optimum weight"

$$A = \left\{\frac{1}{s1} + \frac{0.5}{s2} + \frac{0.2}{s3}\right\}, B = \left\{\frac{1}{w1} + \frac{0.5}{w2} + \frac{0.3}{w3}\right\}$$

Find fuzzy Cartesian product, R, of A and B. (4)

(b) Let a fuzzy set C=$\left\{\frac{0.1}{s1} + \frac{0.6}{s2} + \frac{1}{s3}\right\}$ 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

		S1	S2	S3	S4
No deflection	X_1	0.3	0.6	0.5	0.8
Some deflection	X_2	0.6	0.3	0.5	0.2
Excessive deflection	X_3	0.1	0.1	0	0

Use cosine amplitude method to determine the similarity of the four beam types. (10)

b) Given a fuzzy set "tall" $= \left\{\frac{0.1}{s1} + \frac{0.6}{s2} + \frac{1}{s3}\right\}$, illustrate how the fuzzy set "very tall" (4) be defined.

OR

14 (a) Define tolerance and equivalence relations. Check whether the relation R given (4) below is tolerance or equivalence relation.

$$\begin{bmatrix} 1 & 0.8 & 0 & 0.1 & 0.2 \\ 0.8 & 1 & 0.4 & 0 & 0.9 \\ 0 & 0.4 & 1 & 0 & 0 \\ 0.1 & 0 & 0 & 1 & 0.5 \\ 0.2 & 0.9 & 0 & 0.5 & 1 \end{bmatrix}$$

(b) Given the following data regarding three cities and the quality of their bridges, (10)

find the similarity between the cities using max-min method.

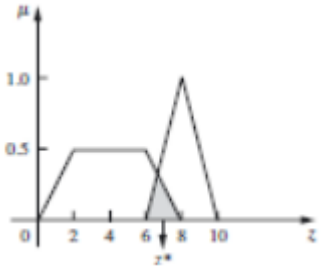
		C1	C2	C3
Poor	Q_1	0.00	0.10	0.10
Fair	Q_2	0.04	0.04	0.08
Good	Q_3	0.02	0.04	0.06

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 X = universe of temperatures (degree fahrenheit) = {160, 165, 170, 175, 180, 185, 190, 195}. Y = universe of

distillate fractions (percentage) = {77, 80, 83, 86, 89, 92, 95, 98}. Given two fuzzy sets
A = "temperature of input steam is hot"= $\left\{\frac{0}{175} + \frac{0.7}{180} + \frac{1}{185} + \frac{0.4}{190}\right\}$

B = "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 $A\tilde{A}$, THEN y is $\bar{B}$ (8)

(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)Differentiate between value encoding and permutation encoding. (8)

(b) Explain the stopping conditions for genetic algorithm. (6)

OR

20 (a) Using Genetic algorithm with Roulette wheel selection method maximize the function $f(X) = X^2$ over {0,1,2,3…31} with initial X values of (13, 24, 8, 19). Show one cross over and mutation. (10)

(b) Explain Single-Point Crossover and Two-Point Crossover with example (4)

No	Lesson Plan Contents	No. of lecture hours (36)
Module-1(Basic Fuzzy Set Theory) (7 hours)		
1.1	Introduction to Fuzzy Concepts – Case for imprecision- utility and limitations of Fuzzy Systems	1
1.2	Classical Sets – Properties, Operations	1
1.3	Fuzzy Sets – Properties, Operations	1
1.4	Classical Relations – Properties, Operations – Cartesian Product, Composition	1
1.5	Fuzzy Relations – Properties, Operations, Cardinality	1
1.6	Fuzzy Cartesian Product, Fuzzy Composition (Lecture 1)	1
1.7	Fuzzy Cartesian Product, Fuzzy Composition (Lecture 2)	1
Module-2 (Fuzzy Membership Functions) (7 hours)		
2.1	Tolerance and Equivalence Relations - Crisp	1
2.2	Tolerance and Equivalence Relations - Fuzzy	1
2.3	Similarity Methods – Cosine, Minmax	1
2.4	Fuzzy Membership Functions- Features	1
2.5	Fuzzification, Defuzzification to crisp sets – λ-cuts	1
2.6	Linguistic Hedges (Lecture 1)	1
2.7	Linguistic Hedges (Lecture 2)	1
Module-3 (Fuzzification and Defuzzification Methods) (7 hours)		
3.1	Development of Membership Functions – Intuition, Inference	1
3.2	Development of Membership Functions – Rank Ordering	1
3.3	Development of Membership Functions – Inductive reasoning	1
3.4	Defuzzification – Max membership principle, weighted average method, mean max membership	1
3.5	Defuzzification – Centroid method	1
3.6	Defuzzification – Center of Sums, Center of Largest area, First/Last of maxima	1
3.7	Defuzzification - exercises	1
Module-4 (Fuzzy Inference) (9 hours)		

4.1	Classical Logic – Propositional Logic	1
4.2	Classical Logic	1
4.3	Fuzzy Logic	1
4.4	Fuzzy Approximation based reasoning	1
4.5	Fuzzy Rule based systems	1
4.6	Multiple conjunctive and disjunctive antecedents, aggregation	1
4.7	Graphical Techniques for Inference	1
4.8	Illustration of Graphical Techniques for Inference	1
4.9	Fuzzy Inference - Exercises	1
Module-5 (Genetic algorithms) (6 hours)		
5.1	Introduction to genetic algorithm	1
5.2	Operators in genetic algorithm	1
5.3	Coding	1
5.4	Selection, Cross over	1
5.5	Mutation, stopping condition for genetic algorithm (Lecture 1)	1
5.6	Mutation, stopping condition for genetic algorithm (Lecture 2)	1

CXT 424	BIG DATA ANALYTICS	Category	L	T	P	Credit	Year of Introduction
		PEC	2	1	0	3	2021

Preamble: This course helps the learner to understand the basic concepts of big data analytics. This course covers big data technologies used for storage, analysis and manipulation of data. The student will learn about fundamentals of Hadoop, MapReduce, Pig, Hive, R and have hands on training on the same. It also helps to develop projects and apply existing data analytics tools to gain comprehensive knowledge on Data analytics. It enables the learners to perform data analysis on a real-world scenario using appropriate tools.

Prerequisite: Basic knowledge in programming

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

CO1	Outline the basics of big data concept. **(Cognitive Knowledge Level: Understand)**
CO2	Categorize and summarize the processing in Big Data and its importance. **(Cognitive Knowledge Level: Understand)**
CO3	Simulate various big data technologies like Hadoop, MapReduce, Pig, Hive, Hbase. **(Cognitive Knowledge Level: Apply)**
CO4	Determine tools and techniques to analyze big data **(Cognitive Knowledge Level: Apply)**
CO5	Solve problems associated with big data using the features of R programming **(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 (Marks)	**Test 2 (Marks)**	
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 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 internal evaluation test is to be conducted based on the first two modules of the Syllabus. The second internal evaluation test is to be conducted based on the third and fourth modules of the Syllabus. There will be two parts: Part A and Part B. Students should answer all questions from Part A. Part B contains 7 questions each with 7 marks. Out of the 7 questions, a student should answer any 5. An assignment/quiz/open book test is to be given based on the fifth module of the Syllabus. The time duration for each internal evaluation test is 1 hour and 30 minutes.

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 Big Data)

Introduction to Big data, Conventional Data vs Big data, Big data architecture, Big data platforms, Nature of data, Analytic processes and tools, 5 V's of Big data, Big data analytical method, Intelligent data analysis, Big data analytics life cycle.

Module - 2 (Introduction to Stream Computing)

Introduction to stream concepts – Streaming data architecture, Stream data model, Sampling techniques for efficient stream processing, Filtering streams – Bloom filter, Count distinct problem– Flajolet martin algorithm, Estimating moments, Counting oneness in a window – DGIM Algorithm

Module - 3 (Hadoop Distributed File System)

History of Hadoop, Hadoop Ecosystem, Core Components, HDFS- Architecture, Using HDFS Files, HDFS Design, Blocks, Name nodes and Data nodes, Basic File system Operations, Hadoop Specific

File Types, Anatomy of a file read, Anatomy of a file write. Data Processing with MapReduce: Execution Pipeline, Runtime Coordination and Task Management in MapReduce, Designing MapReduce implementations: Using MapReduce as a framework for parallel processing, Example-Road Enrichment.

Module 4 (Pig, Hive, HBase)

PIG: Introduction to PIG, Execution Modes of Pig, Comparison of Pig with Databases, Grunt, Pig Latin, User Defined Functions, Data Processing operators. Hive: Hive Shell, Hive Services, Hive Metastore, Comparison with Traditional Databases, HiveQL, Tables, Querying Data and User Defined Functions. Hbase: HBasics, Concepts, Clients, Example, Hbase Versus RDBMS.

Module 5 (Introduction to R programming)

Introduction to R – Overview of modern data analytic tools, Introduction to R, R Graphical User Interfaces - Features of R Language, Vectors, Filtering, Creating Matrices, Applying Functions to Matrix Rows and Columns, Lists, Creating List, General List Operations, Data Frames, Creating Data Frames, Matrix like Operations in Frames, Applying Functions to Data Frames, Reading and Writing Files.

Text Books

1. Tom White “Hadoop: The Definitive Guide” Third Edit on, O’reily Media, 2012.
2. Michael Minelli, Michelle Chambers and Ambiga Dhiraj, “Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses”, Wiley, 2013
3. Boris Lublinsky, Kevin T. Smith, Alexey Yakubovich, Professional Hadoop Solutions. ARTIFICIAL INTELLIGENCE AND DATA SCIENCE
4. Norman Matloff, “The Art of R Programming: A Tour of Statistical Software Design”, NoStarch Press.

Reference Books

1. Bill Franks, “Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics”, 1st Edition, Wiley and SAS Business Series,2012.
2. Jure Leskovec, Anand Rajaraman and Jeffrey David Ullman, "Mining of Massive Datasets", Cambridge University Press, 2014.
3. Seema Acharya, Subhasni Chellappan, “Big Data and Analytics”, Wiley Publications.
4. BIG DATA, Black Book TM, DreamTech Press, 2016 Edition.
5. Nathan Marz and James Warren, “BIG DATA- Principles and Best Practices of Scalable Real-time Systems”.

6. Jason Rutherglen, Dean Wampler, Edward Capriolo, Programming Hive, O'Reilly

Sample Course Level Assessment Questions:

Course Outcome 1 (CO1):

1. Explain the features of the integrated IT solution for Big data management.
2. Define the term "Big data". How do 5 V's help to decide whether a given data source contributes to big data.
3. Identify the differences between data analysis and data reporting.

Course Outcome 2 (CO2):

1. Some websites check availability of username by searching millions of usernames registered with it. Identify one effective method to filter data as in this type of scenario.
2. Discuss the issues in stream processing.

Course Outcome 3 (CO3):

1. Explain the components of Hadoop.
2. Illustrate map reduce job execution flow.
3. Explain HBase client ecosystem.
4. An array consists of some elements A=8, 10, … and the size of array is set to 10. Check whether 96, 21 lies in the array or not. [Hash functions: 3x+3 mod6, 3x+7mod8, 2x+9 mod2, 2x+3mod5].

Course Outcome 4 (CO4):

1. Explain two execution types or modes in PIG.
2. Summarize any three relational operations in Pig Latin with examples.
3. Illustrate managed tables and external tables in HIVE with examples.

Course Outcome 5 (CO5):

1. Illustrate any three R functions used in data analytics with examples.
2. Explain the different categories of attributes and data types in R.
3. Write a short note about how the different types of files can be read and write in R.
4. Use a function that will return TRUE if a given integer is inside a vector.

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: CXT 424
Course Name: BIG DATA ANALYTICS

Max.Marks:100 **Duration: 3 Hours**

PART A
Answer All Questions. Each Question Carries 3 Marks

1. How are big data and Hadoop related to each other?
2. What are the 5 Vs of Big Data?
3. Explain the features and column families of HBase.
4. Compare the specific file types of HDFS.
5. How does Map Reduce Framework provide support for application development?
6. Describe the Map Reduce job implementation in the case of Road Enrichment example.
7. Describe Filtering Streams.
8. Explain about the partitioned and managed tables in Hive.
9. Identify the ways in which a pig program can be executed.
10. Discuss the general list operations in R with example.

(10x3= 30)

Part B

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

11 (a) Illustrate Big Data Architecture. **(10)**

(b) Compare conventional Data and Big Data. **(4)**

OR

12 (a) Explain the life cycle of big data analytics in detail. **(10)**

(b) Compare the types of Big Data with examples. **(4)**

13 (a) Suppose we have a window of length N (say N=24) on a binary system, we want at all times to be able to answer a query of the form "How many 1's are there in the last K bits?" for K<=N. Suggest an algorithm to solve this issue with detailed explanation. Find the total number of ones, when 0111 enters into the given stream ….10101100010111010110010110…. (Assume, the new bit enters from the right side and time stamp of first new bit is 100) **(8)**

(b) Write the advantages and disadvantages of Data Stream. **(6)**

OR

14 (a) Illustrate the working of Bloom filter with examples for

i) Inserting an element

ii) Searching an element. **(10)**

(b) Why is conventional data processing insufficient for stream processing? **(4)**

15 (a) Demonstrate the data model and architecture of HBase. **(10)**

(b)Discuss on the general guidelines for HBase Schema Design. **(4)**

OR

16 (a) Utilize the anatomy of MapReduce Job run with classic MapReduce. **(6)**

(b) Explain the types of Schedulers available in YARN.. **(8)**

17 (a) Explain the main components of Hadoop Pig framework. **(4)**

(b) Develop a program to create a table and partition in Hive. **(10)**

OR

18 (a) Describe about Data Types and File Formats in Hive**.** **(8)**

(b) Utilize Pig Latin Structure and functions with an example. **(6)**

19 (a) Develop a R program to find row and column index of maximum and minimum value in a given matrix. **(8)**

(b) List and explain four R functions used in descriptive statistics. **(6)**

OR

20 (a) Illustrate the data visualization for multiple variables in R. **(8)**

(b) Describe the R functions used for cleaning dirty data. **(6)**

No	Lesson Plan Contents	No. of lecture hours (36 Hrs.)
Module 1 (Introduction to Big Data) (7 hours)		
1.1	Introduction to Big data, Conventional Data vs Big data	1
1.2	Big data architecture	1
1.3	Big data platforms, Nature of data	1
1.4	Analytic processes and tools, 5 V's of Big data	1
1.5	Big data analytical method	1
1.6	Intelligent data analysis	1
1.7	Big data analytics life cycle	1
Module 2 (Introduction to Stream Computing) (7 hours)		
2.1	Introduction to stream concepts, Streaming data architecture	1
2.2	Stream data model	1
2.3	Sampling techniques for efficient stream processing	1
2.4	Filtering streams – Bloom filter	1
2.5	Count distinct problem - Flajolet martin algorithm	1
2.6	Estimating moments	1
2.7	Counting oneness in a window – DGIM algorithm	1

	Module 3 (Hadoop Distributed File System) (8 hours)	
3.1	History of Hadoop, Hadoop Ecosystem and Core Components	1
3.2	HDFS Architecture, Using HDFS Files, HDFS Design	1
3.3	Blocks, Name nodes and Data nodes	1
3.4	Basic File system Operations, Hadoop Specific File Types	1
3.5	Anatomy of a file read, Anatomy of a file write	1
3.6	Execution pipeline	1
3.7	Runtime Coordination and Task Management in MapReduce	1
3.8	Using MapReduce as a framework for parallel processing, Road Enrichment Example	1
	Module 4 (Pig, Hive, Hbase) (6 hours)	
4.1	Pig : Introduction to PIG, Execution Modes of Pig	1
4.2	Comparison of Pig with Databases, Grunt.	1
4.3	Pig Latin, User Defined Functions, Data Processing operators	1
4.4	Hive : Hive Shell, Hive Services, Hive Metastore, Comparison with Traditional Databases.	1
4.5	HiveQL, Tables, Querying Data and User Defined Functions	1
4.6	Hbase : HBasics, Concepts, Clients, Example, Hbase Versus RDBMS.	1
Module 5 (Introduction to R programming) (8 hours)		
5.1	Introduction to R – Overview of modern data analytic tools, Introduction to R, R Graphical User Interfaces	1
5.2	Features of R Language, Vectors	1
5.3	Filtering and Creating Matrices	1
5.4	Applying Functions to Matrix Rows and Columns	1
5.5	Creating List and General List Operations	1
5.6	Examining Multiple Variable	1
5.7	Creating Data Frames and Matrix like Operations in Frames	1
5.8	Applying Functions to Data Frames and Reading and Writing Files	1

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CXT 434	SOFTWARE TESTING AND QUALITY ASSURANCE	Category	L	T	P	Credit	Year of Introduction
		PEC	2	1	0	3	2021

Preamble: To understand the principles and practices of software testing and quality assurance. To apply various testing techniques and methodologies in software development projects. To evaluate the effectiveness of quality models and standards for ensuring software quality. To develop regression testing strategies and manage software testing processes efficiently. To design and implement test automation solutions for improving testing efficiency and effectiveness.

Prerequisite: NIL

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

CO1	Explain software testing fundamentals and quality assurance principles comprehensively. (Knowledge Level: Understand)
CO2	Summarize diverse testing techniques effectively to ensure software quality and reliability. (Knowledge Level: Understand)
CO3	Develop and implement quality plans and assurance strategies to meet project objectives. (Knowledge Level: Apply)
CO4	Utilize regression testing techniques and test management tools proficiently for maintaining software quality. (Knowledge Level: Apply)
CO5	Design and implement automated testing solutions to enhance testing efficiency and effectiveness, while analyzing software quality metrics for continuous improvement. (Knowledge Level: Apply)

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO 7	PO8	PO 9	P O1 0	PO 11	PO 12
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 (Marks)	Test 2 (Marks)	
Remember	**20**	**20**	**20**
Understand	**30**	**30**	**30**
Apply	**50**	**50**	**50**
Analyze			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE	ESE Marks	Time
150	**50**	**100**	**3hrs**

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 internal evaluation test is to be conducted based on the first two modules of the Syllabus. The second internal evaluation test is to be conducted based on the third and fourth modules of the Syllabus. There will be two parts: Part A and Part B. Students should answer all questions from Part A. Part B contains 7 questions each with 7 marks. Out of the 7 questions, a student should answer

any 5. An assignment/quiz/open book test is to be given based on the fifth module of the Syllabus. The time duration for each internal evaluation test is 1 hour and 30 minutes.

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 (Fundamentals of Software Testing and Quality Assurance)

Role of testing in software development, Importance of processes in software quality assurance, Faults, errors, and failures in software testing, Limitations and challenges in software testing, Concepts of verification and validation in software quality assurance.

Module - 2 (Testing Techniques and Methodologies)

White box and black box testing techniques: Black box testing - requirements-based testing, boundary value analysis, equivalence partitioning, White box testing - static analysis, unit testing, control flow testing, Integration, system, and acceptance testing methodologies, Non-functional testing techniques - performance, security, and usability testing.

Module - 3 (Quality Assurance Principles and Standards)

Development of quality plans and objectives, Total Quality Management (TQM) concepts, Evaluation of quality models and standards (ISO, CMM, Six Sigma), Addressing quality challenges, Significance of national quality awards.

Module 4 (Regression Testing and Test Management)

Importance of regression testing in software maintenance, Regression test planning and case selection, Dynamic slicing and test minimization techniques, Tools for regression testing, Test planning, execution, and reporting.

Module 5 (Software Test Automation and Object-Oriented Testing)

Scope and benefits of test automation, Design and implementation of automation frameworks, Utilization of testing tools for automation, Object-oriented testing principles, Analysis of software quality metrics and continuous improvement initiatives.

Text Books

1. Srinivasan Desikan, Gopalaswamy Ramesh, Software Testing: Principles and Practices, Pearson Education India, 2006

2. Paul Ammann, Jeff Offutt, Introduction to Software Testing, Cambridge University Press.

Reference Books

1. Kshirasagar Naik, Priyadarshi Tripathy, Software Testing and Quality Assurance: Theory and Practice, Wiley, August 2008.

Sample Course Level Assessment Questions:

Course Outcome 1 (CO1):

1. What are software errors and faults?
2. What are the software quality factors?
3. Explain SQA system.

Course Outcome 2 (CO2):

1. Explain about software testing.
2. What is the main goal of functional testing?

Course Outcome 3 (CO3):

1. Explain the concept of total quality management (TQM).
2. Differentiate between ISO, CMM, and Six Sigma in the context of software quality management.
3. Illustrate how a quality assurance strategy can be integrated into the software development life cycle (SDLC).

Course Outcome 4 (CO4):

1. What are the benefits of regression testing?
2. Explain the tools used in regression testing.
3. Suppose you are using JaCoCo with a Java application. After running your regression tests, JaCoCo generates a report indicating 75% line coverage and 60% branch coverage. The report highlights that a critical class responsible for user authentication has only 50% line coverage and 30% branch coverage. Explain how to interpret and act on the results to improve test coverage.

Course Outcome 5 (CO5):

1. What is the scope of automation testing?
2. What is the purpose of an automation framework?
3. Implement automated API testing using a tool like Postman or RestAssured. Create a series of tests for a given API and demonstrate how to validate the responses.

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: CXT 434
Course Name: SOFTWARE ENGINEERING AND QUALITY ASSURANCE

Max.Marks:100 **Duration: 3 Hours**

PART A
Answer All Questions. Each Question Carries 3 Marks

1. Differentiate error, defect, and failure?
2. Define verification and validation in testing phase.
3. Discuss the challenges in white box testing.
4. Compare walkthroughs and inspections.
5. List and explain the maturity levels of CMM.
6. What is total quality management (TQM)?
7. Discuss the role of regression testing when developing a new software release.
8. Discuss the importance of Test plan.
9. Define encapsulation and polymorphism.
10. Define quality metric.

(10x3= 30)

Part B

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

11 (a) What is testing? Explain the need of software testing in software development. (7)

(b) Discuss the limitations and challenges in software testing. (7)

OR

12 (a) Explain the difference between quality control and quality assurance. (7)

(b) Discuss the applicability and relevance of life cycle models to verification and validation. (7)

13 (a) Explain the various methods to achieve static testing by humans. (8)

(b)Discuss the importance of traceability matrix. (6)

.

OR

14 (a)Describe the classification of white box testing. (7)

(b) Describe the various reasons for using black box testing. An input value for a product code in an inventory system is expected to be present in a product master table. Identify the set of equivalence classes to test these requirements. (7)

15 (a) Discuss what is six sigma quality. How is it achieved? (7)

(b) Describe the basic concepts of total quality management. (7)

OR

16 (a) List and explain the principles of ISO 9000:2000 standard. (7)

(b) Discuss the relationship between quality factor and criteria. (7)

17 (a). When regression testing is done ? Discuss the difference in regression testing for a major release versus minor release of a product. (7)

(b). Write a short note on tools for regression testing. (7)

OR

18 a. What is program slicing? Explain dynamic program slicing. (6)

b. Describe the techniques of executing tests and reporting results. (8)

19 a. Explain the framework for test automation. (8)

b. Discuss the criteria and steps in selecting the testing tool for automation. (6)

OR

20. a. Describe the tools for testing of object oriented systems. (6)

b. Why do integration and system testing assume special importance for an object oriented system? (8)

Lesson Plan		
	Contents	Total Hrs. (36 Hrs.)
	Module 1(Fundamentals of Software Testing and Quality Assurance) (6 hours)	
1.1	Role of testing in software development	1
1.2	Importance of processes in software quality assurance	1
1.3	Faults, errors, and failures in software testing	1
1.4	Limitations and challenges in software testing	1
1.5	Concepts of verification and validation in software quality assurance. (Lecture-1)	1
1.6	Concepts of verification and validation in software quality assurance. (Lecture-2)	1
	Module 2(Testing Techniques and Methodologies) (8 hours)	
2.1	White box and black box testing techniques: Black box testing – requirements-based testing	1
2.2	Black box testing – boundary value analysis	1
2.3	Black box testing - equivalence partitioning	1
2.4	White box testing – static analysis, unit testing	1
2.5	White box testing – control flow testing	1
2.6	Integration, system, and acceptance testing methodologies	1
2.7	Non-functional testing techniques – performance, security, and usability testing (Lecture-1)	1
2.8	Non-functional testing techniques – performance, security, and usability testing (Lecture-2)	1
	Module 3(Quality Assurance Principles and Standards) (8 hours)	
3.1	Development of quality plans and objectives	1

3.2	Total Quality Management (TQM) concepts	1
3.3	Evaluation of quality models and standards – ISO	1
3.4	Evaluation of quality models and standards – CMM	1
3.5	Evaluation of quality models and standards – Six Sigma	1
3.6	Addressing quality challenges	1
3.7	Significance of national quality awards (Lecture-1)	1
3.8	Significance of national quality awards (Lecture-2)	1
	Module 4(Regression Testing and Test Management)) (7 hours)	
4.1	Importance of regression testing in software maintenance	1
4.2	Regression test planning and case selection(Lecture-1)	1
4.3	Regression test planning and case selection(Lecture-2)	1
4.4	Dynamic slicing and test minimization techniques	1
4.5	Tools for regression testing	1
4.6	Test planning, execution, and reporting (Lecture-1)	1
4.7	Test planning, execution, and reporting(Lecture-2)	1
	Module 5 (Software Test Automation and Object-Oriented Testing) (7 hours)	
5.1	Scope and benefits of test automation	1
5.2	Design and implementation of automation frameworks	1
5.3	Utilization of testing tools for automation	1
5.4	Object-oriented testing principles	1

5.5	Analysis of software quality metrics (Lecture-1)	1
5.6	Analysis of software quality metrics (Lecture-2)	1
5.7	Continuous improvement initiatives	1

CXT 444	MULTIMEDIA COMPRESSION	Category	L	T	P	Credits	Year of Introduction
		PEC	2	1	0	3	2021

Preamble:

This course helps the learners to understand compression techniques on text, image, audio and video data. It covers lossy & lossless compression techniques, various compression mechanisms and standards. 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:

CO1	Describe the fundamental principles of multimedia compression. (Cognitive Knowledge level: Understand)
CO2	Make use of statistical and dictionary-based text compression techniques for various applications. (Cognitive Knowledge level: Apply)
CO3	Explain the principles and standards of Audio Compression Techniques. (Cognitive knowledge level: Understand)
CO4	Illustrate the various image compression standards. (Cognitive Knowledge Level: Understand)
CO5	Articulate various Video Compression Techniques and Standards (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 (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 internal evaluation test is to be conducted based on the first two modules of the Syllabus. The second internal evaluation test is to be conducted based on the third and fourth modules of the Syllabus. There will be two parts: Part A and Part B. Students should answer all questions from Part A. Part B contains 7 questions each with 7 marks. Out of the 7 questions, a student should answer any 5. An assignment/quiz/open book test is to be given based on the fifth module of the Syllabus. The time duration for each internal evaluation test is 1 hour and 30 minutes.

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 FUNDAMENTALS OF MULTIMEDIA COMPRESSION

Introduction To Multimedia – Components of Multimedia , Graphics/Image Data Types, Popular File Formats , Concepts Of Video-Analog video and digital video(definitions only), Digital Audio – digitization of sound, Storage Requirements of Multimedia Applications.

Need For Compression , Elements Of Information Theory, Lossless Compression , Lossy Compression. Compression performance metrics.

Module – 2 TEXT COMPRESSION

Basic Compression Techniques- Run length encoding-Shannon Fano Coding –Static Huffman Coding–binary and non binary Huffman coding-Arithmetic Coding – Dictionary based Coding- LZ77, LZ78 and LZW compression.

Module – 3 AUDIO COMPRESSION

Audio Compression– μ-law and A-law Companding. Frequency Domain And Filtering – Basic Sub-Band Coding – Application To Speech Coding – G.722 – Application To Audio Coding – MPEG Audio. Speech Compression Techniques – Linear Predictive Coding (LPC) and Code Excited LPC.

Module – 4 IMAGE COMPRESSION

Image Compression: Fundamentals — Compression Standards – JPEG Standard –Sub-Band Coding – Wavelet Based Compression – Implementation Using Filters – EZW, SPIHT Coders – JPEG 2000 Standards

– JBIG And JBIG2 Standards, DCT.

Module – 5 VIDEO COMPRESSION

Video Compression Techniques and Standards–MPEG Video Coding: MPEG-1 And MPEG-2 Video Coding: MPEG-3 And MPEG-4–Motion Estimation and Compensation Techniques – H.261 Standard, H.263 Standard, H.264 Codecs.

TEXT BOOKS

1. Mark S.Drew and Ze-Nian Li, "Fundamentals of Multimedia," PHI, 1st Edition,2008.
2. David Salomon, "Data Compression – The Complete Reference," Springer Verlag New York Inc., 3rd Edition, 2008.
3. Fred Halshall "Multimedia Communication - Applications, Networks, Protocols and Standards", Pearson Education, 2007.
4. Khalid Sayood: Introduction to Data Compression, Morgan Kauffman Harcourt India, 3rd Edition, 2010.

REFERENCES

1. Marcus Goncalves "Voice over IP Networks", Mc Graw Hill 1999.
2. KR. Rao,Z S Bojkovic, D A Milovanovic, "Multimedia Communication Systems: Techniques, Standards, and Networks", Pearson Education 2007.
3. R. Steimnetz, K. Nahrstedt, "Multimedia Computing, Communications and Applications", Pearson Education Ranjan Parekh, "Principles of Multimedia", TMH 2007.
4. Yun Q.Shi, Huifang Sun, "Image and Video Compression for Multimedia Engineering - Fundamentals, Algorithms & Standards", CRC press, 2003.

Sample Course Level Assessment Questions:

Course Outcome 1 (CO1):

1. Elaborate the components of Multimedia.
2. Explain the Graphics/Image Data Types and the popular File Formats.
3. Highlight the Fundamental Concepts Of Video, Digital Audio.
4. Differentiate the lossy and lossless compression techniques.
5. Discuss different types of compression performance metrics.

Course Outcome 2 (CO2):

1. Explain RLE based text compression and illustrate with an example.

2. Given the eight symbols A, B, C, D, E, F, G, and H with probabilities 1/30, 1/30, 1/30, 2/30, 3/30, 5/30, 5/30, and 12/30. Obtain the Huffman code and calculate the average length of the code. Repeat the same example with the Shannon Fano method.

3. Differentiate the LZ77 and LZ78 performance with the input given as

'sirsideastmaneasilyteasesseasickseals'

4. For a given sequence of symbols whose probabilities are given, perform arithmetic coding and compute the tag.

Course Outcome 3 (CO3):

1. Differentiate Linear Predictive Coding and Code Excited LPC.
2. Explain MPEG Audio.

Course Outcome 4 (CO4):

1. Explain image compression standards with example.
2. Briefly explain discrete cosine transform with sequential and progressive DCT based encoding algorithms.

Course Outcome 5 (CO5):

1.Briefly explain MPEG-4 video compression standard
2.How H.261 video compression is completed

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: CXT 444
Course Name: Multimedia Compression

Max.Marks:100 **Duration: 3 Hours**

PART A
Answer All Questions. Each Question Carries 3 Marks

1. Define Entropy and state its significance in data compression.

2. Differentiate lossy and lossless compression techniques.

3. With an example, detail the steps involved in Shannon Fano algorithm.

4. Describe LZ77 approach of encoding a string with the help of an example.

5. List out some of the audio compression standards.

6. Define companding.

7. What are the steps of JPEG 2000 image compression?

8. Compare and contrast the JBIG and JBIG2 standards for bi-level image compression.

9.Discuss different components of video.

10.How motion compensation helps in video compression?

(10x3= 30)

Part B

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

11 a. Estimate the amount of storage required for different classes of multimedia data and justify the need for multimedia compression techniques. (6)

b. Discuss the following image data types and file formats.

8 bit color image, 24 bit color image, GIF, PNG. (8)

OR

12 a. In detail explain the different components of multimedia and their characteristics. (6)

b. Outline the steps to digitize audio data. (8)

13 a. With a help of flowchart discuss the RLE text compression for text data given below 'ABBBBBBBBBCDEEEEF'. (8)

b. Define compression ratio and give the limitations of the RLE Algorithm. (6)

OR

14 a. Consider a zero memory source with S={S1, S2,S3,S4,S5,S6,S7} with probabilities P={0.4,0.2,0.1,0.1,0.1,0.05,0.05}

Construct binary Huffman code to obtain the minimum variance. (8)

b. With an example illustrates the steps involved in the LZW Algorithm (6)

15 a. Explain μ-law and A-law companding. (8)

b. Explain Frequency Domain and Filtering (6)

OR

16 a. Explain basic Sub-Band Coding. (6)

b. Explain the working of Linear Predictive Coding. (8)

17 a. Explain in detail about JPEG modes. (8)

b. Define the concept of wavelet-based compression. (6)

OR

18 a . Explain the significance of the Discrete Cosine Transform (DCT) in image compression. How does it contribute to reducing file sizes while preserving visual quality? (8)

18 b. Explain in detail about SPIHT coders. (6)

19a.Describe in details about MPEG-1 video compression. (8)

b. Explain in detail about the functionalities of MPEG-4 (6)

20 a. Differentiate the major changes in MPEG-2 and MPEG-4 (8)

b. Compare and contrast H.261 and H.263 Standards (6)

No	Contents	No. of lecture hours (36 hrs.)
Module 1 (8 hours)		
1.1	Introduction To Multimedia – Components of Multimedia	1
1.2	Graphics/Image Data Types	1
1.3	Popular File Formats	1
1.4	Concepts Of Video-Analog Video and Digital Video (definitions only)	1
1.5	Digital Audio – Digitisation of sound	1
1.6	Storage Requirements of Multimedia Applications, Need For Compression	1
1.7	Elements Of Information Theory	1
1.8	Lossless Compression – Lossy Compression , Compression performance metrics	1
Module 2 (7 hours)		
2.1	Basic Compression Techniques- Run length encoding	1
2.2	Shannon Fano Coding	1
2.3	Static Huffman Coding – Binary and Non-Binary huffman coding	1
2.4	Arithmetic coding	1
2.5	Dictionary based Coding- LZ77	1
2.6	LZ78 compression	1
2.7	LZW compression	1

	Module 3 (7 hours)	
3.1	Audio Compression– M- Law And A- Law Companding	1
3.2	Frequency Domain And Filtering	1
3.3	Basic Sub-Band Coding-Application To Speech Coding	1
3.4	G.722-Application To Audio Coding	1
3.5	MPEG Audio-Speech Compression Techniques	1
3.6	Linear Predictive Coding (LPC)	1
3.7	Code Excited LPC	1
	Module 4 (7 hours)	
4.1	Image Compression Fundamentals & Compression Standards- JPEG Standard	1
4.2	Sub-band coding	1
4.3	Wavelet Based compression	1
4.4	Implementation using Filters	1
4.5	SPIHT coders JPEG 2000	1
4.6	JBIG And JBIG2 Standards	1
4.7	Discrete Cosine Transform	1

	Module 5 (7 hours)	
5.1	Basics of Video Compression-MPEG Video Coding	1
5.2	MPEG-1	1
5.3	MPEG-2	1
5.4	MPEG-3, MPEG-4	1
5.5	Motion Estimation And Compensation Techniques Basics	1
5.6	H.261 Standard , H.263 Standard	1
5.7	H.264 Codecs.	1

CXT 454	PROTOTYPING INTERACTIVE SYSTEMS	Category	L	T	P	Credit	Year of Introduction
		PEC	2	1	0	3	2021

Preamble: This course helps the learner to understand the prototyping and modelmaking, Prototypes and design process, Traditional prototyping methods and tools. Topics covered in this course will include prototyping techniques, guidelines for building prototypes, prototypes and design process, traditional prototyping methods and tools.

Prerequisite: NIL

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

CO1	Explain fundamentals of prototyping (**Cognitive Knowledge Level: Understand**)
CO2	Apply prototyping for Effective Communication and Verification in Design and Technical Testing **(Cognitive Knowledge Level: Apply)**
CO3	Apply participatory design techniques to involve end-users in the prototyping process effectively. **(Cognitive Knowledge level: Apply)**
CO4	Articulate traditional and digital prototyping methods and tools for efficient product development. (**Cognitive Knowledge Level: Understand**)
CO5	Explain the skills and knowledge necessary to prototype advanced user interfaces and emerging technologies effectively. **(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 (Marks)	**Test 2 (Marks)**	
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 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 internal evaluation test is to be conducted based on the first two modules of the Syllabus. The second internal evaluation test is to be conducted based on the third and fourth modules of the Syllabus. There will be two parts: Part A and Part B. Students should answer all questions from Part A. Part B contains 7 questions each with 7 marks. Out of the 7 questions, a student should answer any 5. An assignment/quiz/open book test is to be given based on the fifth module of the Syllabus. The time duration for each internal evaluation test is 1 hour and 30 minutes.

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.

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. How do physical and digital prototypes differ in the context of design development, and what advantages do each offer in terms of speed, cost, and fidelity?
2. Discuss the specific prototyping strategies employed by Motion Computing in the development of the J3400 Tablet, particularly focusing on offline and online rapid prototyping techniques, and their impact

on the final product's design and functionality?

Course Outcome 2 (CO2):

1. What are the ways did Xoran utilize iterative and evolutionary prototyping methods in the development of the Portable xCAT Scanner, and how did these approaches contribute to the refinement of the device's design and functionality?
2. Discuss on the specific guidelines followed by Xoran for building prototypes to ensure effective communication, design verification, and compliance with technical and safety standards during the development of the Portable xCAT Scanner.
3. How various specific techniques can be applied for generating new ideas and for expanding the design space.

Course Outcome 3 (CO3):

1. How do user-centered design and participatory design approaches influence the prototyping process, particularly in terms of exploring and expanding the design space to accommodate diverse user needs and preferences?
2. Explain with examples of how horizontal prototypes, vertical prototypes, task-oriented prototypes, and scenario-based prototypes are strategically employed in different stages of the design process to facilitate effective communication, iteration, and validation of design concepts.
3. Illustrate with an example how brainstorming is applied in participatory design.

Course Outcome 4 (CO4):

1. How do traditional prototyping methods such as paper prototypes and Wizard of Oz prototypes compare with digital prototyping methods like presentation software and coded prototypes in terms of speed, fidelity, and user feedback integration, using real-world examples such as ZURB's Verify?
2. What are the key advantages of utilizing prototyping software and apps in the design process, and how do these tools enhance collaboration, iteration speed, and the overall efficiency of prototype creation and testing?

Course Outcome 5 (CO5):

1. How do iterative and evolutionary prototypes differ from traditional prototypes, and what role do user interface toolkits, builders, and development environments play in facilitating the iterative design process, particularly in the context of mixed reality and pervasive computing systems?

2. What are some prototyping best practices that designers should adhere to when developing mixed reality and pervasive computing systems, and how do these practices ensure efficient iteration, user feedback incorporation, and alignment with project goals and user needs?

Syllabus

Module – 1 (Prototyping and modelmaking)
Definition of prototyping and modelmaking, Physical and Digital Prototypes, prototypes as Design Artifacts, characteristics of prototyping, prototypes and the design process, prototyping strategies, rapid prototyping - offline rapid prototyping - online rapid prototyping techniques, Case study: Motion Computing J3400 Tablet.

Module - 2 (Guidelines for Building Prototypes)
How prototypes are used – Guidelines for Building Prototypes for Communication -Design Verification, Technical Performance Testing, Safety Standards Testing, Prototyping in Different Disciplines, iterative and evolutionary prototypes, Case study - Xoran Portable xCAT Scanner.

Module - 3 (Prototypes and design process)
Prototypes and design process- User centered design, Participatory design, Exploring the design space, Expanding the design space, Contracting the design space, Prototyping strategies- Horizontal prototypes, Vertical prototypes, Task oriented prototypes, Scenario based prototypes.

Module 4 (Prototyping methods and tools)
Traditional prototyping methods and tools- Paper prototypes, Wizard of OZ prototypes. Digital prototyping methods and tools- Presentation software, Coded prototype, Real world example- ZURB's Verify, Prototyping software and apps, Advantages of prototyping tools.

Module 5 (Iterative and Evolutionary Prototypes)
Iterative and Evolutionary Prototypes - User Interface Toolkits ,User Interface Builders , User Interface Development Environments. Prototyping Mixed Reality and Pervasive Computing Systems. Prototyping best practices.

Text Books

1. BJarki Hallgrimson , 'PROTOTYPING AND MODELMAKING FOR PRODUCT DESIGN', 2012.
2. Michel Beaudouin-Lafon and Wendy E. Mackay , 'Prototyping Tools and Techniques', 2009.
3. Jerry Cao, Kamil Zieba & Matt Ellis, 'The ultimate guide to prototyping, the best prototyping methods, tools and processes', 2016.

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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: CXT 454
Course Name: PROTOTYPING INTERACTIVE SYSTEMS
Max.Marks:100 **Duration: 3 Hours**

PART A
Answer All Questions. Each Question Carries 3 Marks

1. Differentiate between Prototyping and Modelmaking.
2. What is Task-Oriented Prototypes?
3. Write short note on design verification.
4. Write any three user interface toolkits in Windows.
5. Compare horizontal and vertical prototypes.
6. Explain advantages of prototyping tools.
7. Differentiate user centered and participatory design.
8. Briefly explain paper prototypes.
9. What is meant by iterative and evolutionary prototypes?
10. Explain the issues raised while prototyping mixed reality and pervasive computing.

(10x3= 30)

Part B

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

11 (a) Explain horizontal and vertical prototypes. (7)

(b) Explain rapid prototyping. **(7)**

OR

12 (a) What is a prototype? Explain its relevance in the design process. (8)

(b) Describe various offline rapid prototyping techniques. (6)

13 (a)What are the guidelines for Building Prototypes for Communication? (8)

(b)Explain prototyping and design of Xoran Portable xCAT Scanner. (6)

OR

14 (a) Explain iterative and evolutionary prototypes. (8)

(b) Describe User Testing with respect to prototyping. (6)

15. Explain different types of prototypes and design process. (14)

OR

16. Explain different prototyping strategies. (14)

17. Demonstrate with a real example the concept of digital prototyping. (14)

OR

18. With examples compare traditional and digital prototyping tools. (14)

19. Explain about the tools used for prototyping user interface toolkits, user interface builders, and user interface development environments. (14)

OR

20. Explain best practices for prototyping. (14)

No	Lesson Plan Contents	No. of lecture hours (36 Hrs)
Module 1 (7 hrs)		
1.1	Definition of prototyping and modelmaking, Physical and Digital Prototypes	1
1.2	Prototypes as Design Artifacts	1
1.3	Characteristics of prototyping	1
1.4	Prototypes and the design process	1
1.5	Prototyping strategies	1
1.6	Rapid prototyping - offline rapid prototyping - online rapid prototyping techniques	1
1.7	Case study: Motion Computing J3400 Tablet	1
Module 2 (6 hrs)		
2.1	Guidelines for Building Prototypes for Communication	1
2.2	Design Verification	1
2.3	Technical Performance Testing, Safety Standards Testing	1
2.4	Prototyping in Different Disciplines	1
2.5	iterative and evolutionary prototypes	1
2.6	Case study - Xoran Portable xCAT Scanner	1
Module 3 (8 hrs)		
3.1	Prototypes and design process- User centered design, Participatory design	1
3.2	Exploring the design space	1
3.3	Expanding the design space	1
3.4	Contracting the design spaces.	1
3.5	Prototyping strategies- Horizontal prototype, Vertical prototypes	1
3.6	Task oriented prototypes	1
3.7	Scenario based prototypes (Lecture 1)	1
3.8	Scenario based prototypes (Lecture 2)	1
Module 4 (7 hrs)		

4.1	Traditional prototyping methods and tools- Paper prototypes	1
4.2	Wizard of OZ prototypes	1
4.3	Digital prototyping methods and tools	1
4.4	Presentation software	1
4.5	Coded prototype	1
4.6	Real world example- ZURB's Verify	1
4.7	Prototyping software and apps, Advantages of prototyping tools	1

Module 5 (8 hrs)		
5.1	Iterative and Evolutionary Prototypes	1
5.2	User Interface Toolkits	1
5.3	User Interface Builders	1
5.4	User Interface Development Environments.	1
5.5	Prototyping Mixed Reality and Pervasive Computing Systems. (Lecture -1)	1
5.6	. Prototyping Mixed Reality and Pervasive Computing Systems. (Lecture-2)	1
5.7	Prototyping best practices (Lecture 1)	1
5.8	Prototyping best practices (Lecture 2)	1

CXT 464	PARALLEL PROGRAMMING	Category	L	T	P	Credit	Year of Introduction
		PEC	2	1	0	3	2021

Preamble:
The objective of this course is to provide a basic introduction to programming parallel systems with MPI, Pthreads, and OpenMP. Topics covered in this course will include parallel computation models, message passing and shared memory paradigms. At the end of this course students should be able to apply parallelization to their project works.

Prerequisite: Programming knowledge in single processor systems, Operating systems and Computer organization and architecture

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

CO1	Outline the architectural elements of modern processors and the tasks involved in developing software that run on parallel systems. (Cognitive Knowledge Level: Understand)
CO2	Utilize the functionality of MPI primitives and MPI programs (Cognitive Knowledge Level: Apply)
CO3	Develop MPI programs to accomplish a computational task (Cognitive Knowledge Level: Apply)
CO4	Explain the working of parallel programming paradigm using shared memory with the help of Pthreads (Cognitive Knowledge Level: Understand)
CO5	Create loops using OpenMP (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 (Marks)	Test 2 (Marks)	
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 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 internal evaluation test is to be conducted based on the first two modules of the Syllabus. The second internal evaluation test is to be conducted based on the third and fourth modules of the Syllabus. There will be two parts: Part A and Part B. Students should answer all questions from Part A. Part B contains 7 questions each with 7 marks. Out of the 7 questions, a student should answer any 5. An assignment/quiz/open book test is to be given based on the fifth module of the Syllabus. The time duration for each internal evaluation test is 1 hour and 30 minutes.

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 Parallel Hardware and Parallel Software:
Introduction, Why Parallel Computing? How Do We Write Parallel Program, Difference- Concurrent, Parallel, Distributed computing.
Parallel Hardware :SIMD Systems, MIMD systems, Interconnection networks, Cache coherence, Shared-memory versus distributed-memory
Parallel Software: Caveats, Coordinating the processes/threads, Shared-memory.

Module - 2 Distributed-Memory Programming with MPI
Getting Started with MPI, Compilation and execution, MPI programs, MPI_Init and MPI_Finalize Communicators, MPI_Comm_size and MPI_Comm_rank , SPMD programs, Communication, MPI_Send, MPI_Recv , Message matching, The status p argument, Semantics of MPI_Send and MPI_Recv.
The Trapezoidal Rule in MPI : The trapezoidal rule , Parallelizing the trapezoidal rule.

Module - 3 Performance Evaluation of MPI
Collective Communication: Tree-structured communication, MPI_Reduce , Collective vs. point-to-point communications, MPI Allreduce . MPI Derived Datatypes.
Performance Evaluation of MPI Programs: Taking timings, Results, Speedup and efficiency, Scalability.
A Parallel Sorting Algorithm: Some simple serial sorting algorithms , Parallel odd-even transposition sort, Safety in MPI programs, Final details of parallel odd-even sort .

Module 4 Shared-Memory Programming with Pthreads
Processes, Threads, and Pthreads, Hello, World:Execution, Preliminaries , Starting the threads, Running the threads, Stopping the threads , Error checking, Other approaches to thread startup. Matrix-Vector Multiplication.
Critical Sections, Busy-Waiting, Mutexes, Producer-Consumer Synchronization and Semaphores. Caches, Cache Coherence, and False Sharing. Thread-Safety.

Module 5 Shared-Memory Programming with OpenMP
Getting Started with OpenMP, Compiling and running OpenMP programs, The program, Error checking .
The Trapezoidal Rule: A first OpenMP version.
Scope of Variables, The Reduction Clause , The parallel for Directive : Caveats, Data dependences, Finding loop-carried dependences, Estimating π , More on scope.
More About Loops in OpenMP: Sorting, Bubble sort, Odd-even transposition sort.

Text Books

1. Peter S Pacheco; An Introduction to Parallel Programming. Publisher: Morgan Kauffman. ISBN: 978-93-80931-75-3. 2011.

Reference Books

1. Marc Snir, Steve W. Otto, Steven Huss-Lederman, David W. Walker and Jack Dongarra; MPI - The Complete Reference – 2nd Edition, Volume 1, The MPI Core.
2. A Grama, A Gupta, G Karypis, and V Kumar; Introduction to Parallel Computing-2nd Ed., Addison-Wesley, 2003.

Sample Course Level Assessment Questions:

Course Outcome 1 (CO1):

1. Describe the key aspects of interconnection networks in parallel hardware. Why is understanding interconnection networks crucial for parallel computing?

2. Explain the differences between Concurrent, Parallel, and Distributed computing. Why is parallel computing essential in today's context?

Course Outcome 2 (CO2):

1. You are tasked with optimizing a parallel application that uses MPI_Reduce extensively. Propose strategies to enhance the performance of collective communication, specifically focusing on tree-structured communication.
2. Consider a scenario where multiple processes need to communicate using MPI_Send and MPI_Recv. Develop a message-passing strategy that ensures efficient communication and minimizes potential deadlocks.

Course Outcome 3 (CO3):

1. Develop a parallel program using MPI that utilizes MPI Derived Datatypes. Justify the use of these data types in your program and discuss how they contribute to better performance.
2. Develop an MPI program to solve a numerical problem of your choice. Include functions such as MPI_Init, MPI_Finalize, MPI_Comm_size, and MPI_Comm_rank. Provide a detailed explanation of how these functions are utilized in your program.
3. Implement the Trapezoidal Rule in MPI for a complex mathematical function. Discuss how you would optimize the parallelization to achieve better load balancing and efficiency.

Course Outcome 4 (CO4):

1. Differentiate between processes, threads, and Pthreads.
2. How does thread-safety impact program execution?
3. Discuss critical sections, busy-waiting, mutexes, and their role in Pthreads.

Course Outcome 5 (CO5):

1. Explain the scope of variables in OpenMP. Discuss challenges related to data dependencies and loop-carried dependencies in parallel programming.
2. Create a loop with dependencies in an OpenMP program. Propose strategies to identify and resolve data dependences. Illustrate with a practical 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: CXT 464
Course Name: Parallel Programming

Max.Marks:100 **Duration: 3 Hours**

PART A
Answer All Questions. Each Question Carries 3 Marks

1. Define and explain the concepts of Concurrent, Parallel, and Distributed computing.
2. Discuss the characteristics of SIMD and MIMD systems. Provide examples for each.
3. What is MPI, and why is it used in parallel programming?
4. Discuss the concepts of SPMD programs and provide an example.
5. Compare and contrast Collective Communication and point-to-point communication in MPI.
6. Explain the concept of MPI Derived Datatypes and provide an example.
7. Differentiate between Processes and Threads. What is the role of Pthreads in parallel programming?
8. Discuss Critical Sections and explain the concepts of Busy-Waiting and Mutexes.
9. Explain the purpose and usage of the Reduction Clause in OpenMP.
10. Discuss the parallelization of the Trapezoidal Rule using OpenMP.

(10x3= 30)

Part B

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

11 (a) Briefly discuss the concept of Cache coherence in parallel hardware. **(4)**

(b) Compare and contrast Shared-memory and distributed-memory parallel systems. **(10)**

OR

12 (a) Explain how processes/threads are coordinated in parallel software. **(7)**

(b) Illustrate with examples the challenges faced in shared-memory systems. Propose solutions for overcoming these challenges. **(7)**

13 (a) Discuss the purpose and usage of MPI_Init and MPI_Finalize functions in MPI. **(7)**

(b) Explain the Trapezoidal Rule in MPI. How is it parallelized using MPI? Provide a code snippet for illustration. **(7)**

OR

14 (a) Discuss how Communicators are created and used in MPI. Provide an example to illustrate their application. **(8)**

(b) Explain how message matching is implemented in MPI programs using the status p argument. **(6)**

15 (a). Describe the purpose and usage of MPI_Reduce and MPI_Allreduce. (8)

(b) How do you evaluate the performance of MPI programs? Discuss in terms of timing, speedup, and efficiency. (6)

OR

16 (a) Describe in detail about parallel odd - even transposition sort **(10)**

(b) Illustrate tree structured communication through suitable diagrams. (4)

17. (a) Evaluate the impact of Caches, Cache Coherence, and False Sharing on program performance in shared-memory systems. **(10)**

(b) Discuss approaches to ensuring Thread-Safety in multithreaded applications. **(4)**

OR

18. Briefly explain about the producer-consumer synchronization and semaphores. **(14)**

19. (a) Implement a parallel bubble sort algorithm using OpenMP.
Discuss the key considerations in parallelizing sorting algorithms with OpenMP, including the scope of variables and the reduction clause. Provide a code snippet and discuss the expected performance improvements achieved through parallelization. (10)

(b) Describe the process of compiling and running OpenMP programs. **(4)**

OR

20. Parallelize the Trapezoidal Rule using OpenMP directives. Discuss the process of compilation and execution of the parallelized program.
Provide a code snippet that demonstrates the use of OpenMP directives and discusses any potential pitfalls or challenges in parallelizing this specific algorithm. **(14)**

No	Lesson Plan Contents	No. of lecture hours (36 Hrs)
Module 1(Parallel Hardware and Parallel Software) (6 hours)		
1.1	Introduction, Why Parallel Computing? How Do We Write Parallel Program	1
1.2	Difference- Concurrent, Parallel, Distributed computing.	1
1.3	SIMD Systems, MIMD systems, Interconnection networks	1
1.4	Cache coherence, Shared-memory versus distributed-memory	1
1.5	Caveats, Coordinating the processes/threads	1
1.6	Shared-memory	1
Module 2(Distributed-Memory Programming with MPI) (6 hours)		
2.1	Getting Started with MPI, Compilation and execution	1
2.2	MPI programs, MPI_Init and MPI_Finalize	1
2.3	Communicators, MPI_Comm_size and MPI_Comm_rank	1
2.4	SPMD programs, Communication	1
2.5	MPI_Send, MPI_Recv , Message matching	1
2.6	The trapezoidal rule , Parallelizing the trapezoidal rule	1

	Module 3(Performance Evaluation of MPI) (7 hours)	
3.1	Collective Communication**,**Tree-structured communication, MPI_Reduce	1
3.2	Collective vs. point-to-point communications	1
3.3	MPI Allreduce , MPI Derived Datatypes	1
3.4	Performance Evaluation of MPI Programs**,** Taking timings, Results	1
3.5	Speedup and efficiency, Scalability	1
3.6	Some simple serial sorting algorithms , Parallel odd-even transposition sort	1
3.7	Safety in MPI programs, Final details of parallel odd-even sort	1
	Module 4(Shared-Memory Programming with Pthreads) (8 hours)	
4.1	Processes, Threads, and Pthreads	1
4.2	Hello, World:Execution, Preliminaries	1
4.3	Starting the threads, Running the threads, Stopping the threads	1
4.4	Error checking, Other approaches to thread startup	1
4.5	Matrix-Vector Multiplication.	1
4.6	Critical Sections, Busy-Waiting, Mutexes	1
4.7	Producer-Consumer Synchronization and Semaphores	1
4.8	Caches, Cache Coherence, and False Sharing. Thread-Safety	1

Module 5(Shared-Memory Programming with OpenMP) (9 hours)		
5.1	Getting Started with OpenMP, Compiling and running OpenMP programs	1
5.2	The program, Error checking	1
5.3	The Trapezoidal Rule, A first OpenMP version Scope of Variables	1
5.4	The Reduction Clause	1
5.5	The parallel for Directive : Caveats, Data dependences	1
5.6	Finding loop-carried dependences	1
5.7	More About Loops in OpenMP, Sorting, Bubble sort (Lecture 1)	1
5.8	More About Loops in OpenMP, Sorting, Bubble sort (Lecture 2)	1
5.9	Odd-even transposition sort	1

CXT 416	DATA AND COMPUTER COMMUNICATION	Category	L	T	P	Credits	Year of Introduction
		PEC	2	1	0	3	2021

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: Understand**)
CO2	Identify the issues in data transmission (**Cognitive knowledge: Understand**)
CO3	Select transmission media based on characteristics and propagation modes (**Cognitive knowledge: Understand**)
CO4	Apply 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 internal evaluation test is to be conducted based on the first two modules of the Syllabus. The second internal evaluation test is to be conducted based on the third and fourth modules of the Syllabus. There will be two parts: Part A and Part B. Students should answer all questions from Part A. Part B contains 7 questions each with 7 marks. Out of the 7 questions, a student should answer any 5. An assignment/quiz/open book test is to be given based on the fifth module of the Syllabus. The time duration for each internal evaluation test is 1 hour and 30 minutes.

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, Biphase. 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 $SNR_{dB} = 24$ 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 Biphase 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

EIGHTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: CXT 416

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 fibers. 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)**

No	**Lesson Plan** **Contents**	**No. of Lecture Hrs. (36 hrs.)**
Module-1 (Data Transmission Basics) (7 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 (Lecture-1)	1
1.7	Noisy channel, Shannon's capacity formula (Lecture-2)	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

***

CXT 436	Processor and System Design	Category	L	T	P	Credit	Year of Introduction
		PEC	2	1	0	3	2021

Preamble: This course helps the learner to understand the concepts related to advanced microprocessors, its peripherals and the peripheral communication standards. This course also helps the learners to understand the concepts of advanced instruction flow techniques and register dataflow techniques.

Prerequisite: Sound knowledge in Logical System Design, Computer organization

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

CO1	Illustrate the architecture, modes of operation and addressing modes of microprocessors **(Cognitive knowledge: Understand)**
CO2	Develop 80x86 assembly language programs. **(Cognitive Knowledge Level: Apply)**
CO3	Illustrate how different peripherals and memory are interfaced with microprocessors. **(Cognitive Knowledge Level: Understand)**
CO4	Utilize advanced instruction flow techniques and register dataflow techniques **(Cognitive Knowledge Level: Apply)**
CO5	Explain the 80386 and Pentium processor architecture, memory hierarchy and performance optimization. **(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 (Marks)	**Test 2 (Marks)**	
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 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 internal evaluation test is to be conducted based on the first two modules of the Syllabus. The second internal evaluation test is to be conducted based on the third and fourth modules of the Syllabus. There will be two parts: Part A and Part B. Students should answer all questions from Part A. Part B contains 7 questions each with 7 marks. Out of the 7 questions, a student should answer any 5. An assignment/quiz/open book test is to be given based on the fifth module of the Syllabus. The time duration for each internal evaluation test is 1 hour and 30 minutes.

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 carries 14 marks.

Syllabus

Module 1 (8086)

Architecture, Block diagram – Addressing modes – Instructions set of 8086 – data transfer – arithmetic – branch – loop – flag manipulation – shift & rotate – string instructions – writing simple program in 8086.

Module 2 (80386)

The Memory System, The Input/output System, Memory and I/O Control Signals, Timing, Wait States, Special 80386 Registers, Control Registers, Debug and Test Registers, 80386 Memory Management, Descriptors and Selectors, Descriptor Tables, The Task State Segment (TSS), Moving to Protected Mode.

Module 3 (Pentium Processors)

The Memory System - Input/output System - System Timing -Branch Prediction Logic - Cache Structure- Superscalar Architecture- Special Pentium Registers- Control Registers- EFLAG Register- Built-In Self-Test (BIST) Pentium Memory Management -Paging Unit -Memory-Management Mode.

Module 4: (Advanced instruction flow techniques)

Static Branch Prediction Techniques: Single-Direction Prediction, backward taken/Forwards Not-Taken, Ball/Laurus Heuristics.

Dynamic Branch Prediction techniques: Basic Algorithms, Interference Reducing Predictors, Predicting with alternative contexts.

Hybrid branch Predictors: The tournament predictor, Static predictor selection, Branch Classification, Multihybrid predictor.

Other instruction flow issues and Techniques: Target prediction, Branch Confidence Prediction, High-Bandwidth Fetch Mechanisms.

Module 5: (Advanced Register dataflow Techniques)

Value Locality and Redundant Execution: Causes of value locality, Quantifying value locality.

Exploiting value locality without speculation: Memorization, Instruction reuse, Basic block and Trace reuse, Dataflow region reuse

Exploiting value locality with speculation: Weak dependence model, Value prediction, Value prediction unit, speculative execution using predicted values. Performance of value prediction.

Textbooks

1.A K Ray, K M Bhurchandi, "*Advanced Microprocessors and Peripherals*", Tata McGraw Hill, New Delhi, 2nd Edition, 2010.

2.Craig Zacker & John Rourke, "*PC Hardware: The Complete Reference*", Tata McGraw Hill, New Delhi, First Edition, 2001.

3.Barry B.Brey, "*The Intel Microprocessors*", PHI, New Delhi, Sixth Edition, 2004.

4.Modern Processor design, Fundamentals of Superscalar Processors, John Paul Shen , Mikko H. Lipasti, 2013 reissued by Waveland Press, Inc.

Reference Books

1.Nilesh B. Bahadure, "Microprocessors", PHI, New Delhi, First Edition, 2010.

2.K.K Tripathi, Rajesh K Gangwar, "*Microprocessor and Its Application*", Acme Learning,2010

3.Douglas V Hall, "*Microprocessors and Interfacing*", Tata McGraw Hill, New Delhi, 2nd Edition, 2006

4.Scott Mueller, "*Upgrading and Repairing PC's*", Pearson Education, 17th Edition, 2006

5. Stephen J.Bigelow, "*Troubleshooting, Maintaining and Repairing PC's*", Tata McGraw Hill, New Delhi, 5th Edition, 2001

Sample Course Level Assessment Questions:

Course Outcome 1 (CO1):

1. Draw and discuss the internal block diagram of 8086.
2. What all are the addressing modes in 8086?
3. What are the differences between respective shift and rotate instructions?

Course Outcome 2 (CO2):

1. Move a byte string, 16 bytes long, from the offset 0200H to 0300H in the segment 7000H.
2. Write a program for the addition of a series of 8-bit numbers. The series contains 100 numbers.
3. Write a program to find out positive and negative numbers from a series of signed numbers.

Course Outcome (CO3):

1.Explain the physical address formation in 80386 registers. Also explain the conversion of linear addressing mode to physical addressing mode.
2. Explain the I/O system of 80386.
3.Explain the memory and I/O control signals for 80386.

Course Outcome (CO4):

1. Explain data addressing in detail.
2. Profiling a program has indicated that a particular branch is taken 53% of the time. How effective are the following at predicting this branch and why? (a) Always-taken static prediction, (b) Bimodal/Smith predictor, c) Local-history predictor, (d) Eager execution. State your assumptions.

3. Assume that a branch has the following sequence of taken (T) and not taken (N) outcomes:
   T, T, T, N, N, T, T, T, N, N, T, T, T, N, N
   What is the prediction accuracy for a 2-bit counter (Smith predictor) for this sequence assuming an initial state of strongly taken?

4. Suppose that most of the branches in a program only need a 6-bit global history predictor to be accurately predicted. What are the advantages and disadvantages to using a longer history length?

Course Outcome (CO5):

1. What is the system memory-management mode of operation for the Pentium?
2. Explain the different registers in Pentium.
3. Can the Pentium execute three instructions simultaneously? Justify.
4. Describe how the Pentium accesses 4M pages.

5. Explain the architecture of 80386.
6. Explain the physical address formation in real address mode of 80386.
7. Draw and discuss the structures of the different descriptors and selectors of 80386. What do you mean by descriptor table?

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: CXT 436
Course Name: Processor and System Design

Max.Marks:100 **Duration: 3 Hours**

PART A
Answer All Questions. Each Question Carries 3 Marks

1. Explain the concept of segmented memory?
2. What do you mean by pipelined architecture?
3. Enlist the salient features of 80386.
4. What are the different data types supported in 80386?
5. Explain the following terms:
    a. MII
    b. VLIW
6. Explain the advantage of using separate code and data cache in Pentium.
7. Explain the different methods to allocate and enable resources to different ports.
8. Explain value prediction unit.
9. Define reuse history mechanism.
10. Explain Smith's algorithm

Part B

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

11.

a. Explain the architecture of 8086. (7)

b. Explain the instruction set of 8086. (7)

OR

12.

a. Explain the different types of Flag registers in 8086. (7)

b. With suitable examples explain the below addressing modes. (7)

i. Immediate

ii. Direct

iii. Register

iv. Indexed

13.

a. Explain the register organization of 80386 registers. (7)

b. Explain the structure of the 80386 descriptor. (7)

OR

14.

a. Explain the physical address formation in 80386 registers. Also explain the conversion of linear addressing mode to physical addressing mode. (7)

b. Explain the enhanced instruction set of 80386. (7)

15.

a. Explain CPU architecture of Pentium. (7)

b. Explain the control registers in Pentium. (7)

OR

16.

a. Explain the cache structure of the Pentium processor. (7)

b. Explain the superscalar organization in Pentium. (7)

17. a. Profiling a program has indicated that a particular branch is taken 53% of the time. How effective are the following at predicting this branch and why? (a) Always-taken static prediction, (b) Bimodal/Smith predictor, c) Local-history predictor, (d) Eager execution. State your assumptions. (7)

b. Assume that a branch has the following sequence of taken (T) and not taken (N) outcomes:
T, T, T, N, N, T, T, T, N, N, T, T, T, N, N
What is the prediction accuracy for a 2-bit counter (Smith predictor) for this sequence assuming an initial state of strongly taken? (7)

OR

18. a. Suppose that most of the branches in a program only need a 6-bit global history predictor to be accurately predicted. What are the advantages and disadvantages to using a longer history length? (7)

b. Explain a Global-history two-level predictor with a 4-bit Branch History Register. (7)

19. a. Construct a sequence of load value outcomes where a last-value predictor will perform better than a FCM predictor or a stride predictor. Compute the prediction rate for each type of predictor for your sequence. (7)

b. Construct a sequence of load value outcomes where an FCM predictor will perform better than a last-value predictor or a stride predictor. Compute the prediction rate for each type of predictor for your sequence. (7)

OR

20. a. Explain the history-based predictors. (7)

b. Explain with an example the Value Prediction with Selective Reissue. (7)

Lesson Plan		
	Contents	Total Hrs (36 Hrs)
	Module 1 (6 hours)	
1.1	Architecture, Block diagram – Addressing modes.	1

1.2	Instructions set of 8086 – data transfer.	1
1.3	Arithmetic – branch.	1
1.4	Loop – flag manipulation, Shift & rotate – string instructions.	1
1.5	Writing simple program in 8086. (Lecture-1)	1
1.5	Writing simple program in 8086. (Lecture -2)	1
	Module 2 (7 hours)	
2.1	The Memory System, The Input/output System. Memory and I/O Control Signals.	1
2.2	Timing, Wait States, Special 80386 Registers.	1
2.3	Control Registers, Debug and Test Registers.	1
2.4	80386 Memory Management.	1
2.5	Descriptors and Selectors.	1
2.6	Descriptor Tables.	1
2.7	The Task State Segment (TSS). Moving to Protected Mode.	1
	Module 3 (7 hours)	
3.1	The Memory System – Input/output System – System Timing .	1
3.2	Branch Prediction Logic – Cache Structure.	1
3.3	Superscalar Architecture- Special Pentium Registers.	1
3.4	Control Registers- EFLAG Register.	1
3.5	Built-In Self-Test (BIST).	1
3.6	Pentium Memory Management.	1

3.7	Paging Unit -Memory-Management Mode.	1
	Module 4 (8 hours)	
4.1	Single-Direction Prediction, backward taken/Forwards Not-Taken,	1
4.2	Ball/Laurus Heuristics	1
4.3	Dynamic Branch Prediction techniques: Basic Algorithms,	1
4.4	Interference Reducing Predictors, Predicting with alternative contexts.	1
4.5	Hybrid branch Predictors: The tournament predictor,	1
4.6	Static predictor selection, Branch Classification, Multihybrid predictor.	1
4.7	Other instruction flow issues and Techniques: Target prediction	1
4.8	Branch Confidence Prediction, High-Bandwidth Fetch Mechanisms.	1
	Module 5 (8 hours)	
5.1	Value Locality and Redundant Execution: Causes of value locality	1
5.2	Quantifying value locality.	1
5.3	Exploiting value locality without speculation: Memorization,	1
5.4	Instruction reuse, Basic block and Trace reuse, Dataflow region reuse.	1

5.5	Exploiting value locality with speculation: Weak dependence model,	1
5.6	Value prediction.	1
5.7	Value prediction unit, speculative execution using predicted values.	1
5.8	Performance of value prediction.	1

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CXT 446	COMPUTER GAME DESIGN AND PROGRAMMING	Category	L	T	P	Credit	Year of Introduction
		PEC	2	1	0	3	2021

Preamble:

The purpose of this course is to make awareness about the basic concepts in game and strategies involved in the game design. This course helps the learner to understand various design techniques to develop new games. The study of computer game design enables the development of algorithms for creating various games.

Prerequisite: A sound knowledge of Graphics and a programming language.

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

CO#	CO
CO1	Use the game design principles to develop interactive games. **(Cognitive Knowledge level: Apply)**
CO2	Develop and frame systems with levels of interactivity. **(Cognitive Knowledge level: Apply)**
CO3	Summarize games and schemas in game development. **(Cognitive Knowledge level: Understand)**
CO4	Design games which implement programming with OpenGL. **(Cognitive Knowledge level: Apply)**
CO5	Design graphical objects using OpenGL for game design. **(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 (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 internal evaluation test is to be conducted based on the first two modules of the Syllabus. The second internal evaluation test is to be conducted based on the third and fourth modules of the Syllabus. There will be two parts: Part A and Part B. Students should answer all questions from Part A. Part B contains 7 questions each with 7 marks. Out of the 7 questions, a student should answer any 5. An assignment/quiz/open book test is to be given based on the fifth module of the Syllabus. The time duration for each internal evaluation test is 1 hour and 30 minutes.

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 a maximum of 2 subdivisions and carries 14 marks.

Syllabus

Module - 1 (Game Design Introduction)

Introduction, Game Design Schemas, Game Design Fundamentals, Design Process – iterative design

Game design exercises – creation modification analysis.

Module - 2 (Systems and Interactivity)

Introduction to systems & Interactivity-Elements of System-Framing of system-Open and Closed System-Defining interactivity-Multivalent Model of Interactivity -interaction and choice.

Module - 3 (Game designing)

Defining games – play and games-Role playing games-Defining digital games-Traits of digital games

Primary Schemas-Formal schema-Experimental Schema-Contextual Schema-Defining Rules, Quality of Rules-Three kinds of rules.

Module - 4 (OpenGL Introduction)

Introduction to OpenGL-OpenGL architecture – OpenGL utility Library – Glut, Simulation Games-First-Person Shooters, Real-time Strategy Games-Turn-Based Strategy Games- Role-Playing Games.

Module - 5 OpenGL-Creating objects)

Typical Game Loop-Getting started with OpenGL -Initialization – Context Types and Window Options-Display Modes- Window Creation- Function Call backs -Clear screen, Main loop- resizing-rendering – adding Glew, Vertices and Shapes -Buffer Objects- Introduction to shaders-Creating Buffer Objects. Creating rectangles with OpenGL.

Text Book

1.OpenGL Book, https://openglbook.com/the-book.html.
2.Katie Salen Tekinbas, Eric Zimmerman - Rules of Play_ Game Design Fundamentals (The MIT Press)-The MIT Press (2003).

References

1. Jesse Schell - The Art of Game Design: A Book of Lenses, Third Edition - CRC Press.
2. K.Patinson - Game Development : Gaming Design & Programming - Code Academy.
3. Ernest Adams- Fundamentals of Game Design, Third Edition - New Riders Publishing;
4. Joey de Vries Page - Learn OpenGL: Learn modern OpenGL graphics programming in a step-by-step fashion -Kendall & Wells

Sample Course Level Assessment Questions.

Course Outcome 1 (CO1):

1. RULES, PLAY, and CULTURE is a structure that can facilitate critical design thinking in any design field. Justify the above statement.
2. Briefly explain the game design exercises.

Course Outcome 2 (CO2):

1. Explain four modes of interactivity.
2. What are the elements of the system?

Course Outcome 3 (CO3):

1. With the help of traits, explain the special qualities of digital games.
2. Distinguish between physical game and digital games.

Course Outcome 4(CO4):

1. How to create an OpenGL context with FreeGLUT?
2. Explain about the creation of buffer objects.

Course Outcome 5 (CO5):

1. How can an OpenGL be used to create a rectangle?
2. Explain the following
    1. Window Creation.
    2. Function Call-Backs.

Model Question paper

	QP Code		**Total Pages :3**
Reg No.		**Name:**	
APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY EIGHTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH and YEAR			
Course Code: CXT 446			
Course Name: COMPUTER GAME DESIGN AND PROGRAMMING			
Max. Marks: 100		**Duration: 3 Hours**	
PART A			
		Answer all questions, each carries 3 marks.	Marks
1		Play and games have a unique relationship. Justify.	(3)
2		Explain game design fundamentals.	(3)
3		What is the best environment for a system?	(3)
4		List three framings of a game as a system.	(3)
5		What are the different stages that help to construct a choice in a game?	(3)
6		Briefly explain Role-playing games.	(3)
7		Distinguish between games and digital games.	(3)
8		Define meaningful play.	(3)
9		Discuss about Creating rectangles with OpenGL.	(3)
10		Write notes on shaders.	(3)

		PART B ***Answer any one Question from each module. Each question carries 14 Marks***	
11	a)	Explain game Design Schemas.	(6)
	b)	What is an iterative design process? Explain briefly.	(8)
		OR	
12	a)	Explain game Design Fundamentals.	(7)
	b)	Demonstrate game creation exercises with an example.	(7)
13	a)	Differentiate between open and closed systems.	(7)
	b)	Depict the anatomy of a Choice.	(7)
		OR	
14	a)	What are the elements of the system?	(6)
	b)	Describe different modes of interactivity.	(8)
15	a)	What are the special qualities of digital games?	(6)
	b)	Summarize three kinds of rules.	(8)
		OR	
16		Explain the following. I. Primary Schemas II. Formal schema III. Experimental Schema IV. Contextual Schema	(14)

17	a)	Illustrate OpenGL architecture.	(8)
	b)	Distinguish between Real-time Strategy Games and Turn-Based Strategy Games.	(6)
		OR	
18		How to create an OpenGL context with FreeGLUT? Explain in detail.	(14)
19	a)	Demonstrate the creation and use of Buffer Objects.	(10)
	b)	Illustrate the working of 1. Resizing 2. Rendering	(4)
		OR	
20		Show how objects and shapes are constructed in OpenGL.	(14)
		***	

Teaching Plan		
No	**Topic**	**No. of Lectures (36)**
	Module-1	**7**
1.1	Introduction	1
1.2	Game Design Schemas	1
1.3	Game Design Fundamentals	1
1.4	Design Process – iterative design	1
1.5	Game design exercises – creation	1
1.6	Modification	1
1.7	Analysis	1
	Module-2	**7**
2.1	Introduction to systems & Interactivity	1
2.2	Elements of System	1
2.3	Framing of system	1
2.4	Open System, Closed System	1
2.5	Defining interactivity	1
2.6	Multi valent Model of Interactivity	1
2.7	Interaction, Choice	1
	Module-3	**8**
3.1	Defining games – play and games	1
3.2	Role playing games	1
3.3	Defining digital games	1
3.4	Traits of digital games	1
3.5	Primary Schemas- Formal schema	1

3.6	Experimental Schema-Contextual Schema	1
3.7	Defining Rules, Quality of Rules	1
3.8	Three kinds of rules	1
	Module-4	**7**
4.1	Introduction to OpenGL	1
4.2	OpenGL architecture – OpenGL utility Libarary – Glut	1
4.3	Simulation Games	1
4.4	First-Person Shooters	1
4.5	Real-time Strategy Games	1
4.6	Turn-Based Strategy Games	1
4.7	Role-Playing Games	1

	Module-5	7
5.1	Typical Game Loop	1
5.2	Getting started with OpenGL -Intialization – Context Types and Window Options	1
5.3	Display Modes- Window Creation- Function Call backs -Clear screen	1
5.4	Main loop- resizing- rendering – adding Glew	1
5.5	Vertices and Shapes -Buffer Objects- Introduction to shaders,	1
5.6	Creating Buffer Objects.	1
5.7	Creating rectangles with OpenGL	1

***

CXT 456	OPTIMIZATION TECHNIQUES	Category	L	T	P	Credit	Year of Introduction
		PEC	2	1	0	3	2021

Preamble: This course will help to build an understanding on the basics of optimization techniques and introduces basics of linear programming, network flow problems, computational complexity of various problems and meta heuristic search techniques. The course helps to understand how to develop hybrid models to solve an optimization problem.

Prerequisite: NIL

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

CO1	Explain the concepts of decision making, queuing theory, Monte Carlo technique, basic concepts in operations research and optimization, different metaheuristic search techniques. **(Cognitive Knowledge Level: Understand)**
CO2	Solve optimization problems. **(Cognitive Knowledge Level: Apply)**
CO3	Solve network flow and shortest route problems. **(Cognitive Knowledge Level: Apply)**
CO4	Apply the concepts of computational complexity theory to categorize the given problem. **(Cognitive Knowledge Level: Apply)**
CO5	Apply metaheuristic search techniques for various problems. **(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 - 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 internal evaluation test is to be conducted based on the first two modules of the Syllabus. The second internal evaluation test is to be conducted based on the third and fourth modules of the Syllabus. There will be two parts: Part A and Part B. Students should answer all questions from Part A. Part B contains 7 questions each with 7 marks. Out of the 7 questions, a student should answer any 5. An assignment/quiz/open book test is to be given based on the fifth module of the Syllabus. The time duration for each internal evaluation test is 1 hour and 30 minutes.

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 carries 14 marks.

Syllabus

Module – 1 (Basics of Operations Research)

Decision-making procedure under certainty and under uncertainty - Operations Research-Probability and decision - making- Queuing or Waiting line theory - Simulation and Monte - Carlo Technique - Nature and organization of optimization problems- Scope and hierarchy of optimization- Typical applications of optimization.

Module - 2 (Formulation of optimization problems)

Essential features of optimization problems - Objective function- Continuous functions - Discrete functions - Unimodal functions - convex and concave functions, Investment costs and operating costs in objective function - Optimizing profitably constraints - Internal and external constraints - Formulation of optimization problems. Continuous functions - Discrete functions - Unimodal functions - convex and concave functions.

Module - 3 (Linear Programming)

Necessary and sufficient conditions for optimum of unconstrained functions - Numerical methods for unconstrained functions - One-dimensional search - Gradient-free search with fixed step size.

Linear Programming - Basic concepts of linear programming - Graphical interpretation - Simplex method - Apparent difficulties in the Simplex method.

Module - 4 (Network flow Problem)

Network analysis by linear programming and shortest route, maximal flow problem. Introduction to Non-traditional optimization, Computational Complexity – NP-Hard, NP-Complete. Tabu Search - Basic Tabu search, Neighborhood, Candidate list, Short term and Long term memory.

Module - 5 (Genetic Algorithm)

Introduction to Heuratics serarch. Genetic Algorithms- Basic concepts, Simulated Annealing - Acceptance probability, Cooling, Neighborhoods, Cost function. Application of GA and Simulated Annealing in solving sequencing and scheduling problems and Travelling salesman problem.

Text Books

1. G. Zapfel, R. Barune and M. Bogl, Meta heuristic search concepts: A tutorial with applications to production and logistics, Springer, 2010.
2. Hamdy A. Taha, Operations Research – An introduction, Pearson Education, 2010.
3. Rao S.S., Optimization Theory and Applications, Wiley Eastern, 1984.

Reference Books

1. Gass S. I., Introduction to Linear Programming, Tata McGraw Hill.
2. Goldberg, Genetic algorithms in Search, optimization and Machine Learning, Addison Wesley, 1989.
3. K. Deb, Optimization for engineering design – algorithms and examples, Prentice Hall of India, 2004.
4. Reeves C., Modern heuristic techniques for combinatorial problems, Orient Longman, 1993.

Sample Course Level Assessment Questions:

Course Outcome 1 (CO1):

1. What is decision making under certainty with the help of a suitable example?
2. Comment on the statement: “Functions with finite no. of maxima and minima on a given interval are called Unimodal functions”.

3. Differentiate long term and short-term memory in Tabu Search.
4. What is the verification stage in determining algorithms? How can a problem be identified as a NP problem?
5. What is Simulated Annealing? What is its advantage in optimization?

Course Outcome 2 (CO2):

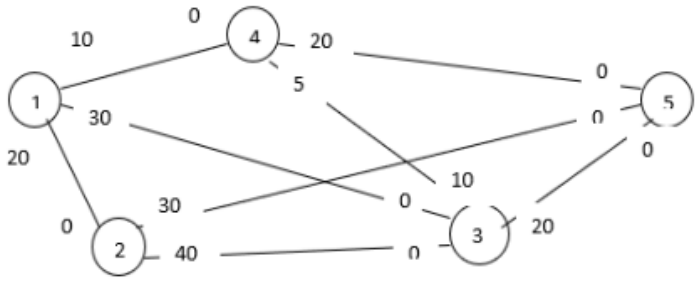
1. Customers arrive at a booking office window, being manned by a single individual at the rate of 25 / hour. Time Required to serve a customer has exponential distribution with a mean of 120 seconds. Find the average waiting time of customers.
2. A dealer wishes to purchase a number of fans and sewing machines. He has only Rs.5760 to invest and has space at most for 20 items. A fan costs him Rs.360 and a sewing machine Rs.240. His expectation is that he can sell a fan at a profit of Rs.22 and a sewing machine at a profit of Rs.18. Assuming that he can sell all the items that he can buy, how should he invest his money in order to maximize his profit? Formulate the mathematical model

Course Outcome 3 (CO3):

1. A woman worker has two types of jobs in a handicraft center (i) spinning thread, (ii) knitting patterns from the thread produced. She produces one unit of thread per hour and one unit of pattern per hour, and is paid $ 10 per unit of thread produced and $ 15 per unit of pattern knitted. She wants to earn not less than $ 60 per day and wants to work not more than 6 hours a day. The thread spun should not exceed the thread consumed by more than 2 units. The center desires that her earnings from knitting should not exceed her earnings from spinning by $ 40. Selling profit is $ 10 per unit of thread and $ 20 per unit of pattern. Formulate the optimization problem to find how many units of thread and pattern should the woman produce every day to maximize her earnings?
2. Solve the following LPP using simplex method: min = $5x + 3y$, subject to, $x+ 2y \leq 6$, $x+y= 5$; $5x+ 2y \geq 10$.

Course Outcome 4 (CO4):

1. Consider the network in Figure. The bidirectional capacities are shown on the respective arcs using the convention. For example, for arc (3,4), the flow limit is 10 units from 3 to 4 and 5 units from 4 to 3. Determine the maximal flow in the network.



2. Draw the network defined by: N = {1,2,3,4,5,6},A ={{1,2),(1,5), (2,3), (2,4),(3,4), (3,5), (4,3),(4,6), (5,2),(5,6)}. Find all the shortest path from 1 to 6 and from 1 to 5.

Course Outcome 5 (CO5):

1. Suppose that GA is used to find the maximum of f(x), x = 0, 1,….., 275. Let x =107 and x = 254 represent parents P 1 and P 2 .Given 0.6712, 0.1926, 0.2567, 0.4651(Use these numbers ,if required , in the given order):
   a) Represent P 1 and P 2 as binary codes
   b) Use uniform crossover to create off springs C 1 and C 2
   c) Create the offsprings C 1 and C 2 using a1-point cross over (after 3rd bit)
   d) Create the offsprings C 1 and C 2 using a2-point crossover (use 3rd and 4th random number)
2. With an appropriate example, explain the recombination, mutation and evaluation in solving traveling salesman problem using genetic algorithm.

Model Question Paper

QP CODE:

Reg No: _____

Name: _____ **PAGES : 4**

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

EIGHTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

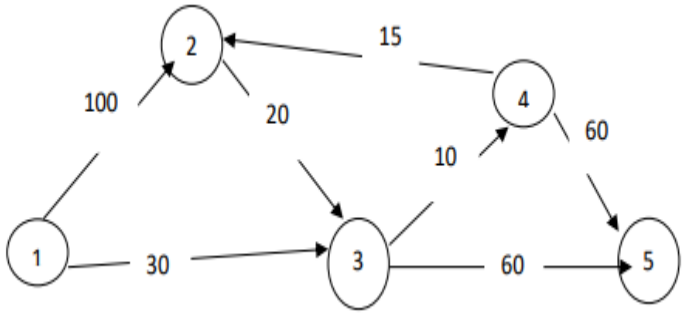
Course Code: CXT 456
Course Name: Optimization Techniques

Max.Marks:100 **Duration: 3 Hours**

PART A

Answer All Questions. Each Question Carries 3 Marks

1. What is decision making under certainty? Explain with the help of a suitable example?
2. Differentiate between convex and concave functions using their graphs.
3. Distinguish between constrained and unconstrained optimization problems.
4. What are the steps involved in the decision-making procedure?
5. Differentiate between relative maximum and global maximum.
6. Determine the extreme points of the function $f(x) = x^3 - 3x + 6$.
7. Distinguish between NP-Complete and NP-Hard problems.
8. What are the main 2 main advantages and disadvantages of Tabu search?
9. Describe the simple Genetic Algorithm with the help of a flow chart.
10. The following network gives the permissible routes and their lengths in km between city 1 (node 1) and four other cities (nodes 2 to 5). Determine the shortest route from city 1 to each of the remaining four cities.



(10x3=30 marks)

Part B

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

11 (a) A manufacturer has two products A and B both of which are produced in two stages by machines M1 and M2. The process times per unit for the product on the machines and their selling price per unit are given in the table.

Product\machines	M_1	M_2	Selling price per unit
A	4	5	**10**
B	5	2	**5**
Allowable Hours	**100**	**80**	

The manufacturer is in a market upswing and can sell as much as he can produce of both the product. Formulate the optimization problem. (7)

(b) What are essential features of an optimization problem? (7)

OR

12 (a) With the help of a schematic representation, introduce the characteristics of a waiting line system. (8)

(b) How does Monte Carlo simulation work? (6)

13 (a) Find the interval of concavity and convexity and find points of inflection , if any, of

$f(x) = x^3-6x^2-3x+1$ (8)

(b) Define investment cost. What are the different types of investment cost incurring while we buy or sell an investment? (6)

OR

14 (a) Explain the factors that can be used to measure the performance of a waiting-line system. (6)

(b) What is the investment cost and operating cost in Objective function? (8)

15 (a) Solve by Simplex method

$$Max\ Z= 10x1+15x2+20x3 \text{ subject to } 2x1 + 4x2 + 6x3 \leq 24$$
$$3x1 + 9x2 + 6x3 \leq 30$$
$$x1, x2 \geq 0$$ (7)

(b) A company produces two products A and B . The sales volume for A is at least 80 % of the total sales of both A and B. However, the company cannot sell more than 110 units of A per day. Both products use one raw material of which the maximum daily availability is 240lb. The usage rate of the raw material are 2lb per unit of A and 4lb per unit of B . The profit units for A and B are $10 and $25 respectively. Determine the optimal product mix for the company, using graphical method. (7)

OR

16 (a) Solve graphically.

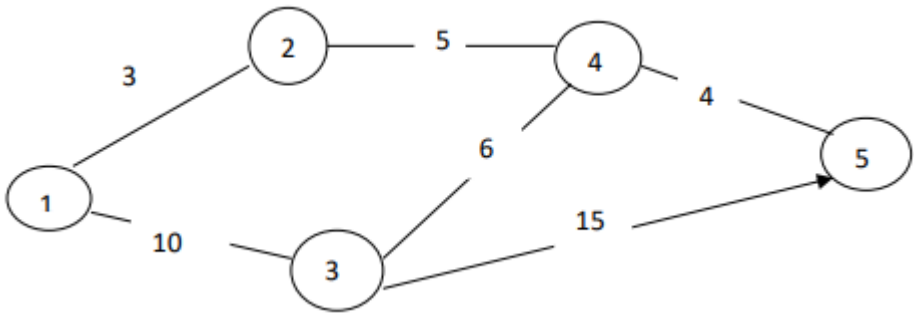
$$\text{Max } Z= -x1 + 2x2 \text{ subject to: } -x1 + x2 \leq 1$$
$$-x1 + 2x2 \leq 4$$
$$x1,x2, \geq 0$$ (7)

(b) A book salesperson who lives in Basin must call once a month on four customers located in Wald, Bon, Mena, and Kiln before returning home to Basin. The following table gives the distances in miles among the different cities. Minimize the total distance traveled by the salesperson.

(7)

Miles between cities					
	Basin	Wald	Bon	Mena	Kiln
Basin	0	125	225	155	215
Wald	125	0	85	115	135
Bon	225	85	0	165	190
Mena	155	115	165	0	195
Kiln	215	135	190	195	0

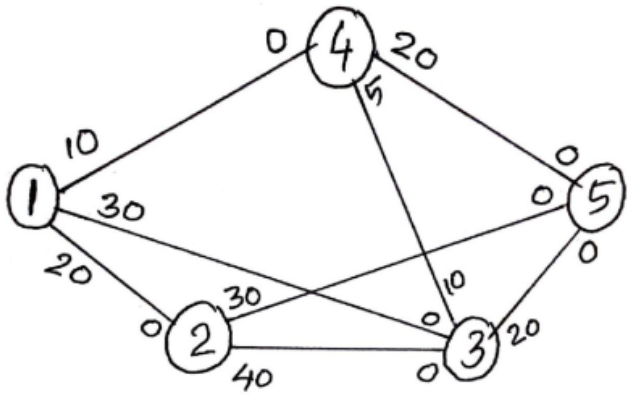
17 (a) Apply Floyd's Algorithm to find the shortest route between every two nodes for the given network. The distance in km is given on the arcs. Arc (3,5) is directional so that no traffic is allowed from node 5 to node 3. All the other arcs allow traffic in both directions.
(7)



(b) Explain Tabu Search algorithm and write two criterion for improving the quality of the final solution obtained using Tabu Search algorithm. (7)

OR

18 (a) Find the maximum flow in the following network. Also find the flow in the individual arcs ? (8)



(b) What is the relationship between P, NP and NP hard? Give at least one example and justification for each. (6)

19 (a) Explain the application of Genetic algorithm in scheduling problem. (10)

(b) What is the reason behind the infeasibility in Genetic algorithm? What are the options to deal with such infeasibility? (4)

OR

20 (a) What is the role of the Metropolis algorithm in simulated annealing? Under what assumptions, simulated annealing is described as the repeated application of Metropolis algorithm? (8)

(b) What is the need of mutation in Genetic Algorithm? What are the significant differences between Traditional algorithm and Genetic algorithm? (6)

No	Lesson Plan Contents	No. of lecture hours 37
Module 1(Basics of Operations Research) (7 hours)		
1.1	Decision-making procedure under certainty and under uncertainty	1
1.2	Operations Research-Probability and decision - making	1
1.3	Queuing or Waiting line theory	1
1.4	Simulation and Monte - Carlo Technique	1

1.5	Nature and organization of optimization problems	1
1.6	Scope and hierarchy of optimization	1
1.7	Typical applications of optimization	1
Module 2 (Formulation of optimization problems) (7 hours)		
2.1	Essential features of optimization problems	1
2.2	Objective function- Continuous functions, Discrete functions	1
2.3	Unimodal functions Convex and concave functions	1
2.4	Investment costs and operating costs in objective function	1
2.5	Optimizing profitably constraints - Internal and external constraints	1
2.6	Formulation of optimization problems	1
2.7	Continuous functions - Discrete functions - Unimodal functions - Convex and concave functions.	1

	Module 3 (Linear Programming) (7 hours)	
3.1	Necessary and sufficient conditions for optimum of unconstrained functions	1
3.2	Numerical methods for unconstrained functions	1
3.3	One-dimensional search	1
3.4	Gradient-free search with fixed step size	1
3.5	Basic concepts of linear programming	1
3.6	Graphical interpretation Simplex method	1
3.8	Apparent difficulties in the Simplex method	1
	Module 4 (Network flow Problem) (7 hours)	
4.1	Network analysis by linear programming and shortest route	1
4.2	Maximal flow problem	1

4.3	Introduction to Non-traditional optimization	1
4.4	Computational Complexity-NP-Hard, NP-Complete	1
4.5	Tabu Search - Basic Tabu search	1
4.6	Neighborhood, Candidate list	1
4.7	Short term and Long term memory	1

Module 5 (Genetic Algorithm) (8 hours)		
5.1	Introduction to heuristics search	1
5.2	Genetic Algorithms- Basic concepts (Lecture-1)	1
5.3	Genetic Algorithms- Basic concepts (Lecture-2)	1
5.4	Simulated Annealing - Acceptance probability (Lecture-1)	1
5.5	Simulated Annealing - Acceptance probability (Lecture-2)	1
5.6	Cooling, Neighborhoods, Cost function	1
5.7	Application of GA	1
5.7	Simulated Annealing in solving sequencing and scheduling problems	1
5.8	Traveling salesman problem	1

***

CXT 418	DESIGNING HUMAN CENTERED SYSTEMS	Category	L	T	P	Credit	Year of Introduction
		PEC	2	1	0	3	2021

Preamble: This course serves as an introductory exploration into the creation, development, and assessment of user interfaces. Central to the course's focus is the inquiry: how can we craft systems centered around human needs and preferences, ensuring they are both functional and user-friendly.

Prerequisite: NIL

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

CO1	Summarize a collection of methods for practicing Human-Centered Design- the discipline of developing solutions in the service of people. (Cognitive Knowledge Level: Understand)
CO2	Explain observational studies to understand work practices within real-world contexts, identifying patterns and opportunities for improvement. (Cognitive Knowledge Level: Understand)
CO3	Illustrate critical thinking skills to assess the relevance and reliability of work activity data, distinguishing between meaningful insights and noise. (Cognitive Knowledge Level: Understand)
CO4	Apply best practices in interaction design, drawing from industry standards and expert recommendations to create intuitive and user-centered interfaces. (Cognitive Knowledge Level: Apply)
CO5	Articulate design thinking, ideation, and sketching methodologies into a cohesive design process, from problem exploration to solution implementation. (Cognitive Knowledge Level: Understand)
CO6	Explain the fundamentals of mental models and their role in shaping user perception and interaction with digital products and to prototype interfaces using appropriate tools and techniques. (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 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
	Test 1 (Marks)	Test 2 (Marks)	
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 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 internal evaluation test will be conducted based on the first two modules of the Syllabus. The second internal evaluation test will be conducted based on the third and fourth modules of the Syllabus. There will be two parts: Part A and Part B. Students should answer all questions from Part A. Part B contains 7 questions each with 7 marks. Out of the 7 questions, a student should answer any 5. An assignment/quiz/open book test is to be given based on the fifth module of the Syllabus. The time duration for each internal evaluation test is 1 hour and 30 minutes.

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 (7 HRS) Observing Human Experience and Contextual Enquiry
Methods for Observing Human Experience: Ethnographic research - Interviewing, Fly-on-the-Wall Observation, Walk-a-Mile Immersion (Textbook 1) Contextual Inquiry: -Eliciting Work Activity Data (Textbook 2) Participatory Research, Evaluative Research. (Textbook 1).

Module - 2 (6 HRS) Contextual Analysis
Methods for Analyzing Challenges & Opportunities - People and Systems, Patterns and Priorities, Problem Framing. (Textbook 1) Contextual Analysis: Consolidating and Interpreting Work Activity Data (Textbook 2).

Module - 3 (8 HRS) Interaction Design Requirements
Extracting Interaction Design Requirements, Constructing Design - Informing Models: second span of the bridge, Some general "how to" suggestions, A New example domain: slideshow presentations, User models, Usage models, Work environment models, Barrier summaries, Model Consolidation, Protecting your sources, A bridged methods for design-informing models extraction, Roots of essential use cases in software use cases. (Textbook 2).

Module - 4 (7 HRS) Envisioning Future Possibilities
Methods for Envisioning Future Possibilities: Concept Ideation, Modeling and Prototyping, Design Rationale. (Textbook 1) Design Thinking, Ideation, and Sketching: Design paradigms, Design thinking, Design perspectives, User personas, Ideation, Sketching (Textbook 2).

Module - 5 (8 HRS) Mental Models and Conceptual Design
Mental Models and Conceptual Design: Introduction, Mental models, Conceptual design, Storyboards, Design influencing user behavior, Design for embodied interaction, Ubiquitous and situated interaction.
Prototyping: Introduction, Depth, and breadth of a prototype, Fidelity of prototypes, Interactivity of prototypes, Choosing the right breadth, depth, level of fidelity, and amount of interactivity, Paper prototypes, Advantages of and cautions about using prototypes, Prototypes in transition to the product, Software tools for prototyping (Textbook 2).

Text Books

1. Innovating for People: Handbook of Human-Centered Design Methods, 2012 LUMA Institute, LLC, ISBN 978-0-9857509-0-9.
2. Pardha S. Pyla and Rex Hartson, The UX Book: Process and Guidelines for Ensuring a Quality User Experience, Morgan Kaufmann / Elsevier, 2012, ISBN: 9780123852427.

Reference Books

1. Donald A. Norman. The Design of Everyday Things. Basic Books; 1st Basic edition (September 2002), ISBN: 0-465- 06710-7 (paperback).
2. Bill Buxton., Sketching User Experiences: Getting the Design Right and the Right Design (Interactive Technologies). Morgan Kaufmann, 1st edition (March 30, 2007), ISBN- 10: 0123740371.
3. Beyer, H. and Holtzblatt, K., Contextual Design: Defining Customer-Centered Systems. 1998, San Francisco, CA: Morgan Kaufmann Publishers, Inc. ISBN: 1-55860-411-1 (paperback).
4. Jakob Nielsen. Usability Engineering. Morgan Kaufmann, San Francisco, 1994. ISBN 0-12-518406-9 (paperback).

Sample Course Level Assessment Questions:

Course Outcome 1 (CO1):

1. How does ethnographic research contribute to understanding human experiences?
2. What are the key techniques involved in conducting effective interviews for gathering insights into human experiences?
3. How does walk-a-mile immersion enhance our understanding of human experiences in various contexts?
4. What are the advantages and limitations of each method for observing human experience: ethnographic research, interviewing, fly-on-the-wall observation, and walk-a-mile immersion?

Course Outcome 2 (CO2):

1. How does contextual inquiry differ from traditional methods of gathering work activity data?
2. What are the key principles of participatory research, and how do they contribute to the contextual inquiry process?
3. What are the benefits of conducting evaluative research within the contextual inquiry framework?
4. How do researchers ensure that the work activity data elicited through contextual inquiry is accurate and representative of real-world scenarios?

Course Outcome 3 (CO3):

1. What are the key patterns and priorities to consider when analyzing challenges and opportunities?
2. How does problem framing influence the outcomes of an analysis of challenges and opportunities?
3. How does contextual analysis contribute to a deeper understanding of work practices within real-world contexts?
4. What challenges may arise when interpreting work activity data within its contextual framework,

and how are they addressed?

Course Outcome 4 (CO4):

1. Apply the role of psychological factors such as cognitive biases and creativity inhibitors in shaping the ideation process, proposing strategies for mitigating their effects.
2. Critically assess the limitations of relying on user personas in design projects, considering factors such as bias, evolving user needs, and cultural diversity.
3. Illustrate the effectiveness of design thinking in addressing complex societal challenges, citing examples from both successful and unsuccessful implementations.
4. Apply the role of constraints in the ideation process, considering how limitations can foster creative problem-solving and lead to novel design solutions.

Course Outcome 5 (CO5):

5. What are the key steps involved in modeling and prototyping to explore and refine design concepts for future scenarios?
6. How does documenting design rationale help in envisioning and communicating future possibilities for a product or service?
7. What are the core principles of design thinking, and how do they shape the process of envisioning future possibilities?
8. How does sketching facilitate the exploration and communication of design ideas when envisioning future possibilities?

Course Outcome 6 (CO6):

1. How can design influence user behavior, and what strategies are effective in shaping desired behaviors?
2. How does ubiquitous and situated interaction differ from traditional interaction design approaches?
3. How do prototypes transition from the design phase to becoming a final product, and what challenges may arise during this transition?
4. What software tools are commonly used for prototyping, and what are their key features and functionalities?

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: CXT 418
Course Name: DESIGNING HUMAN-CENTERED SYSTEM

Max.Marks:100 **Duration: 3 Hours**

PART A
Answer All Questions. Each Question Carries 3 Marks

1. Describe the key steps involved in conducting a contextual inquiry.
2. Discuss the benefits and challenges of participatory research approaches.
3. "Work role is a collection of responsibilities that accomplish a coherent part of the work." Justify.
4. Define WAAD.
5. Differentiate design and development.
6. Define user models and explain their significance in the design of interactive systems.
7. Explain model consolidation with examples.
8. What is design thinking?
9. What is ideation in design?
10. How to formulate a conceptual design by using metaphors.

(10x3= 30)

Part B
(Answer any one question from each module. Each question carries 14 Marks)

11 (a) What is the significance of observing human experience in the design and development of products, services and systems **(7)**

(b) Explain the concept of contextual inquiry and its role in observing human experience. **(7)**

OR

12 (a) Discuss the importance of ethnographic research in understanding human experience within cultural contexts. (8)

(b) Differentiate between ethnographic research and participatory research. (6)

13 (a) Explain the different methods that will help in developing your ability to support all people. and systems. (7)

(b) Explain the different methods used in finding patterns and determining prioritization. (7)

OR

14 (a) List and explain methods that will help you to think differently by enabling you to ask differently. (6)

(b) Explain data interpretation in contextual analysis. (8)

15 a) Describe a scenario where a bridged method for design was successfully employed to address complex design challenges. (8)

b) Explain work environment models with examples. (6)

OR

16 (a) What is meant by "informing models" in the context of design, and why is it important in the design process? (7)

(b) Describe the Roots of essential use cases in software use cases. (7)

17(a) Explain the different methods in concept ideation and design rationale. (8)

(b) Explain the different design paradigms. (6)

OR

18(a) Explain the different design perspectives. (7)

(b) What is sketching? Explain the essential concepts in sketching. (7)

19(a) Explain the conceptual design from the emotional perspective with the help of an example. (7)

(b) Explain the importance of Between-Frame Transitions (7)

OR

20 (a) What are the key considerations when selecting tools and techniques for prototyping in mental models and conceptual design? (6)

(b)What are the limitations or challenges associated with prototyping in mental models and conceptual design. And how can they be addressed? (8)

	LESSON PLAN	
No	**Contents**	**No. of lecture hours (36 Hrs.)**
	Module 1(7 hours)	
1.1	Methods for Observing Human Experience	1
1.2	Ethnographic research - Interviewing	1
1.3	Fly-on-the-Wall Observation	1
1.4	Walk-a-Mile Immersion	1
1.5	Contextual Inquiry:-Eliciting Work Activity Data	1
1.6	Participatory Research	1
1.7	Evaluative Research	1
	Module 2(6 hours)	
2.1	Methods for Analyzing Challenges & Opportunities	1
2.2	People and Systems, Patterns and Priorities	1
2.3	Problem Framing	1
2.4	Contextual Analysis	1
2.5	Consolidating and Interpreting Work Activity Data- Lecture 1	1
2.6	Consolidating and Interpreting Work Activity Data - Lecture 1	1
	Module 3 (8 hours)	
3.1	Extracting Interaction Design Requirements	1
3.2	Constructing Design - Informing Models: second span of the bridge	1
3.3	Some general “how to” suggestions	1
3.4	A New example domain: slideshow presentations	1
3.5	User models, Usage models, Work environment models	1
3.6	Barrier summaries, Model Consolidation, Protecting your sources	1
3.7	Abridged methods for design-informing models’ extraction	1
3.8	Roots of essential use cases in software use cases	1
	Module 4 (7 hours)	
4.1	Methods for Envisioning Future Possibilities	1
4.2	Concept Ideation, Modeling, and Prototyping	1
4.3	Design Rationale	1
4.4	Design Thinking, Ideation, and Sketching	1
4.5	Design paradigms, Design thinking	1

4.6	Design perspectives	1
4.7	User personas, Ideation, Sketching	1

Module 5 (8 hours)		
5.1	Mental Models and Conceptual Design: Introduction, Storyboards	1
5.2	Design influencing user behavior, Design for embodied interaction	1
5.3	Ubiquitous and situated interaction	1
5.4	Prototyping: Introduction, Depth and breadth of a prototype	1
5.5	Fidelity of prototypes, Interactivity of prototypes	1
5.6	Choosing the right breadth, depth, level of fidelity, and amount of interactivity, Paper prototypes	1
5.7	Advantages of and cautions about using prototypes	1
5.8	Prototypes in transition to the product, Software tools for prototyping	1

CXT 428	Evolutionary Computing	Category	L	T	P	Credit	Year of Introduction
		PEC	2	1	0	3	2021

Preamble: This course helps the learner to gain knowledge of evolutionary computation techniques and methodologies in the context of modern heuristic methods. It also helps learners to get an idea of how to apply these techniques to the optimization problems and the problems that require machine learning techniques.

Prerequisite: NIL.

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

CO1	Explain the basic concepts of evolutionary algorithms and its applications **(Cognitive knowledge level: Understand)**
CO2	Utilize the different concepts of simulated annealing and hill climbing in diverse domains. **Cognitive knowledge level: Apply)**
CO3	Illustrate the concept of genetic algorithms and their applications **(Cognitive knowledge level: Understand)**
CO4	Apply different ant colony optimizations to solve problems. **(Cognitive knowledge level: Apply)**
CO5	Understand different PSO and artificial bee colony optimizations and its application to real world problems. **(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	**PO 10**	Communication
PO5	Modern tool usage	**PO 11**	Project Management and Finance
PO6	The Engineer and Society	**PO 12**	Lifelong learning

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination Marks
	Test 1 (Marks)	Test 2 (Marks)	
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 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. The first internal evaluation test is to be conducted based on the first two modules of the Syllabus. The second internal evaluation test is to be conducted based on the third and fourth modules of the Syllabus. There will be two parts: Part A and Part B. Students should answer all questions from Part A. Part B contains 7 questions each with 7 marks. Out of the 7 questions, a student should answer any 5. An assignment/quiz/open book test is to be given based on the fifth module of the Syllabus. The time duration for each internal evaluation test is 1 hour and 30 minutes.

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

Historical Development, Features, Classification and Components of Evolutionary Computing, Advantages, Applications. Comparison with other optimization techniques (Gradient Descent).

Module - 2

Simulated Annealing: Annealing Schedule, Parameter Selection, Applications. Hill Climbing: Mathematical Description, Types of hill climbing algorithms. Local and Global Maxima, Ridges, Plateau. Hybrid approaches combining Simulated Annealing and Hill Climbing.

Module - 3

Introduction to genetic algorithms -Biological Background ,Genetic Algorithm vs. Traditional Algorithms ,Simple genetic algorithm,Classification of Genetic Algorithm -Messy Genetic Algorithms,Adaptive Genetic Algorithms ,Hybrid Genetic Algorithms,Parallel Genetic Algorithm. Genetic Programming ,Working of Genetic Programming ,Characteristics of Genetic Programming ,Advantages and Limitations of Genetic Algorithm ,Applications of Genetic Algorithm.

Module 4

Ant Colony Optimization: Ant Foraging Behavior, Theoretical Considerations, Convergence Proofs, ACO Algorithm, ACO And Model Based Search, Variations Of ACO: Elitist Ant System (EAS), Minmax Ant System (MMAS) , Rank Based Ant Colony System (RANKAS).

Module 5

Principles of Bird Flocking and Fish Schooling , Evolution of PSO , Operating Principles , PSO Algorithm , Neighborhood Topologies , Convergence Criteria , Variations of PSO

Artificial Bee Colony (ABC) Optimization: Behaviour Of Real Bees, ABC Algorithm, Variations of ABC: Abcgbest and Abcgbestdist.

Text Books

1. Goldberg D E, “Genetic Algorithms in search”, Optimization and machine learning, Addison-Wesley 2005.
2. Kenneth A DeJong, “Evolutionary Computation A Unified Approach”, Prentice Hall of India, New Delhi, 2006.
3. Marco Dorigo and Thomas Stutzle, “Ant Colony optimization”, Prentice Hall of India, New Delhi 2005.

4. S.N.Sivanandam and S.N.Deepa,"Principles of Soft Computing",2nd edition,John Wiley & Sons(Module 3)
5. Elaine Rich, Kevin Knight, " Artificial Intelligence" Tata McGraw Hill Education Private Limited, 2011

Reference Books

1. E. Eiben and J. E. Smith, "An Introduction to Evolutionary Computing", Natural Computing Series, Springer, 2nd Edition, 2015.
2. Eyal Wirsansky, "Hands-On Genetic Algorithms with Python: Applying Genetic Algorithms to Solve Real-World Deep Learning and Artificial Intelligence Problems", Packt Publishing, 2020.

Sample Course Level Assessment Questions.

Course Outcome 1 (CO1):

1. Define evolutionary algorithms and explain their significance in optimization.
2. Discuss two real-world applications where evolutionary algorithms have been successfully employed. Provide details on how evolutionary algorithms were applied in each case.
3. Compare and contrast the basic concepts of evolutionary algorithms with traditional optimization techniques such as gradient descent. Highlight the advantages and limitations of each approach.

Course Outcome 2 (CO2):

1. Explain the basic principle of simulated annealing and how it differs from hill climbing algorithms.
2. Provide an example of a problem where simulated annealing would be more suitable than hill climbing. Justify your choice.
3. Design a hybrid algorithm that combines simulated annealing and hill climbing. Describe how each component of the algorithm works and how they complement each other in optimization tasks.

Course Outcome 3 (CO3):

1. Explain the different classification for genetic algorithms.
2. Discuss the advantages of genetic algorithms over traditional optimization techniques in solving complex optimization problems.
3. Show how genetic programming work.

Course Outcome 4 (CO4):

1. Describe the key principles of ant colony optimization (ACO) and its inspiration from ant foraging behavior.
2. Compare and contrast the Elitist Ant System (EAS) with the Rank Based Ant Colony System (RANKAS). Provide examples of problems where each approach would be more suitable.
3. Develop an ACO algorithm to solve the vehicle routing problem. Explain how pheromone updates and ant movement strategies are applied in your algorithm.

Course Outcome 5 (CO5):

1. Explain the operating principles of Particle Swarm Optimization (PSO) and artificial bee colony optimization.
2. Discuss the convergence criteria used in PSO algorithms and how they ensure the algorithm converges to a solution.

Model Question paper

	QP Code:	**Evolutionary Computing**	**Total Pages:3**

Reg No.:		**Name:**

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
EIGHTH SEMESTER B. TECH DEGREE EXAMINATION, MONTH and YEAR

Course Code: CXT 428

Course Name: Evolutionary Computing

Max. Marks: 100		**Duration: 3 Hours**

PART A

	Answer all questions, each carries 3 marks.	Marks
1	Explain the significance of historical development in evolutionary computing.	(3)
2	Compare and contrast evolutionary computing techniques with traditional optimization methods.	(3)
3	Describe the annealing schedule in simulated annealing and its impact on optimization performance.	(3)
4	Discuss the difference between local and global maxima in hill climbing algorithms. Provide an example to illustrate each.	(3)
5	State the general generic algorithm.	(3)

6	What is the importance of hybrid GAs?	(3)
7	Explain the theoretical considerations of Ant Colony Optimization (ACO) and how they are related to ant foraging behavior.	(3)
8	Discuss the convergence proofs in Ant Colony Optimization (ACO) algorithms.	(3)
9	Explain the principles of Bird Flocking and Fish Schooling.	(3)
10	Explain the operating principles of Artificial Bee Colony (ABC) Optimization.	(3)

PART B			
Answer any one Question from each module. Each question carries 14 Marks			
11	a)	Discuss the classification of evolutionary computing techniques and provide examples of each category?	(7)
	b)	Discuss the practical applications of evolutionary computing in diverse fields such as engineering, finance, and biology. Provide specific examples to illustrate its versatility	(7)
		OR	
12	a)	Explore the evolutionary computing techniques in modern optimization.	(7)
	b)	Explain the advantages and limitations of evolutionary computing techniques with traditional optimization methods.	(7)
13	a)	Explain how hybrid approaches combining simulated annealing and hill climbing algorithms leverage the strengths of both methods. Provide examples of real-world problems where such hybridization is beneficial.	(7)
	b)	Discuss the mathematical description of hill climbing algorithms and their various types. Evaluate the advantages and limitations of each type in optimization tasks.	(7)

		OR	
14	a)	Explain the concept of an annealing schedule in simulated annealing algorithms. How does the choice of annealing schedule affect optimization performance?	(7)
	b)	Define the terms local maxima, global maxima, ridges, and plateaus in the context of hill climbing algorithms. Provide examples to illustrate each.	(7)
15	a)	Differentiate between messy GA and parallel GA.	(7)
	b)	With a neat flowchart explain genetic programming.	(7)
		OR	
16	a)	Describe the classification of genetic algorithms. Provide insights into how each class addresses different optimization challenges.	(7)
	b)	Explain the steps in two·stage hybrid optimization approach.	(7)
17	a)	How do the convergence proofs in Ant Colony Optimization (ACO)ensure the effectiveness of ACO in finding optimal solutions?	(7)
	b)	Compare and contrast the ACO algorithm with model-based search techniques. Highlight the advantages and limitations of each approach in solving optimization problems.	(7)
		OR	
18	a)	Discuss the theoretical considerations underlying Ant Colony Optimization (ACO) algorithms, with a focus on ant foraging behavior.	(7)
	b)	Compare and contrast the variations of ACO algorithms, including Elitist Ant System (EAS), Minmax Ant System (MMAS), and Rank Based Ant Colony System (RANKAS).	(7)
19	a)	Explain the principles of bird flocking and fish schooling behaviors and their relevance to Particle Swarm Optimization (PSO) algorithms. How	(7)

		do these principles influence the design of PSO algorithms?	
	b)	Discuss the behavior of real bees that inspired the Artificial Bee Colony (ABC) Optimization algorithm. Evaluate the effectiveness of ABCgbest and ABCgbestdist variations in optimizing complex problems.	(7)
		OR	
20	a)	Explain the operating principles of Particle Swarm Optimization (PSO), including neighborhood topologies and convergence criteria.	(7)
	b)	Discuss the convergence criteria used in PSO algorithms and how they ensure the algorithm converges to a solution.	(7)

Teaching Plan		
No	**Topic**	**No. of Lectures (36 Hrs)**
	Module-1	**6 hrs**
1.1	Historical Development.	1
1.2	Features, Classification and Components of Evolutionary Computing-Lecture 1	1
1.3	Features, Classification and Components of Evolutionary Computing-Lecture 2	1
1.4	Advantages.	1
1.5	Applications.	1

1.6	Comparison with other optimization techniques-Lecture 1	1
	Module-2	**6 hrs**
2.1	Simulated Annealing.	1
2.2	Annealing Schedule, Parameter Selection.	1
2.3	Applications. Hill Climbing: Mathematical Description, Types of hill climbing algorithms.	1
2.4	Local and Global Maxima, Ridges, Plateau.	1
2.5	Hybrid approaches combining Simulated Annealing and Hill Climbing-Lecture 1	1
2.6	Hybrid approaches combining Simulated Annealing and Hill Climbing-Lecture 2	1
	Module-3	**10 hrs**
3.1	**Introduction to genetic algorithms-Biological Background**	1
3.2	**Genetic Algorithm vs. Traditional Algorithms**	1
3.3	**Simple genetic algorithm**	1
3.4	**Classification of Genetic Algorithm -Messy Genetic Algorithms**	1
3.5	**Adaptive Genetic Algorithms**	1
3.6	**Hybrid Genetic Algorithms**	1

3.7	**Parallel Genetic Algorithm**	
3.8	**Genetic Programming-Working of Genetic Programming**	1
3.9	**Characteristics of Genetic Programming, Advantages and Limitations of Genetic Algorithm**	1
3.10	**Applications of Genetic Algorithm**	1
	Module-4	**7 hrs**
4.1	Ant Colony Optimization.	1
4.2	Ant Foraging Behavior, Theoretical Considerations.	1
4.3	Convergence Proofs, ACO Algorithm.	1
4.4	ACO And Model Based Search.	1
4.5	Variations Of ACO: Elitist Ant System (EAS).	1
4.6	Minmax Ant System (MMAS)	1
4.7	Rank Based Ant Colony System (RANKAS)	1
	Module-5	**7 hrs**
5.1	Principles of Bird Flocking and Fish Schooling.	1

5.2	Evolution of PSO, Operating Principles, PSO Algorithm.	1
5.3	Neighborhood Topologies , Convergence Criteria	1
5.4	Variations of PSO	1
5.5	Artificial Bee Colony (ABC) Optimization: Behaviour Of Real Bees-Lecture 1	1
5.6	Artificial Bee Colony (ABC) Optimization: Behaviour Of Real Bees-Lecture 2	1
5.7	ABC Algorithm, Variations of ABC: Abcgbest and Abcgbestdist.	1

CXT 438	ADVANCED DATABASE SYSTEMS	Category	L	T	P	Credit	Year of Introduction
		PEC	2	1	0	3	2021

Preamble: This course will address the advanced issues in modern database systems and applications. Students will get an introduction to different Databases like Distributed Database, Active Database, Spatial Database, Temporal Database, Biological Database etc. This course also covers different indexing and optimization techniques used in Database.

Prerequisite: Database Management Systems.

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

CO1	Describe the basics of distributed database systems. **(Cognitive Knowledge Level: Understand)**
CO2	Demonstrate the features of indexing in database applications and Heuristic optimization of query trees. **(Cognitive Knowledge Level: Apply)**
CO3	Make use of concepts and techniques of Data Mining and data warehousing. **(Cognitive Knowledge Level: Apply)**
CO4	Summarize the concepts in Active Databases, Temporal Databases, Spatial Databases, Multimedia Databases and Deductive Databases. **(Cognitive Knowledge Level: Understand)**
CO5	Describe the challenges posed by GIS and Biological Databases and to explain how blockchain databases differ from the traditional 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	✓	✓	✓									✓

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	**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 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 internal evaluation test is to be conducted based on the first two modules of the Syllabus. The second internal evaluation test is to be conducted based on the third and fourth modules of the Syllabus. There will be two parts: Part A and Part B. Students should answer all questions from Part A. Part B contains 7 questions each with 7 marks. Out of the 7 questions, a student should answer any 5. An assignment/quiz/open book test is to be given based on the fifth module of the Syllabus. The time duration for each internal evaluation test is 1 hour and 30 minutes.

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 distributed Databases). (8 Hours)

Distributed database concepts, Types of Distributed Database systems, Distributed Database Architectures, Data fragmentation, replication and allocation techniques for distributed database design, query processing and optimization in distributed databases, overview of transaction management in distributed databases, overview of concurrency control and recovery in distributed databases, distributed catalogue management.

Module - 2 (Database file indexing techniques and Query optimization). (7 Hours)

Database file indexing techniques – types of single level ordered indexes, multilevel indexes, Dynamic multilevel indexes using B – Trees and B+ - trees. Heuristic Query optimization.

Module - 3 (Data Mining and Data warehousing). (7 Hours)

Data Mining – concepts, association rules, classification, clustering, applications. Data warehousing – Introduction, characteristics, modelling and building Data warehouse.

Module 4 (Advanced Database Models and Applications). (7 Hours)

Active database concepts and triggers, temporal database concepts, spatial Database concepts, multimedia database concepts, Introduction to Deductive Databases.

Module 5 (Emerging Database Technologies and Applications). (7 Hours)

Block chain Databases – Overview-, Block chain properties, Achieving Block chain properties via cryptographic hash functions, Geographic Information Systems (GIS), Biological and Genomic Databases and Emerging applications.

Text Books

1. Elmasri R. and S. Navathe, Database Systems: Models, Languages, Design and Application Programming, 6e,2013
2. Sliberschatz A., H. F. Korth and S. Sudarshan, Database System Concepts, 7/e, McGraw Hill, 2019.

Reference Books

1. Data base Management Systems, Raghurama Krishnan, Johannes Gehrke, McGrawHill Education, 3rd Edition, 2003.
2. C.J.Date, A.Kannan, S.Swamynathan, ―An Introduction to Database Systems, Eighth Edition, Pearson Education, 2006.

Sample Course Level Assessment Questions:

Course Outcome 1 (CO1):

1. State the advantages of keeping the data in a distributed database.
2. Explain different steps involved in distributed query processing.
3. Summarize the different data fragmentation techniques used in distributed databases. Give an example for each technique.

Course Outcome 2 (CO2):

1. Illustrate the structure of internal nodes and leaf nodes of a B+ -tree.
2. Show how multilevel indexing improves the efficiency of searching an index with t levels.
3. Demonstrate heuristic query optimization with an example. 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 3 (CO3):

1. List the pre-programmed functionalities that are available in a data warehouse transactional environment.
2. Consider the Data set D. Given the minimum support2, apply Apriori algorithm on this dataset**.**

Transaction ID	Items
100	A,C,D
200	B,C,E
300	A,B,C,E
400	B,E

3. Describe an association rule among hierarchies with examples.

Course Outcome 4 (CO4):

1. Demonstrate the implementation of insert, delete and update commands on a valid time relation.
2. With an example, illustrate how active rules can be specified.
3. Define the clausal form of formulas and Horn clauses.

Course Outcome 5 (CO5):

1. Explain any three constraints in GIS.
2. Explain the benefits and potential risks of sharding.
3. Explain the characteristics of biological 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: CXT 438

Course Name: ADVANCED DATABASE SYSTEMS

Max.Marks:100 **Duration: 3 Hours**

PART A
Answer All Questions. Each Question Carries 3 Marks

1. List the advantages and disadvantages of DDBMS.

2. When are voting and elections used in distributed databases?

3. Show two non-canonical query trees for the following relational algebra expression:

   Π ROLLNO, CID(COURSE⋈ENROLL⋈STUDENT))
   COURSE.CID=ENROLL.CNO
   EROLL.ROLL=STUDENT.ROLLNO.

4. What are the applications that can be developed using information in genomic and protomic databases?

5. What is a data warehouse? How does it differ from a Database?

6. How is clustering index different from primary index?

7. How do spatial databases differ from regular databases?

8. What are deductive databases?

9. Discuss briefly some of the general GIS applications.

10. What is entropy and how is it used in building decision trees?

(10x3= 30)

Part B

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

11 (a) Compare the primary site method with the primary copy method for distributed concurrency control.

(b) How does the use of backup sites affect each? **(14)**

OR

12 (a) What is a fragment of a relation in a Distributed Database? What are the main types of fragments? **(8)**

(b) Why is fragmentation a useful concept in distributed database design? **(6)**

13 (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, 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) (ii)Multi-level primary index is used. **(10)**

(b) How does multilevel indexing improve the efficiency of searching an index file? **(4)**

OR

14 (a) Consider three tables COURSE (CNO, CNAME, CREDITS), STUDENT (ROLLNO, NAME, ADDRESS, SEM) and ENROLLMENT (CNO, ROLL NO, GRADE). Foreign keys have the Same name as primary keys. Identify one initial canonical query tree for the following SQL Expression and show the steps to optimize it using heuristics. Assume that CNAME is a candidate key.

SELECT S.NAME, S. ADDRESS, E. GRADE FROM COURSE C, STUDENT S, ENROLLMENT E WHERE S. ROLLNO =E. ROLLNO AND C.CNO = E.CNO AND CNAME='ADBMS'. **(14)**

15.(a) Define data mining. Explain with an example the working of Apriori. **(7)**

(b) Consider the Data set D. Given the minimum support2, apply Apriori algorithm on this dataset**.** **(7)**

Transaction ID	Items
100	A,C,D
200	B,C,E
300	A,B,C,E
400	B,E

OR

16 Explain the steps involved in constructing a data warehouse. **(14)**

17 Explain Spatial database and its data types. **(14)**

OR

18 Explain ECA model used in Active Databases. **(14)**

19 What are the characteristics of biological data? Explain. **(14)**

OR

20 (a) Explain the distinction between a public and a permissioned blockchain and when each would be more desirable. **(7)**

(b) Explain the components in a GIS system. **(7)**

No	Lesson Plan Contents	No. of lecture hours (36 Hrs.)
Module 1 (Introduction to distributed Databases) (8 hours)		
1.1	Distributed database concepts, Types of Distributed Database systems.	1
1.2	Distributed Database Architectures.	1
1.3	Data fragmentation, replication.	1
1.4	Allocation techniques for distributed database design.	1
1.5	Query processing and optimization in distributed databases.	1
1.6	Overview of transaction management in distributed databases	1
1.7	Overview of concurrency control and recovery in distributed databases.	1
1.8	Distributed catalog management	1
Module 2 (Database files indexing techniques. Query optimization) (7 hours)		
2.1	Types of single level ordered indexes.	1
2.2	Types of single level ordered indexes	1
2.3	Multilevel indexes (sample problems required).	1
2.4	Dynamic multilevel indexes using B – Trees and B+ - trees(Structure only, Algorithms not required).	1
2.5	Dynamic multilevel indexes using B – Trees and B+ - trees(Structure only, Algorithms not required).	1
2.6	Heuristic Query optimization (sample Problems to optimize query required).	1
2.7	Heuristic Query optimization (sample Problems to optimize query required).	1

	Module 3 (Data Mining and Data warehousing) (7 hours)	
3.1	Data Mining – concepts, association rules -Market-Basket model, Support and Confidence	1
3.2	Apriori Algorithm, Sampling Algorithm.	1
3.3	Frequent-pattern tree Algorithm.	1
3.4	Classification.	1
3.5	Clustering (K- Means Clustering Algorithm), Applications of Data Mining.	1
3.6	Data warehousing – Introduction, Characteristics	1
3.7	Modelling and building Data warehouse	1
	Module 4 (Advanced Database Models and Applications) (7 hours)	
4.1	Active database concepts and triggers-generalized model, Design and implementation issues, Applications.	1
4.2	Temporal Database concepts- Time representations, Calendars, and Time Dimensions, Tuple versioning, Attribute versioning, Time series data.	1
4.3	Spatial Database Concepts- Introduction, Data types and models, Operators, Spatial data indexing, Spatial data mining, Applications of spatial data.	1
4.4	Multimedia Database Concepts- Automatic analysis of images, Object recognition in images, Semantic tagging, Analysis of audio data sources.	1
4.5	Introduction to Deductive Databases- Overview of deductive Databases, Prolog/Datalog notation	1
4.6	Clausal form and Horn Clauses, Interpretation of Rules, Datalog programs,	1
4.7	Use of relational operations, Evaluation of Non recursive Datalog Queries	1
Module 5 (Emerging Database Technologies and Applications) (7 hours)		
5.1	Block chain Databases – Overview-, Block chain properties, Achieving Block chain properties via cryptographic hash functions	1
5.2	Consensus, Data management in a Block chain, Smart contracts	1
5.3	Performance enhancement, Applications.	1
5.4	Geographic Information Systems (GIS) – Components of GIS, Characteristics of Data in GIS	1
5.5	Conceptual data models, GIS applications and software	1
5.6	Biological and Genomic Databases and Emerging applications – Characteristics of Biological Data.	1
5.7	Biological Databases, Applications.	1

***

CXT404	COMPREHENSIVE COURSE VIVA	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		PCC	1	0	0	1	2021

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.

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**

CXD416	PROJECT PHASE II	CATEGORY	L	T	P	CREDIT
		PWS	0	0	12	4

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 [COs]: After successful completion of the course, the students will be able to:

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	PO0	Communication
PO5	Modern tool usage	PO11	Project Management and Finance
PO6	The Engineer and Society	PO12	Lifelong learning

PROJECT PHASE II

Phase 2 Targets

- 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 workdone 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 forthe originality of the work done by theteam . 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 ofphase - 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 budgetplan. 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 extentafter 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 trackthe 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)

2-d	Interim Results. [CO6] [Group assessment]	**5**	There are no interim results to show.	The team showed some interim results, but they are not complete / consistent to the current stage, Some corrections are needed.	The interim results showed were good and mostly consistent/correct with respect to the current stage. There is room for improvement.	There were significant interim results presented which clearly shows the progress.
			(0 - 1 Marks)	(2 - 3 Marks)	(4 Marks)	(5 Marks)
2-e	Presentation [Individual assessment]	**5**	Very poor presentation and there is no interim results. The student has no idea about the project proposal.	Presentation is average, and the student has only a feeble idea about the team work.	Good presentation. Student has good idea about the team's project. The overall presentation quality is good.	Exceptionally good presentation. Student has excellent grasp of the project. The quality of presentation is outstanding.
			(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 o f 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 knowledgein 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 anexcellent 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 isevolved 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 toderive 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)

2-n	Presentation - Part I Preparation of slides. [CO6] [Group Assessment].	5	The presentation slides are shallow and in a clumsy format. It does not follow proper organization.	Presentation slides follow professional style formats to some extent. However, its organization is not very good. Language needs to be improved. All references are not cited properly, or acknowledged. Presentation slides needs to be more professional.	Presentation slides follow a good style format and there are only a few issues. Organization of the slides is good. Most of references are cited properly. The flow is good and team presentation is neatly organized. Some of the results are not clearly shown. There is room for improvement.	The presentation slides are exceptionally good. Neatly organized. All references cited properly. Diagrams/Figures, Tables and equations are properly numbered, and l i s ted. Results/ inferences clearly highlighted and readable.
			(0 - 1 Marks)	(2 - 3 Marks)	(4 Marks)	(5 Marks)
	Presentation - Part II: Individual Communication [CO6] [Individual Assessment].	5	The student is not communicating properly. Poor response to questions.	The student is able to explain some of the content. The student requires a lot of prompts to get to the idea. There are language issues.	Good presentation/ communication by the student. The student is able to explain most of the content very well. There are however, a few areas where the student shows lack of preparation. Language is better.	Clear and concise communication exhibited by the student. The presentation is outstanding. Very confident and tackles all the questions without hesitation. Exceptional traits of communicator.
			(0 - 1 Marks)	(2 - 3 Marks)	(4 Marks)	(5 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						

CXD482	MINI PROJECT	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		PWS	0	0	3	4	2021

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 Computer graphics. 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 Design. 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 Roman18, Bold; Heading 2 – Times New Roman16, Bold; Heading 3 – Times NewRoman14, 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.

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- **Suggestive order of documentation:**
  i. Top Cover
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  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

CXD496	MINI PROJECT	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		PWS	0	0	3	2	2021

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 IOT. 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 Design. 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 **(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.

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