MITS Kochi
Muthoot Institute of Technology and Science
(Autonomous)

MCA

(MASTER OF COMPUTER APPLICATION)

CURRICULUM & SYLLABUS

SEMESTER 1&2

2025 REGULATION

MASTER OF COMPUTER APPLICATIONS

(MCA)

2025 REGULATION

CURRICULUM & SYLLABUS

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CURRICULUM STRUCTURE

SEM	SLOT	COURSE CATEGORY	COURSE CODE	COURSE NAME	L	T	J	P	S	C	CREDIT / SEM
I	A	PC	A250201/MA100A	Mathematical Foundations for Computing	3	1	0	0	4	4	22
	B	PC	A250201/CA100B	Digital Fundamentals and Computer Architecture	3	1	0	0	4	4	
	C	PC	A250201/CA100C	Advanced Data Structures	3	1	0	0	4	4	
	D	PC	A250201/CA100D	Advanced Software Engineering	3	1	0	0	4	4	
	T	PC	A250201/CA130T	Programming Lab	1	0	0	3	0	2	
	U	PC	A250201/CA130U	Web Programming Lab	1	0	1	2	0	2	
	V	PC	A250201/CA130V	Data Structures Lab	0	1	0	3	0	2	
	K	SE	A250201/CA130K	Entrepreneurship and Innovations in Technology	0	0	0	1	0	0	
II	A	PC	A250201/CA200A	Advanced Database Management Systems	3	1	0	0	4	4	23
	B	PC	A250201/CA200B	Advanced Computer Networks	3	1	0	0	4	4	
	C	PE	A250201/CA21*C	Program Elective I	3	1	0	0	4	4	
	D	PE	A250201/CA21*D	Program Elective II	3	1	0	0	4	4	
	T	PC	A250201/CA230T	Object Oriented Programming Lab	1	0	0	3	0	2	
	U	PC	A250201/CA230U	Advanced DBMS Lab	0	1	1	2	0	2	
	V	PC	A250201/CA230V	Networking and System Administration Lab	1	0	0	3	0	2	
			A250201/CA230L	First NPTEL course						1	
III	A	PC	A250201/CA300A	Data Science and Machine Learning	3	1	0	0	4	4	22
	B	PC	A250201/CA300B	Design & Analysis of Algorithms	3	1	0	0	4	4	
	C	PE	A250201/CA31*C	Program Elective I	3	1	0	0	4	4	
	D	PE	A250201/CA31*D	Program Elective II	3	1	0	0	4	4	
	T	PC	A250201/CA330T	Data Science Lab	0	1	0	3	0	2	
	U	PC	A250201/CA330U	Mobile Application Development Lab	1	0	1	2	0	2	
	V	PS	A250201/CA330V	Mini Project	0	0	4	0	0	2	
	K	SE	A250201/CA330K	Skill Enhancement Course-III	0	0	0	1	0	0	
VI	A	PS	A250201/CA430A	Comprehensive Viva	0	0	0	0	4	4	19
	B	PS	A250201/CA430B	Main Project	0	0	0	27	12	12	
	K	PS	A250201/CA430K	Research Seminar	0	0	0	2	2	2	
			A250201/CA430L	Second NPTEL course						1	
Total Earned Credits											86

Program Elective I		
Sem	Course Code	Course Name
2	A250201/MA211C	Applied Statistics
2	A250201/CA212C	Block Chain Technology
2	A250201/CA213C	Organizational Behaviour
2	A250201/CA214C	Advanced Operating Systems
3	A250201/CA311C	Operations Research
3	A250201/CA312C	Cyber Security & Cryptography
3	A250201/CA313C	Cloud Computing
3	A250201/CA314C	Compiler Design

Program Elective II		
Sem	Course Code	Course Name
2	A250201/CA211D	IPR & Cyber Laws
2	A250201/CA212D	Business Management
2	A250201/CA213D	Cyber Forensics
2	A250201/CA214D	Artificial Intelligence
3	A250201/CA311D	Internet of Things
3	A250201/CA312D	Deep Learning
3	A250201/CA313D	Digital Image Processing
3	A250201/CA314D	Bioinformatics

PROGRAM OUTCOMES (PO)	
PO	**PO Statement**
PO 1	**Foundation Knowledge:** Apply knowledge of mathematics, programming logic and coding fundamentals for solution architecture and problem solving**.**
PO 2	**Problem Analysis:** Identify, review, formulate and analyse problems for primarily focussing on customer requirements using critical thinking frameworks.
PO 3	**Development of Solutions:** Design, develop and investigate problems with as an innovative approach for solutions incorporating ESG/SDG goals.
PO 4	**Modern Tool Usage:** Select, adapt and apply modern computational tools such as development of algorithms with an understanding of the limitations including human biases**.**
PO 5	**Individual and Teamwork:** Function and communicate effectively as an individual or a team leader in diverse and multidisciplinary groups. Use methodologies such as agile.
PO 6	**Project Management and Finance:** Use the principles of project management such as scheduling, work breakdown structure and be conversant with the principles of Finance for profitable project management.
PO 7	**Ethics:** Commit to professional ethics in managing software projects with financial aspects. Learn to use new technologies for cyber security and insulate customers from malware
PO 8	**Life-long learning:** Change management skills and the ability to learn, keep up with contemporary technologies and ways of working.

SEMESTER I

APPROVAL

This is to certify that the syllabus titled “syllabus for Master of Computer Applications (MCA)” implemented from the academic year 2025–2026, is prepared in accordance with the regulations, academic framework, and Outcome Based Education guidelines prescribed by the Institution and the affiliating University.

The syllabus has been discussed, reviewed, and approved by the following statutory bodies.

BOARD OF STUDIES (BOS)

Approved in the Board of Studies Meeting of the MCA held on 01/09/2025.

Chairperson, BoS

Name: Dr. Saritha K Designation: Professor

Signature: _____ Date: _____

ACADEMIC COUNCIL

Approved by the Academic Council in its meeting held on 30/08/2025

PRINCIPAL

Recommended for implementation from the Academic year 2025-2026.

Name: Dr. Neelakantan P C

Signature: _____ Date: _____

SEMESTER 1

CURRICULUM

SLOT	COURSE CATEGORY	COURSE CODE	COURSE NAME	L	T	J	P	SS	C
A	PC	A250201/MA100A	Mathematical Foundations for Computing	3	1	0	0	4	4
B	PC	A250201/CA100B	Digital Fundamentals and Computer Architecture	3	1	0	0	4	4
C	PC	A250201/CA100C	Advanced Data Structures	3	1	0	0	4	4
D	PC	A250201/CA100D	Advanced Software Engineering	3	1	0	0	4	4
T	PC	A250201/CA130T	Programming Lab	1	0	0	3	0	2
U	PC	A250201/CA130U	Web Programming Lab	1	0	1	2	0	2
V	PC	A250201/CA130V	Data Structures Lab	0	1	0	3	0	2
K	SE	A250201/CA130K	Entrepreneurship and Innovations in Technology	0	1	0	0	0	0
				14	**6**	**1**	**8**		**22**

(L- Lecture, T-Tutorial, J-Project, P-Practical, S-Self-learning & Team Work, C- Credit)

(PC- Programme Core, SE- Skill Enhancement Course)

COURSE DESCRIPTION							
Regulation	**2025**	**L-T-J-P-S**	**3-1-0-0-4**	**Version**	**25/0**	**Credits**	**4**
(L- Lecture, T-Tutorial, J-Project, P-Practical, S-Self-learning & Team Work)							

Course Code	**Course Name**	**Course Category**
A250201/MA100A	**MATHEMATICAL FOUNDATIONS FOR COMPUTING**	**PC**
Pre-requisite		
A basic knowledge in set theory and statistics.		

COURSE OBJECTIVES	
1	To build a strong foundation in set theory, relations, and functions, enabling them to solve computational problems.
2	To equip the students with the skills to solve linear congruences, Linear Diophantine equations and recurrence relations.
3	To introduce the basic concepts of graph theory and thereby enabling them to solve problems related to modelling, connectivity, and optimization.
4	To provide the fundamentals of linear systems of equations and eigenvalues, thereby enabling students to perform eigen decomposition of matrices.
5	To enable students to analyze bivariate data using correlation and regression coefficients and to apply curve fitting for data interpretation and prediction.

COMPETENCY STATEMENT (CC)	
CC1	**Demonstrate the ability** to apply mathematical concepts from set theory, number theory, graph theory, linear algebra, and statistics to model, analyze, and solve computational problems.

COURSE OUTCOMES (CO)

Course Outcomes (CO): At the end of this course, learners will be able to:

CO	CO Statement	CC Mapping	Cognitive (C)
CO 1	**Apply** concepts of sets, relations, and functions to solve computational problems.	CC 1	A
CO 2	**Apply** the concepts of divisibility, congruences, and recurrence relations to solve computational problems.	CC 1	A
CO 3	**Make use of** the graph theoretic concepts to model and solve computational problems.	CC 1	A
CO 4	**Apply** linear algebra techniques to solve systems of equations and eigenvalue problems.	CC 1	A
CO 5	**Apply** correlation, regression, and curve fitting for interpretation and prediction of bivariate data.	CC 1	A

Cognitive (Revised blooms Level): *- **R**: Remember; **U**: Understand; **A**: Apply; **An**: Analyse; **E**: Evaluate; **C**: Create*

	Program Outcomes & Program Specific Outcomes Correlation Matrix										
	PO								**PSO**		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**1**	**2**	**3**
1	**3**							**1**			
2	**3**							**1**			
3	**3**							**1**			
4	**3**							**1**			

Correlation [3 – High, 2 -Medium, 1 – Low]

TEACHING AND ASSESSMENT SCHEME									
Teaching Scheme / Week					Credit	Hours / Semester	Examination Scheme		
							Theory		
L	T	J	P	S	C		CIA	ESE	Total
3	1	0	0	4	4	120	40	60	100

***L**: Lecture (One unit is of one-hour duration), **T**: Tutorial (One unit is of one-hour duration), **P**: Practical (One unit is of one-hour duration), **J**: Project (One unit is of one-hour duration), **S**: Self-Learning & Team Work (One unit is of one-hour duration), **CIA**: Continuous Internal Assessment, **ESE**: End Semester Examination*

SYLLABUS (Major Topics)			
Module	Title	Major Topics	Hrs
1	**Sets, Relations and Functions**	Sets, Relations, Equivalence Relations, Partial Ordering, Functions.	**9**
2	**Number Theory and Recurrence relations**	Division Algorithm, GCD, Primes, Euclidean Algorithm, Congruences, Solutions of Linear Congruences, Chinese Remainder Theorem, Recurrence Relations.	**10**
3	**Graph Theory**	Graph Terminology, Graph Models, Representing Graphs and Graph Isomorphism, Connectivity, Shortest-Path Problems, Planar Graphs.	**9**
4	**Linear Algebra**	Linear system of equations, Gauss elimination method, Determination of eigenvalues and eigenvectors, Diagonalization of matrix, Quadratic forms.	**9**
5	**Statistics**	Bivariate data – Scatter Diagram, Linear correlation and regression, Principle of least squares, Curve fitting.	**8**

SELF-LEARNING / TEAM WORK		
Sl. No	Self-learning / Team Work Description	Hrs/Semester
1	Sets, Set Operations	3
2	Functions, Definition, Examples, one-one functions, onto functions	2
3	**Team Work**- Writing python programs to implement set operations, to check whether a given relation is reflexive, symmetric or transitive and for plotting graphs of functions.	2
4	**Practice Problems from Module 1**	5
5	Division Algorithm, prime numbers	2
6	**Assignment**- Applications of Chinese Remainder theorem in Cyber Security.	3
7	**Team Work**- Writing python programs to implement Euclidean algorithm, to solve linear Diophantine equations.	2
8	**Practice Problems from Module 2**	5
9	Graphs, Graph Models, Basic Terminology, Some Special Types of Graphs	4
10	Graph Coloring	3
11	**Practice Problems from Module 3**	5
12	Vectors, Linear Independence	3
13	Rank of a matrix	3
14	**Team Work**- Writing python programs to implement Gaussian Elimination and to find rank of a matrix.	2
15	**Practice Problems from Module 4**	5
16	Bivariate Data-scatter plot-correlation	3
17	**Team Work-** Implement scatter plot using python, writing python programs to find correlation coefficient.	3
18	**Practice Problems from Module 5**	5
		60 Hours

SUGGESTED LEARNING RESOURCES

Text Book			
Sl. No.	Title of Book	Author	Publication
1	Discrete mathematics and its applications	Kenneth H. Rosen	McGraw-Hill, (7th Edition),
2	Elementary Number Theory	David M. Burton	McGraw-Hill, 7th Edition
2	Advanced Engineering Mathematics	Erwin Kreyszig	10th ed., Wiley
3	Fundamentals of Mathematical Statistics	Gupta S.C and Kapoor V. K	Sultan Chand and Sons 11th edition.

Reference			
Sl. No.	Title of Book	Author	Publication
1	Discrete and Combinatorial Mathematics: An applied introduction	Ralph P Grimaldi	Pearson Education, 5th Edition
2	Elementary Number Theory	David M. Burton	McGraw-Hill, 7th Edition
3	Linear Algebra and its Applications	Gilbert Strang	S. Chand Company Ltd,4th edition
4	Probability and Random Process	Veerarajan T	Tata McGraw-Hill,3rd edition

Web Resource	
1	NPTEL COURSE ON DISCRETE MATHEMATICS https://youtube.com/playlist?list=PLEAYkSg4uSQ2Wfc_l4QEZUSRdx2ZcFziO&si=a8D72YEwGRZ55Dr6
2	NPTEL COURSE ON LINEAR ALGEBRA https://youtube.com/playlist?list=PLFW6lRTa1g80fZ1giRbqbe_XdXPdkkyqY&si=ng790dWbHs0eaNGU
3	NPTEL COURSE ON GRAPH THEORY https://youtube.com/playlist?list=PLEAYkSg4uSQ2fXcfrTGZdPuTmv98bnFY5&si=xLn5XiQqi5xtDuwh
4	LECTURE ON THE TOPIC BIVARIATE DATA https://youtu.be/Ro5N7DcZ-cQ?si=3Ai39Z-p2K1u8CRl
5	eBooks- https://drive.google.com/drive/folders/14bhDT1gX1AwSMQZaz_oXVBkNyvZ0GV5x?usp=drive_link

Detailed Syllabus *(Self-learning if any to be marked)*					
Module	Major Topic & Sub Topic	Mode of Delivery	Relevant Cos	Learning Domain Level	Teaching Hours
				C	
1	Sets, Set Operations	S	CO1	U	3
	Laws in Set theory	L	CO1	A	2
	Relations-Definition and properties, Classification of relations	L	CO1	U	1
	Equivalence relation, Equivalence class	L	CO1	A	1
	Partial Ordering Relation	L	CO1	A	1
	Matrix Representation of Relations, Closure of relation	L	CO1	U	1
	Transitive Closure Using Warshall's Algorithm	L	CO1	A	1
	Functions, Definition, Examples, one-one functions, onto functions	S	CO1	U	2
	Bijection, Composition of functions, Inverse, n-ary relation	L	CO1	A	2
2	Division Algorithm, prime numbers	S	CO2	U	2
	Greatest common Divisor, Euclidean Algorithm	L	CO2	A	1
	Extended Euclidean Algorithm	L	CO2	A	1
	Linear Diophantine Equations	L	CO2	A	1

	Congruences -definition, properties	L	CO2	U	1
	Linear congruence-solutions	L	CO2	A	2
	Recurrence relation -introduction, First order Linear Recurrence Relation	L	CO2	U	1
	Second Order Linear Homogeneous Recurrence Relation with constant coefficients	L	CO2	U	1
	Non-homogeneous Recurrence relation	L	CO2	A	2
3	Graphs, Graph Models, Basic Terminology, Some Special Types of Graphs	S	CO3	U	4
	Representation of Graphs (simple graphs, multi graphs, digraphs)	L	CO3	U	2
	Isomorphism of Graphs	L	CO3	U	1
	Connectivity in Graphs, Euler Graphs	L	CO3	A	2
	Hamiltonian Graphs, Connectivity in Digraphs, Shortest path problems	L	CO3	A	2
	Planar Graphs -Introduction, Examples, Euler's Formula	L	CO3	U	1
	More results related to planar graphs, Kuratowski's theorem	L	CO3	A	1
4	Vectors, Linear Independence	S	CO4	U	5
	Rank of a matrix	S	CO4	U	3
	Solving System of Equations Using Gaussian Elimination-three different cases -	L	CO4	A	3
	Eigenvalues and Eigenvectors – definition	L	CO4	U	1
	Eigenvalues and Eigenvectors of a matrices of order 2,3	L	CO4	A	2
	Diagonalizability	L	CO4	A	1
	Quadratic forms, Principal Axes theorem	L	CO4	A	2
5	Bivariate Data-scatter plot-correlation	S	CO5	U	3
	Karl Pearson's Coefficient of correlation	L	CO5	A	1
	Spearman's rank Correlation	L	CO5	A	2
	Curve fitting-Principle of Least squares, Fitting of a straight line	L	CO5	A	2
	Fitting of a Parabola	L	CO5	A	1
	Regression concept, Lines of Regression	L	CO5	A	1
	Regression coefficients, properties	L	CO5	A	1

TABLE OF SPECIFICATIONS (ToS) FOR QUESTION PAPER DESIGN

Module	Module Title	Distribution of Marks (Revised Bloom's Level)						Total Marks
		R	U	A	An	E	C	
1	Sets, Relations and Functions	√	√	√				12
2	Number Theory and Recurrence relations	√	√	√				12
3	Graph Theory	√	√	√				12
4	Linear Algebra	√	√	√				12
5	Statistics	√	√	√				12

This ToS shall be treated as a general guideline for students and teachers for distribution of marks.

ASSESSMENT PATTERN	
Assessment Methods	**Marks**
Continuous Internal Assessment	**40**
1.Internal Examination	**20**
2. Learning Activity	**12**
3. Regularity	**8**
4. Course Project	
End Semester Examination	**60**
Total	**100**

MODEL QUESTION PAPER

			Total Pages: 2
Register No.:	.....	Name:	.....

(AN AUTONOMOUS COLLEGE AFFILIATED TO APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY, THIRUVANATHAPURAM)

FIRST SEMESTER MCA DEGREE (REGULAR) EXAMINATION, DECEMBER 2025 (2025 SCHEME)			
Course Code:	**A250201/MA100A**		
Course Name:	**MATHEMATICAL FOUNDATIONS FOR COMPUTING**		
Max. Marks	**60**	**Duration**:	3 hours

PART A

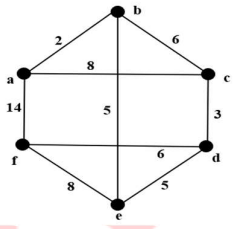
(Answer all questions. Each question carries 3 marks)

No.	***Question***	***CO***	***Marks***
1	Let A and B be two sets such that $A - B = B - A$. If $A \cap B = \{1,3,5,7\}$ determine the sets A and B.	CO 1	(3)
2	Obtain the matrix representation of the relation $\bar{R}$ on the set $A = \{1,2,3,4\}$ where $R = \{(m,n): n = 5 - m\}$.	CO 1	(3)
3	Find the smallest even natural number that leaves a remainder of 1 when divided by 5 and a remainder of 5 when divided by 7.	CO 2	(3)
4	Prove that the square of any integer is of the form $3k$ or $3k+1$ where $k \in \mathbb{Z}$.	CO 2	(3)
5	Define bipartite graph. For which values of n is the cycle C_n bipartite? Justify your answer.	CO 3	(3)
6	The adjacency matrix A of a connected simple graph G is given below. Determine whether G is Euler. $A = \begin{bmatrix} 0 & 1 & 0 & 1 \\ 1 & 0 & 1 & 0 \\ 0 & 1 & 0 & 1 \\ 1 & 0 & 1 & 0 \end{bmatrix}$.	CO 3	(3)
7	Find the values of a and b such that following system of equations is consistent with unique solution. $ax + by = 0$ $-bx + ay = 0.$	CO 4	(3)
8	Reduce the matrix $A = \begin{bmatrix} 1 & 2 & 3 \\ 1^2 & 2^2 & 3^2 \\ 1^3 & 2^3 & 3^3 \end{bmatrix}$ to row-echelon form and obtain its rank.	CO 4	(3)
9	Use principle of least squares to obtain the line of best fit, y= $a + bx$ for the following data; x: 0, 2, 3, 4 y: 1, 4, 6, 9	CO 5	(3)
10	Let X and Y be two variables in a bivariate data. The coefficient of regression of X on Y is 2 and the coefficient of regression of Y on X is 0.5. Find the coefficient of correlation. State the nature of correlation.	CO 5	(3)

PART B

(Answer any one full question from each module, each question carries 6 marks)

No.		***Question***	***CO***	***Marks***
		MODULE I		
11	a)	Determine whether the relation R on the set of integers $\mathbb{Z}$ defined by, $R = \{(x,y): xy \geq 0, x, y \in \mathbb{Z}\}$ is an equivalence relation.	CO 1	(4)
	b)	Let $f, g: \mathbb{R} \to \mathbb{R}$ defined by $f(x) = 4x + 2$ and $g(x) = 7x + 4$.Obtain the composite functions $f \circ g$ and $g \circ f$.	CO 1	(2)
		OR		
12	a)	Find the transitive closure of the relation $R = \{(1,2),(2,1),(2,3),(3,4),(4,1)\}$ on the set $A = \{1,2,3,4\}$ using Warshall's Algorithm.	CO 1	(4)
	b)	Determine whether the function $f: \mathbb{R} \to \mathbb{R}$ defined by $f(x) = x^3 - x$ is invertible.	CO 1	(2)

		MODULE II		
13		Solve the recurrence relation $a_{n+2} - 4a_{n+1} + 3a_n = 2(3^n)\ \forall\ n \geq 2$ with initial conditions $a_0 = 3$ and $a_1 = 8$.	CO 2	(6)
		OR		
14		Obtain the Bezout's Identity to express gcd(252,198) as linear combination of 252 and 198.	CO 2	(6)
		MODULE III		
15	a)	If G is a connected planar graph with v vertices and e edges and $v \geq 3$. Prove that $e \leq 3v - 6$.	CO 3	(4)
	b)	Show that K_5 is non-planar.	CO 3	(2)
		OR		
16		Using Dijkstra's algorithm find the length of shortest paths from the vertex a to each of the other vertices and give examples of such paths in the following graph.  	CO 3	(6)
		MODULE IV		
17		Diagonalize the matrix $\begin{bmatrix} 4 & 1 & -1 \\ 2 & 5 & -2 \\ 1 & 1 & 2 \end{bmatrix}$.	CO 4	(6)
		OR		
18		What kind of conic section is given by the quadratic form $4x_1^2 + 6x_1x_2 - 4x_2^2 = 10$? Transform it to principal axes.	CO 4	(6)
		MODULE V		
19		A programmer records the number of comparisons (Y) made by a Bubble Sort algorithm for different list lengths(X). x: 1, 3, 4, 7, 8, 9 y: 0, 3, 6, 21, 28, 36 Fit a second-degree curve $y = a + bx + cx^2$ to the above bivariate data and estimate the number of comparisons required if the list length is 100.	CO 5	(6)
		OR		
20		Obtain Spearman's rank correlation coefficient for the following bivariate data: x: 68, 64, 75, 50, 64, 80, 75, 40 y: 62, 58, 68, 45, 81, 60, 68, 48	CO 5	(6)

****

COURSE DESCRIPTION							
Regulation	**2025**	**L-T-J-P-S**	**3-1-0-0-4**	**Version**	**25/0**	**Credits**	**4**
(L- Lecture, T-Tutorial, J-Project, P-Practical, S-Self-learning & Team Work)							

Course Code	Course Name	Course Category
A250201|CA100B	**DIGITAL FUNDAMENTALS & COMPUTER ARCHITECTURE**	**PC**
Pre-requisite		
Understanding number systems and binary arithmetic.		

COURSE OBJECTIVES	
1	To enable students to apply the fundamentals of digital electronics in designing and implementing simple combinational logic circuits.
2	To equip students with the ability to apply digital electronics principles for the design and implementation of sequential logic circuits.
3	To enable students to comprehend the fundamental design features of computer architecture, components, addressing modes and instruction formats.
4	To provide students with insights into processor logic design conventions, data paths, pipelining and hazards, as well as I/O organization, interrupts, and direct memory access.
5	To enable students to gain a comprehensive knowledge on memory systems and to apply effective memory design techniques for improving computer system performance.

COMPETENCY	
CC1	Demonstrate the ability to apply the principles of digital electronics to design, analyse, and implement simple combinational and sequential circuits based on specific requirements.
CC2	Demonstrate a clear insight on modern computer architecture and organization, including the design features, key components and functional aspects of a computer system.

COURSE OUTCOMES

Course Outcomes (CO): At the end of this course, learners will be able to:

CO	CO Statement	CC Mapping	Cognitive (C)
CO 1	**Apply** the basics of digital electronics to design and realize simple combinational logic circuits.	CC 1	A
CO 2	**Apply** the principles of digital electronics to design sequential logic circuits.	CC 1	A
CO 3	**Apply** the principles of computer architecture, key components, processor and memory technologies, addressing modes and instruction formats in problem-solving.	CC 2	A
CO 4	**Apply** processor design conventions, pipelining, I/O organization, interrupts and DMA in computer system operations.	CC 2	A
CO 5	**Analyse** the characteristics of RAM, ROM, cache, virtual memory, and evaluate different memory design techniques for system performance.	CC 2	An

Cognitive (Revised blooms Level): *- **R**: Remember; **U**: Understand; **A**: Apply; **An**: Analyse; **E**: Evaluate; **C**: Create*

	Program Outcomes & Program Specific Outcomes Correlation Matrix										
	PO								PSO		
CO	1	2	3	4	5	6	7	8	1	2	3
1	3	3	3					3			
2	3	3	3					3			
3	3	2	2					3			
4	3	2	2					3			
5	3	2	2					3			

Correlation [3 – High, 2 -Medium, 1 – Low]

TEACHING AND ASSESSMENT SCHEME									
Teaching Scheme / Week					Credit	Hours / Semester	Examination Scheme		
							Theory		
L	T	J	P	S	C		CIA	ESE	Total
3	1	0	0	4	4	120	40	60	100

***L**: Lecture (One unit is of one-hour duration), **T**: Tutorial (One unit is of one-hour duration), **P**: Practical (One unit is of one-hour duration), **J**: Project (One unit is of one-hour duration), **S**: Self-Learning & Team Work (One unit is of one-hour duration), **CIA**: Continuous Internal Assessment, **ESE**: End Semester Examination*

SYLLABUS (Major Topics)			
Module	Title	Major Topics	Hrs
1	Logic Gates, Boolean algebra & Combinational Circuits	Representation of signed numbers – 1's complement and 2's complement, Logic gates – AND OR – NOT - NAND- NOR - XOR , Boolean algebra - Basic laws and theorems , Boolean functions - truth table, Standard forms of Boolean Expressions – Sum of Products and Product of Sums - minimization of Boolean function using Karnaugh map method - Realization using logic gates, Floating point numbers Combinational Circuits - Half adder - Full Adder- Decoder -Encoder- Multiplexer – Demultiplexer	11
2	Sequential circuits, Counters & Registers	Sequential circuit - Clocking, Flip flops - SR – JK- D -T flip flops, Counters - Synchronous and asynchronous counters - UP/DOWN counters, Registers - Serial in serial out - Serial in parallel out - Parallel in serial out - Parallel in parallel out registers	10
3	Computer Architecture	Computer abstractions and technology - Introduction, Computer architecture -8 Design features, Application program - layers of abstraction, Five key components of a computer, Technologies for building processors and memory, Performance, Instruction set principles – Introduction, Classifying instruction set architectures, Memory addressing, Encoding an instruction set.	10
4	Processor and I/O	The Processor - Introduction, Logic design conventions, Building a data path, A simple implementation scheme, An overview of pipelining - Pipelined data path and control - Structural hazards - Data hazards - Control hazards I/O organization - Accessing I/O devices, interrupts - handling multiple devices, Direct memory access	10
5	Memory	The Memory System – basic concepts, semiconductor RAM memories - organization – static and dynamic RAM, Structure of larger memories, semiconductor ROM memories, Speed, Size and cost, Cache memory – mapping functions – replacement algorithms, Virtual memory – paging and segmentation.	9

SELF-LEARNING / TEAM WORK		
Sl. No	Self-learning / Team Work Description	Hrs
1	Sign Magnitude representation Universal gates, Realization of other logic gates using universal gates Minimization of POS expression using K-map method Realization of full adder using two half adders, 1 bit magnitude comparator	10
2	Comparison of sequential circuits with combinational circuits, Master Slave flipflop	10
3	Bus Structure, RISC and CISC, Introduction to Arduino and Raspberry Pi	10
4	Input devices, Output devices, Modern processors, Overview of Hardware Description Languages (HDL) such as Verilog or VHDL	20
5	Memory Hierarchy, Compare RAM and ROM, Shared memory	20

SUGGESTED LEARNING RESOURCES

Text Book			
Sl. No.	Title of Book	Author	Publication
1	Digital Fundamentals	Thomas L Floyd	Pearson Education, 11th edition, 2018
2	Fundamentals of Digital Circuits	A Anand Kumar	PHI, 4th edition, 2016
3	Computer Organization and Design: The Hardware/Software Interface	David A. Patterson, John L. Hennessy	Elsevier (India) Pvt. Ltd., New Delhi, 6th edition, 2021
4	Computer Organization	Hamacher, Vranesic & Zaky	5th Edition, McGraw Hill

Reference			
Sl. No.	Title of Book	Author	Publication
1	Computer Organization and Architecture: Designing for Performance	William Stallings	Pearson Education 11th edition, 2022
2	Modern Digital Electronics	R. P. Jain, Kishore Sarawadekar	McGraw Hill., 5 th Edition, 2022
3	Digital Design: With an Introduction to Verilog HDL	M Morris Mano, Michael D Ciletti	Pearson Education, 6th Edition, 2018

Web Resource	
1	https://www.coursera.org/learn/computer-architecture
2	https://nptel.ac.in/courses/106105185
3	https://nptel.ac.in/courses/108105132

Module	Major Topic & Sub Topic	Mode of Delivery	COs	Learning Domain Level C	Teaching Hours
1	Signed Numbers- Representation, 1's complement and 2's complement	L	CO1	A	2
	Different Logic Gates- AND, OR, NOT, NAND NOR, XOR, XNOR	L,T	CO1	A	2
	Boolean Algebra - Basic laws and theorems, Boolean functions- truth table, Standard forms of Boolean Expressions – Sum of Products and Product of Sums - minimization of SOP expression using Karnaugh map method, Realization using logic gates	L	CO1	A	4
	Combinational Circuits - Half adder, Full Adder, Decoder, Encoder, Multiplexer, Demultiplexer	L,T	CO1	A	3
2	Introduction - Clocking,	L	CO2	A	1
	Flipflops-RS, JK, D, T flip flops	L,T	CO2	A	3
	Counters-Synchronous and asynchronous counters, UP/DOWN counters.	L	CO2	A	4
	Registers- Serial in serial out,Serial in parallel out, Parallel in serial out, Parallel in parallel out registers	L	CO2	A	2
3	Design features Computer abstractions and technology, Computer architecture, 8 Design features, Application program, layers of abstraction	L	CO3	A	3
	Key Components Input unit, output unit, CPU, ALU, Control unit, Memory Technologies for building processors and memory, Performance	L	CO3	A	4

	Instruction set principles- Introduction, Classifying instruction set architectures, Memory addressing, Encoding an instruction set, Addressing modes	L	CO3	A	3
4	The Processor- Introduction, Logic design conventions, Building a data path, A simple implementation scheme	L	CO4	A	4
	An overview of pipelining- Pipelined data path and control - Structural hazards - Data hazards - Control hazards	L,T	CO4	A	3
	I/O organization- Accessing I/O devices, interrupts - handling multiple devices, Direct memory access	L	CO4	A	3
5	The Memory System Basic concepts, semiconductor RAM memories, organization, static and dynamic RAM, Structure of larger memories, semiconductor ROM memories, Speed, Size and cost	L,T	CO5	An	3
	Cache memory - Mapping functions, Replacement algorithms	L,T	CO5	An	3
	Virtual memory - Paging and segmentation	L	CO5	An	3

TABLE OF SPECIFICATIONS (ToS) FOR QUESTION PAPER DESIGN

Module	Module Title	Distribution of Marks (Revised Bloom's Level)						Total Marks
		R	U	A	An	E	C	
1	Logic Gates, Boolean algebra & Combinational Circuits	✓	✓	✓				12
2	Sequential circuits, Counters & Registers	✓	✓	✓				12
3	Computer Architecture	✓	✓	✓				12
4	Processor and I/O	✓	✓	✓				12
5	Memory	✓	✓	✓	✓			12

This ToS shall be treated as a general guideline for students and teachers for distribution of marks.

ASSESSMENT PATTERN

Assessment	Marks
Continuous Internal Assessment	**40**
1. Internal Examination	20
2. Learning Activity	12
3. Regularity	8
4. Course Project	
End Semester Examination	60
Total	**100**

MODEL QUESTION PAPER

			Total Pages : 2
Register No.:	.....	Name:	.....

(AN AUTONOMOUS COLLEGE AFFILIATED TO APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY, THIRUVANATHAPURAM)

FIRST SEMESTER MCA DEGREE (REGULAR) EXAMINATION, DECEMBER 2025 (2025 SCHEME)			
Course Code:	**A250201/CA100B**		
Course Name:	**DIGITAL FUNDAMENTALS AND COMPUTER ARCHITECTURE**		
Max. Marks	**60**	**Duration**:	3 hours

PART A

(Answer all questions. Each question carries 3 marks)

No.	*Question*	*CO*	*Marks*
1	Express +45 and -45 in sign magnitude, 1's complement and 2's complement notations.	CO1	(3)
2	Identify the combinational circuit used for data selection, allowing one input to be chosen from several available inputs and send to a single output.	CO1	(3)
3	Sketch the block diagrams of combinational and sequential circuit and differentiate between them.	CO2	(3)
4	Demonstrate the working of a JK flip flop. How does it eliminate the invalid condition in SR flip flop?	CO2	(3)
5	Explain the role of special purpose registers in a computer.	CO3	(3)
6	Apply the concept of byte ordering to illustrate the difference between little-endian and big-endian representations.	CO3	(3)
7	Apply Direct Memory Access (DMA) to demonstrate how data transfer takes place without CPU intervention.	CO4	(3)
8	Demonstrate how a processor executes instructions and controls system operations.	CO4	(3)
9	Using the concept of memory hierarchy, explain the various components, their interaction and performance.	CO5	(3)
10	Explain how virtual memory handles large programs on limited physical memory.	CO5	(3)

PART B

(Answer any one full question from each module, each question carries 6 marks)

No.		*Question*	*CO*	*Marks*
		MODULE I		
11	a)	Apply De Morgan's theorem and prove using a truth table that a NAND gate is equivalent to an OR gate with inverted (bubbled) inputs.	CO1	(2)
	b)	Minimize the Boolean expression f (A, B, C, D) = Σm (1,5,6,7,9,15) + d (2,3,11,13) using Karnaugh map and realize it using logic gates.	CO1	(4)
		OR		
12	a)	Apply the concept of decoder to sketch the functional block diagram of a 2-to-4 decoder.	CO1	(2)
	b)	Design a combinational circuit to add two binary inputs and realize the circuit using logic gates.	CO1	(4)
		MODULE II		
13	a)	Identify the basic storage element applied in designing a 1-bit memory cell in a sequential circuit.	CO2	(2)
	b)	Design an asynchronous Mod 6 counter using T flipflops.	CO2	(4)
		OR		
14	a)	Identify the sequential circuit applied for tracking the number of occurrences of input pulses in digital systems.	CO2	(2)
	b)	Apply the functionality of various shift registers in data storage and transfer operations. Provide examples showing how data is input and output.	CO2	(4)

MODULE III				
15	a)	Explain the major design features applied in computer architecture that influence performance and efficiency.	CO3	(2)
	b)	Demonstrate how the five classic components of a computer system work together to perform a specific task. Use a diagram to support your explanation.	CO3	(4)
OR				
16	a)	How instruction set is applied in a CPU to perform various operations?	CO3	(2)
	b)	Explain the concept of addressing modes and demonstrate the use of any 3 addressing modes by providing examples for each.	CO3	(4)
MODULE IV				
17	a)	State the sequence of steps applied by a processor to execute an instruction.	CO4	(2)
	b)	Identify the different types of pipeline hazards by describing each type with an example, and explain how these hazards affect instruction execution in a pipelined CPU.	CO4	(4)
OR				
18	a)	Explain how a single bus structure can be applied to transfer data among registers and memory.	CO4	(2)
	b)	Demonstrate how a computer system handles interrupts from multiple devices by applying the concept of interrupt priority and control mechanisms.	CO4	(4)
MODULE V				
19	a)	Identify the memory used to supplement the primary memory and analyse its characteristics.	CO5	(2)
	b)	Compare and contrast the various types of ROM by analysing their features, advantages, limitations and specific use cases.	CO5	(4)
OR				
20	a)	Analyse the effect of hit and miss in cache memory on the overall performance of a computer.	CO5	(2)
	b)	Differentiate between the various cache mapping techniques by breaking down how each method organizes and accesses data. What are the strengths and weaknesses of each and how do they affect overall system performance?	CO5	(4)

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COURSE DESCRIPTION							
Regulation	**2025**	**L-T-J-P-S**	**3-1-0-0-4**	**Version**	**25/0**	**Credits**	**4**
(L- Lecture, T-Tutorial, J-Project, P-Practical, S-Self-learning & Team Work)							

Course Code	Course Name	Course Category
A250201/CA100C	**ADVANCED DATA STRUCTURES**	**PC**
Pre-requisite		
A solid understanding of basic data structures and fundamentals of programming in C		

COURSE OBJECTIVES	
1	To build a foundation in basic data structures for problem solving.
2	To analyse and apply hashing, sets, amortized analysis, and disjoint sets.
3	To evaluate and implement advanced tree and heap structures.
4	To equip students with the skills to **design and create efficient graph-based solutions** for real world computational problems.

COMPETENCY STATEMENT (CC)	
CC1	Apply advanced data structures to design and implement efficient algorithms for real-world computational problems.

COURSE OUTCOMES (CO)

Course Outcomes (CO): At the end of this course, learners will be able to:

CO	CO Statement	CC Mapping	Cognitive (C)
CO1	**Apply** arrays, stacks, queues, linked lists, and trees to solve computational problems.	CC1	A
CO 2	**Analyse** hashing techniques, set representations, amortized analysis methods, and disjoint set operations for efficient data handling.	CC1	An
CO 3	**Apply** advanced tree structures for efficient data organization and retrieval.	CC1	A
CO 4	**Apply** advanced heap structures and perform efficient heap operations to solve computational problems.	CC1	A
CO 5	**Apply** graph traversal, spanning tree, and shortest path algorithms to design efficient graph-based solutions.	CC1	A

Cognitive (Revised blooms Level): *- **R**: Remember; **U**: Understand; **A**: Apply; **An**: Analyse; **E**: Evaluate; **C**: Create*

	Program Outcomes & Program Specific Outcomes Correlation Matrix										
	PO								**PSO**		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**1**	**2**	**3**
1	**3**	**2**	**2**	**2**				**1**			
2	**3**	**3**	**2**	**2**				**1**			
3	**3**	**2**	**3**	**3**				**1**			
4	**2**	**3**	**3**	**3**				**1**			
5	**2**	**3**	**3**	**3**				**2**			

Correlation [3 – High, 2 -Medium, 1 – Low]

TEACHING AND ASSESSMENT SCHEME									
Teaching Scheme / Week					Credit	Hours / Semester	Examination Scheme		
							Theory		
L	T	J	P	S	C		CIA	ESE	Total
3	1`	0	0	4	4	120	40	60	100

***L**: Lecture (One unit is of one-hour duration), **T**: Tutorial (One unit is of one-hour duration), **P**: Practical (One unit is of one-hour duration), **J**: Project (One unit is of one-hour duration), **S**: Self-Learning & Team Work (One unit is of one-hour duration), **CIA**: Continuous Internal Assessment, **ESE**: End Semester Examination*

SYLLABUS (Major Topics)			
Module	Title	Major Topics	Hrs
1	Basic Data Structures	Basic Data Structures: - Arrays and Its representation, Stack, Queue and its Applications, Circular Queue, Priority Queue, Linked List- Singly LL, DLL, CLL., Header Linked List, Linked Stack and Linked Queue, Introduction to Tree	**12**
2	Hashing and Set data structure	Hashing: - Simple hash functions, Collision and Collision Resolution techniques Set Data Structure: - Representation of sets, Set implementation using bit string. Amortised Analysis - Aggregate, Accounting and Potential Methods (using the examples Multipop Stack and Incrementing Binary Counter only) Disjoint sets- representations, Union, Find algorithms	**8**
3	Advanced tree structures	Advanced Tree Structures: - Balanced Binary Search trees, Red-Black trees- Properties of Red Black trees, Rotations, Insertion, Deletion. B-Trees- Basic operations on B-Trees – Insertion and Deletion, Introduction to Splay Trees and Suffix Trees.	**12**
4	Advanced Heap structures	Advanced Heap Structures: - Mergeable Heaps and operations on Mergeable Heaps. Binomial Heaps, Binomial Heap operations and Analysis, Fibonacci Heaps, Fibonacci Heap operations and Analysis.	**10**
5	Advanced Graph Structures	Advanced Graph Structures: - Representation of graphs, Depth First and Breadth First Traversals, Topological Sorting, Strongly connected Components and Biconnected Components Minimum Cost Spanning Tree algorithms- Prim's Algorithm, Kruskal' Algorithm, Shortest Path Finding algorithms – Dijikstra's single source shortest paths algorithm.	**9**

SELF-LEARNING / TEAM WORK		
Sl. No	Self-learning / Team Work Description	Hrs
1	Real-world applications of stack & queue	3
2	Double Ended Queue operations, Applications of Linked List, Create an application/Animations for various sorting methods	5
3	Team work- Implement priority queues and discuss their applications	4
4	Team work-Design a small simulation (like ticket booking or job scheduling) using queue or linked list.	4
5	Binary Expression Tree, Create Binary Expression Tree from expression.	5
6	Team work- Applications of trees in real-world (compiler design, databases, networks)	5
7	Mini Project: Build a simple dictionary using BST/AVL	5
8	Applications of Binomial Heap, and Fibonacci Heap	4
9	Team work- Mergeable heaps vs Binary heaps (use cases & efficiency)	5
10	Implement binomial heap operations in groups	5
11	**Lab work**	5

12	All Pairs Shortest Path Algorithm, learn about Bellman-Ford Algorithm for Finding Single-Source Shortest Paths in Weighted Graphs with Negative Edge Weights and Detecting Negative Cycles.	4
13	Case study: Real-world applications of shortest path algorithms (network routing, transportation, etc.)	5
14	Team work-Applications of shortest path algorithms in AI (path planning/robotics)	5
15	**Lab work**	5

SUGGESTED LEARNING RESOURCES

Text Book			
Sl. No.	Title of Book	Author	Publication
1	Introduction to Algorithms	Cormen T.H., Leiserson C.E, Rivest R.L. and Stein C	Prentice Hall India, New Delhi, 4th edition, 2022
2	Classic Data structures	D.Samantha	Prentice Hall India, New Delhi,2009

Reference			
Sl. No.	Title of Book	Author	Publication
1	Data Structures – a pseudocode approach with C	Richard F Gilberg, Behrouz A Forouzan	Thomson Learning, 2nd Edition, Cengage Learning C, 2005, ISBN-13: 9780534390808
2	Fundamentals of Data Structures In C	Ellis Horowitz and Sartaj Sahni	Orient Blackswan,2008, ISBN: 9788173716058, 8173716056
3	Data Structures, Algorithms, and Applications in C++	Sahni S	Mc Graw Hill, 2000, ISBN-13: 978-0072362268
4	Data Structures and Algorithms	Aho A.V., Hopcroft J.E., and Ullman J.D.	Pearson Education, New Delhi, 1983, ISBN 13: 9780201000238

Web Resource	
1	http://www.digimat.in/nptel/courses/video/106102064/L01.html
2	https://ds1-iiith.vlabs.ac.in/List%20of%20experiments.html
3	https://www.programiz.com/dsa/stack
4	https://www.geeksforgeeks.org/queue-data-structure/
5	https://www.upgrad.com/blog/sorting-in-data-structure-with-examples/
6	https://www.javatpoint.com/hashing-in-data-structure
7	https://www.geeksforgeeks.org/applications-advantages-and-disadvantages-of-set/
8	https://www.tutorialspoint.com/time-and-space-complexity-in-data-structure
9	https://www.scholarhat.com/tutorial/datastructures/avl-tree-in-data-structures
10	https://www.javatpoint.com/daa-red-black-tree
11	https://www.baeldung.com/cs/b-tree-data-structure

DETAILED SYLLABUS *(Self-learning if any to be marked)*

Module	Major Topic & Sub Topic	Mode of Delivery	COs	Learning Domain Level (C)	Teaching Hours
1	Review of basic data structures Array, and Its representation	L	CO1	A	2
	Stack, Queue and its Applications	L,T	CO1	A	2
	Circular Queue,	L	CO1	A	1
	Priority Queue	L,T	CO1	A	1
	Linked List- Singly LL	L	CO1	A	1
	DLL	L,T	CO1	A	1
	CLL	L	CO1	A	1
	Header Linked List	L,T	CO1	A	1
	Linked Stack and Linked Queue	L	CO1	A	1

	Introduction to Tree	L	CO1	A	1
2	Representation of sets, Set implementation using bit string.	L	CO2	A	1
	Hashing – Simple hash functions	L	CO2	A	1
	Collision and Collision Resolution techniques	L	CO2	U	1
	Amortised Analysis- Aggregate Method (Multipop Stack and Incrementing Binary Counter)	L	CO2	A	1
	Accounting Method (Multipop Stack and Incrementing Binary Counter)	L	CO2	U	1
	Potential Method (Multipop Stack and Incrementing Binary Counter)	L	CO2	U	1
	A Disjoint sets- representations	L	CO2	U	1
	Union, Find algorithms	L	CO2	U	1
3	Tree terminologies, Types of Binary Trees, Representation of Binary tree	L	CO3	A	1
	Introduction to Binary Search Tree, Creation of BST with example	L	CO3	U	1
	Implementation of the creation of a node in BST, Insertion operation with algorithm and example	L	CO3	A	1
	Different traversal operations, Searching operation	L	CO3	A	1
	Properties of Red Black Tree, Left Rotation & Right Rotation	L	CO3	U	1
	Insertion of a new node with example	L	CO3	A	1
	Deletion with example	L	CO3	A	1
	B-Trees- Introduction	L	CO3	A	1
	Search a node in B Tree- Algorithm and example	L	CO3	U	1
	Insertion of a node in B Tree	L	CO3	A	1
	Introduction to Splay Trees and Suffix Trees	L	CO3	A	1
	Introduction to Heap Tree and Binomial Tree	L	CO3	A	1
4	Introduction to Binomial Heap, Operations on Mergeable Heaps	L	CO4	U	1
	Introduction to Binomial heap	L	CO4	A	1
	Binomial Heaps operations - Minimum Key and Union and Analysis	L	CO4	A	1
	Binomial Heaps operations- Insertion and analysis	L	CO4	A	1
	Binomial Heaps operations- Deletion and Analysis	L	CO4	A	1
	Fibonacci Heaps properties, its representation and mergable operations	L	CO4	A	1
	Insertion operation in Fibonacci heap	L	CO4	A	1
	Fibonacci Heap union operations and Analysis.	L	CO4	A	1
	Extract the minimum key and analysis	L	CO4	A	1
	Decrease key and analysis	L	CO4	A	1
5	Representation of graphs	L	CO5	A	1
	Depth First and Breadth First Traversals	L	CO5	A	1
	Topological Sorting	L	CO5	A	1
	Strongly connected Components	L	CO5	A	1
	Biconnected Components	L	CO5	A	1
	Minimum Cost Spanning Tree	L	CO5	A	1
	Prim's Algorithm	L	CO5	A	1
	Kruskal's Algorithm	L	CO5	A	1
	Dijikstra's single source shortest paths algorithm	L	CO5	A	1

TABLE OF SPECIFICATIONS (ToS) (ESE Question Paper Design)								
Module	Module Title	Distribution of Marks (RBL)						Total Marks
		R	U	A	An	E	C	
1	Basic Data Structures	✓	✓	✓				12
2	Hashing and Set data structure	✓	✓	✓				12
3	Advanced tree structures	✓	✓	✓				12
4	Advanced Heap structures	✓	✓	✓				12
5	Advanced Graph Structures	✓	✓	✓				12
This ToS shall be treated as a general guideline for students and teachers for distribution of marks.								

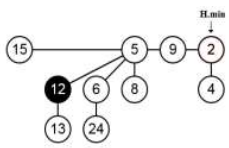
ASSESSMENT PATTERN	
Assessment	**Marks**
Continuous Internal Assessment	**40**
1. Internal Examination	20
2. Learning Activity	12
3. Regularity	8
4. Course Project	--
End Semester Examination	**60**
Total	**100**

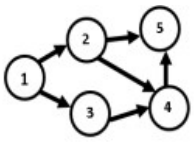
MODEL QUESTION PAPER

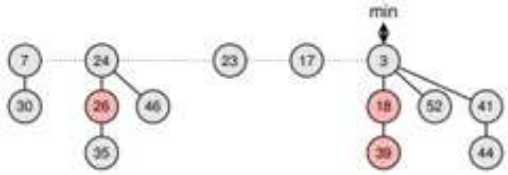
			Total Pages: 2
Register No.:	.....	Name:	.....

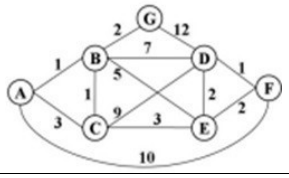
(AN AUTONOMOUS COLLEGE AFFILIATED TO APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY, THIRUVANATHAPURAM)

FIRST SEMESTER MCA DEGREE (REGULAR) EXAMINATION, DECEMBER 2025 (2025 SCHEME)			
Course Code:	**A250201/CA100C**		
Course Name:	**ADVANCED DATA STRUCTURES**		
Max. Marks	**60**	**Duration**:	3 hours

PART A			
(Answer all questions. Each question carries 3 marks)			
No.	***Question***	***CO***	***Marks***
1	Implement stack operations using a linked list and push the elements 1, 2, 3 sequentially.	CO1	(3)
2	Analyse the limitations of arrays compared to linked lists in terms of memory utilization.	CO1	(3)
3	Illustrate intersection and union set operations for sets {1,2,3,4,5} and {2, 4, 6} using Bit Strings of length 6.	CO2	(3)
4	Explain any two collision resolution methods in Hashing.	CO2	(3)
5	Create a binary search tree for the following data and do in-order and post-order traversal of the tree. 50, 60, 25, 40, 30, 70, 35, 10, 55, 65, 5.	CO3	(3)
6	What is Splay Tree? List the Rotations in Splay Tree.	CO3	(3)
7	Explain Find-Min () operation of Binomial heap with example.	CO4	(3)
8	Find the Potential of the Fibonacci Heap given below. 	CO4	(3)
9	Write any one of the Topological Ordering of the graph.	CO5	(3)

			
10	In a weighted graph, assume that the shortest path from a source 's' to a destination 't' is correctly calculated using a shortest path algorithm. If we increase weight of every edge by 1, the shortest path always remains same. Is the following statement true?	CO5	(3)

PART B				
(Answer any one full question from each module, each question carries 6 marks)				
No.		***Question***	***CO***	***Marks***
MODULE I				
11	a)	Create a doubly linked list (DLL) with elements A, B, C and show the forward traversal.	CO1	(3)
	b)	Show the backward traversal of the same DLL	CO1	(3)
OR				
12	a)	Insert the elements 10, 20, 30, 40 into a circular queue of size 4 and show the final state of the queue.	CO1	(3)
	b)	Apply dequeue operations twice and display the resulting queue contents.	CO1	(3)
MODULE II				
13	a)	Explain about collision in hashing.	CO2	(2)
	b)	Given the values {2341, 4234, 2839, 430, 22, 397, 3920} in a hash table of size 7 and a hash function, h(x) = x mod 7. Show the resulting table after inserting the values in the given order with each of the following collision resolution strategies. i) Quadratic Probing ii) Double Hashing	CO2	(4)
OR				
14	a)	How do you perform Amortised Analysis using Accounting method?	CO2	(2)
	b)	Illustrate with Multipop Stack example.	CO2	(4)
MODULE III				
15	a)	Delete the node 8 from the Red-Black Tree containing {8, 18, 5, 15} and show the result.	CO3	(3)
	b)	Apply the necessary fix-up steps to maintain Red-Black Tree properties.	CO3	(3)
OR				
16	a)	Construct a B-Tree of order five from the following data items: 16,20,22,42,12,30	CO3	(3)
	b)	Delete a node from the above B-Tree. Explain with algorithm.	CO3	(3)
MODULE IV				
17	a)	Draw a binomial heap whose keys are 6,3,5,18,1,10,7,9,16,10,20	CO4	(2)
	b)	Explain how union operation is performed in a Binomial heap with algorithm	CO4	(4)
OR				
18	a)	Extract the minimum node from the below given Fibonacci heap. 	CO4	(2)
	b)	Describe how this operation is performed on the given Fibonacci heap	CO4	(4)
MODULE V				

19	a)	Consider the following undirected, weighted graph. Step through Dijkstra's algorithm to calculate the single-source shortest paths from A to every other vertex. Show your steps in the table.  	CO5	(6)
		OR		
20	a)	Explain Kruskal's algorithm.	CO5	(2)
	b)	Find the minimum cost spanning tree of the graph whose vertices are v1,v2,v3,v4,v5,v6, and v7. The cost of the graph's edges are (v1,v2)=28, (v1,v6)=10, (v6,v5)=25, (v5,v4)=22, (v5,v7)=24, (v7,v2)=14, (v2,v3)=16, (v3,v4)= 12 and (v4,v7)=18.	CO5	(4)

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COURSE DESCRIPTION							
Regulation	**2025**	**L-T-J-P-S**	**3-1-0-0-4**	**Version**	**25/0**	**Credits**	**4**
(L- Lecture, T-Tutorial, J-Project, P-Practical, S-Self-learning & Team Work)							

Course Code	Course Name	Course Category
A250201/CA100D	**ADVANCED SOFTWARE ENGINEERING**	**PC**
Pre-requisite		
Programming proficiency in at least one of C, C++, Java, Python or PHP programming languages. Basic understanding of the software life cycle.		

COURSE OBJECTIVES	
1	To provide students with a comprehensive understanding of the software development life cycle, including software planning, analysis, design, and engineering models.
2	To develop competence in modern coding practices, version control, and software quality assurance for building maintainable systems.
3	To strengthen students' ability to design robust and reusable solutions by applying design patterns effectively.
4	To familiarise students with software testing principles, strategies and automation tools for ensuring reliability and performance.
5	To cultivate professional software engineering practices through Agile methodologies and continuous integration/continuous delivery (CI/CD) pipelines.

COMPETENCY STATEMENT (CC)	
CC1	Students will be able to engineer high-quality, scalable software systems by applying advanced software engineering practices, Agile methodologies, and CI/CD automation across the full software life cycle.

COURSE OUTCOMES (CO)

Course Outcomes (CO): At the end of this course, learners will be able to:

CO	CO Statement	CC Mapping	Cognitive (C)
CO1	Demonstrate a comprehensive understanding of the Software Development Life Cycle (SDLC), encompassing project planning, requirement analysis, system design, and various software engineering models.	CC1	A
CO2	Employ effective coding standards, utilise version control with Git, and incorporate fundamental software quality practices in development activities.	CC1	A
CO3	Interpret and make use of core design pattern principles to structure robust and maintainable software solutions.	CC1	A
CO4	Explain and apply software testing methodologies and automation techniques to ensure the reliability and performance of software products.	CC1	A
CO5	Participate in and contribute to team-based activities using Agile development practices and collaborative tools.	CC1	A
CO6	Implement Continuous Integration and Continuous Deployment (CI/CD) processes to streamline and enhance the software delivery pipeline.	CC1	A

Cognitive (Revised blooms Level): *- **R**: Remember; **U**: Understand; **A**: Apply; **An**: Analyse; **E**: Evaluate; **C**: Create*

	Program Outcomes & Program Specific Outcomes Correlation Matrix										
	PO								**PSO**		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**1**	**2**	**3**
1		3	3			1	3	1			
2				3	3	2					
3			3	3							
4				3		3					
5			3	2	2	2	2	3			
6				3			1				

Correlation [3 – High, 2 -Medium, 1 – Low]

TEACHING AND ASSESSMENT SCHEME

Teaching Scheme / Week					Credit	Hours / Semester	Examination Scheme		
							Theory		
L	T	J	P	S	C		CIA	ESE	Total
3	1	0	0	4	4	120	40	60	100

***L**: Lecture (One unit is of one-hour duration), **T**: Tutorial (One unit is of one-hour duration), **P**: Practical (One unit is of one-hour duration), **J**: Project (One unit is of one-hour duration), **S**: Self-Learning & Team Work (One unit is of one-hour duration), **CIA**: Continuous Internal Assessment, **ESE**: End Semester Examination*

SYLLABUS (Major Topics)

Module	Title	Major Topics	Hrs
1	Software Engineering	Introduction to Software Engineering, Life cycle of a software system, Project planning phase, Software Engineering models, Software requirements specification	10
2	Industry Best Practices	Programming Style Guides and Coding Standards, GIT Version Control System, Software Quality	10
3	System Design Methodologies and Software Testing Principles.	OOP Concepts, Design Patterns, Unit Testing and Unit Testing frameworks, Software Testing Principles, Testing Automation	15
4	Agile Development Methodology	Concepts of Agile Development Methodology, Agile Development Models, Scrum Framework	10
5	Continuous Integration/ Continuous Delivery and Deployment	Software Configuration Management, Continuous Integration, Continuous Delivery, Build and deployment automation	10

SELF-LEARNING / TEAM WORK

Sl. No	Self-learning / Team Work Description	Hrs
1	Software Requirements Specification Document Preparation	10
2	Git and Git hub account creation and basic operations of Git	10
3	Git and Git hub: Working in collaboration in a team environment	5
4	Clone an open-source project using Git and perform all the basic operations.	7
5	OOPs concept	10
6	JUnit, unit test, PHPDbg, Software testing applications	8
7	Agile and Scrum and JIRA	5
8	CI/CD software tools→ Jira, Docker, Kubernets, Ansible, Datadog	5
9	CI: Jenkins, GitLab CI/CD (CE), Buildbot, Drone CD (Delivery): Spinnaker, GoCD, Concourse CD (Deployment): Argo CD, Flux, Tekton	5

SUGGESTED LEARNING RESOURCES

Text Book

Sl. No.	Title of Book	Author	Publication
1	What Every Engineer Should Know about Software Engineering	Philip A. Laplante	CRC Press, 2nd Edition, 2022
2	Mastering Software Quality Assurance: Best Practices, Tools and Technique for Software Developers	Murali Chemuturi	J Ross Publishing, 2010
3	Design Patterns: Elements of Reusable Object-Oriented Software	Erich Gamma et. al.	Addison-Wesley, 1st Edition, 1994
4	Agile Software Development with Scrum	Ken Schwaber	Pearson, 1st Edition, 2002
5	Unit Test Frameworks	Paul Hamill	O'Reilly Media, 2005
6	Continuous Delivery: Reliable Software Releases through Build, Test, and Deployment Automation	Jez Humble and David Farley	Pearson Education, 2010

Reference

Sl. No.	Title of Book	Author	Publication
1	Pro Git, 2nd Edition	Ben Straub, Scott Chacon	Apress, 2nd Edition, 2014
2	Java Design Patterns: A Hands-On Experience with Real-World Examples	Vaskaran Sarcar	Apress, 2nd Edition, 2018
3	Agile Software Development: The Cooperative Game (2nd edition)	Alistair Cockburn and Robert Cecil Martin	Addition Wesley, 2nd Edition, 2006
4	Agile Testing: A Practical Guide for Testers and Agile Teams	Lisa Crispin	Adison Wesley, 1st Edition, 2009
5	The Art of Software Testing	Glenford J. Myers, et. al.,	Wiley, 3rd Edition, 2011
6	A Practitioner's Guide to Software Test Design	Lee Copeland	Artech House Publishers, Illustrated, 2003

Web Resource	
1	https://www.geeksforgeeks.org/software-engineering/
2	https://www.geeksforgeeks.org/software-development-life-cycle-sdlc/
3	https://guides.github.com/introduction/git-handbook/ ,
4	https://en.wikibooks.org/wiki/Introduction_to_Software_Engineering/Quality
5	https://opensource.com/article/19/7/understandingsoftware-design-pattern
6	https://docs.python.org/3/library/unittest.html
7	https://www.scrumguides.org/docs/scrumguide/v2017/2017-Scrum-Guide-US.pdf
8	https://www.redhat.com/en/topics/devops/what-is-ci-cd

DETAILED SYLLABUS *(Self-learning if any to be marked)*

Module	Title	Major Topic & Sub Topic	Mode of Delivery	COs	Learning Domain Level (C)	Teaching Hours
1	Software Engineering	What is Software Engineering, Characteristics of Software Engineering	L	CO1	A	2
		Life cycle of a software system	L	CO1	A	2
		Project planning	L	CO1	A	1
		Software Engineering Models	L, T	CO1	A	2
		Software Requirements Specification	L, T	CO1	A	3
2	Industry Best Practices	Programming style guides and coding standards	L	CO2	A	1
		Software version control systems, basic concepts	L	CO2	A	1
		Git distributed version control system, introduction	L, T	CO2	A	2
		Common operations in Git	L, T	CO2	A	4
		Software quality dimensions	L	CO2	A	2
3	System Design Methodologies and Software Testing Principles	Object-Oriented Programming	L	CO3	A	1
		Software Design Patterns	L, T	CO3	A	4
		Unit Testing concepts and xUnit architecture	L	CO4	A	1
		Unit testing frameworks: Junit, unittest, phpdbg	L, T	CO4	A	2
		Writing unit test code	L	CO4	A	2
		Software Testing Principles: Program Inspection, Program Review, and Program Walkthrough.	L	CO4	A	3

		Blackbox testing, and Whitebox testing.				
		Testing Automation: Defect life cycle, Regression testing, and testing functional requirements.	L	CO4	A	2
4	Agile Development Methodology	Agile Development methodology, introduction	L, T	CO5	A	3
		Agile Development Models: eXtreme Programming, Kanban, Lean Software Development (LSD), Feature-Driven Development (FDD), Scrum	L	CO5	A	2
		Scrum framework	L, T	CO5	A	5
5	Continuous Integration / Continuous Delivery and Deployment (CI/CD)	Configuration Management	L	CO6	A	2
		Continuous Integration, concepts and practices	L, T	CO6	A	2
		Continuous Delivery, concepts and practices	L	CO6	A	2
		Build and deployment automation	L	CO6	A	2
		Test automation for CI/CD	L, T	CO6	A	2

TABLE OF SPECIFICATIONS (ToS) (ESE Question Paper Design)

Module	Module Title	Distribution of Marks (RBL)						Total Marks
		R	U	A	An	E	C	
1	Software Engineering	✓	✓					12
2	Industry Best Practices	✓	✓	✓				12
3	System Design Methodologies and Software Testing	✓	✓	✓				12
4	Agile Development Methodology	✓	✓	✓				12
5	Continuous Integration/ Continuous Delivery and Deployment	✓	✓	✓				12

This ToS shall be treated as a general guideline for students and teachers for distribution of marks.

ASSESSMENT PATTERN	
Assessment	**Marks**
Continuous Internal Assessment	**40**
1. Internal Examination	20
2. Learning Activity	12
3. Regularity	8
4. Course Project	-
End Semester Examination	**60**
Total	**100**

MODEL QUESTION PAPER

			Total Pages: 2
Register No.:	.....	Name:	.....

(AN AUTONOMOUS COLLEGE AFFILIATED TO APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY, THIRUVANATHAPURAM)

FIRST SEMESTER MCA DEGREE (REGULAR) EXAMINATION, DECEMBER 2025 (2025 SCHEME)			
Course Code:	**A250201/CA100D**		
Course Name:	**ADVANCED SOFTWARE ENGINEERING**		
Max. Marks	**60**	**Duration**:	**3 hours**
Specify if the question paper is common to different programmes			

PART A

(Answer all questions. Each question carries 3 marks)

No.	***Question***	***CO***	***Marks***
1	What are the key qualities of well-written software requirements, and how do they contribute to the success of a software project?	CO 1	(3)
2	What is the purpose of the basic COCOMO model in software cost estimation, and how does it help estimate the effort needed for a project like an organic type with 50,000 lines of code?	CO 1	(3)
3	Which Git commands can be used to first check for new changes in a remote repository without changing local files, and then to update the local branch with those changes? Explain what each command does.	CO 2	(3)
4	Explain Conformance Quality. What are the techniques used for ensuring conformance quality?	CO 2	(3)
5	"A design pattern may turn into an antipattern." Justify the statement.	CO 3	(3)
6	What classes from the xUnit architecture should be included when designing a unit testing framework for a software project, and how does each one help in the testing process?	CO 4	(3)
7	How is a product backlog used to manage and prioritise the Scrum team's work?	CO 5	(3)
8	Explain the primary purpose of the Sprint Review event in the Scrum framework.	CO 5	(3)
9	How can configuration management help prevent issues when several people are working on the same code? Explain the main benefits and common practices.	CO 6	(3)
10	What are the key principles behind modern software delivery pipelines, and how do they ensure faster, safer, and more efficient software releases?	CO 6	(3)

PART B

(Answer any one full question from each module, each question carries 6 marks)

No.		***Question***	***CO***	***Marks***
MODULE I				
11	a)	How can the main steps of the Software Development Life Cycle (SDLC) help plan the development of a new software application? Explain the activities involved in each step.	CO 1	(3)
	b)	Discuss the important concepts in software requirements engineering.	CO 1	(3)
OR				
12	a)	What are predictive and adaptive waterfall models in software development, and in what types of projects would each be most suitable?	CO 1	(3)
	b)	How do predictive and adaptive waterfall models differ from approaches where development phases occur in parallel or overlap, such as in iterative or agile models?	CO 1	(3)
MODULE II				
13	a)	What core Git operations are used to manage work on a software project hosted on GitHub?	CO 2	(4)
	b)	Explain the process of cloning a project repository to a local machine and the subsequent steps required to contribute changes.	CO 2	(2)
OR				
14	a)	How can the four dimensions of software quality be applied to comprehensively evaluate a newly released software product?	CO 2	(3)
	b)	For each dimension, describe a specific metric or attribute that would be measured to determine the product's overall quality.	CO 2	(3)

MODULE III				
15	a)	How do design patterns help developers solve common problems in software development? Provide examples to support your answer.	CO 3	(3)
	b)	Explain how an Antipattern differs from a design pattern and provide one example.	CO 3	(3)
OR				
16	a)	Describe the bug life cycle process, including the typical states a bug passes through from when it is reported to when it is closed.	CO 4	(4)
	b)	Explain how this workflow would be applied to manage a newly discovered defect using a suitable diagram.	CO 4	(2)
MODULE IV				
17	a)	A development team is finding it difficult to keep up with frequent changes in customer requirements. How can adopting agile principles help the team improve their flexibility and deliver faster?	CO 5	(4)
	b)	Give examples of two agile principles in action.	CO 5	(2)
OR				
18	a)	Explain the Scrum framework, including its key roles, events, and artefacts.	CO 5	(3)
	b)	Use a diagram to help a new teammate understand the Scrum Framework.	CO 5	(3)
MODULE V				
19	a)	Explain the essential practices required for continuous integration.	CO 6	(3)
	b)	A software team wants to start automating their testing and deployment. What should they do first to set up a Continuous Integration (CI) pipeline?	CO 6	(3)
OR				
20	a)	How would you create a deployment pipeline for a web app to make sure continuous integration and delivery work well?	CO 6	(4)
	b)	A simple diagram of the CI/CD pipeline may be used to support the answer.	CO 6	(2)

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COURSE DESCRIPTION							
Regulation	**2025**	**L-T-J-P-S**	**1-0-0-3-0**	**Version**	**25/0**	**Credits**	**2**
(L- Lecture, T-Tutorial, J-Project, P-Practical, S-Self-learning & Team Work)							

Course Code	Course Name	Course Category
A250201/CA130T	**PROGRAMMING LAB**	**PC**
Pre-requisite		
. Basics of programming.		

COURSE OBJECTIVES	
1	To enable students to apply the basics of Python Programming language including input/output functions, operators, basic and collection data types in developing simple programs.
2	To prepare students to implement decision making, looping constructs and functions in Python.
3	To equip students to design modules and packages in Python language.
4	To prepare students to implement object-oriented programming and exception handling.
5	To train students to create files in Python and apply regular expressions for effective search operations on strings and files.

COMPETENCY STATEMENT (CC)	
CC1	Demonstrates the ability to write and execute basic Python programs using input/output functions, operators, and data types (primitive and collections), and applies control flow structures (if-else, loops) along with user-defined functions to develop reusable, modular solutions for problem-solving.
CC2	Develops well-structured Python programs by organizing code with modules and packages, applying object-oriented principles (encapsulation, inheritance, polymorphism), and using exception handling for robust execution, while also performing file operations and employing regular expressions to process and validate data effectively.

COURSE OUTCOMES (CO)

Course Outcomes (CO): At the end of this course, learners will be able to:

CO	CO Statement	CC Mapping	Cognitive (C)
CO 1	Apply the fundamental concepts of Python programming, including input/output operations, operators, and various data types	CC1	A
CO 2	Implement decision making, looping constructs and functions	CC1	A
CO 3	Apply the concepts of modules and packages to design built in and user defined packages	CC2	A
CO 4	Implement object-oriented programming and exception handling.	CC2	A
CO 5	Manage files and form regular expressions for effective search operations on strings and files.	CC2	A

Cognitive (Revised blooms Level): *- **R**: Remember; **U**: Understand; **A**: Apply; **An**: Analyse; **E**: Evaluate; **C**: Create*

	Program Outcomes & Program Specific Outcomes Correlation Matrix										
	PO								PSO		
CO	1	2	3	4	5	6	7	8	1	2	3
1	2	2			3						
2	2	3	2		3						
3	2	2	3		3						
4	2	2	3		3						
5	2	2	2	2	3						

Correlation [3 – High, 2 -Medium, 1 – Low]

TEACHING AND ASSESSMENT SCHEME									
Teaching Scheme / Week					Credit	Hours / Semester	Examination Scheme		
							Practical		
L	T	J	P	S	C		CIA	ESE	Total
1	0	0	3	0	2	60	50	50	100

***L**: Lecture (One unit is of one-hour duration), **T**: Tutorial (One unit is of one-hour duration), **P**: Practical (One unit is of one-hour duration), **J**: Project (One unit is of one-hour duration), **S**: Self-Learning & Team Work (One unit is of one-hour duration), **CIA**: Continuous Internal Assessment, **ESE**: End Semester Examination*

SYLLABUS (Major Topics)			
Module	Title	Major Topics	Hrs
1	Introduction	Basics of Python Programming, Data types, Operators, Input/Output, Built-in Functions	10
2	Control Structures and Functions	Decision making, Looping, User defined functions Recursion	10
3	Packages	Modules, Package	5
4	Object Oriented Programming	Objects, Class in Python, Constructors, Inheritance, Polymorphism, Exception Handling	10
5	Files	Creation, Reading, Writing files	10

SUGGESTED LEARNING RESOURCES

Text Book			
Sl. No.	Title of Book	Author	Publication
1	Core Python Applications Programming, 3rd Edition	Wesley J. Chun	Pearson Education,2016
2	Introduction to Computer Science using Python	Charles Dierbach	Wiley,2015

Reference			
Sl. No.	Title of Book	Author	Publication
1	Taming Python by Programming	Jeeva Jose	Khanna Publishers, New Delhi,2018
2	How to Think Like a Computer Scientist: Learning with Python	Downey, A. et al.	John Wiley, 2015

Web Resource	
1	https://archive.org/details/MIT6.00SCS11
2	https://www.coursera.org/course/pythonlearn
3	http://www.learnerstv.com/Free-Computer-Science-Video-lectures-ltv163-Page1.htm
4	https://www.coursera.org/learn/python-databases
5	https://realpython.com/
6	https://docs.python.org/3/tutorial/

Detailed Syllabus *(Self-learning if any to be marked)*					
Module	Major Topic & Sub Topic	Mode of Delivery	COs	Learning Domain Level C	Hrs
1	Introduction: History, Features of Python, Integrated Development Environment (IDE), Data Types	L	1	U	4
2	Control Structures and Functions: Sequential execution, Conditional statements, Loops	L	2	U	3
3	Packages: Need for Packages and Modules, Components of a package, Creation and Access	L	3	U	2

4	Object Oriented Programming: Fundamentals, Objects and Classes in Python, Access specifiers	L	4	U	3
5	Files: Types, Modes, Regular Expressions and Pattern Matching	L	5	U	3

PRACTICAL SYLLABUS

Objective	Topic	COs	Learning Domain Level (C)	Teaching Hours
To familiarize with Python basics, input/output operations, operators, and different data types to write simple programs	Introduction	CO1	A	10
To implement problem-solving using conditional statements, loops, and user-defined functions	Control Structures and Functions	CO2	A	10
To organize programs using built-in and user-defined modules/packages for modularity and reusability	Packages	CO3	A	5
To design and implement Python programs using OOP principles and operator overloading	Object Oriented Programming	CO4	A	10
To perform file operations (text, binary, CSV) and apply regular expressions for data validation and processing	Files	CO5	A	10

ASSESSMENT PATTERN

Assessment	Mark	
Continuous Internal Assessment		**50**
1. Internal Examination for theory	10	
2. Internal Examination for Lab	10	
3. Continuous Lab Evaluation		25
a. Maintenance of daily lab record and GitHub management	9	
b. Regular class viva	7	
c. Timely completion of day-to-day tasks	9	
4. Learning Activity	--	
5. Regularity	5	
6. Course Project		
End Semester Examination		**50**
Total		**100**

End Semester Examination Pattern:

Maximum Marks: 50			
Verification of Daily program record and Git Repository			5 marks
Viva			10 marks
Problem solving (Based on difficulty level, one or more questions may be given)	Flowchart / Algorithm / Structured description of problem to explain how the problem can be solved / Interface Design	15%	35 marks
	Program correctness	50%	
	Code efficiency	15%	
	Formatted output and pushing to remote Git Repository	20%	
		Total Marks	**50 marks**

COURSE DESCRIPTION							
Regulation	**2025**	**L-T-J-P-S**	**1-0-1-2-0**	**Version**	**25/0**	**Credits**	**2**
(L- Lecture, T-Tutorial, J-Project, P-Practical, S-Self-learning & Team Work)							

Course Code	Course Name	Course Category
A250201/CA130U	**WEB PROGRAMMING LAB**	**PC**
Pre-requisite		
Basic understanding of computer programming, Internet and, Database will be very helpful.		

COURSE OBJECTIVES	
1	To provide foundational knowledge of markup languages and their features for creating interactive and well-structured web pages.
2	To develop skills in client-side scripting for implementing validation and enhancing user interaction.
3	To enable students to design and integrate front-end web interfaces with back-end databases for dynamic data-driven applications.
4	To impart practical experience in both client-side and server-side scripting for building functional web components.
5	To train students in the development of complete web applications that demonstrate usability, scalability, and maintainability.

COMPETENCY STATEMENT (CC)	
CC1	Students completing this course will be able to design and develop dynamic, interactive, and database-driven web applications by applying markup languages, client- and server-side scripting, and web integration techniques.

COURSE OUTCOMES (CO)			
Course Outcomes (CO): At the end of this course, learners will be able to:			
CO	**CO Statement**	**CC Mapping**	**Cognitive (C)**
CO1	Develop well-structured web pages using markup language features to organise content and layout.	CC1	C
CO2	Apply client-side scripting techniques to enforce input validation and enhance user interaction.	CC1	C
CO3	Create functional components using both client-side and server-side scripting to support dynamic web behaviour.	CC1	C
CO4	Develop programs to link front-end interfaces with back-end databases to enable data storage, retrieval, and processing.	CC1	C
CO5	Assemble and deploy complete web applications by integrating interface design, scripting, and database connectivity.	CC1	C
Cognitive (Revised blooms Level): *- **R**: Remember; **U**: Understand; **A**: Apply; **An**: Analyse; **E**: Evaluate; **C**: Create*			

	Program Outcomes & Program Specific Outcomes Correlation Matrix										
	PO								**PSO**		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**1**	**2**	**3**
1	3	3	3	2			3				
2	3	3	3	2	1		3				
3	3	3	3	2			3	2			
4	3	3	3	2			3				
5	3	3	3	3		2	3	2			
Correlation [3 – High, 2 -Medium, 1 – Low]											

TEACHING AND ASSESSMENT SCHEME									
Teaching Scheme / Week					Credit	Hours / Semester	Examination Scheme		
							Practical		
L	T	J	P	S	C		CIA	ESE	Total
1	0	1	2	0	2	60	50	50	100

***L**: Lecture (One unit is of one-hour duration), **T**: Tutorial (One unit is of one-hour duration), **P**: Practical (One unit is of one-hour duration), **J**: Project (One unit is of one-hour duration), **S**: Self-Learning & Team Work (One unit is of one-hour duration), **CIA**: Continuous Internal Assessment, **ESE**: End Semester Examination*

SYLLABUS (Major Topics)			
Module	Title	Major Topics	Hours
1	Introduction To Web, HTML and CSS	Introduction to Web: Client/Server concepts, Components of Web Application, Types of Web Content, Overview of HTTP - HTTP request – response, Generation of dynamic web pages, Application Servers, Web Security. Markup Language (HTML): Formatting and Fonts, Commenting Code, Anchors, Backgrounds, Images, Hyperlinks, Lists, Tables, Frames, HTML Forms. Cascading Style Sheet (CSS): The need for CSS, Basic syntax and structure, Inline Styles, Embedding Style Sheets, Linking External Style Sheets, Backgrounds, manipulating text, Margins and Padding, Positioning using CSS.	**18**
2	Client-Side Scripting using JavaScript	Client-Side Scripting using JavaScript: Core features, Data types and Variables, Operators-Expressions and Statements, Functions, Objects, Array, String - Date and Math related Objects, Document Object Model, Event Handling, Form handling and validations.	**12**
3	Relational Database Design	An overview of Relational Database Design: Tables, Attributes, Tuples, Primary keys, Foreign keys, Indexes, DDL Commands – CREATE, ALTER, DROP and TRUNCATE; DML Commands – SELECT, INSERT, UPDATE and DELETE.	**10**
4	Server-Side Scripting using PHP	Server-Side Scripting using PHP: Setting up the environment (Example - XAMP server), PHP Programming basics - Print/echo, Variables and constants, Strings and Arrays, Operators, Control structures and looping structures, Functions, Reading Data in Web Pages, Embedding PHP within HTML, establishing connectivity with database, Debugging with phpdbg.	**12**
5	Web Application development in any PHP framework and debugging Web Apps	Web Application development in any PHP framework (Laravel, CodeIgniter, Symfony, CakePHP, etc.), Naming convention, MVC model, Connectivity with Database, Database interaction. Debugging web apps: Browser debugging tools (Any browser web developer tools) – View and change the DOM and CSS, Console, Debug JavaScript, View and debug network activity, Performance tools, etc.	**8**

SUGGESTED LEARNING RESOURCES

Text Book			
Sl. No.	Title of Book	Author	Publication
1	*The Internet Book: Everything You Need to Know About Computer Networking and How the Internet Works*	Douglas E Comer	5th Edition, Chapman and Hall/CRC, 2018
2	*Database System Concepts*	Abraham Silberschatz, Henry F. Korth, S. Sudarshan	McGraw Hill Education ISBN: 9780078022159, 7th Edition (2019),

Reference			
Sl. No.	Title of Book	Author	Publication
1	JavaScript: The Definitive Guide	David Flanagan	7th Edition, O'Reilly Media, 2020
2	Internet and World Wide Web - How To Program	Harvey Deitel and Abbey Deitel	Fifth Edition, published in 2018, Pearson Education
3	PHP6 and MySQL 6 Bible	Steve Suehring, Tim Converse, and Joyce Park	Wiley India Pvt Ltd (2022)
4	PHP-The Complete Reference	Steven Holzner	McGraw Hill Education, Indian Edition (2017)
5	JavaScript: The Complete Reference	Thomas A Powell, Fritz Schneider	3rd Edition, Tata McGraw Hill, 2012

Web Resource	
1	http://php.net/manual/
2	https://pepa.holla.cz/wp-content/uploads/ 2016 /08/JavaScript-The-Definitive-Guide-6th-Edition.pdf
3	http://index-of.es/PHP/PHP6%20and%20MySQL%20Bible.pdf
4	https://www.udemy.com/course/html5-fundamentals-for-beginners/
5	https://www.udemy.com/course/programming-in-javascript/
6	https://www.udemy.com/course/php-mysql-tutorial/

Detailed Syllabus *(Self-learning if any to be marked)*					
Module	Major Topic & Sub Topic	Mode of Delivery	CO	Learning Domain Level	Hrs
1	**Introduction to Web and HTML**: Client/Server concepts, Components of Web Application, Types of Web Content, Overview of HTTP - HTTP request – response, Generation of dynamic web pages, Application Servers, Web Security.	L	CO 1	U	1
	HTML links and tags: Formatting and Fonts, Commenting Code, Anchors, Backgrounds, Images, Hyperlinks, Lists, Tables, Frames		CO 1	U	1
	Introduction to CSS: The need for CSS, Basic syntax and structure, Inline Styles, Embedding Style Sheets, Linking External Style Sheets, Backgrounds, Manipulating text, Margins and Padding, Positioning using CSS.		CO 1	U	2
2	**Introduction Client-Side Scripting using JavaScript:** Core features, Data types and Variables, Operators-Expressions and Statements, Functions, Objects, Array, String - Date and Math related Objects	L	CO 2	U	2
	JavaScript Event Handling: Document Object Model, Event Handling, Form handling and validations.		CO 2	U	1
3	**Server-Side Scripting using PHP**: Setting up the environment (Example - XAMP server), PHP Programming basics - Print/echo, Variables and constants, Strings and Arrays, Operators, Control structures and looping structures, Functions, Reading Data in Web Pages, Embedding PHP within HTML.	L	CO 3	U	2
	PHP-MySQL Connectivity: Establishing connectivity with the database, debugging with phpdbg.		CO 3	U	2
4	**An overview of Relational Database Design**: Tables, Attributes, Tuples, Primary keys, Foreign keys, Indexes	L	CO 4	U	2
	MySQL DDL & DML Commands: DDL -CREATE, ALTER, DROP and TRUNCATE; DML– SELECT, INSERT, UPDATE and DELETE.		CO 4	U	2

5	**Web application development**: Web Application development in any PHP framework (Laravel, CodeIgniter, Symfony, CakePHP etc.): Naming convention, MVC model, Connectivity with Database, Database interaction.	L	CO 5	U	1
	Debugging web apps: Browser debugging tools (Any browser web developer tools) – View and change the DOM and CSS, Console, Debug JavaScript, View and debug network activity, Performance tools etc.	L	CO 5	U	1

PRACTICAL SYLLABUS

Objective	Topic	CO	Learning Domain Level	Hrs
To provide foundational knowledge of markup languages and their features for creating interactive and well-structured web pages.	**Introduction to Web and HTML**: Simple HTML file creation to demonstrate the use of different tags.	CO 1	C	2
	HTML Links and Tags: HTML file creation to link to different HTML pages that contain images, Lists, Tables, and also links within a page.	CO 1	C	3
	HTML Frames: HTML page creation with different types of frames like floating frame, navigation frame & mixed frame.	CO 1	C	3
	Introduction to CSS: HTML file creation by applying the different styles using inline, external & internal style sheets.	CO 1	C	3
	HTML Forms Creation: Registration form creation using HTML.	CO 1	C	3
To develop skills in client-side scripting for implementing validation and enhancing user interaction.	**Introduction to JavaScript**: HTML page creation to explain the use of various predefined functions in a string and math object in java script.	CO 2	C	2
	Client Side Scripting using JavaScript: Calendar generation using JavaScript code by getting the year from the user.	CO 2	C	2
	Registration form Validation using JavaScript HTML registration form creation and validation of the form using JavaScript code.	CO 2	C	2
	JavaScript Event Handling: HTML page creation to change the background color for every click of a button using JavaScript Event Handling.	CO 2	C	1
	JavaScript Event Handling: HTML page creation to display a new image and text when the mouse comes over the existing content in the page using JavaScript Event Handling.	CO 2	C	1
	JavaScript Script Application: HTML page creation to show an online exam using JavaScript.	CO 2	C	1
To impart practical experience in both client-side and server-side scripting for building functional web components.	**Introduction to PHP**: Registration form creation using PHP and performing necessary validations.	CO 3	C	2
	Server-Side Scripting using PHP: Electricity bill generation from user input based on a given tariff using PHP.	CO 3	C	2
	PHP Array Functions: PHP code building to store name of students in an array and display it using print_r function. Sort and display the same using asort & arsort functions.	CO 3	C	1
	PHP Array: PHP code generation to store names of Indian Cricket players in an array and display the same in HTML table.	CO 3	C	1
To enable students to design and integrate front-end web interfaces with back-end databases for dynamic data-driven applications.	**Relational Database Design with MySQL**: Tables, Attributes, Tuples, Primary keys, Foreign keys, Indexes, MySQL DDL, DML, DQL commands	CO 4	C	4
	PHP-MySQL Connectivity: PHP program development to connect to a MySQL database, retrieve data from a table, and show the details in a neat format.	CO 4	C	4

To train students in the development of complete web applications that demonstrate usability, scalability, and maintainability.	**PHP Web Applications**: Web applications development using HTML and PHP and deploy.	CO 5	C	1
	PHP and MySQL: PHP and MySQL program development to accept book information viz. Accession number, title, authors, edition and publisher from a web page and store the information in a database and search function.	CO 5	C	1
	Web Application Development Micro Project: Design and development of a functional web application within a team environment using modern web technologies—including HTML, CSS, JavaScript, PHP, and MySQL—while following structured development practices.	CO 5	C	4

ASSESSMENT PATTERN		
Assessment		**Mark**
Continuous Internal Assessment		**50**
7. Internal Examination for theory		10
8. Internal Examination for Lab		10
9. Continuous Lab Evaluation		20
d. Maintenance of daily lab record and GitHub management	7	
e. Regular class viva	6	
f. Timely completion of day-to-day tasks	7	
10. Learning Activity		--
11. Regularity		5
12. Course Project		5
End Semester Examination		**50**
Total		**100**

End Semester Examination Pattern:

Maximum Marks: 50			
Verification of Daily program record and Git Repository			5 marks
Viva			10 marks
Problem solving (Based on difficulty level, one or more questions may be given)	Flowchart / Algorithm / Structured description of problem to explain how the problem can be solved / Interface Design	15%	35 marks
	Program correctness	50%	
	Code efficiency	15%	
	Formatted output and pushing to remote Git Repository	20%	
		Total Marks	**50 marks**

COURSE DESCRIPTION							
Regulation	**2025**	**L-T-J-P-S**	**0-1-0-3-0**	**Version**	**25/0**	**Credits**	**2**
(L- Lecture, T-Tutorial, J-Project, P-Practical, S-Self-learning & Team Work)							

Course Code	Course Name	Course Category
A250201/CA130V	**DATA STRUCTURES LAB**	**PC**
Pre-requisite		
Basic understanding of C programming		

COURSE OBJECTIVES	
1	Efficiently find and fix code errors and improve performance.
2	Implement specialized data structures for grouping and relationship problems.
3	Apply advanced tree structures to organize data effectively.
4	Use modern heap structures to solve complex optimization problems.
5	Apply advanced graph algorithms to solve network and routing problems.

COMPETENCY STATEMENT (CC)	
CC1	Solved complex problems using advanced data structures and algorithms, like heap and graph, to optimize network routing.

COURSE OUTCOMES (CO)			
Course Outcomes (CO): At the end of this course, learners will be able to:			
CO	**CO Statement**	**CC Mapping**	**Cognitive (C)**
CO1	Use Debuggers, Profilers and advanced Compiler options.	CC1	A
CO2	Implement the basic data structures Array, stack, queue and linked list	CC1	A
CO3	Implement the Set and Disjoint Set Data Structures.	CC1	A
CO4	Implement practical aspects of Advanced Tree Structures.	CC1	A
CO5	Realise Modern Heap Structures for effectively solving advanced Computational problems.	CC1	A
CO6	Implement Advanced Graph algorithms suitable for solving advanced computational problems.	CC1	A
Cognitive (Revised blooms Level): *- **R**: Remember; **U**: Understand; **A**: Apply; **An**: Analyse; **E**: Evaluate; **C**: Create*			

	Program Outcomes & Program Specific Outcomes Correlation Matrix										
	PO								**PSO**		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**1**	**2**	**3**
1	3	3	3	2				2			
2	3	3	3	2				2			
3	3	3	3	2				2			
4	3	3	3	2				2			
5	3	3	3	3				2			
6	3	3	3	3				2			
Correlation [3 – High, 2 -Medium, 1 – Low]											

TEACHING AND ASSESSMENT SCHEME									
Teaching Scheme / Week					**Credit**	**Hours / Semester**	**Examination Scheme**		
							Practical		
L	**T**	**J**	**P**	**S**	**C**		**CIA**	**ESE**	**Total**
0	0	1	3	0	2	60	50	50	100

***L**: Lecture (One unit is of one-hour duration), **T**: Tutorial (One unit is of one-hour duration), **P**: Practical (One unit is of one-hour duration), **J**: Project (One unit is of one-hour duration), **S**: Self-Learning & Team Work (One unit is of one-hour duration), **CIA**: Continuous Internal Assessment, **ESE**: End Semester Examination*

PRACTICAL SYLLABUS				
Objectives	Topic	COs	Learning Domain Level (C)	Hours
To equip students with the ability to use important GCC compiler options.	Advanced use of gcc: Important Options - o, -c, -D, -l, -I, -g, -O, -save- temps, -pg	CO1	A	2
To enable students to apply essential GDB commands for effective debugging and error analysis in C program	Familiarisation with gdb: Important Commands - break, run, next, print, display, help	CO1	A	2
To develop skills in profiling applications with gprof for performance measurement and optimization.	Using gprof: Compile, Execute and Profile	CO1	A	1
To strengthen students' understanding of fundamental data structures by enabling them to implement and manipulate arrays, stacks, queues, and linked lists through different operations	Review of Basic Data Structures (Array, List, Stack, Queue) • Merge two sorted arrays and store in a third array • Circular Queue - Add, Delete, Search • Singly Linked Stack - Push, Pop, Linear Search • Doubly linked list - Insertion, Deletion, Search	CO2	A	12
To develop the ability to implement set and disjoint set operations for efficient data representation and manipulation.	Set Data Structure and set operations (Union, Intersection and Difference) using Bit String.	CO3	A	3
	Disjoint Sets and the associated operations (create, union, find)	CO3	A	4
To develop practical skills in implementing and manipulating advanced tree structures for efficient data storage and retrieval	Binary Search Trees- Insertion, Deletion, Search	CO4	A	4
	Red Black Trees and its operations	CO4	A	4
	B Trees and its operations	CO4	A	4
To enable students to understand the structure of binomial heaps and to gain practical skills in implementing core operations	Binomial Heaps and operations (Create, Insert, Delete, Extract-min, Decrease key)	CO5		4
To develop the ability to apply graph traversal, connectivity, spanning tree, and shortest path algorithms for efficient problem-solving in graphs.	Graph Traversal techniques (DFS and BFS) and Topological Sorting	CO6	A	4
	Finding the Strongly connected Components in a directed graph	CO6	A	3
	Prim's Algorithm for finding the minimum cost spanning tree	CO6	A	3
	Kruskal's algorithm using the Disjoint set data structure	CO6	A	3
	Single Source shortest path algorithm using any heap structure that supports mergeable heap operations	CO6	A	3

SUGGESTED LEARNING RESOURCES

Text Book			
Sl. No.	Title of Book	Author	Publication
1	*Introduction to Algorithms*	Cormen T.H., Leiserson C.E, Rivest R.L. and Stein C.	Prentice Hall India, New Delhi, 2004

Reference			
Sl. No.	Title of Book	Author	Publication
1	Algorithm design	Kleinberg, Jon, and Eva Tardos	Pearson Education India, 2006.
2	*Data Structures and Algorithms*,	Aho A.V., Hopcroft J.E., and Ullman J.D.,	Pearson Education, New Delhi, 1983.
3	Data Structures, *Algorithms, and Applications in C++*,	Sahni S	Mc Graw Hill, Singapore, 1998.

Web Resource	
1	https://gcc.gnu.org/onlinedocs/gcc/Option-Summary.html
2	https://www.gnu.org/software/gdb/documentation/
3	https://ftp.gnu.org/old-gnu/Manuals/gprof-2.9.1/html_mono/gprof.html

ASSESSMENT PATTERN		
Assessment		**Mark**
Continuous Internal Assessment		**50**
1. Internal Examination		15
2. Continuous Lab Evaluation		27.5
g. Maintenance of daily lab record and GitHub management	10	
h. Regular class viva	7.5	
i. Timely completion of day to day tasks	10	
3. Learning Activity		-
4. Regularity		7.5
5. Course Project		-
End Semester Examination		**50**
Total		**100**

End Semester Examination Pattern:

Maximum Marks: 50			
Verification of Daily program record and Git Repository			5 marks
Viva			10 marks
Problem solving (Based on difficulty level, one or more questions may be given)	Flowchart / Algorithm / Structured description of problem to explain how the problem can be solved / Interface Design	15%	35 marks
	Program correctness	50%	
	Code efficiency	15%	
	Formatted output and pushing to remote Git Repository	20%	
		Total Marks	**50 marks**

COURSE DESCRIPTION							
Regulation	**2025**	**L-T-J-P-S**	**0-1-0-0-0**	**Version**	**25/0**	**Credits**	**-**
(L- Lecture, T-Tutorial, J-Project, P-Practical, S-Self-learning & Team Work)							

Course Code	Course Name	Course Category
A250201/CA130K	**ENTREPRENEURSHIP AND INNOVATIONS IN TECHNOLOGY**	**SE**
Pre-requisite		
NIL		

COURSE OBJECTIVES	
1	Build foundational knowledge of entrepreneurship, innovation, and entrepreneurial ecosystems.
2	Expose students to technological and social innovation, and their role in sustainable development.
3	Familiarize students with business model frameworks, intellectual property rights, and funding mechanisms.
4	Develop entrepreneurial skills in problem identification, ideation, and pitching.

COMPETENCY STATEMENT (CC)	
CC1	Apply entrepreneurial knowledge and innovative thinking to identify opportunities, design business models, and evaluate startup feasibility in the technology domain.

COURSE OUTCOMES (CO)

Course Outcomes (CO): At the end of this course, learners will be able to:

CO	CO Statement	CC Mapping	Cognitive (C)
CO1	**Apply** the concepts of innovation and entrepreneurship to identify opportunities and sources of innovation**.**	CC1	A
CO 2	**Analyse** different forms of social innovation and evaluate business models of social enterprises.	CC1	An
CO 3	**Evaluate** technology-based business models using business planning tools and feasibility assessment.	CC1	E
CO 4	**Create** a business plan or project pitch by integrating entrepreneurial and innovative approaches.	CC1	C

Cognitive (Revised blooms Level): *- **R**: Remember; **U**: Understand; **A**: Apply; **An**: Analyse; **E**: Evaluate; **C**: Create*

	Program Outcomes & Program Specific Outcomes Correlation Matrix										
	PO								PSO		
CO	1	2	3	4	5	6	7	8	1	2	3
1	3	2	1			2	2	1			
2	2	3	2	1		2	2	2			
3	3	3	2	2	2	1		2			
4	2	2	3	2	3	1		3			

Correlation [3 – High, 2 -Medium, 1 – Low]

TEACHING AND ASSESSMENT SCHEME									
Teaching Scheme / Week					Credit	Hours / Semester	Examination Scheme		
							Theory		
L	T	J	P	S	C		CIA	ESE	Total
0	1`	0	0	0	-	15	50	-	50

***L**: Lecture (One unit is of one-hour duration), **T**: Tutorial (One unit is of one-hour duration), **P**: Practical (One unit is of one-hour duration), **J**: Project (One unit is of one-hour duration), **S**: Self-Learning & Team Work (One unit is of one-hour duration), **CIA**: Continuous Internal Assessment, **ESE**: End Semester Examination*

SYLLABUS (Major Topics)			
Module	Title	Major Topics	Hrs
1	Practice of Innovation & Entrepreneurship	Systematic Entrepreneurship and Purposeful Innovation, Sources of Innovative Opportunity, Entrepreneurial Management, Types of Innovations, Activity: Identify recent Indian innovations and classify them under innovation types.	**4**
2	Social Innovation & Social Entrepreneurship	Differences between Social Innovation and other Innovations, Sources and Types of Social Innovation, Business Models of Social Enterprises Activity: Case study analysis of SELCO/Aravind Eye Care/Akshaya Patra.	**4**
3	Technology-Based Business Models	Technology-driven business models, Objectives and contents of business plans, Tools and methods for assessing and analysing new ideas Activity: Team-based one-page business plan presentation.	**4**

SUGGESTED LEARNING RESOURCES

Text Book			
Sl. No.	Title of Book	Author	Publication
1	Social Innovation and Social Entrepreneurship: Fundamentals, Concepts, and Tools	Luis Portales	Springer, 2nd Edition, 2022
2	Entrepreneurship	Robert D. Hisrich, Michael P. Peters, Dean A. Shepherd	McGraw-Hill, 12th Edition, 2020
3	Business Model Generation	Alexander Osterwalder, Yves Pigneur	Wiley, Updated Reprint, 2020

Reference			
Sl. No.	Title of Book	Author	Publication
1	The Art of the Start 2.0, Penguin	Guy Kawasaki	2021 Reprint Edition
2	Entrepreneurship Development	Sangeeta Sharma	PHI Learning, 3rd Edition, 2023

Web Resource	
1	https://www.ediindia.org/
2	https://www.ycombinator.com/library
3	https://www.startupindia.gov.in/

DETAILED SYLLABUS *(Self-learning if any to be marked)*					
Module	Major Topic & Sub Topic	Mode of Delivery	COs	Learning Domain Level (C)	Teaching Hours
1	Systematic Entrepreneurship, Purposeful Innovation, Sources of Innovative Opportunity	L	CO1	A	2
	Entrepreneurial Management, Types of Innovations	L,T	CO1	A	2
2	Differences between Social Innovation and other Innovations	L	CO2	An	1
	Sources and Types of Social Innovation	L	CO2	An	2
	Business Models of Social Enterprises	L	CO2	E	1
3	Technology-driven business models	L	CO3	E	1

	Objectives and contents of business plans	L,T	CO3	A	2
	Tools and methods for assessing and analyzing new ideas	Activity	CO4	C	1

ASSESSMENT PATTERN		
Assessment		**Marks**
Continuous Internal Assessment		**50**
i.	Internal Examination	20
ii.	Learning Activity (Course based task/Seminars/Quiz/Assignment)	20
iii.	Regularity	10
iv.	Course Project	
End Semester Examination		-
Total		**50**

MITS Kochi

SEMESTER II

APPROVAL

This is to certify that the syllabus titled "syllabus for Master of Computer Applications (MCA)" implemented from the academic year 2025–2026, is prepared in accordance with the regulations, academic framework, and Outcome Based Education guidelines prescribed by the Institution and the affiliating University.

The syllabus has been discussed, reviewed, and approved by the following statutory bodies.

BOARD OF STUDIES (BOS)

Approved in the Board of Studies Meeting of the MCA held on 08/12/2025.

Chairperson, BoS

Name: Dr. Saritha K Designation: Professor

Signature: _____ Date: _____

ACADEMIC COUNCIL

Approved by the Academic Council in its meeting held on 16/12/2025

PRINCIPAL

Recommended for implementation from the Academic year 2025-2026.

Name: Dr. Neelakantan P C

Signature: _____ Date: _____

SEMESTER II

CURRICULUM

SLOT	COURSE CATEGORY	COURSE CODE	COURSE NAME	L	T	J	P	S	C
A	PC	A250201/CA200A	Advanced Database Management Systems	3	1	0	0	4	4
B	PC	A250201/CA200B	Advanced Computer Networks	3	1	0	0	4	4
C	PE	A250201/CA21*C	Program Elective I	3	1	0	0	4	4
D	PE	A250201/CA21*D	Program Elective II	3	1	0	0	4	4
T	PC	A250201/CA230T	Object Oriented Programming Lab	1	0	0	3	0	2
U	PC	A250201/CA230U	Advanced DBMS Lab	0	1	1	2	0	2
V	PC	A250201/CA230V	Networking and System Administration Lab	1	0	0	3	0	2
		A250201/CA230L	First NPTEL course						1
				14	**5**	**1**	**8**		**23**

(L- Lecture, T-Tutorial, J-Project, P-Practical, S-Self-learning & Team Work, C- Credit)

(PC- Programme Core, SE- Skill Enhancement Course)

LIST OF APPROVED MOOC COURSES

Sl. No	**Course Name**	**MITS Course Code**	**Course Institute**	**Subject Matter Expert Name**	**Duration**	**Offering Platform**	**Start Date**
1	Discrete Mathematics	A250201/CA230L	IIT, ROPAR	Prof. Sudarshan Iyengar	12 Weeks	NPTEL	Jan 19, 2026
2	Business Intelligence & Analytics	A250201/CA230L	IIT, Madras	Prof. Saji K Mathew	12 Weeks	NPTEL	Feb 16, 2026
3	Introduction to Internet of Things	A250201/CA230L	IIT, Kharagpur	Prof. Sudip Misra	12 Weeks	NPTEL	Jan 19, 2026
4	Introduction to Industry 4.0 And Industrial Internet of Things	A250201/CA230L	IIT, Kharagpur	Prof. Sudip Misra	12 Weeks	NPTEL	Jan 19, 2026

5	Discrete Mathematics	A250201/CA230L	IIT Ropar	Prof. Sudarshan Iyengar	12 Weeks	NPTEL	Jan 19, 2026
6	Introduction to Database Systems	A250201/CA230L	IIT, Madras	Prof. Sreenivasa Kumar	12 Weeks	NPTEL	Jan 19, 2026
7	Artificial Intelligence: Knowledge Representation and Reasoning	A250201/CA230L	IIT, Madras	Prof. Deepak Khemani	12 Weeks	NPTEL	Jan 19, 2026
8	Blockchain and Its Applications	A250201/CA230L	IIT, Kharagpur	Prof. Sandip Chakraborty, Prof. Shamik Sural	12 Weeks	NPTEL	Jan 19, 2026
9	Cloud Computing	A250201/CA230L	IIT, Kharagpur	Prof. Soumya Kanti Ghosh	12 Weeks	NPTEL	Jan 19, 2026
10	Theory of Computation	A250201/CA230L	IIT Hyderabad	Prof. Subrahmanyam Kalyanasundaram	12 Weeks	NPTEL	Jan 19, 2026
11	Introduction To Industry 4.0 And Industrial Internet of Things	A250201/CA230L	IIT, Kharagpur	Prof. Sudip Misra	12 Weeks	NPTEL	Jan 19, 2026
12	Object Oriented System Development Using Uml, Java and Patterns	A250201/CA230L	IIT, Kharagpur	Prof. Rajib Mall	12 Weeks	NPTEL	Jan 19, 2026
13	Getting Started with Competitive Programming	A250201/CA230L	IIT Gandhinagar	Prof. Neeldhara Misra	12 Weeks	NPTEL	Jan 19, 2026
14	Advanced Computer Architecture	A250201/CA230L	IIT Delhi	Prof. Smruti R.Sarangi	12 Weeks	NPTEL	Jan 19, 2026
15	Social Networks	A250201/CA230L	IIT Ropar	Prof. Sudarshan Iyengar	12 Weeks	NPTEL	Jan 19, 2026

COURSE DESCRIPTION							
Regulation	**2025**	**L-T-J-P-S**	**3-1-0-0-4**	**Version**	**25/0**	**Credits**	**4**
(L- Lecture, T-Tutorial, J-Project, P-Practical, S-Self-learning & Team Work)							

Course Code	Course Name	Course Category
A250201/CA200A	**Advanced Database Management Systems**	**PC**
Pre-requisite		
Basic knowledge of Database Management Systems (DBMS), SQL, and data modeling and Familiarity with relational algebra and normalisation concepts.		

COURSE OBJECTIVES	
1	To provide an in-depth understanding of relational and non-relational database concepts.
2	To develop skills in database design using normalisation and ER modelling.
3	To introduce transaction management and concurrency control mechanisms.
4	To explore data storage structures and query optimisation.
5	To expose learners to emerging database technologies like XML and NoSQL.

COMPETENCY STATEMENT (CC)	
CC1	Develop, manage, and optimize relational and non-relational databases to efficiently support organizational data requirements.

COURSE OUTCOMES (CO)			
CO	**CO Statement**	**CC Mapping**	**Cognitive (C)**
CO1	**Comprehend** the fundamentals of relational database systems, including data models, architectures, and ER features.	CC1	A
CO2	**Apply** normalisation techniques for effective database design.	CC1	A
CO3	**Implement** transaction management and concurrency control mechanisms.	CC1	A
CO4	**Demonstrate** database storage, file organisation, and query processing techniques.	CC1	A
CO5	**Explain** object-oriented, distributed, and NoSQL databases with XML-based data representation.	CC1	A
Cognitive (Revised blooms Level): *- **R**: Remember; **U**: Understand; **A**: Apply; **An**: Analyse; **E**: Evaluate; **C**: Create*			

	Program Outcomes & Program Specific Outcomes Correlation Matrix										
	PO								**PSO**		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**1**	**2**	**3**
CO1	3	2	1	-	-	-	-	-			
CO2	3	3	2	1	-	-	-	-			
CO3	2	3	3	1	-	-	-	-			
CO4	2	3	3	2	1	-	-	-			
CO5	2	3	3	2	-	-	-	1			
Correlation [3 – High, 2 -Medium, 1 – Low]											

TEACHING AND ASSESSMENT SCHEME									
Teaching Scheme / Week					Credit	Hours / Semester	Examination Scheme		
							Theory		
L	T	J	P	S	C		CIA	ESE	Total
3	1`	0	0	4	4	120	40	60	100

***L**: Lecture (One unit is of one-hour duration), **T**: Tutorial (One unit is of one-hour duration), **P**: Practical (One unit is of one-hour duration), **J**: Project (One unit is of one-hour duration), **S**: Self-Learning & Team Work (One unit is of one-hour duration), **CIA**: Continuous Internal Assessment, **ESE**: End Semester Examination*

SYLLABUS (Major Topics)			
Module	Title	Major Topics	Hrs
1	Relational Databases	Data Models, DB Architecture, ER Modelling, Relational Algebra	15
2	Database Design	Functional Dependencies, Normalization (1NF–5NF), BCNF	10
3	Transaction Management & Concurrency Control	Transaction Properties, Locking, Deadlock, Recovery	10
4	Data Storage & Querying	RAID, Indexing, B+ Trees, Hashing, Query Processing	10
5	Advanced Databases	Distributed Databases, Object-oriented Databases, XML, NoSQL, CAP Theorem	15

SELF-LEARNING / TEAM WORK		
Sl. No	Self-learning / Team Work Description	Hrs
1	Prepare an E-R diagram and relational schema for a mini real-life project such as a Library or Hospital Management System, using any online tool (e.g., draw.io, Lucidchart).	10
2	Perform normalisation up to 3NF or BCNF on the selected dataset and justify your design choices through a short report.	10
3	Conduct a hands-on experiment on transaction management—demonstrate concurrency issues (deadlock, lost updates) using SQL queries.	10
4	Implement indexing and query optimisation using SQL commands (EXPLAIN PLAN or ANALYZE) and document performance improvements.	10
5	Create a NoSQL database (MongoDB), insert sample documents, and demonstrate CRUD operations with JSON-like data.	5
6	Prepare and present a team seminar on emerging database technologies (e.g., distributed databases, CAP theorem, Cassandra).	15

SUGGESTED LEARNING RESOURCES

Text Book			
Sl. No.	Title of Book	Author	Publication
1	*Principles of Distributed Database Systems* (4th Edition)	M. Tamer Özsu, Patrick Valduriez	Springer, 2020
2	*Database System Concepts* (7th Edition)	Abraham Silberschatz, Henry F. Korth, S. Sudarshan	McGraw-Hill, 2020

Reference			
Sl. No.	Title of Book	Author	Publication
1	Fundamentals of Database Systems (7th Edition)	Ramez Elmasri, Shamkant B. Navathe	Pearson, 2016
2	Distributed Databases: Principles and Systems	Stefano Ceri, Giuseppe Pelagatti	McGraw-Hill, 2008
3	NoSQL Distilled	Pramod J. Sadalage, Martin Fowler	Addison-Wesley, 2013

Web Resource	
1	https://www.postgresql.org/docs/
2	https://www.mongodb.com/resources
3	https://cassandra.apache.org/doc/latest/
4	https://spark.apache.org/
5	https://cloud.google.com/bigquery/docs

DETAILED SYLLABUS *(Self-learning if any, to be marked)*

Module	Major Topic & Sub Topic	Mode of Delivery	COs	Learning Domain Level (C)	Teaching Hours
1	Introduction to relational databases, purpose and applications of DBMS, data abstraction, data models, database architecture, users and administrators.	L	CO1	A	5
	Relational model, keys, schemas, relational algebra operations, and E-R modelling (entities, relationships, attributes, constraints).	L, T	CO1	A	5
	E-R to relational mapping, specialisation, generalisation, and aggregation (Self-learning: Extended ER concepts).	L	CO1	A	5
2	Database tables and normalisation, functional dependencies, minimal set, conversion to 1NF, 2NF, 3NF, BCNF.	L, T	CO2	A	3
	Higher normal forms (4NF, 5NF, join dependencies), design improvement, and surrogate key considerations.	L	CO2	A	3
	Case study on normalisation and schema design improvement.	L, T	CO2	A	4
3	Transaction management, properties of transactions, SQL transaction control, and transaction logs.	L	CO3	A	4
	Concurrency control – locking mechanisms, deadlocks, timestamping, and optimistic methods.	L	CO3	A	3
	Database recovery management and case studies on transaction failures.	L, T	CO3	A	3
4	Data storage and file organisation, record organisation, RAID, and indexing concepts.	L	CO4	A	3
	B-tree and B+ tree index structures, static and dynamic hashing, and query processing overview.	L, T	CO4	A	3
	Query optimisation and selection operation (Self-learning: Visualisation of indexing and query plans).	L	CO4	A	4
5	Distributed databases – homogeneous and heterogeneous systems, distributed data storage, transactions.	L	CO5	A	5
	Object-oriented databases – structure, inheritance, object identity, and reference types in SQL.	L, T	CO5	A	5
	XML databases (DTD, Schema, Applications), NoSQL databases (MongoDB, HBase, Cassandra, CAP theorem).	L	CO5	A	5

TABLE OF SPECIFICATIONS (ToS) (ESE Question Paper Design)

Module	Module Title	Distribution of Marks (RBL)						Total Marks
		R	U	A	An	E	C	
1	Relational Databases	√	√	√		-	-	12
2	Database Design (Normalisation)	√	√	√		-	-	12
3	Transaction Management & Concurrency Control	√	√	√		-	-	12

4	Data Storage & Querying	√	√	√		-	-	12
5	Advanced Databases (Distributed, Object-oriented, XML, NoSQL)	√	√	√		-	-	12

This ToS shall be treated as a general guideline for students and teachers for the distribution of marks.

ASSESSMENT PATTERN	
Assessment	**Marks**
Continuous Internal Assessment	**40**
5. Internal Examination	20
6. Learning Activity	12
7. Regularity	8
8. Course Project	--
End Semester Examination	**60**
Total	**100**

MODEL QUESTION PAPER

Total Pages:.....

Register No.: ..... Name: .....

FIRST SEMESTER MCA DEGREE (REGULAR) EXAMINATION, DECEMBER 2025 (2025 SCHEME)			
Course Code:	A250201/CA200A		
Course Name:	Advanced Database Management Systems		
Max. Marks	**60**	**Duration**:	3 hours

PART A			
(Answer all questions. Each question carries 3 marks)			
No.	***Question***	***CO***	***Marks***
1	Define weak entity set with an example.	CO1	(3)
2	With the help of a diagram explain the different levels of data abstraction?	CO1	(3)
3	Differentiate between BCNF and 3NF with an example.	CO2	(3)
4	Explain functional dependency with suitable example.	CO2	(3)
5	Discuss the ACID properties of transaction.	CO3	(3)
6	Define deadlock and discuss the strategies for managing deadlocks.	CO3	(3)
7	Diagrammatically represent the basic steps in query processing.	CO4	(3)
8	Differentiate static and dynamic hashing.	CO4	(3)
9	Illustrate the different types of Distributed Databases.	CO5	(3)
10	Define collection and document in MongoDB.	CO5	(3)

PART B				
(Answer any one full question from each module, each question carries 6 marks)				
No.		***Question***	***CO***	***Marks***
MODULE I				
11		Draw an E-R diagram of a college database with entities student, staff, course, teacher, clerk, department & hostel? Relationship names must be meaningful, and there should be an ISA relationship in the diagram.	CO1	(6)
OR				
12		Explain the relational model concept and discuss the different relational models constraints.	CO1	(6)
MODULE II				
13		Analyse the common anomalies found in databases. How can we eliminate it through normalisation?	CO2	(6)
OR				
14		Define Normalisation. Explain 1NF, 2NF and 3NF in detail.	CO2	(6)
MODULE III				
15		Define deadlock. How can we deal with deadlocks?	CO3	(6)

		OR		
16		Explain concurrency control with locking methods	CO3	(6)
		MODULE IV		
17		Explain the various RAID levels with appropriate diagrams	CO4	(6)
		OR		
18		Differentiate between Dense index and Sparse index with an example.	CO4	(6)
		MODULE V		
19		Explain HBase and Cassandra.	CO5	(6)
		OR		
20	a)	Explain XML and its applications.	CO5	(6)

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COURSE DESCRIPTION							
Regulation	**2025**	**L-T-J-P-S**	**3-1-0-0-4**	**Version**	**25/0**	**Credits**	**4**
(L- Lecture, T-Tutorial, J-Project, P-Practical, S-Self-learning & Team Work)							

Course Code	Course Name	Course Category
A250201/CA200B	**Advanced Computer Networks**	**PC**
Pre-requisite		
Fundamentals of Computer Networks and Operating Systems		

COURSE OBJECTIVES	
1	To understand advanced network architectures, communication models, and protocol layering principles.
2	To analyse the design and performance of transport, network, and link layer protocols.
3	To explore advanced routing, congestion control, and Quality of Service (QoS) mechanisms.
4	To familiarize with modern networking paradigms such as SDN, virtualization.
5	To understand network security threats, management, and emerging paradigms in wireless and mobile communication.

COMPETENCY STATEMENT (CC)	
CC1	Design, analyze, and optimize core network protocols and mechanisms like transport and routing for high performance and reliability.
CC2	Evaluate traditional and emerging network architectures such as mobile and wireless networks and implement security and protection methods.

COURSE OUTCOMES (CO)

Course Outcomes (CO): At the end of this course, learners will be able to:

CO	CO Statement	CC Mapping	Cognitive (C)
CO1	**Apply** layered communication architectures and protocol design principles for modern networked systems.	CC1	A
CO2	**Apply** transport layer mechanisms, including reliability and congestion control, to improve performance optimization.	CC1	A
CO3	**Analyze** and compare routing algorithms and address allocation techniques across heterogeneous networks.	CC1	An
CO4	**Apply** link-layer technologies and switching mechanisms to improve network efficiency and reliability.	CC1	A
CO5	**Apply** emerging networking and security paradigms, including wireless, mobile, and management frameworks.	CC2	A

Cognitive (Revised blooms Level): *- **R**: Remember; **U**: Understand; **A**: Apply; **An**: Analyse; **E**: Evaluate; **C**: Create*

	Program Outcomes & Program Specific Outcomes Correlation Matrix										
	PO								PSO		
CO	1	2	3	4	5	6	7	8	1	2	3
1	3	2	1	2				1			
2	2	3	1	2				1			
3	2	3	2	2				1			
4	2	2	2	3				1			
5	1	2	2	2			3	3			

Correlation [3 – High, 2 -Medium, 1 – Low]

TEACHING AND ASSESSMENT SCHEME									
Teaching Scheme / Week					Credit	Hours / Semester	Examination Scheme		
							Theory		
L	T	J	P	S	C		CIA	ESE	Total
3	1`	0	0	4	4	120	40	60	100

***L**: Lecture (One unit is of one-hour duration), **T**: Tutorial (One unit is of one-hour duration), **P**: Practical (One unit is of one-hour duration), **J**: Project (One unit is of one-hour duration), **S**: Self-Learning & Team Work (One unit is of one-hour duration), **CIA**: Continuous Internal Assessment, **ESE**: End Semester Examination*

SYLLABUS (Major Topics)			
Module	Title	Major Topics	Hrs
1	Network Architectures and Performance Fundamentals	Overview of Networks and Internet Evolution; Protocol Architecture and Layered Models; Switched Networks and Performance Concepts	10
2	Transport Layer Mechanisms	Introduction to Transport Layer; Multiplexing and Demultiplexing; Reliable Data Transfer Mechanisms; Transmission Control Protocol (TCP) and User Datagram Protocol (UDP); Flow and Congestion Control.	10
3	Network Layer and Routing	Network Layer functions and services; Virtual circuits and datagram switching; Internet Protocol (IPv4): addressing, subnetting, and CIDR; Routing principles and algorithms: Link State and Distance Vector routing; Internet routing protocols: RIP, OSPF, BGP.	10
4	Link and Physical Layer Technologies	Error Detection Techniques; Multiple Access Protocols; IEEE 802.3 Ethernet and Switching.	10
5	Emerging Networks and Security	Wireless and Mobile Network Technologies; Network Security Fundamentals; Network Protection Mechanisms; Network Management with SNMP.	10

SELF-LEARNING / TEAM WORK		
Sl. No	Self-learning / Team Work Description	Hrs
1	Report on Classless Addressing (CIDR) – concept, subnet aggregation, and its role in efficient IP address utilization, Virtual circuits vs. datagram networks.	10
2	Presentation on 5G Technology – architecture, key features, and advancement over 4G networks.	10
3	Exploration of Peer-to-Peer (P2P) File Sharing Networks – working principles, examples, and security considerations, Multiplexing and Demultiplexing: Concept and purpose of multiplexing and demultiplexing; Socket and port addressing.	15
4	Emerging Topics – IPv6 and Software Defined Networking (SDN) – IPv6 header overview, SDN architecture, and OpenFlow basics, Multicast routing overview, Interior and Exterior Gateway Protocols (I-GP vs E-GP)	15
5	Physical Layer Transmission Media: Guided media (copper, fiber) and unguided media (wireless) ; Signal strength, attenuation, interference; Data encoding schemes (NRZ, Manchester overview)	10
6	Network Security Fundamentals: Common network attacks (DOS, spoofing, sniffing, phishing); Security objectives (confidentiality, integrity, availability); Basic mitigation techniques and defense layers, Overview of cellular network structure. Traffic Analysis tools & configuration management.	10

SUGGESTED LEARNING RESOURCES

Text Book			
Sl. No.	Title of Book	Author	Publication
1	Computer Networks: A Top-Down Approach	Behrouz A. Forouzan, Firouz Mosharraf	McGraw Hill Education, 1st Edition, 2023
2	Computer Networks	Andrew S. Tanenbaum, David J. Wetherall, Nick Feamster	Pearson Education, 6th Edition, 2022
3	Data Communications and Networking	Behrouz A. Forouzan	McGraw Hill Education, 6th Edition, 2022

4	Foundations of Modern Networking: SDN, NFV, QoE, IoT and Cloud	William Stallings	Pearson Education, 1st Edition (2022)
5	Computer Networks: Protocols, Standards and Interface	Uyless Black	Prentice Hall India Learning Private Limited, 8th Edition (2015).

Reference			
Sl. No.	Title of Book	Author	Publication
1	Computer Networking: A Top-Down Approach	James F. Kurose, Keith W. Ross	Pearson Education, 8th Edition, 2021
2	Computer Networks: A Systems Approach	Larry L. Peterson, Bruce S. Davie	Morgan Kaufmann Publishers, 6th Edition, 2020
3	The Illustrated Network: How TCP/IP Works in a Modern Network	Walter Goralski	Morgan Kaufmann Publications, 2nd Edition, 2017
4	TCP/IP Illustrated, Volume 1 – The Protocols	Kevin R. Fall, W. Richard Stevens	Pearson Education, 2nd Edition (2014)

Web Resource	
1	Computer Networks and Internet Protocol – NPTEL Course by IIT Kharagpur https://archive.nptel.ac.in/courses/106/105/106105183
2	The Bits and Bytes of Computer Networking – Coursera (Google Career Certificates) https://www.coursera.org/learn/computer-networking
3	An Introduction to Computer Networks – Peter L. Dordal (Online Textbook) http://intronetworks.cs.luc.edu/current2/ComputerNetworks.pdf
4	Cisco Networking Basics Tutorials – Cisco Learning Portal https://learningnetwork.cisco.com
5	Transport Layer Protocols – NPTEL Course (IIT Kharagpur) https://archive.nptel.ac.in/courses/106/105/106105183
6	Computer Networking – Transport Layer Module (Coursera, Google Career Certificates) https://www.coursera.org/learn/computer-networking
7	Routing and Network Layer Concepts – Coursera (Google Career Certificates) https://www.coursera.org/learn/computer-networking
8	IEEE 802.3 Ethernet Standards – IEEE SA Portal https://standards.ieee.org

DETAILED SYLLABUS *(Self-learning if any to be marked)*					
Module	Major Topic & Sub Topic	Mode of Delivery	COs	Learning Domain Level (C)	Teaching Hours
1	Overview of computer networks and Internet evolution.	L	CO1	A	1
	Protocol stack and layered architecture, OSI and TCP/IP models.	L,T	CO1	A	3
	Application layer protocols – HTTP, DNS, FTP, SMTP, POP3.	L	CO1	A	2
	Switched networks – Circuit-switched, Packet-switched and Virtual Circuits.	L	CO1	A	2
	Network performance concepts – Delay, Throughput and Quality of Service (QoS).	L	CO1	A	2
2	Introduction to Transport Layer: Role and services of the Transport Layer.	L	CO2	A	2
	Reliable Data Transfer Mechanisms: Principles of reliable data transfer; Stop-and-Wait ARQ; Go-Back-N sliding window mechanisms.	L	CO2	A	3
	Transmission Control Protocol (TCP) and User Datagram Protocol (UDP): Features and comparison of TCP and UDP; TCP segment structure, connection establishment (three-way handshake), and termination.	L,T	CO2	A	3
	Flow and Congestion Control : Need for flow control and congestion control ; Window management ;	L	CO2	A	2

	Principles of efficiency and fairness in congestion control; TCP congestion-avoidance algorithms (slow start, AIMD).				
3	Network Layer Functions and Services: Purpose of the Network Layer in the OSI/TCP IP stack; Forwarding and routing.	L	CO3	A	2
	Internet Protocol (IPv4): IPv4 address structure, subnetting and CIDR notation– IPv4 packet format and basic header fields.	L	CO3	A	2
	Routing Principles and Algorithms: Basic routing principles and objectives; Link State and Distance Vector routing algorithms with examples.	L,T	CO3	A	3
	Internet Routing Protocols: Operation of RIP, OSPF, and BGP protocols.	L	CO3	A	3
4	Error Detection Techniques: – Parity check, checksum computation; Cyclic Redundancy Check (CRC).	L,T	CO4	A	3
	Multiple Access Protocols: Random access protocols (ALOHA, CSMA/CD) ;Controlled access and token-based protocols.	L	CO4	A	3
	IEEE 802.3 Ethernet and Switching: Ethernet architecture, MAC addressing and frame structure; Switching and bridging operations; ARP and FIB concepts.	L	CO4	A	4
5	Wireless and Mobile Network Technologies: IEEE 802.11 Wi-Fi architecture, components, and frame structure ; Bluetooth architecture and protocol stack.	L	CO5	A	3
	Network Security Fundamentals: Common network attacks (DoS, spoofing, sniffing); security objectives – confidentiality, integrity, and availability. Network Protection Mechanisms: Firewalls (types and rule filtering); Virtual Private Networks (VPNs) and tunneling; Network Address Translation (NAT).	L,T	CO5	A	4
	Network Management with SNMP: SNMP architecture and components (Manager, Agent, MIB) ; Operations (GET, SET, TRAP).	L	CO5	A	3

TABLE OF SPECIFICATIONS (ToS) (ESE Question Paper Design)

Module	Module Title	Distribution of Marks (RBL)						Total Marks
		R	U	A	An	E	C	
1	Network Architectures and Performance Fundamentals	✓	✓	✓				12
2	Transport Layer Mechanisms	✓	✓	✓				12
3	Network Layer and Routing	✓	✓	✓	✓			12
4	Link and Physical Layer Technologies	✓	✓	✓				12
5	Emerging Networks and Security	✓	✓	✓				12

This ToS shall be treated as a general guideline for students and teachers for distribution of marks.

ASSESSMENT PATTERN	
Assessment	**Marks**
Continuous Internal Assessment	**40**
1. Internal Examination	20
2. Learning Activity	12
3. Regularity	8
4. Course Project	--
End Semester Examination	**60**
Total	**100**

MODEL QUESTION PAPER

			Total Pages:...2.....
Register No.:	.....	Name:	.....

FIRST SEMESTER MCA DEGREE (REGULAR) EXAMINATION, DECEMBER 2025 (2025 SCHEME)			
Course Code:	**A250201 / CA200B**		
Course Name:	**ADVANCED COMPUTER NETWORKS**		
Max. Marks	**60**	**Duration**:	3 hours

PART A

(Answer all questions. Each question carries 3 marks)

No.	*Question*	*CO*	*Marks*
1	Distinguish between protocol, service, and interface in layered network architecture.	CO1	(3)
2	What is the Internet protocol stack? Name its layers.	CO1	(3)
3	What is multiplexing? Explain its role in the transport layer.	CO2	(3)
4	Define congestion control. Why is it necessary in TCP?	CO2	(3)
5	What is classless addressing? State its advantage over classful addressing.	CO3	(3)
6	Differentiate between link-state and distance-vector routing algorithms.	CO3	(3)
7	List any three error detection techniques used in data communication.	CO4	(3)
8	What is CSMA/CD? Where is it used?	CO4	(3)
9	Define firewall. State its purpose in network security.	CO5	(3)
10	What is SNMP? Mention its basic components.	CO5	(3)

PART B

(Answer any one full question from each module, each question carries 6 marks)

No.		*Question*	*CO*	*Marks*
		MODULE I		
11	a)	Explain the OSI reference model and describe the functions of each layer.	CO1	(3)
	b)	How does layered architecture simplify network design?	CO1	(3)
		OR		
12	a)	Explain the Internet protocol stack with a neat diagram.	CO1	(3)
	b)	Discuss the performance metrics used in computer networks.	CO1	(3)
		MODULE II		
13	a)	Explain Stop-and-Wait and Go-Back-N protocols used in reliable data transfer.	CO2	(3)
	b)	Compare TCP and UDP.	CO2	(3)
		OR		
14	a)	Describe TCP connection establishment and termination mechanisms.	CO2	(3)
	b)	Explain the need for flow control and congestion control in transport layer.	CO2	(3)
		MODULE III		
15	a)	Explain IPv4 addressing and CIDR with suitable examples.	CO3	(3)
	b)	Discuss the importance of subnetting.	CO3	(3)
		OR		
16	a)	Describe the Link State routing algorithm with an example.	CO3	(3)
	b)	Explain the operation of RIP and OSPF routing protocols.	CO3	(3)
		MODULE IV		
17	a)	Explain various error detection techniques used in the data link layer.	CO4	(3)
	b)	Describe the Ethernet frame format.	CO4	(3)
		OR		
18	a)	What is the multiple access problem?	CO4	(3)
	b)	Explain the CSMA/CD protocol used in Ethernet networks.	CO4	(3)
		MODULE V		
19	a)	Explain the IEEE 802.11 wireless LAN architecture.	CO5	(3)
	b)	Discuss the major security issues in wireless networks.	CO5	(3)
		OR		
20	a)	Explain the working of firewalls and their types.	CO5	(3)
	b)	Describe the architecture and operations of SNMP.	CO5	(3)

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Program Elective I

COURSE DESCRIPTION							
Regulation	**2025**	**L-T-J-P-S**	**3-1-0-0-4**	**Version**	**25/0**	**Credits**	**4**
(L- Lecture, T-Tutorial, J-Project, P-Practical, S-Self-learning & Team Work)							

Course Code	**Course Name**	**Course Category**
A250201/MA211C	**APPLIED STATISTICS**	**PC**
Pre-requisite		
A basic knowledge in probability and statistics.		

COURSE OBJECTIVES	
1	To understand the basic concepts of random experiments and random variables, and to study various discrete probability distributions such as uniform, binomial, geometric, and Poisson, along with the computation of their mean and variance.
2	To build a strong foundation in continuous random variables and probability density functions, enabling students to analyze and interpret continuous probability distributions such as uniform, normal, and exponential.
3	To apply the principles of curve fitting, correlation, and regression for data analysis and modeling relationships between variables.
4	To develop an understanding of sampling techniques, estimation, and construction of confidence intervals for population parameters.
5	To formulate and test statistical hypotheses related to means and proportions, and make valid inferences based on sample data.

COMPETENCY STATEMENT (CC)	
CC1	Demonstrate the ability to apply the concepts of probability and probability distributions to model, analyze, and interpret real-world random phenomena effectively.
CC2	Demonstrate the ability to use statistical tools such as curve fitting, correlation, regression, sampling, and hypothesis testing for data-driven problem solving and decision-making.

COURSE OUTCOMES (CO)

Course Outcomes (CO): At the end of this course, learners will be able to:

CO	**CO Statement**	**CC Mapping**	**Cognitive (C)**
CO 1	**Apply** the concept of discrete probability distributions to solve near to real life problems	CC 1	A
CO 2	**Apply** the concept of continuous probability distributions to solve near to real life problems.	CC 1	A
CO 3	**Apply** the principles of correlation and regression in practical problems	CC 2	A
CO 4	**Develop** confidence intervals for various problems.	CC 2	U
CO 5	**Test** the given hypothesis on the basis of known criteria.	CC 2	A

Cognitive (Revised blooms Level): *- **R**: Remember; **U**: Understand; **A**: Apply; **An**: Analyse; **E**: Evaluate; **C**: Create*

	Program Outcomes & Program Specific Outcomes Correlation Matrix										
	PO								**PSO**		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**1**	**2**	**3**
1	**3**							**1**			
2	**3**							**1**			
3	**3**							**1**			
4	**3**							**1**			

Correlation [3 – High, 2 -Medium, 1 – Low]

TEACHING AND ASSESSMENT SCHEME									
Teaching Scheme / Week					Credit	Hours / Semester	Examination Scheme		
							Theory		
L	T	J	P	S	C		CIA	ESE	Total
3	1	0	0	4	4	120	40	60	100

***L**: Lecture (One unit is of one-hour duration), **T**: Tutorial (One unit is of one-hour duration), **P**: Practical (One unit is of one-hour duration), **J**: Project (One unit is of one-hour duration), **S**: Self-Learning & Team Work (One unit is of one-hour duration), **CIA**: Continuous Internal Assessment, **ESE**: End Semester Examination*

SYLLABUS (Major Topics)			
Module	Title	Major Topics	Hrs
1	**Discrete Probability Distributions**	Introduction – Random Experiment, Random Variables, Discrete Random Variables, Probability Distributions and Probability Mass Functions, Mean and Variance of a Discrete Random Variable, Discrete Uniform Distribution - Mean and Variance, Binomial Distribution - Mean and Variance, Geometric Distribution – Mean and Variance, Poisson Distribution - Mean and Variance	**10**
2	**Continuous Probability Distributions**	Continuous Random Variables, Probability Density Functions, Mean and Variance of a Continuous Random Variable, Continuous Uniform Distribution- Mean and Variance, Normal Distribution-Mean and Variance (Proof not required), Standard Normal Distribution, Exponential Distribution.	**10**
3	**Statistics**	Curve fitting – Principle of least squares – fitting a straight line – fitting a parabola – linear correlation and regression – Karl's Pearson's Coefficient of Correlation. Joint and marginal probability distribution - Conditional probability distribution - independent random variable (discrete case only).	**8**
4	**Sampling Distribution**	Sampling distribution – Introduction to sampling – random sampling – sampling distribution –standard error – estimation – interval estimates and confidence interval – estimation of population mean and proportions (small and large samples).	**8**
5	**Testing of Hypothesis**	Testing of hypothesis – introduction – basic concepts – Hypothesis concerning a mean – equality of means – Hypothesis concerning one proportion – difference of two proportions.	**9**

SELF-LEARNING / TEAM WORK		
Sl. No	Self-learning / Team Work Description	Hrs/Semester
1	Practice problems on Discrete Random Variables, mean and variance, Probability Distributions **(3 hours)**, Practice problems on Discrete Uniform Distribution - Mean and Variance **(2 hours)**, Practice problems on Binomial Distribution - Mean and Variance **(3 hours)**, Practice problems on Geometric Distribution – Mean and Variance **(1 hour)**, Practice problems on Poisson Distribution - Mean and Variance **(3 hours).**	12
2	Practice problems on Continuous Random Variables, Probability Density Functions, Mean and Variance of a Continuous Random Variable **(3 hours)**, Practice problems on Continuous Uniform Distribution- Mean and Variance **(3 hours)**, Practice problems on Normal Distribution-Mean and Variance, Standard Normal Distribution **(3 hours)**, Practice problems on Exponential Distribution **(3 hours)**,	12
3	Practice problems on Curve fitting – Principle of least squares – fitting a straight line **(2 hours)** – Practice problems on fitting a parabola **(2 hours)** – Practice problems on linear correlation and regression – Karl's Pearson's Coefficient of Correlation **(3 hours)**. Practice problems on Joint and marginal probability distribution **(2 hours)** - Practice problems on Conditional probability distribution - independent random variable **(3 hours).**	12
4	Practice problems on estimation of confidence interval –population mean of small samples **(3 hours)**, Practice problems on estimation of confidence interval –population mean of large samples **(3 hours)**, Practice problems on estimation of confidence interval –population proportion of small samples **(3 hours)**, Practice problems on estimation of confidence interval –population proportion of large samples **(3 hours).**	12

5	Practice problems on Testing of hypothesis –Hypothesis concerning a mean **(3 hours),** Practice problems on Testing of hypothesis- Hypothesis concerning equality of means **(3 hours)**, Practice problems on Testing of hypothesis- Hypothesis concerning one proportion **(3 hours),** Practice problems on Testing of hypothesis - Hypothesis concerning difference of two proportions **(3 hours)**.	12
		60 Hours

SUGGESTED LEARNING RESOURCES

Text Book			
Sl. No.	Title of Book	Author	Publication
1	Probability and Random Process	Veerarajan T	3rd Edition, Tata McGraw-Hill (2002)
2	Fundamentals of Mathematical Statistics	Gupta S.C and Kapoor V. K	Sultan Chand and Sons (2014)

Reference			
Sl. No.	Title of Book	Author	Publication
1	Introduction to practice of statistics	David S. Moore and George P. McCabe	W.H. Freeman & Company, 5th Edition (2005)
2	Introduction to Probability and Statistics Using R	G. Jay Kerns	Chapman & Hall (2010)
3	Applied Statistics and Probability for Engineers	Douglas C. Montgomery and George C. Runger	Wiley India, 5th Edition (2012)

Web Resource	
1	NPTEL COURSE ON DISCRETE PROBABILITY DISTRIBUTION https://onlinecourses.nptel.ac.in/noc22_mg31/preview
2	NPTEL COURSE ON CONTINUOUS PROBABILITY DISTRIBUTIONS https://onlinecourses.nptel.ac.in/noc22_mg31/preview
3	LECTURE ON THE TOPIC BIVARIATE DATA https://youtu.be/Ro5N7DcZ-cQ?si=3Ai39Z-p2K1u8CRl
4	SAMPLING DISTRIBUTIONS https://youtu.be/L3wQw0wva3g
5	NPTEL COURSE ON TESTING OF HYPOTHESIS https://youtu.be/heLP5118oyQ

Detailed Syllabus *(Self-learning if any to be marked)*

Module	Major Topic & Sub Topic	Mode of Delivery	Relevant Cos	Learning Domain Level	Teaching Hours
				C	
1	Discrete Random Variables, Probability mass function, Cumulative distribution function	L	CO1	U	2
	Mean and variance of discrete probability functions	L	CO1	U	1
	Tutorial Problems	T		U	1
	Binomial Distribution – its mean and variance	L	CO1	A	2
	Poisson Approximation to the Binomial Distribution.	L	CO1	A	1
	Poisson distribution- Mean and Variance,	L	CO1	A	1
	Tutorial Problems	T	CO1	A	1
	Discrete Uniform Distribution - Mean and Variance,	L	CO1	A	2
	Geometric Distribution - Mean and Variance	L	CO1	A	1
	Tutorial Problems	T	CO1	A	1
2	Continuous random variable, probability density function	L	CO2	U	2
	Distribution function, Mean and variance of continuous probability functions	L	CO2	U	1
	Tutorial Problems	T	CO2	U	1
	Uniform Distribution, mean and variance	L	CO2	A	1

	Exponential Distribution, mean and variance	L	CO2	A	1
	Tutorial Problems	T	CO2	A	2
	Normal Distribution, mean, variance, normal curve and its properties, Standard Normal Distribution.	L	CO2	A	1
	Tutorial Problems	T	CO2	A	1
3	Curve fitting, Principle of least squares	L	CO3	U	1
	Fitting a straight line	L	CO3	U	1
	Fitting a parabola	L	CO3	U	1
	Tutorial Problems	T	CO3	U	1
	Linear correlation and regression	L	CO3	U	1
	Karl's Pearson's Coefficient of Correlation	L	CO3	A	1
	Tutorial Problems	T	CO3	U	1
	Joint and marginal probability distribution	L	CO3	A	2
	Conditional probability distribution	L	CO3	A	1
	Tutorial Problems	T	CO3	A	1
4	Sampling distribution	L	CO4	U	1
	Introduction to sampling, random sampling	L	CO4	U	1
	Sampling distribution – standard error, estimation	L	CO4	U	1
	Tutorial Problems	T	CO4	U	1
	Estimation – interval estimates and confidence interval	L	CO4	U	1
	Estimation of population mean and proportions (small samples)	L	CO4	U	2
	Tutorial Problems	T	CO4	U	1
	Estimation of population mean and proportions (large samples)	L	CO4	U	2
	Tutorial Problems	T		U	1
5	Testing of hypothesis – introduction – basic concepts	L	CO5	U	1
	Hypothesis concerning a mean	L	CO5	A	2
	Tutorial Problems	T	CO5	A	1
	Hypothesis concerning Equality of means	L	CO5	A	2
	Tutorial Problems	T	CO5	A	1
	Hypothesis concerning one proportion	L	CO5	A	2
	Hypothesis concerning difference of two proportions	L	CO5	A	2
	Tutorial Problems	T	CO5	A	1

TABLE OF SPECIFICATIONS (ToS) FOR QUESTION PAPER DESIGN

Module	Module Title	Distribution of Marks (Revised Bloom's Level)						Total Marks
		R	U	A	An	E	C	
1	Discrete Probability Distributions	√	√	√				12
2	Continuous Probability Distributions	√	√	√				12
3	Statistics	√	√	√				12
4	Sampling Distribution	√	√	√				12
5	Testing of Hypothesis	√	√	√				12

This ToS shall be treated as a general guideline for students and teachers for distribution of marks.

ASSESSMENT PATTERN	
Assessment Methods	**Marks**
Continuous Internal Assessment	**40**
1.Internal Examination	**20**
2. Learning Activity	**12**
3. Regularity	**8**
4. Course Project	**-**
End Semester Examination	**60**
Total	**100**

MODEL QUESTION PAPER

			Total Pages:.....
Register No.:	.....	Name:	.....

FIRST SEMESTER MCA DEGREE (REGULAR) EXAMINATION, DECEMBER 2025 (2025 SCHEME)			
Course Code:	**A250201/MA211C**		
Course Name:	**APPLIED STATISTICS**		
Max. Marks	**60**	**Duration**:	3 hours
Specify if the question paper is common to different programmes			
Use of Data Book / IS codes, etc to be specified by the question paper setter			

PART A

(Answer all questions. Each question carries 3 marks)

No.	*Question*	*CO*	*Marks*
1	Suppose an unbiased coin is tossed 4 times. Using binomial distribution, find the probability of getting exactly 3 heads.	CO	(3)
2	If X follows Poisson distribution with P (X = 2) = P (X = 3), find P (X = 4).	CO	(3)
3	Is the function $f(x) = \begin{cases} 3e^{-3x}, & x > 0 \\ 0, & x \leq 0 \end{cases}$ a probability density function of a continuous random variable. If so, find P (2 < x < 4).	CO	(3)
4	Derive the mean and variance of uniform distribution.	CO	(3)
5	If the two regression lines are 3x − 2y = 5 and x − 4y = 7, find the regression coefficients of x on y and y on x.	CO	(3)
6	From the following data, find the most likely value of y when x = 24. Given correlation coefficient = 0.58, mean of x = 18.1, mean of y = 985.5, standard deviation of x = 2, standard deviation of y = 36.4.	CO	(3)
7	Define sampling distribution and standard error.	CO	(3)
8	Distinguish between population and sample with example.	CO	(3)
9	What do you mean by critical region and acceptance region?	CO	(3)
10	A coin is thrown 400 times and head turns up 245 times. Is the coin unbiased?	CO	(3)

PART B

(Answer any one full question from each module, each question carries 6 marks)

No.	*Question*	*CO*	*Marks*
	MODULE I		
11	A random variable X has the following probability distribution. X: -2, -1, 0, 1, 2, 3 f(X): 1/10, k, 1/5, 2k, 3/10, 3k Find: (a) value of k, (b) P [|x| < 2], (c) mean of X.	CO1	(6)
	OR		
12	The probability that the noise level of a wide band amplifier will exceed 2 dB is 0.05. Using binomial distribution, find the probability that, among 12 such amplifiers, the noise level of (i) at most two will exceed 2 dB (ii) two or more will exceed 2 dB.	CO1	(6)
	MODULE II		
13	The length of satisfactory service (years) provided by a certain laptop computer is a random variable that follows exponential distribution with mean as 4.5 years. Find the probabilities that one of the laptops will provide satisfactory service for (a) at most 2.5 years, (b) anywhere from 4 to 6 years, (c) at least 6.75 years.	CO2	(6)
	OR		
14	In a normally distributed population, 5% of the items are under 60 and 40% are between 60 and 65. Find the mean and standard deviation of the population.	CO2	(6)
	MODULE III		
15	Fit a parabola of the form $y = a + bx + cx^2$ by the principle of least squares for the following data	CO3	(6)

		x	1	2	3	4	5	
		y	3	9	13	21	31	
	OR							
16	The joint probability distribution of X and Y is given by f (x, y) = c (x+2y), x = 0, 1, 2 and y = 0, 1, 2, 3. Find: (i) c, (ii) P [X + Y ≤ 4], (iii) P [X ≤ 1 / Y < 3].						CO3	(6)
	MODULE IV							
17	The mean operating life for a random sample of 10 light bulbs is 4000 hours, with a standard deviation of 200 hours. Estimate a 95% confidence interval for the population mean.						CO4	(6)
	OR							
18	A random sample of 500 apples were taken from a large consignment and 60 were found to be bad. Find a 98% confidence interval for the percentage of bad apples.						CO4	(6)
	MODULE V							
19	The average marks scored by 32 boys is 72 with a standard deviation of 8, while that for 36 girls is 70 with a standard deviation of 6. Test at 1% of level of significance, whether the boys perform better than girls.						CO5	(6)
	OR							
20	A manufacturer claims that only 4% of the products supplied by him are defective. A random sample of 600 products contained 36 defectives. Test the claim a. At 5% level b. At 1% level.						CO5	(6)

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COURSE DESCRIPTION							
Regulation	**2025**	**L-T-J-P-S**	**3-1-0-0-4**	**Version**	**25/0**	**Credits**	4
(L- Lecture, T-Tutorial, J-Project, P-Practical, S-Self-learning & Team Work)							

Course Code	Course Name	Course Category
A250201/CA212C	**BLOCK CHAIN TECHNOLOGY**	**PE**
Pre-requisite		
Basics of centralised and distributed database and network technologies.		

COURSE OBJECTIVES	
1	To demonstrate the fundamental concepts, working principles, and types of Blockchain technology, and differentiate it from Bitcoin and distributed systems.
2	To explain the Blockchain architecture, versions, and variants, and illustrate its real-world applications and cryptocurrency use cases.
3	To demonstrate key Blockchain mechanisms such as double spending prevention, hashing, mining, proof-of-work, and Merkle tree construction for secure transactions.
4	To describe Bitcoin operations, including wallet configuration, transaction processes, and block generation, and compare Bitcoin with other digital currencies.
5	To design and develop Smart Contracts using Blockchain platforms such as Ethereum and Hyperledger, and illustrate their role in decentralised applications and governance.

COMPETENCY STATEMENT (CC)	
CC1	This course will teach students the core concepts and mechanics of Blockchain technology, its architecture, difference between Blockchain, Bitcoin, and distributed systems, and gain the skills needed to design and build secure decentralised applications (DApps) and Smart Contracts using platforms like Ethereum and Hyperledger for real-world use.

COURSE OUTCOMES (CO)

Course Outcomes (CO): At the end of this course, learners will be able to:

CO	CO Statement	CC Mapping	Cognitive (C)
CO1	Gain a deep knowledge of the fundamental concepts of Blockchain technology and its key differences from Bitcoin and traditional distributed systems.	CC1	U
CO2	Have a great comprehension of the Blockchain architecture, and illustrate its real-world applications and cryptocurrency use cases.	CC1	A
CO3	Demonstrate key Blockchain mechanisms that ensure secure and trusted transactions.	CC1	A
CO4	Get well familiarised with the usage of Bitcoin and its impact on the economy.	CC1	A
CO5	Illustrate and assess the potential real-world applications of Blockchain across various industries, including its specific use cases	CC1	A

Cognitive (Revised blooms Level): *- **R**: Remember; **U**: Understand; **A**: Apply; **An**: Analyse; **E**: Evaluate; **C**: Create*

	Program Outcomes & Program Specific Outcomes Correlation Matrix										
	PO								**PSO**		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**1**	**2**	**3**
1	**3**	**2**	**2**				**1**				
2		**3**	**3**	**2**				**2**			
3	**3**		**3**	**3**							
4			**3**	**2**		**2**					
5			**3**	**3**	**2**			**3**			

Correlation [3 – High, 2 -Medium, 1 – Low]

TEACHING AND ASSESSMENT SCHEME									
Teaching Scheme / Week					Credit	Hours / Semester	Examination Scheme		
							Theory		
L	T	J	P	S	C		CIA	ESE	Total
3	1	0	0	4	4	120	40	60	100

***L**: Lecture (One unit is of one-hour duration), **T**: Tutorial (One unit is of one-hour duration), **P**: Practical (One unit is of one-hour duration), **J**: Project (One unit is of one-hour duration), **S**: Self-Learning & Team Work (One unit is of one-hour duration), **CIA**: Continuous Internal Assessment, **ESE**: End Semester Examination*

SYLLABUS (Major Topics)			
Module	Title	Major Topics	Hrs
1	Introduction to Blockchain	Introduction to Blockchain, How Blockchain works, Blockchain vs Bitcoin, Practical applications, public and private key basics, Distributed systems, History of blockchain and Bitcoin, Types of blockchain. Pros and Cons of Blockchain, Myths about Bitcoin.	10
2	Blockchain Architecture	Blockchain Architecture, versions, variants, Use cases, Life use cases of blockchain, Blockchain vs Shared Database, Introduction to Cryptocurrencies, Types, Applications.	10
3	Blockchain mechanisms for secure transactions	Concept of Double Spending, Hashing, Mining, Proof of Work (PoW). Introduction to Merkel tree, Privacy, Payment verification, Resolving Conflicts, Creation of Blocks	10
4	Introduction to Bitcoin	Introduction to Bitcoin, key concepts of Bitcoin, Merits and Demerits, Fork and Segwits, Sending and Receiving Bitcoins, choosing a Bitcoin wallet, Converting Bitcoins to Fiat Currency, Bitcoin digital keys and addresses, Transactions, Blockchain mining. Alternative Coins. Limitations of Bitcoin.	12
5	Introduction to Blockchain Platforms	Introduction to Blockchain Platforms: Ethereum, Hyperledger, IOTA, EOS, Multichain, Bigchain, etc., Advantages and Disadvantages, Ethereum vs Bitcoin, Introduction to Smart contracts, usage, application, working principle, Law and Regulations. Case Study, Blockchain applications.	12

SELF-LEARNING / TEAM WORK		
Sl. No	Self-learning / Team Work Description	Hrs
1	Blockchain vs Bitcoin	8
2	Cryptocurrency Types	8
3	Creation of Blocks	10
4	Blockchain mining	10
5	Key concepts of Bitcoin	10
6	Ethereum	10
7	Blockchain Case Study	10

SUGGESTED LEARNING RESOURCES

Text Book			
Sl. No.	Title of Book	Author	Publication
1	Beginning Blockchain: A Beginner's Guide to Building Blockchain Solutions.	Arshdeep Bikramaditya Singhal, Gautam Dhameja, Priyansu Sekhar Panda	APress, 2018
2	Blockchain Applications: A Hands-On Approach	Bahga, Vijay Madisetti	VPT, 2018
3	Blockchain: Blueprint for a New Economy	Melanie Swan	O'Reilly, 2015

Reference			
Sl. No.	Title of Book	Author	Publication
1	Bitcoin and Cryptocurrency Technologies	Aravind Narayan. Joseph Bonneau	Princeton, 2016
2	Bitcoin and Blockchain Basics: A non-technical introduction for beginners on Blockchain Technology, Cryptocurrency, Bitcoin, Altcoins, Ethereum, Ripple, Investing, Mining, Wallets and Smart Contracts	Arthur T Brooks	WonderBook, 2019

Web Resource	
1	https://bitcoin.org/bitcoin.pdf
2	http://scet.berkeley.edu/wp-content/uploads/BlockchainPaper.pdf
3	https://github.com/anders94/blockchain-demo
4	http://blockchain.mit.edu/how-blockchain-works
5	https://anders.com/blockchain/
6	http://learnmeabitcoin.com/
7	Live map: https://bitnodes.earn.com/nodes/live-map/
8	Realtime Bitcoin Globe: https://blocks.wizb.it/
9	Unconfirmed Transactions Visualization: http://dailyblockchain.github.io/

DETAILED SYLLABUS *(Self-learning if any to be marked)*

Module	Title	Major Topic & Sub Topic	Mode of Delivery	COs	Learning Domain Level (C)	Teaching Hours
1	Introduction to Blockchain	Introduction to Blockchain	L	CO1	U	1
		How Blockchain works.	L	CO1	U	1
		Blockchain vs Bitcoin	L	CO1	U	1
		Practical applications	L, T	CO1	U	1
		public and private key basics	L	CO1	U	1
		Distributed systems	L	CO1	U	1
		History of blockchain and Bitcoin	L	CO1	U	1
		Types of blockchain	L, T	CO1	U	1
		Pros and Cons of Blockchain	L	CO1	U	1
		Myths about Bitcoin	L	CO1	U	1
2	Blockchain Architecture	Blockchain Architecture, Versions, and variants	L	CO2	A	2
		Use cases	L, T	CO2	A	2
		Life use cases of blockchain	L	CO2	A	2
		Blockchain vs Shared Database	L	CO2	A	2
		Introduction to Cryptocurrencies, Types, Applications.	L	CO2	A	2
3	Blockchain mechanisms for secure transactions	Concept of Double Spending	L, T	CO3	A	1
		Hashing, Mining, Proof of Work (PoW)	L	CO3	A	3
		Introduction to Merkel tree, Privacy, Payment verification	L	CO3	A	3
		Resolving Conflicts	L	CO3	A	1
		Creation of Block	L, T	CO3	A	2
4	Introduction to Bitcoin	Key concepts of Bitcoin	L	CO4	A	2
		Merits and Demerits	L	CO4	A	1
		Fork and Segwits, Sending and Receiving Bitcoins	L	CO4	A	2
		Choosing a Bitcoin wallet	L, T	CO4	A	1

		Converting Bitcoins to Fiat Currency	L	CO4	A	1
		Bitcoin digital keys and addresses	L	CO4	A	1
		Transactions, Blockchain mining	L	CO4	A	2
		Alternative Coins. Limitations of Bitcoin	L, T	CO4	A	2
5	Introduction to Blockchain Platforms	Introduction to Blockchain Platforms, Ethereum	L	CO5	A	1
		Hyperledger, IOTA, EOS, Multichain, Bigchain	L	CO5	A	2
		Advantages and Disadvantages	L	CO5	A	1
		Ethereum vs Bitcoin	L, T	CO5	A	1
		Introduction to Smart contracts, usage, application, Working principle	L	CO5	A	2
		Law and Regulations	L	CO5	A	1
		Case Study	L	CO5	A	2
		Blockchain applications	L,T	CO5	A	2

TABLE OF SPECIFICATIONS (ToS) (ESE Question Paper Design)

Module	Module Title	Distribution of Marks (RBL)						Total Marks
		R	U	A	An	E	C	
1	Introduction to Blockchain	✓	✓					12
2	Blockchain Architecture	✓	✓	✓				12
3	Blockchain mechanisms for secure transactions	✓	✓	✓				12
4	Introduction to Bitcoin	✓	✓	✓				12
5	Introduction to Blockchain Platforms	✓	✓	✓				12

This ToS shall be treated as a general guideline for students and teachers for distribution of marks.

ASSESSMENT PATTERN

Assessment	Marks
Continuous Internal Assessment	**40**
1. Internal Examination	20
2. Learning Activity	12
3. Regularity	8
4. Course Project	-
End Semester Examination	**60**
Total	**100**

MODEL QUESTION PAPER

Total Pages:.....

Register No.: ..... Name: .....

FIRST SEMESTER MCA DEGREE (REGULAR) EXAMINATION, DECEMBER 2025 (2025 SCHEME)

Course Code:	**A250201/CA212C**		
Course Name:	**BLOCK CHAIN TECHNOLOGY**		
Max. Marks	**60**	**Duration**:	**3 hours**

PART A

(Answer all questions. Each question carries 3 marks)

No.	*Question*	*CO*	*Marks*
1	Define Blockchain and list any two practical applications of Blockchain.	CO1	(3)
2	Differentiate between Blockchain and Bitcoin.	CO1	(3)
3	Explain the basic components of Blockchain Architecture.	CO2	(3)
4	What is a shared database? How is Blockchain different from a shared database?	CO2	(3)

5	What is the concept of Double Spending in Blockchain?	CO3	(3)
6	Define Proof of Work (PoW) and state its purpose.	CO3	(3)
7	What is a Bitcoin wallet? Mention any two types.	CO4	(3)
8	What is a Bitcoin fork? Briefly explain SegWit.	CO4	(3)
9	What is a smart contract? Mention any one application.	CO5	(3)
10	List any three popular Blockchain platforms with one use case each.	CO5	(3)

PART B

(Answer any one full question from each module, each question carries 6 marks)

No.		*Question*	*CO*	*Marks*
		MODULE I		
11	a)	Explain how Blockchain works with a neat diagram.	CO1	(2)
	b)	Discuss the pros and cons of Blockchain technology.	CO1	(4)
		OR		
12	a)	Explain public key and private key cryptography in Blockchain.	CO1	(3)
	b)	Discuss common myths about Bitcoin and clarify the facts.	CO1	(3)
		MODULE II		
13	a)	Explain Blockchain Architecture in detail.	CO2	(4)
	b)	Discuss different versions and variants of Blockchain.	CO2	(2)
		OR		
14	a)	Explain real-life use cases of Blockchain in different domains.	CO2	(3)
	b)	Describe types of cryptocurrencies and their applications.	CO2	(3)
		MODULE III		
15	a)	Explain hashing and its role in Blockchain security.	CO3	(3)
	b)	Describe the block creation process in Blockchain.	CO3	(3)
		OR		
16	a)	Explain Merkle Tree with an example.	CO3	(3)
	b)	Discuss privacy, payment verification, and conflict resolution in Blockchain.	CO3	(3)
		MODULE IV		
17	a)	Explain key concepts of Bitcoin.	CO4	(3)
	b)	Discuss merits and demerits of Bitcoin.	CO4	(3)
		OR		
18	a)	Explain the process of sending and receiving Bitcoins.	CO4	(3)
	b)	Discuss Bitcoin mining and its limitations.	CO4	(3)
		MODULE V		
19	a)	Explain Ethereum architecture and smart contract execution.	CO5	(3)
	b)	Compare Ethereum vs Bitcoin.	CO5	(3)
		OR		
20	a)	Explain any two Blockchain platforms (Hyperledger, IOTA, EOS, etc.).	CO5	(3)
	b)	Discuss legal and regulatory issues related to Blockchain technology with a case study.	CO5	(3)

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COURSE DESCRIPTION							
Regulation	**2025**	**L-T-J-P-S**	**3-1-0-0-4**	**Version**	**25/0**	**Credits**	**4**
(L- Lecture, T-Tutorial, J-Project, P-Practical, S-Self-learning & Team Work)							

Course Code	Course Name	Course Category
A250201/CA213C	**ORGANIZATIONAL BEHAVIOUR**	**PE**
Pre-requisite		
NIL		

COURSE OBJECTIVES	
1	To help students understand how people behave in organizations.
2	To explain how differences in individual behaviour affect work performance.
3	To develop skills to manage and motivate people effectively.
4	To understand group behaviour and improve teamwork and communication.
5	To study how organizational structure and culture influence employee behaviour.

COMPETENCY STATEMENT (CC)	
CC1	Demonstrate the ability to apply and analyse the principles of organizational behaviour to improve individual, group, and organizational performance.

COURSE OUTCOMES (CO)			
Course Outcomes (CO): At the end of this course, learners will be able to:			
CO	**CO Statement**	**CC Mapping**	**Cognitive (C)**
CO1	Apply organizational behaviour concepts to identify managers' challenges and opportunities in improving individual and organizational effectiveness.	CC1	A
CO 2	Analyse various characteristics of individual behaviour and evaluate their impact on organizational performance.	CC1	An
CO 3	Apply behavioural theories to understand and manage the complexities of individual behaviour within organizations.	CC1	A
CO 4	Analyse group behaviour to develop effective interpersonal relationships, teamwork, and leadership skills.	CC1	An
CO 5	Apply understanding of organizational structure, culture, and design to evaluate their influence on employee behaviour and performance.	CC1	A
Cognitive (Revised blooms Level): *- **R**: Remember; **U**: Understand; **A**: Apply; **An**: Analyse; **E**: Evaluate; **C**: Create*			

	Program Outcomes & Program Specific Outcomes Correlation Matrix										
	PO								**PSO**		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**1**	**2**	**3**
1	**3**	**2**	**2**			**2**	**2**	**2**			
2	**3**	**3**	**2**			**2**	**2**	**2**			
3	**3**	**2**	**2**			**3**	**2**	**2**			
4	**2**	**2**	**2**			**3**	**3**	**2**			
5	**3**	**3**	**2**			**2**	**3**	**2**			
Correlation [3 – High, 2 -Medium, 1 – Low]											

TEACHING AND ASSESSMENT SCHEME									
Teaching Scheme / Week					Credit	Hours / Semester	Examination Scheme		
							Theory		
L	T	J	P	S	C		CIA	ESE	Total
3	1`	0	0	4	4	120	40	60	100

***L**: Lecture (One unit is of one-hour duration), **T**: Tutorial (One unit is of one-hour duration), **P**: Practical (One unit is of one-hour duration), **J**: Project (One unit is of one-hour duration), **S**: Self-Learning & Team Work (One unit is of one-hour duration), **CIA**: Continuous Internal Assessment, **ESE**: End Semester Examination*

SYLLABUS (Major Topics)			
Module	Title	Major Topics	Hrs
1	Introduction to Organizational Behaviour (OB) and Management	Organisations and Organisational Behaviour (OB), Nature of OB, Management and Managers, Challenges in OB	9
2	Foundations of Individual Behaviour	Individual Behaviour, Intelligence, Perception and Attribution, Learning	10
3	Motivation, Attitudes, and Work Behaviour	Attitudes and Values, Motivation, Applied Motivational Practices, Work Stress	9
4	Group and Leadership Dynamics	Group Dynamics, Team Dynamics, Leadership, Communication	12
5	Organisational Structure, Culture, Innovation and Change	Organisational Structure, Organisational Culture, Creativity and Innovation in Organisations, Organisational Change and Development	10

SELF-LEARNING / TEAM WORK		
Sl. No	Self-learning / Team Work Description	Hrs
1	Management and managers: Contemporary Trends in Management Thinking Challenges in OB: Talent management Case Study: OB Principles: Prepare a short report on how OB principles are applied in a well-known company (e.g., Google, Infosys, or TCS) Case Study: Employee Behaviour in Remote / Work-from-Home Environments	10
2	Personality: Nature of Personality – The Shaping of Personality – Determinants of Personality – Personality Structure – OB Related Personality Traits	10
3	Applied Motivational Practices: Quality of Work Life, Employee Engagement Work stress: Case Study/ Discussion: Managing Work Stress and Burnout in an IT Organisation	20
4	Workplace Behaviour: Nature of Conflict – Changing Views of Conflict – Functional and Dysfunctional Conflict – The Process of Conflict – Levels of Conflict – Conflict Resolution – Conflict Management Styles - Managerial Implications – Negotiation and Conflict Resolution	15
5	Creativity and Innovation in Organisations: Fostering a Creative Organisational Climate, Managerial Role in Promoting Innovation Organisational Change and Development: The Change Process, Organisational Development, Managerial Implications	15

SUGGESTED LEARNING RESOURCES

Text Book			
Sl. No.	Title of Book	Author	Publication
1	Organizational Behaviour	K Aswathappa	Himalaya Publishing House, 13th edition, 2018
2	Organizational Behavior (Indian edition)	Stephen P. Robbins; Timothy A. Judge; Neharika Vohra	Pearson Education, 18th edition, 2019 ISBN: 978-9353067038

Reference			
Sl. No.	Title of Book	Author	Publication
1	Organizational Behaviour	Steven McShane & Mary Ann Von Glinow	McGraw-Hill Education, 10th Edition (Feb 2023)
2	Management and Organizational Behaviour	Laurie J. Mullins	Pearson Education, 13th Edition (2023)

Web Resource	
1	NPTEL Online Certification (NOC): Organizational Behaviour – IIT Hyderabad by M. P. Ganesh — https://nptel.ac.in/courses/110106145
2	Free online course (Great Learning) – "Organizational Behaviour" — https://www.mygreatlearning.com/academy/learn-for-free/courses/organizational-behaviour (MyGreatLearning)
3	NPTEL Course: Advance Course in Organizational Behavior – IIT Roorkee — https://nptel.ac.in/courses/109107740

DETAILED SYLLABUS *(Self-learning if any to be marked)*

Module	Major Topic & Sub Topic	Mode of Delivery	COs	Learning Domain Level (C)	Teaching Hours
1	Organisations and Organisational Behaviour (OB): Organizations, Purpose of organizations, Organizational Behaviour	L	CO1	A	2
	Nature of OB: Foundations of OB, Contemporary OB, Scope of Organisational Behaviour, Contextual Perspectives of OB, Evolution of OB, OB Model	L	CO1	A	3
	Management and Managers: Functions of Management, Manager's Roles, Types of Managers, Evolution of Management Theory	L, T	CO1	A	2
	Challenges in OB: Managing Inclusivity/Diversity, Career Management, Globalisation	L	CO1	A	2
2	Foundations of Individual Behaviour: Personal Factors – Environmental Factors – Organisational Systems and Resources – Models of Individual Behaviour	L	CO2	An	3
	Intelligence: Nature of Intelligence – Types of Intelligence– Model, Theories, Measurement of Intelligence– Factors Influencing Intelligence	L	CO2	An	2
	Perception and Attribution: Perception: Meaning and Definition– Factors Influencing Perception – Perceptual Process– Perception and OB	L	CO2	An	2
	Learning: Explicit and Tacit Knowledge– How Learning Occurs?– Principles of Learning– Learning and OB	L, T	CO2	An	3
3	Attitudes and Values: Nature of Attitudes – Components of Attitudes – Formation of Attitudes – Functions of Attitudes – Changing Attitudes – Work-related Attitudes – Values	L, T	CO3	A	3
	Motivation: Nature of Motivation– Importance of Motivation– Motivational Challenges– Theories on Motivation	L	CO3	A	2
	Applied Motivational Practices: Rewards – Job Design– Behaviour Modification– Empowerment– Problem Employees	L	CO3	A	2
	Work Stress: Work Stress Model– Burnout– Stress Management – Stress and Performance	L	CO3	A	2
4	Group Dynamics: Nature of Groups – Types of Groups – Group Development – Usefulness & Pitfalls of Groups – Determinants of Group Behaviour– Group Structuring – Group Decision Making	L	CO4	An	3

	Team Dynamics: Teams vs. Groups– Benefits from Teams– Types of Teams– Implementing Teams in Organisations – Team Properties – Effective Teamwork	L	CO4	An	3
	Leadership: Nature of Leadership– Leadership and Management– Importance of Leadership– Formal and Informal Leadership– Leadership Styles and Their Implications– Theories of Leadership– Contemporary Issues on Leadership– Leadership Development	L	CO4	An	3
	Communication: Interpersonal Communication– Organisational Communication– Communication Networks– Communication Roles– Informal Communication– Communication Media– Information Technologies – Managerial Implications	L, T	CO4	An	3
5	Organisational Structure: Nature of Organisations – Organisational Structure– Key Factors of Organisational Structure– Types of Organisational Structures– Organisations for Future.	L	CO5	A	2
	Organisational Culture: Cultural Dimensions – How is Culture Created? – Sustaining Culture– Effects of Culture – Changing Organisational Culture	L	CO5	A	2
	Creativity and Innovation in Organisations: Factors influencing creativity in organisations, Innovation process within organisations, Building and sustaining an innovative organisational culture	L, T	CO5	A	3
	Organisational Change and Development: Nature of Change – Levels of Change – Types of Change – Forces for Change in Organisations– Resistance to Change – Force Field Theory of Change	L	CO5	A	3

TABLE OF SPECIFICATIONS (ToS) (ESE Question Paper Design)

Module	Module Title	Distribution of Marks (RBL)						Total Marks
		R	U	A	An	E	C	
1	Introduction to Organizational Behaviour (OB) and Management	✓	✓	✓				12
2	Foundations of Individual Behaviour	✓	✓	✓	✓			12
3	Motivation, Attitudes, and Work Behaviour	✓	✓	✓				12
4	Group and Leadership Dynamics	✓	✓	✓	✓			12
5	Organisational Structure, Culture, Innovation and Change	✓	✓	✓				12

This ToS shall be treated as a general guideline for students and teachers for distribution of marks.

ASSESSMENT PATTERN	
Assessment	**Marks**
Continuous Internal Assessment	**40**
1. Internal Examination	20
2. Learning Activity	12
3. Regularity	8
4. Course Project	--
End Semester Examination	**60**
Total	**100**

MODEL QUESTION PAPER

			Total Pages :.....
Register No.:	.....	Name:	.....

FIRST SEMESTER MCA DEGREE (REGULAR) EXAMINATION, DECEMBER 2025 (2025 SCHEME)			
Course Code:	A250201/CA213C		
Course Name:	**ORGANIZATIONAL BEHAVIOUR**		
Max. Marks	**60**	**Duration**:	3 hours

PART A

(Answer all questions. Each question carries 3 marks)

No.	*Question*	*CO*	*Marks*
1	Explain the scope of organizational behaviour in an organization.	CO1	(3)
2	Distinguish between career management and talent management.	CO1	(3)
3	Identify the major job attitude and job satisfaction parameters.	CO2	(3)
4	Explain classical conditioning theory of learning.	CO2	(3)
5	Identify the various components of attitude.	CO3	(3)
6	What is learning and what are theories of learning?	CO3	(3)
7	Explain any 3 pitfalls of group.	CO4	(3)
8	Differentiate between formal and informal groups.	CO4	(3)
9	Discuss the importance of innovation in organisational success.	CO5	(3)
10	Explain how culture is created and sustained in organizations.	CO5	(3)

PART B

(Answer any one full question from each module, each question carries 6 marks)

No.		*Question*	*CO*	*Marks*
		MODULE I		
11	a)	Describe how organizational behaviour is an inter disciplinary subject. Support your answer with suitable examples.	CO1	(6)
		OR		
12	a)	Explain how a manager can apply the functions of management to improve organizational performance.	CO1	(6)
		MODULE II		
13	a)	Define intelligence. What are the theories of intelligence?	CO2	(6)
		OR		
14	a)	Define perception. How can a manager apply the factors influencing perception to improve communication in the workplace?	CO2	(6)
		MODULE III		
15	a)	Explain the theories of motivation.	CO3	(6)
		OR		
16	a)	Explain the term stress and stressors. Discuss how stress and productivity are related to each other.	CO3	(6)
		MODULE IV		
17	a)	Explain the concept of team dynamics and its effects on team effectiveness.	CO4	(6)
		OR		
18	a)	What are the potential problems with upward and downward communications? How can managers alleviate these problems?	CO4	(6)
		MODULE V		
19	a)	How can different types of organisational structures be applied to improve coordination and communication in a company?	CO5	(6)
		OR		
20	a)	Explain how Lewin's Force Field Theory can be applied by managers to implement organisational change effectively.	CO5	(6)

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COURSE DESCRIPTION							
Regulation	**2025**	**L-T-J-P-S**	**3-1-0-0-4**	**Version**	**25/0**	**Credits**	**4**
(L- Lecture, T-Tutorial, J-Project, P-Practical, S-Self-learning & Team Work)							

Course Code	Course Name	Course Category
A250201/CA214C	**ADVANCED OPERATING SYSTEMS**	**PE**
Pre-requisite		
Basic concepts of computer operating systems.		

COURSE OBJECTIVES	
1	To understand synchronization mechanisms and concurrency issues in single and distributed systems.
2	To examine mutual exclusion techniques and explore system security threats
3	To understand the design of distributed shared memory and issues in load distribution
4	To examine design issues and synchronization in multiprocessor systems.
5	To understand synchronization and concurrency control mechanisms in database systems

COMPETENCY STATEMENT (CC)	
CC1	Demonstrate the ability to design and analyze synchronization and concurrency control mechanisms for secure, efficient, and well-coordinated operation of single, distributed, multiprocessor and database systems.

COURSE OUTCOMES (CO)

Course Outcomes (CO): At the end of this course, learners will be able to:

CO	CO Statement	CC Mapping	Cognitive (C)
CO1	Analyse and resolve synchronization and concurrency issues in single and distributed systems using semaphores, monitors, and message passing.	CC1	An
CO 2	Analyse various mutual exclusion algorithms and security violations.	CC1	An
CO 3	Apply distributed shared memory concepts to develop applications with shared memory in distributed environments.	CC1	A
CO 4	Analyse design issues and synchronization in multiprocessor systems.	CC1	An
CO 5	Analyse concurrency control techniques and optimistic concurrency control in database transactions.	CC1	An

Cognitive (Revised blooms Level): *- **R**: Remember; **U**: Understand; **A**: Apply; **An**: Analyse; **E**: Evaluate; **C**: Create*

	Program Outcomes & Program Specific Outcomes Correlation Matrix										
	PO								PSO		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**1**	**2**	**3**
1	**3**	**2**	**3**					**1**			
2	**3**	**2**	**3**					**1**			
3	**3**	**2**	**3**					**1**			
4	**3**	**2**	**3**					**1**			
5	**3**	**2**	**3**					**1**			

Correlation [3 – High, 2 -Medium, 1 – Low]

TEACHING AND ASSESSMENT SCHEME									
Teaching Scheme / Week					Credit	Hours / Semester	Examination Scheme		
							Theory		
L	T	J	P	S	C		CIA	ESE	Total
3	1`	0	0	4	4	120	40	60	100

***L**: Lecture (One unit is of one-hour duration), **T**: Tutorial (One unit is of one-hour duration), **P**: Practical (One unit is of one-hour duration), **J**: Project (One unit is of one-hour duration), **S**: Self-Learning & Team Work (One unit is of one-hour duration), **CIA**: Continuous Internal Assessment, **ESE**: End Semester Examination*

SYLLABUS (Major Topics)			
Module	Title	Major Topics	Hrs
1	Overview of Operating Systems (OS)	Introduction to Operating Systems (OS), Synchronization Mechanisms, Advanced Synchronization Concepts, Distributed Operating Systems	10
2	Distributed Mutual Exclusion and Security	Distributed Mutual Exclusion, Security in OS	10
3	Resource and Load Management in Distributed Systems	Resource Management, Distributed Shared Memory, Load Management	10
4	Multiprocessor and Virtualized Operating Systems	Multiprocessor Operating Systems, Virtualization in Operating Systems	10
5	Concurrency Control in Database Systems	Fundamentals of Concurrency Control, Concurrency Control Algorithms	10

SELF-LEARNING / TEAM WORK		
Sl. No	Self-learning / Team Work Description	Hrs
1	Distributed Operating Systems: Lamport's Logical clocks, Causal Ordering of Messages.	10
2	Distributed Mutual Exclusion: Requirements of Distributed Mutual Exclusion.	10
3	Analyzing case studies of real-world distributed systems and identifying the resource management strategies employed.	10
4	Real Time Operating System (RTOS): Introduction, Characteristics, Types, Application of Real Time Operating System	10
5	Multiversion Timestamp Ordering Algorithm, Conservative Timestamp Ordering Algorithm	10
6	Distributed and Cloud Systems: Cloud Operating Systems and Virtualization, Resource Management in Cloud Environments, Load Balancing Techniques in Distributed Systems	10
7	Emerging Trends: Operating Systems for Mobile and IoT Devices, Energy-aware Operating Systems, Introductory Concepts on Blockchain-based Operating Systems.	10

SUGGESTED LEARNING RESOURCES

Text Book			
Sl. No.	Title of Book	Author	Publication
1	Advanced Concepts in Operating Systems: Distributed, Database, and Multiprocessor Operating Systems	Mukesh Singhal, Niranjan G. Shivaratri	McGraw-Hill Education, 1st edition, 2017
2	Modern Operating Systems	Andrew S. Tanenbaum, Herbert Bos	Pearson Education, 5th edition, 2022
3	Operating System Concepts	Abraham Silberschatz, Peter B. Galvin, Greg Gagne	Wiley India Pvt. Ltd, 10th Edition, 2019

Reference			
Sl. No.	Title of Book	Author	Publication
1	Distributed Operating Systems: Concepts and Design	Pradeep K. Sinha	PHI Learning Pvt. Ltd., 1st edition, 2014

2	Distributed Systems, Concepts and Design	George Coulouris, Jean Dollimore, Tim Kindberg	Pearson,5th Edition,2019.

Web Resource	
1	https://www.classcentral.com/course/udacity-advanced-operating-systems-1016
2	https://www.my-mooc.com/en/mooc/advanced-operating-systems--ud189/
3	https://www.tutorialspoint.com/operating_system
4	https://www.geeksforgeeks.org/operating-systems/
5	https://www.javatpoint.com/os-tutorial
6	https://researchgate.net/publication/Advanced_Operating_Systems

DETAILED SYLLABUS *(Self-learning if any to be marked)*

Module	Major Topic & Sub Topic	Mode of Delivery	COs	Learning Domain Level (C)	Teaching Hours
1	Introduction to Operating Systems: Definition, Functions of Operating System	L	CO1	U	1
	Design Approaches –Types of Advanced Operating Systems	L	CO1	U	1
	Synchronization Mechanisms: Concept of Processes and Threads –The Critical Section Problem	L	CO1	A	2
	Advanced Synchronization Concepts: Other Synchronization Problems: Monitor –Serializer– Path Expressions.	L	CO1	An	3
	Distributed Operating Systems: Definition, Issues in Distributed Operating System – Communication Networks and Primitives	L, T	CO1	A	3
2	Distributed Mutual Exclusion: Classification of Distributed Mutual Exclusion Algorithms	L	CO2	U	3
	Lamport's Algorithm, Ricart–Agrawala Algorithm, Suzuki–Kasami's Broadcast Algorithm.	L	CO2	An	3
	Security in OS: Potential Security Violations– Design Principles for Secure Systems– The Access Matrix Model and Implementation- The Access Control list Method.	L, T	CO2	A	4
3	Resource Management: Introduction to resource management in distributed systems, Mechanisms for building Distributed File Systems – Design Issues	L	CO3	U	2
	Distributed Shared Memory– Algorithms for Implementing Distributed Shared memory	L	CO3	A	2
	Load Management: Issues in Load Distributing, Types of Load Distribution Algorithms, Load Balancing v/s Load Sharing, Preemptive v/s Non- Preemptive Transfer	L, T	CO3	A	3
	Components of Load Distributing Algorithm, Sender Initiated Algorithm, Receiver- Initiated Algorithm	L	CO3	A	3
4	Multiprocessor Operating Systems: Basic Multiprocessor System Architectures– Interconnection Networks– Structures	L	CO4	U	3
	Design Issues– Threads– Process Synchronization – Processor Scheduling – Memory Management	L	CO4	A	2
	Virtualization in Operating Systems: Virtualization concepts, Types of Hypervisors	L, T	CO4	A	3
	Paravirtualization, Memory Virtualization, I/O Virtualization	L	CO4	An	2
5	Fundamentals of Concurrency Control: Concurrency Control, Problem of Concurrency Control	L	CO5	U	2
	Serializability, Basic Synchronization Primitives for Concurrency Control	L	CO5	U	2

	Concurrency Control Algorithms: Lock-Based Algorithms	L, T	CO5	An	2
	Time Stamp Based Algorithms	L	CO5	An	2
	Optimistic Algorithms	L	CO5	An	2

TABLE OF SPECIFICATIONS (ToS) (ESE Question Paper Design)

Module	Module Title	Distribution of Marks (RBL)						Total Marks
		R	U	A	An	E	C	
1	Overview of Operating Systems (OS)	✓	✓	✓				12
2	Distributed Mutual Exclusion and Security	✓	✓	✓				12
3	Resource and Load Management in Distributed Systems	✓	✓	✓				12
4	Multiprocessor and Virtualized Operating Systems	✓	✓	✓				12
5	Concurrency Control in Database Systems	✓	✓	✓	✓			12

This ToS shall be treated as a general guideline for students and teachers for distribution of marks.

ASSESSMENT PATTERN

Assessment	Marks
Continuous Internal Assessment	**40**
1. Internal Examination	20
2. Learning Activity	12
3. Regularity	8
4. Course Project	--
End Semester Examination	**60**
Total	**100**

MODEL QUESTION PAPER

			Total Pages: …
Register No.:	……	Name:	……

MODEL QUESTION PAPER: SECOND SEMESTER MCA DEGREE EXAMINATION			
Course Code:	**A250201/CA214C**		
Course Name:	**ADVANCED OPERATING SYSTEMS**		
Max. Marks	**60**	**Duration**:	3 hours

PART A			
(Answer all questions. Each question carries 3 marks)			
No.	***Question***	***CO***	***Marks***
1	Categorize various advanced operating systems.	CO1	(3)
2	Explain the concept of path expressions.	CO1	(3)
3	Discuss the significance of mutual exclusion in distributed systems.	CO2	(3)
4	Describe the implementation of access matrix model.	CO2	(3)
5	How resources are managed in distributed system?	CO3	(3)
6	Define load distribution and state the issues in load distribution.	CO3	(3)
7	Write notes on UMA and NUMA.	CO4	(3)
8	Explain virtualization in operating systems.	CO4	(3)
9	Explain the problems associated with concurrency control.	CO5	(3)
10	Describe log equivalence.	CO5	(3)

PART B

(Answer any one full question from each module, each question carries 6 marks)				
No.		***Question***	***CO***	***Marks***
MODULE I				
11	a)	Explain how the operating system applies its functions to ensure efficient execution and resource utilization.	CO1	(6)
OR				
12	a)	Demonstrate the application of mutex and semaphore mechanisms in solving the critical section problem.	CO1	(6)
MODULE II				
13	a)	Illustrate how Ricart–Agrawala and Lamport's algorithms are applied in a distributed environment.	CO2	(6)
OR				
14	a)	Explain any six secure system design principles that can be applied to protect system resources and data.	CO2	(6)
MODULE III				
15	a)	Given a distributed environment with geographically separated nodes, explain how DFS mechanisms are applied to provide reliable file access.	CO3	(6)
OR				
16	a)	Using suitable examples, demonstrate how DSM algorithms are applied to implement distributed shared memory.	CO3	(6)
MODULE IV				
17	a)	Explain how suitable interconnection structures are applied to improve data transfer and system performance.	CO4	(6)
OR				
18	a)	Explain different types of hypervisors.	CO4	(6)
MODULE V				
19	a)	Analyse the basic synchronization primitives for concurrency control in database systems.	CO5	(6)
OR				
20	a)	Analyse the operation of any two concurrency control algorithms used in operating systems or distributed systems.	CO5	(6)

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Program Elective II

COURSE DESCRIPTION							
Regulation	**2025**	**L-T-J-P-S**	**3-1-0-0-4**	**Version**	**25/0**	**Credits**	**4**
(L- Lecture, T-Tutorial, J-Project, P-Practical, S-Self-learning & Team Work)							

Course Code	**Course Name**	**Course Category**
A250201/CA211D	**IPR AND CYBER LAWS**	PE
Pre-requisite		
General awareness on internet essentials, web technologies and e-commerce		

COURSE OBJECTIVES	
1	This course intends to provide insight into Intellectual Property Rights and Cyber Laws.
2	It includes detailed discussion on various intellectual property rights, procedures to apply for copyrights &patents, legalities of intellectual property to avoid plagiarism and other IPR related crimes.
3	To be familiarized Effectiveness of cyber-laws and other countermeasures against cybercrime and cyber warfare
4	To solve the modern, real-life problems in the most effective manner.

COMPETENCY STATEMENT (CC)	
CC1	Demonstrate the ability to apply Various kinds of Intellectual Property issues in cyberspace and the growth and development of the law in this regard.

COURSE OUTCOMES (CO)

Course Outcomes (CO): At the end of this course, learners will be able to:

CO	CO Statement	CC Mapping	Cognitive (C)
CO1	Explain the basic concepts and purpose of IPR and patents.	CC1	U
CO 2	Apply trademarks and copyrights to solve real-world intellectual property problems.	CC1	A
CO 3	Demonstrate how industrial designs, trade secrets, and geographic indications are used in real business or legal contexts.	CC1	E
CO 4	Apply the roles and policies of Internet governance bodies to improve Internet safety and security.	CC1	A
CO 5	Assess the adequacy and effectiveness of penalties under the IT Act in deterring cybercrimes.	CC1	E

***Cognitive (Revised blooms Level): - R**: Remember; **U**: Understand; **A**: Apply; **An**: Analyse; **E**: Evaluate; **C**: Create*

	Program Outcomes & Program Specific Outcomes Correlation Matrix										
	PO								**PSO**		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**1**	**2**	**3**
1	**3**	**2**	**2**	**1**		**1**					
2	**3**	**3**	**2**	**1**		**1**					
3	**3**	**2**	**1**	**1**							
4	**2**	**2**	**1**			**1**					
5	**2**	**2**	**1**	**1**		**1**					
Correlation [3 – High, 2 -Medium, 1 – Low]											

TEACHING AND ASSESSMENT SCHEME									
Teaching Scheme / Week					Credit	Hours / Semester	Examination Scheme		
							Theory		
L	T	J	P	S	C		CIA	ESE	Total
3	1`	0	0	4	4	120	40	60	100

***L**: Lecture (One unit is of one-hour duration), **T**: Tutorial (One unit is of one-hour duration), **P**: Practical (One unit is of one-hour duration), **J**: Project (One unit is of one-hour duration), **S**: Self-Learning & Team Work (One unit is of one-hour duration), **CIA**: Continuous Internal Assessment, **ESE**: End Semester Examination*

SYLLABUS (Major Topics)			
Module	Title	Major Topics	Hrs
1	**Fundamentals of IPR and Patents**	**Fundamentals of IPR**- Introduction– Intellectual property– Need for protection of intellectual property– **WIPO**– Intellectual property rights and development – Rationale of protection– TRIPS Agreement- **Patents**– Introduction – Patentable and Non-patentable Invention– Types of patent applications– Guidelines for registration of patent– patent filing – grant of patent– types of patent documents.	10
2	**Trademarks and Copyright**	**Trademarks**– Introduction– Guidelines for registration- Requirements for filing trademarks– Trademark Infringement– Protection of trademarks– **Copyright**– Introduction– Rights conferred by copyright– registration– ownerships– terms– transfer of copyrights– copyright infringement– databases and copyright- **Software Copyright**–Introduction – Need of software copyright classification of software according to copyright – software auditing – copyright notice – transfer of copyright.	10
3	**Industrial Designs and Trade Secret**	**Industrial Designs**- Introduction – Need for protection of design – requirements for registration of designs – Design Act,2000 – Duration of registration of design – application procedure – **Geographic Indications** –Introduction – Filing – **Granting** – Protection of geographic indications. **Trade Secret** – definition – discovering and protecting of trade secret.	10
4	**Cyber law**	Need for cyber laws - Historical perspective - cyberspace - deception by squatting in cyberspace - protection of copyright on cyberspace - infringement of copyright on cyberspace – linking, hyperlinking and framing - ISP in cyberspace - cyberspace and protection of patents in India.	8
5	**Information Technology Act and Punishments**	Introduction to IT Act 2000- Amendments on IT Act - Violation of the right of privacy in cyberspace/internet-punishment for violation of privacy, breach of confidentiality and privacy under IT act-Terrorism on cyberspace Overview of cybercrimes-offences by intermediaries-offences related to protected system- offences of misrepresentation punishment for Abetment and Attempt to commit offences under the IT act.	10

SELF-LEARNING / TEAM WORK		
Sl. No	Self-learning / Team Work Description	Hrs
1	Case Studies in IPR - Apple vs. Samsung – Patent Infringement Google vs. Oracle – Copyright & Software Patents Case Studies in Patents- Dyson Vacuum Cleaner – Technology Patent Monsanto vs. Indian Farmers	15
2	Case Studies Trademark Registration – “Zomato vs. Zomato Fitness” Trademark Filing Requirements – “Apple” (India) Trademark Infringement – “Bata India vs. Relaxo” Transfer of Copyright – “Amar Chitra Katha” Copyright Infringement – “R.G. Anand vs. Delux Films”	15
3	Case Studies REGISTRATION OF INDUSTRIAL DESIGNS Design Registration – “Apple iPhone Design” Design Infringement – “Crocs Inc. vs. Aqualite”	12

	Granting of GI – "Darjeeling Tea" Protection of GI – "Basmati Rice Dispute" GI Infringement – "Banarasi Sarees"	
4	Case Studies Cyber Law Application – "State of Tamil Nadu vs. Suhas Katti" Cybersquatting – "Yahoo Inc. vs. Akash Arora" Copyright Protection Online – "Super Cassettes vs. MySpace" Copyright Protection – E-Learning Content Online Piracy – "UTV Software vs. 1337x & Others" Social Media Infringement – Instagram Reels Software Patent Claims Online	15
5	Case Studies IT Act Amendment – Strengthening Cyber Law Privacy Violation – "Justice K.S. Puttaswamy Case" Online Data Leak – E-Commerce Website Breach of Confidentiality – Call Centre Employee Cyber Terrorism – Attack on Government Website Cybercrime – Online Banking Fraud Intermediary Liability – Social Media Platform Protected System – Power Grid Attack Misrepresentation – Digital Signature Certificate	15

SUGGESTED LEARNING RESOURCES

Text Book			
Sl. No.	Title of Book	Author	Publication
1	Intellectual Property Rights: Text and Cases	Dr. R. Radhakrishnan and Dr. S. Balasubramanian	Excel Books
2	Cyber Law and IT Protection	Harish Chander,	PHI Learning Pvt.Ltd.

Reference			
Sl. No.	Title of Book	Author	Publication
1	Introduction to Computer Law	D.Bainbridge	Pearson Education
2	Cyber Crime & Corporate Liability	RohasNagpal,	CCH, 2008

Web Resource	
1	https://www.udemy.com/course/cyber-security-law/
2	https://www.coursera.org/specializations/introduction-intellectual-property

DETAILED SYLLABUS *(Self-learning if any to be marked)*					
Module	Major Topic & Sub Topic	Mode of Delivery	COs	Learning Domain Level (C)	Teaching Hours
1	**Fundamentals of IPR-** Introduction – Intellectual property – Need for protection of intellectual property	L	CO1	U	2
	WIPO – Intellectual property rights and development – Rationale of protection – TRIPS Agreement	L,T	CO1	U	3
	Patents:–Introduction**–** Patentable and Non-patentable Invention. Types of patent applications – Guidelines for registration of patent – patent filing – grant of patent – types of patent documents	L	CO1	U	5
2	**Trademarks**– Introduction – Guidelines for registration – Requirements for filing trademarks – Trademark Infringement – Protection of trademarks	L	CO2	A	3
	Copyright – Introduction – Rights conferred by copyright – registration – ownerships – terms – transfer of copyrights – copyright infringement – databases and copyright	LT	CO2	A	3

	Software Copyright– Introduction – Need of software copyright – classification of software according to copyright – software auditing – copyright notice – transfer of copyright.	L	CO2	A	4
3	**Industrial Designs**– Introduction – Need for protection of design – requirements for registration of designs – Design Act,2000 – Duration of registration of design – application procedure	L	CO3	E	4
	Geographic Indications – Introduction **–** Filing **Granting** – Protection of geographic indications	LT	CO3	E	4
	Trade Secret – definition – discovering and protecting of trade secret.	L	CO3	E	2
4	**Cyber law** - Need for cyber laws - Historical perspective - cyberspace- deception by squatting in cyberspace.	L	CO4	A	3
	Protection of copyright on cyberspace - infringement of copyright on cyberspace - linking, hyper linking and framing	LT	CO4	A	3
	ISP in cyberspace - cyberspace and protection of patents in India.	L	CO4	A	2
5	**Information Technology Act and Punishments**- Introduction to IT Act2000- Amendments on IT Act	L	CO5	E	2
	Violation of the right of privacy in cyberspace/internet- punishment for violation of privacy, breach of confidentiality and privacy under IT act- Terrorism on cyberspace overview of cybercrimes	LT	CO5	E	4
	Offences by intermediaries- offences related to protected system- offences of misrepresentation- punishment for Abetment and Attempt to commit offences under the IT act.	L	CO5	E	4

TABLE OF SPECIFICATIONS (ToS) (ESE Question Paper Design)

Module	Module Title	Distribution of Marks (RBL)						Total Marks
		R	U	A	An	E	C	
1	Fundamentals of IPR and Patents	✓	✓					
2	Trademarks and Copyright	✓	✓	✓				
3	Industrial Designs and Trade Secret	✓	✓	✓	✓	✓		
4	Cyber law	✓	✓	✓				
5	Information Technology Act and Punishments	✓	✓	✓	✓	✓		
This ToS shall be treated as a general guideline for students and teachers for distribution of marks.								

ASSESSMENT PATTERN	
Assessment	**Marks**
Continuous Internal Assessment	**40**
1. Internal Examination	20
2. Learning Activity	12
3. Regularity	8
4. Course Project	--
End Semester Examination	**60**
Total	**100**

MODEL QUESTION PAPER

			Total Pages: …
Register No.:	……	Name:	……

MODEL QUESTION PAPER: SECOND SEMESTER MCA DEGREE EXAMINATION			
Course Code:	**A250201/CA211D**		
Course Name:	**IPR AND CYBER LAWS**		
Max. Marks	**60**	**Duration**:	3 hours

PART A			
(Answer all questions. Each question carries 3 marks)			
No.	***Question***	***CO***	***Marks***
1	What are the core activities of WIPO?	CO1	(3)
2	Explain any three conditions to be satisfied by a patentable invention.	CO1	(3)
3	What is copyright? Give two examples of copyright infringement.	CO2	(3)
4	Define: (i) Shareware (ii) Freeware (iii) Public Domain Software	CO2	(3)
5	Give any three benefits of protecting industrial designs.	CO3	(3)
6	What is meant by design under the Design Act,2000?	CO3	(3)
7	Explain the need for cyber laws.	CO4	(3)
8	Specify the liabilities of an ISP in cyberspace.	CO4	(3)
9	Write a note on Indian IT Act 2000.	CO5	(3)
10	Define abetment and the punishments for abetment under the IT Act.	CO5	(3)

PART B				
(Answer any one full question from each module, each question carries 6 marks)				
No.		***Question***	***CO***	***Marks***
		MODULE I		
11		Explain the basic steps of applying for a patent.	CO1	(6)
		OR		
12		What is Trademark? Explain the role of trademark and its usefulness in marketing.	CO1	(6)
		MODULE II		
13		Describe software copyright and how can software be classified according to copyrights?	CO2	(6)
		OR		
14		Explain the different process, procedures and documents associated in trade mark. Draw a rough figure to explain	CO2	(6)
		MODULE III		
15		Explain basic concepts of Geographic Indications such as filing, granting and Protection of geographic indications.	CO3	(6)
		OR		
16		Describe the procedure of discovering and protecting of trade secret.	CO3	(6)
		MODULE IV		
17		Define Hyperlinking, Deep-linking and Framing.	CO4	(6)
		OR		
18		Define the term ‘Cyber Squatting’ and what kinds of protection available to the consumers in the Cyber World against it?	CO4	(6)
		MODULE V		
19		Explain cyber terrorism and how it is defined under ITAA-2008. What are the punishments for committing cyber terrorism?	CO5	(6)
		OR		
20		Define privacy. What is meant by violation or breach of confidentiality and privacy? Explain the punishments given for the same.	CO5	(6)

COURSE DESCRIPTION							
Regulation	**2025**	**L-T-J-P-S**	**3-1-0-0-4**	**Version**	**25/0**	**Credits**	**4**
(L- Lecture, T-Tutorial, J-Project, P-Practical, S-Self-learning & Team Work)							

Course Code	Course Name	Course Category
A250201/CA212D	**BUSINESS MANAGEMENT**	PET
Pre-requisite		
NIL		

COURSE OBJECTIVES	
1	To understand basic principles of management and accounting.
2	Effective and efficient management the goals of the organisation can be attained
3	Basic idea regarding book keeping and accounting is also required for managers for taking decisions
COMPETENCY STATEMENT (CC)	
CC1	Learners will be able to apply basic principles of management and accounting to effectively manage resources and make informed decisions in organizational and everyday contexts.

COURSE OUTCOMES (CO)			
Course Outcomes (CO): At the end of this course, learners will be able to:			
CO	**CO Statement**	**CC Mapping**	**Cognitive (C)**
CO1	To Understand management as a process critically analyse and evaluate management theories and practices	CC1	U
CO 2	Perform planning and organising for an organisation	CC1	An
CO 3	Do staffing and related human resource development function	CC1	A
CO 4	Take proper decisions to get competitive advantage	CC1	C
CO 5	Understand basic concepts in book keeping and accounting.	CC1	C
***Cognitive (Revised blooms Level):* - *R**: Remember; **U**: Understand; **A**: Apply; **An**: Analyse; **E**: Evaluate; **C**: Create*			

	Program Outcomes & Program Specific Outcomes Correlation Matrix										
	PO								**PSO**		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**1**	**2**	**3**
1	**3**							**2**			
2		**3**									
3			**3**								
4											
5					**3**	**2**					
6	**3**							**3**			
Correlation [3 – High, 2 -Medium, 1 – Low]											

TEACHING AND ASSESSMENT SCHEME									
Teaching Scheme / Week					**Credit**	**Hours / Semester**	**Examination Scheme**		
							Theory		
L	**T**	**J**	**P**	**S**	**C**		**CIA**	**ESE**	**Total**
3	1`	0	0	4	4	120	40	60	100

***L**: Lecture (One unit is of one-hour duration), **T**: Tutorial (One unit is of one-hour duration), **P**: Practical (One unit is of one-hour duration), **J**: Project (One unit is of one-hour duration), **S**: Self-Learning & Team Work (One unit is of one-hour duration), **CIA**: Continuous Internal Assessment, **ESE**: End Semester Examination*

SYLLABUS (Major Topics)			
Module	Title	Major Topics	Hrs
1	Introduction to Management and Early Contributions in Management	Basic Managerial Concepts, Levels of management, Managerial Skills, Managerial role. Management functions- Planning, Organising, Staffing, leading and Controlling. Management thought - Classical approach, scientific management, contributions of Taylor, Gilbreths, Fayol's 14 principles of management. Human relation approach - contribution of Elton Mayo Systems approach - organization as an open system and Contingency approach	10
2	Planning and Organising	Nature and importance of planning, types of plans - Steps in planning, Levels of planning - The Planning Process - MBO definition and process, SWOT Analysis, importance. Nature of organizing,-span of control in management, factors affecting span of control- Authority and responsibility. Organisation structure - Formal and informal, Types of organization structure line, line and staff, functional, divisional, project, matrix, virtual form of organisations.	8
3	Staffing and related HRD Functions	Meaning, nature, staffing process, Job analysis and manpower planning, job description and job specification, Recruitment & selection, selection process, Tests and interviews. Training and development - concept and methods, Performance, appraisal-concept and methods.	9
4	Managerial Decision Making and controlling	Decision making –types of decisions, decision making process, Decision Making Tools, Importance of controlling, Techniques of controlling- Break Even Analysis, Budgetary Control - Benchmarking –importance and limitations of benchmarking, Six Sigma importance, limitations and process of six sigma, Total Quality Management-Introduction to marketing management-Marketing mix- product life cycle	12
5	Book- Keeping and Accountancy	Elements of Double Entry -Book- Keeping - rules for journalizing - Ledger accounts –Cash book- – Trial Balance- Method of Balancing accounts- the journal proper (simple problems). Final accounts: Preparation of trading and profit and loss Account- Balance sheet (with simple problems) - Introduction to Accounting packages (Description only)	10

SELF-LEARNING / TEAM WORK		
Sl. No	Self-learning / Team Work Description	Hrs
1	CASE STUDY Basic Managerial Concepts & Levels of Management Case: Growth of Sunrise Textiles Management Functions (POSDC) Case: ABC Healthcare Hospital Scientific Management Case: Speed Motors Manufacturing Unit	10
2	Case Study: Planning and Organising at Suzuki India Ltd	15
3	Human Resource Management (HRM) Organisation Chosen: UST Case Studies on: Meaning & Nature of Staffing Staffing Process Job Analysis & Manpower Planning Recruitment & Selection Selection Process Tests & Interviews	10
4	Case Studies on Decision Making, Controlling, Quality & Marketing Organisation Chosen: Hindustan Unilever Limited- Decision Making – Types of Decisions	15

	Decision Making Tools Importance of Controlling Techniques of Controlling – Break Even Analysis Budgetary Control Benchmarking – Importance & Limitations Six Sigma – Importance, Limitations & Process Total Quality Management (TQM)	
5	Case Studies on Financial Accounting- Business Chosen: **Muthoot Finance-** Elements of Double Entry System, Book-Keeping, Rules for Journalizing, Ledger Accounts, Cash Book, Trial Balance, Final Accounts	10

SUGGESTED LEARNING RESOURCES

Text Book			
Sl. No.	Title of Book	Author	Publication
1	Principles of Management	L M Prasad	Sultan Chand & Sons, 8th Edition (2010)
2	The Practice of Management	Peter F Drucker	Butterworth-Heinemann Publication, 2nd Edition (2007)

Reference			
Sl. No.	Title of Book	Author	Publication
1	Essentials of Management	Harold Koontz and Heinz Weihrich 10th Edition (2015).	McGraw Hill Education
2	Management	Robbins and Coulter 13th Edition, 2016	Pearson Education

Web Resource	
1	Management Functions http://nptel.ac.in/courses/122108038/
2	Leadership http://nptel.ac.in/courses/110105033/33

DETAILED SYLLABUS *(Self-learning if any to be marked)*

Module	Major Topic & Sub Topic	Mode of Delivery	COs	Learning Domain Level (C)	Teaching Hours
1	Introduction to Management: Basic Managerial concepts	L	CO1	U	2
	Levels of management, Managerial Skills	L,T	CO1	U	2
	Management roles	L	CO1	U	1
	Early Contributions in Management: Management thought – Classical approach, scientific management, contributions of Taylor, Gilbreths, Fayol's 14 principles of management. Human relation approach - contribution of Elton Mayo Systems	L	CO2	U	2
2	Planning: Nature and importance of planning, types of plans - Steps in lanning, Levels of planning - The Planning Process	L	CO3	An	3
	MBO definition and process, SWOT Analysis, importance	L,T	CO3	An	2
	Organising: Nature of organizing,-span of control in management, factors affecting span of control-authority and responsibility.	L	CO3	An	2
	Organisation structure - Formal and informal, Types of organization structure line, line and staff, functional, divisional, project, matrix, virtual form of organisations	L	CO3	An	2
3	Staffing and related HRD Functions: meaning, nature, staffing process.	L	CO4	A	2
	Job analysis and manpower planning, job description and job specification	L,T	CO4	A	2

	Recruitment & selection, selection process, Tests and interviews. Training and development - concept and methods	L	CO4	A	3
	Performance appraisal - concept and methods.	L	CO4	A	2
4	Managerial Decision Making and controlling: Decision making –types of decisions, decision making process, Decision Making Tools.	L	CO5	C	2
	Importance of controlling, Techniques of controlling- Break Even Analysis, Budgetary Control	L,T	CO5	C	2
	Benchmarking –importance and limitations of benchmarking	L	CO5	C	2
	Six Sigma importance, limitations and process of six sigma	L	CO5	C	2
	Total Quality Management	L	CO5	C	2
	Introduction to marketing management-Marketing mix- product life cycle	L	CO5	C	2
5	Book- Keeping and Accountancy -Elements of Double Entry -Book- Keeping	L	CO6	C	2
	Rules for journalizing -Ledger accounts –Cash book	L,T	CO6	C	3
	Trial Balance- Method of Balancing accounts- (simple problems). Final accounts: Preparation of trading and profit and loss Account- Balance sheet (with simple problems)	L	CO6	U	3
	Introduction to Accounting packages.	L	CO6	U	2

TABLE OF SPECIFICATIONS (ToS) (ESE Question Paper Design)

Module	Module Title	Distribution of Marks (RBL)						Total Marks
		R	U	A	An	E	C	
1	Introduction to Management and Early Contributions in Management	✓	✓	✓				12
2	Planning and Organising	✓	✓	✓	✓			12
3	Staffing and related HRD Functions	✓	✓	✓				12
4	Managerial Decision Making and controlling	✓	✓	✓				12
5	Book- Keeping and Accountancy	✓	✓	✓				12

This ToS shall be treated as a general guideline for students and teachers for distribution of marks.

ASSESSMENT PATTERN

Assessment	Marks
Continuous Internal Assessment	**40**
1. Internal Examination	20
2. Learning Activity	12
3. Regularity	8
4. Course Project	--
End Semester Examination	**60**
Total	**100**

MODEL QUESTION PAPER

			Total Pages:.....
Register No.:	.....	Name:	.....

(AN AUTONOMOUS COLLEGE AFFILIATED TO APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY, THIRUVANATHAPURAM)

FIRST SEMESTER MCA DEGREE (REGULAR) EXAMINATION, DECEMBER 2025 (2025 SCHEME)			
Course Code:	**A250201/CA212D**		
Course Name:	**BUSINESS MANAGEMENT**		
Max. Marks	**60**	**Duration**:	3 hours

PART A			
(Answer all questions. Each question carries 3 marks)			
No.	***Question***	***CO***	***Marks***
1	Define management. What are the levels of management?	CO	(3)
2	Distinguish between efficiency and effectiveness in management	CO	(3)
3	Explain system approach in management.	CO	(3)
4	Illustrate different types of plans	CO	(3)
5	Explain matrix form of organisation	CO	(3)
6	What is meant by job analysis?	CO	(3)
7	Explain bench marking.	CO	(3)
8	What is product life cycle?	CO	(3)
9	Explain the rules of debit and credit.	CO	(3)
10	Explain the advantages of accounting software.	CO	(3)

PART B				
(Answer any one full question from each module, each question carries 6 marks)				
No.		***Question***	***CO***	***Marks***
MODULE I				
11	a)	What are the different roles that managers play in an organisation?	CO	(6)
OR				
12	a)	Explain the major contributions of F W Taylor to scientific management.	CO	(6)
MODULE II				
13	a)	Explain various steps involved in planning with a case example	CO	(6)
OR				
14	a)	Explain any 3 types of organisation structures	CO	(6)
MODULE III				
15	a)	Explain various steps involved in selection of employees for an organisation	CO	(6)
OR				
16	a)	Describe different types of training methods for employees in an organisation.	CO	(6)
MODULE IV				
17	a)	Illustrate the decision process in an industry by giving different steps involved in it	CO	(6)
OR				
18	a)	Explain the marketing mix elements with a case example.	CO	(6)
MODULE V				
19	a)	What is a Journal? Explain the rules of journalising	CO	(6)
OR				
20	a)	What are final accounts? Explain the procedure of preparing balance sheet with a simple example.	CO	(6)

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COURSE DESCRIPTION							
Regulation	**2025**	**L-T-J-P-S**	**3-1-0-0-4**	**Version**	**25/0**	**Credits**	**4**
(L- Lecture, T-Tutorial, J-Project, P-Practical, S-Self-learning & Team Work)							

Course Code	Course Name	Course Category
A250201/CA213D	**CYBER FORENSICS**	**PE**
Pre-requisite		
Basic knowledge in operating systems and computer networks.		

COURSE OBJECTIVES	
1	Understand the fundamentals of cyber forensics, cybercrimes, and the principles of digital investigation.
2	Learn to collect, preserve, and analyze digital evidence using industry-standard tools and techniques.
3	Explore file systems, mobile, network, memory, and introductory cloud forensics.
4	Develop professional forensic reporting skills with ethical and legal awareness in digital investigations.

COMPETENCY STATEMENT (CC)	
CC1	Develop the knowledge and skills to conduct ethical and systematic digital forensic investigations using proper tools, methods, and legal practices.

COURSE OUTCOMES (CO)			
Course Outcomes (CO): At the end of this course, learners will be able to:			
CO	**CO Statement**	**CC Mapping**	**Cognitive (C)**
CO1	Explain computer crimes and company-policy violations.	CC1	U
CO 2	Gather and preserve digital evidence using standard acquisition and validation tools.	CC1	A
CO 3	Analyse file systems and recover data with Autopsy/Sleuth Kit.	CC1	A
CO 4	Demonstrate network, mobile, and introductory cloud/memory forensic techniques.	CC1	A
CO 5	Prepare professional forensic reports and discuss ethics and expert-witness roles.	CC1	U
Cognitive (Revised blooms Level): *- **R**: Remember; **U**: Understand; **A**: Apply; **An**: Analyse; **E**: Evaluate; **C**: Create*			

	Program Outcomes & Program Specific Outcomes Correlation Matrix										
	PO								**PSO**		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**1**	**2**	**3**
1	3	2	1	1	1	-	3	1			
2	2	3	2	3	1	-	2	2			
3	1	2	3	3	2	1	2	2			
4	2	3	3	3	3	2	3	3			
5	1	2	2	2	3	2	3	3			
Correlation [3 – High, 2 -Medium, 1 – Low]											

TEACHING AND ASSESSMENT SCHEME									
Teaching Scheme / Week					Credit	Hours / Semester	Examination Scheme		
							Theory		
L	T	J	P	S	C		CIA	ESE	Total
3	1`	0	0	4	4	120	40	60	100

***L**: Lecture (One unit is of one-hour duration), **T**: Tutorial (One unit is of one-hour duration), **P**: Practical (One unit is of one-hour duration), **J**: Project (One unit is of one-hour duration), **S**: Self-Learning & Team Work (One unit is of one-hour duration), **CIA**: Continuous Internal Assessment, **ESE**: End Semester Examination*

SYLLABUS (Major Topics)			
Module	Title	Major Topics	Hrs
1	Fundamentals of Cyber Forensics	Overview of computer crimes, policy violations, evidence handling, case preparation, evidence formats (Raw, AFF), acquisition tools, digital evidence validation, introduction to Autopsy.	13
2	File Systems and Digital Evidence	Digital storage, boot sequence, FAT/NTFS/ReFS systems, BitLocker encryption, Windows Registry, data acquisition, and validation.	14
3	Linux and macOS Forensics	Linux file structures (Ext4), macOS HFS/APFS, Autopsy/Sleuth Kit case study, write blockers, dd/dcfldd, data validation, introduction to memory forensics using Volatility.	15
4	Mobile and Network Forensics	Mobile device evidence acquisition, SIM and data extraction, tools (Cellebrite, MOBILedit), network traffic analysis using Wireshark, basics of cloud forensics (AWS/Azure).	14
5	Forensic Reporting and Ethics	Forensic report writing, court admissibility, expert witness role, Autopsy report generation, ethics, and forensic readiness planning.	12

SELF-LEARNING / TEAM WORK		
Sl. No	Self-learning / Team Work Description	Hrs
1	Case study on real-world cybercrime incident and evidence chain.	8
2	Demonstration: Disk image creation using Autopsy/Sleuth Kit.	7
3	Group exercise on hashing and digital signature validation.	7
4	Mini-project: Packet capture and analysis using Wireshark.	9
5	Seminar on emerging trends – Memory and Cloud Forensics.	6
6	Prepare a sample forensic report for mock investigation.	7
7	Role-play: Expert witness presentation in court.	8

SUGGESTED LEARNING RESOURCES

Text Book			
Sl. No.	Title of Book	Author	Publication
1	Guide to Computer Forensics and Investigations, 7th Edition, 2024	Bill Nelson, Amelia Phillips, Christopher Steuart	Information Security

Reference			
Sl. No.	Title of Book	Author	Publication
1	Computer Forensics and Cyber Crime An Introduction 3rd Edition Digital Version 2025	Marjie T. Britz	Pearson
2	Computer Forensics: Cybercriminals, Laws, and Evidence, 2015	Marie - Helen Maras	Jones & Bartlett Learning
Web Resource			
1	https://www.autopsy.com – Autopsy official documentation.		

2	https://www.volatilityfoundation.org – Volatility Framework for Memory Forensics.
3	https://www.wireshark.org/docs/ – Wireshark Documentation.
4	https://learn.microsoft.com/en-us/security/forensics/ – Microsoft Security and Forensics Guide.
5	https://csrc.nist.gov/projects/computer-forensics – NIST Computer Forensics Project.
6	https://www.sleuthkit.org – Sleuth Kit and Autopsy resources.
7	https://www.ceh.com/forensics – EC-Council Forensic Practices Portal.

DETAILED SYLLABUS *(Self-learning if any to be marked)*					
Module	Major Topic & Sub Topic	Mode of Delivery	COs	Learning Domain Level (C)	Teaching Hours
1	Fundamentals of Cyber Forensics – Crimes, evidence collection, validation tools	L	CO1	U	7
	Preparing case, industrial espionage, formats, Autopsy intro	L, T	CO1	A	6
2	File Systems & Digital Evidence – Boot process, FAT/NTFS/ReFS	L	CO2	A	8
	Disk imaging, BitLocker, data validation	L, P	CO2	A	6
3	Linux/macOS Forensics – Ext4, Sleuth Kit, Autopsy	L, T	CO3	A	8
	Memory forensics (Volatility)	L, P	CO3	A	7
4	Mobile & Network Forensics – Device and SIM acquisition	L, P	CO4	A	8
	Network capture with Wireshark, cloud forensics	L, P	CO4	A	6
5	Forensic Reporting & Ethics – Report structure, court admissibility, expert witness roles	L	CO5	U	6
	Ethics, forensic readiness planning	L, T	CO5	U	6

TABLE OF SPECIFICATIONS (ToS) (ESE Question Paper Design)								
Module	Module Title	Distribution of Marks (RBL)						Total Marks
		R	U	A	An	E	C	
1	Fundamentals of Cyber Forensics	√	√	√	√			
2	File Systems and Digital Evidence	√	√	√	√			
3	Linux/macOS Forensics	√	√	√	√			
4	Mobile and Network Forensics	√	√	√	√			
5	Forensic Reporting and Ethics	√	√	√	√			
This ToS shall be treated as a general guideline for students and teachers for distribution of marks.								

ASSESSMENT PATTERN	
Assessment	**Marks**
Continuous Internal Assessment	**40**
1. Internal Examination	20
2. Learning Activity	12
3. Regularity	8
4. Course Project	--
End Semester Examination	**60**
Total	**100**

MODEL QUESTION PAPER

			Total Pages: ...
Register No.:	.....	Name:	.....

MODEL QUESTION PAPER: SECOND SEMESTER MCA DEGREE EXAMINATION			
Course Code:	**A250201 / CA213D**		
Course Name:	**CYBER FORENSICS**		
Max. Marks	**60**	**Duration**:	3 hours

PART A			
(Answer all questions. Each question carries 3 marks)			
No.	***Question***	***CO***	***Marks***
1	Define cyber forensics. State its importance in cybercrime investigation.	CO1	(3)
2	What is a computer crime? Give any two examples of company policy violations.	CO1	(3)
3	List the different digital evidence storage formats used in cyber forensics.	CO2	(3)
4	What is bit-stream copy of evidence? Why is it important?	CO2	(3)
5	Write the steps involved in the Windows booting process.	CO3	(3)
6	Differentiate between FAT and NTFS file systems.	CO3	(3)
7	What is a write blocker? State its role in forensic investigation.	CO4	(3)
8	List any three tools used for mobile device forensics.	CO4	(3)
9	What is network forensics? Mention the purpose of Wireshark.	CO5	(3)
10	State any three guidelines for writing a forensic report admissible in court.	CO5	(3)

PART B			
(Answer any one full question from each module, each question carries 6 marks)			
No.	***Question***	***CO***	***Marks***
	MODULE I		
11	Explain the steps involved in conducting a cyber forensic investigation.	CO1	(6)
	OR		
12	Describe different storage formats for digital evidence and compare Raw and Proprietary formats.	CO1	(6)
	MODULE II		
13	Explain NTFS file system structure with reference to MFT and file attributes.	CO2	(6)
	OR		
14	What is whole disk encryption? Explain Microsoft BitLocker in detail.	CO2	(6)
	MODULE III		
15	Explain Linux file structure and differentiate between hard link and symbolic link.	CO3	(6)
	OR		
16	Describe the process of data acquisition using Linux tools dd and dcfldd.	CO3	(6)
	MODULE IV		
17	Explain the standard procedures involved in mobile device forensic investigation.	CO4	(6)
	OR		
18	Discuss the need for network forensics and explain the features of Wireshark packet analyser.	CO4	(6)
	MODULE V		
19	Explain the importance of forensic reports and list the types of forensic reports.	CO5	(6)
	OR		
20	Discuss the ethical responsibilities and role of an expert witness in cyber forensics.	CO5	(6)

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COURSE DESCRIPTION							
Regulation	**2025**	**L-T-J-P-S**	**3-1-0-0-4**	**Version**	**25/0**	**Credits**	**4**
(L- Lecture, T-Tutorial, J-Project, P-Practical, S-Self-learning & Team Work)							

Course Code	Course Name	Course Category
A250201/CA214D	**ARTIFICIAL INTELLIGENCE**	**PE**
Pre-requisite		
Mathematical Foundations for Computing, Advanced Data structures		

COURSE OBJECTIVES	
1	To introduce the fundamental concepts of Artificial Intelligence and the process of formal problem specification for intelligent system design.
2	To develop the ability to apply and analyse control strategies and heuristic search techniques for effective problem-solving in various AI domains.
3	To provide an understanding of game theory problems and knowledge structures, enabling students to reason and make intelligent decisions.
4	To equip students with the skills to represent and reason with knowledge using propositional and predicate logic through resolution techniques.
5	To introduce expert systems, fuzzy logic and modern AI techniques for solving real-world problems.

COMPETENCY STATEMENT (CC)	
CC1	Demonstrate the ability to apply Artificial Intelligence principles and modern methodologies to design intelligent systems and develop effective solutions for complex real-world applications.

COURSE OUTCOMES (CO)			
Course Outcomes (CO): At the end of this course, learners will be able to:			
CO	**CO Statement**	**CC Mapping**	**Cognitive (C)**
CO1	Apply the steps needed to provide a formal specification for solving problems.	CC1	A
CO 2	Apply and analyse the different types of control and heuristic search methods to solve problems.	CC1	A
CO 3	Apply the concepts of game theory and knowledge structures to analyse and solve intelligent decision-making problems.	CC1	A
CO 4	Apply knowledge representation, planning, and learning techniques to develop intelligent solutions for complex real-world problems.	CC1	A
CO 5	Examine expert systems, fuzzy logic concepts and emerging trends in Artificial Intelligence.	CC1	A
Cognitive (Revised blooms Level): *- **R**: Remember; **U**: Understand; **A**: Apply; **An**: Analyse; **E**: Evaluate; **C**: Create*			

	Program Outcomes & Program Specific Outcomes Correlation Matrix										
	PO								**PSO**		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**1**	**2**	**3**
1	**3**	**3**	**3**								
2	**3**	**3**	**3**								
3	**3**	**3**	**3**								
4	**3**	**3**	**3**								
5	**3**			**3**			**3**				
Correlation [3 – High, 2 -Medium, 1 – Low]											

TEACHING AND ASSESSMENT SCHEME									
Teaching Scheme / Week					Credit	Hours / Semester	Examination Scheme		
							Theory		
L	T	J	P	S	C		CIA	ESE	Total
3	1`	0	0	4	4	120	40	60	100

***L**: Lecture (One unit is of one-hour duration), **T**: Tutorial (One unit is of one-hour duration), **P**: Practical (One unit is of one-hour duration), **J**: Project (One unit is of one-hour duration), **S**: Self-Learning & Team Work (One unit is of one-hour duration), **CIA**: Continuous Internal Assessment, **ESE**: End Semester Examination*

SYLLABUS (Major Topics)			
Module	Title	Major Topics	Hrs
1	Artificial Intelligence (AI) and Production Systems	Artificial Intelligence, Intelligent Agents, Problem Solving, Production System	8
2	Search Strategies	Preliminaries of searching, Uninformed (Blind) Search strategies, Informed (Heuristic) Search strategies	10
3	Adversarial Search	Game Theory, Minimax algorithm, Alpha-beta Pruning	9
4	Knowledge Representation	Knowledge in AI, Knowledge Representation, Using Logic, Knowledge Representation Systems	8
5	Knowledge Based Systems and Modern Trends in AI	Expert Systems, Fuzzy Logic, Modern trends in AI, Ethics in AI	10

SELF-LEARNING / TEAM WORK		
Sl. No	Self-learning / Team Work Description	Hrs
1	Example AI Problems: 8 Puzzle problem, Missionary Cannibals Problem, Blocks world problem	20
2	Simple Hill Climbing and Steepest Ascending Hill Climbing, Simulated Annealing	10
3	Knowledge Representation Using logic: Propositional Logic, Inference Rules in First Order Predicate Logic, Clausal forms or Conjunctive Normal Form (CNF), Conversion of WFF to clausal form	20
4	Planning: Overview, components of a planning system, Goal stack planning, Hierarchical planning, Learning: Forms of learning, neural net learning and genetic learning	10
5	Expert Systems: Forward Chaining and Backward Chaining, Fuzzy logic: Overview of Neuro-fuzzy systems, Advanced AI Technologies: Machine Learning, AI in Robotics, Autonomous Systems, Applications and case studies	15

SUGGESTED LEARNING RESOURCES

Text Book			
Sl. No.	Title of Book	Author	Publication
1	Artificial Intelligence: A Modern Approach	Stuart Russell and Peter Norvig	Pearson Education 4th Edition

Reference			
Sl. No.	Title of Book	Author	Publication
1	Artificial Intelligence	Elaine Rich, Kevin Knight, Shivashankar B. Nair	Tata McGraw Hill
2	Artificial Intelligence: Structures and Strategies for Complex Problem Solving	George F. Luger	Pearson Education
3	Principles of Artificial Intelligence	Nils J. Nilsson	Narosa Publishing

Web Resource	
1	https://www.coursera.org/specializations/ai – Introductory online AI courses
2	NPTEL Course: Introduction to Artificial Intelligence – IIT Kharagpur – https://nptel.ac.in/courses/106105077
3	MIT OpenCourseWare – 6.034 Artificial Intelligence – https://ocw.mit.edu
4	Stanford AI Lab – AI and Ethics Resources – https://ai.stanford.edu
5	TutorialsPoint – Fuzzy Logic and Expert Systems – https://www.tutorialspoint.com/fuzzy_logic

DETAILED SYLLABUS *(Self-learning if any to be marked)*					
Module	Major Topic & Sub Topic	Mode of Delivery	COs	Learning Domain Level (C)	Teaching Hours
1	Artificial Intelligence (AI): Introduction, Applications	L	CO1	A	1
	Intelligent agents: Agents and environments, Structure of agents	L	CO1	A	2
	Problem solving: Definition, Characteristics, Example AI Problems: Crypt arithmetic problems	L	CO1	A	3
	Production system: Definition, Characteristics, Production System Example: Water Jug problem	L, T	CO1	A	2
2	Preliminaries of searching: Search problems and Solutions, Formulating problems	L	CO2	A	2
	Uninformed (Blind) Search Strategies: Breadth-First Search (BFS), Depth-First Search (DFS), Examples	L	CO2	A	4
	Informed (Heuristic) Search Strategies: Heuristic Function, Best first search, Greedy best first search, A* algorithm, Examples	L, T	CO2	A	4
3	Game Theory: Games considered in AI, Two-player Zero-sum game, Formulation of a Game as a search Problem	L	CO3	A	3
	Minimax Algorithm: Algorithm, Example	L	CO3	A	3
	Apha-beta Pruning: Algorithm, Example	L, T	CO3	A	3
4	Knowledge in AI: Basic Concepts, Different Types of Knowledge, Knowledge Representation, Properties	L	CO4	A	2
	Knowledge Representation Using logic: First Order Predicate Logic (FOPL), Quantifiers, Examples of Quantified Statements, Well-Formed Formulas (WFF) in FOPL, Resolution-Refutation method in FOPL	L	CO4	A	2
	Knowledge Representation Systems: Semantic networks, Frames, Examples	L	CO4	A	2
	Knowledge Representation Systems: Frames, Conceptual Dependency, Examples	L	CO4	A	2
5	Expert Systems: Definition and characteristics, Architecture and components, Typical examples of expert system	L	CO5	A	2
	Fuzzy Logic: Fuzzy Variables, Fuzzy Sets and Fuzzy Set Operations, Typical Examples using Fuzzy Sets	L	CO5	A	2
	Advanced AI Technologies (Overview): Deep Learning and Generative AI – Natural Language Processing (NLP) and Large Language Models (LLMs), Edge AI and Quantum AI	L, T	CO5	A	3
	Ethics in AI: Introduction to AI ethics, Ethical Dimensions of AI – Fairness, transparency, and accountability, Bias and privacy issues, Explainable AI (XAI), Overview of AI governance and societal impacts.	L	CO5	A	3

TABLE OF SPECIFICATIONS (ToS) (ESE Question Paper Design)								
Module	Module Title	Distribution of Marks (RBL)						Total Marks
		R	U	A	An	E	C	
1	Artificial Intelligence (AI) and Production Systems	✓	✓	✓				12
2	Search Strategies	✓	✓	✓				12
3	Adversarial Search	✓	✓	✓				12
4	Knowledge Representation	✓	✓	✓				12
5	Knowledge Based Systems and Modern Trends in AI	✓	✓	✓				12
This ToS shall be treated as a general guideline for students and teachers for distribution of marks.								

ASSESSMENT PATTERN	
Assessment	**Marks**
Continuous Internal Assessment	**40**
1. Internal Examination	20
2. Learning Activity	12
3. Regularity	8
4. Course Project	--
End Semester Examination	**60**
Total	**100**

MODEL QUESTION PAPER

			Total Pages:…….
Register No.:	……	Name:	……

(AN AUTONOMOUS COLLEGE AFFILIATED TO APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY, THIRUVANATHAPURAM)

SECOND SEMESTER MCA DEGREE (REGULAR) EXAMINATION, DECEMBER 2025 (2025 SCHEME)			
Course Code:	A250201/CA214D		
Course Name:	**ARTIFICIAL INTELLIGENCE**		
Max. Marks	**60**	**Duration**:	3 hours

PART A			
(Answer all questions. Each question carries 3 marks)			
No.	***Question***	***CO***	***Marks***
1	Discuss any three application areas of artificial intelligence.	CO1	(3)
2	Explain the 8 puzzle problem.	CO1	(3)
3	Illustrate the concept of search tree with an example.	CO2	(3)
4	Differentiate between DFS and BFS.	CO2	(3)
5	Explain heuristic function and admissible heuristic function with example.	CO3	(3)
6	List the requirements for knowledge representation systems.	CO3	(3)
7	Explain existential quantifier and universal quantifier in first order logic.	CO4	(3)
8	Identify the components of a planning system.	CO4	(3)
9	Discuss any three typical expert system.	CO5	(3)
10	Define fuzzy set.	CO5	(3)

PART B				
(Answer any one full question from each module, each question carries 6 marks)				
No.		***Question***	***CO***	***Marks***
MODULE I				
11	a)	Solve the crypt arithmetic problem SEND+MORE=MONEY.	CO1	(6)
OR				
12	a)	Explain the classes of production system.	CO1	(6)
MODULE II				
13	a)	Explain uninformed search strategies.	CO2	(6)
OR				
14	a)	Explain different types of hill climbing.	CO2	(6)
MODULE III				
15	a)	Describe alpha-beta pruning with example.	CO3	(6)
OR				
16	a)	Describe semantic networks with example.	CO3	(6)
MODULE IV				
17	a)	Explain frames and conceptual dependency.	CO4	(6)
OR				
18	a)	Explain goal stack planning and hierarchical planning.	CO4	(6)
MODULE V				
19	a)	Using a suitable diagram, explain the architecture of expert system.	CO5	(6)
OR				
20	a)	Explain any two fuzzy set operations with example.	CO5	(6)

****

COURSE DESCRIPTION							
Regulation	**2025**	**L-T-J-P-S**	**1-0-0-3-0**	**Version**	**25/0**	**Credits**	**2**
(L- Lecture, T-Tutorial, J-Project, P-Practical, S-Self-learning & Team Work)							

Course Code	Course Name	Course Category
A250201/CA230T	**OBJECT ORIENTED PROGRAMMING LAB**	**PC**
Pre-requisite		
Knowledge of OOPs concepts		

COURSE OBJECTIVES	
1	Help students learn the basics of Java programming using arrays and strings.
2	Teach students how to solve problems using classes and objects in Java.
3	Enable students to use OOP concepts to create simple real-life applications.
4	Train students to use multithreading, file handling, and the Collection Framework in Java.
5	Help students build programs that use event handling and basic networking features.

COMPETENCY STATEMENT (CC)	
CC1	Ability to design and develop Java applications using fundamental and advanced programming concepts to solve near real-time problems.

COURSE OUTCOMES (CO)			
Course Outcomes (CO): At the end of this course, learners will be able to:			
CO	**CO Statement**	**CC Mapping**	**Cognitive (C)**
CO1	Analyze Java programs using object-oriented concepts to develop structured and reusable solutions.	CC1	An
CO2	Implement OOP concepts to effectively solve near to real time problems.	CC1	A
CO3	Analyze Java applications utilizing packages, collections, and exception handling with respect to modularity and robustness.	CC1	An
CO4	Create Java programs incorporating file handling and multithreading techniques to achieve concurrent and efficient processing.	CC1	C
CO5	Create event-driven Java applications using appropriate event handling mechanisms to address practical computing problems.	CC1	C
Cognitive (Revised blooms Level): *- **R**: Remember; **U**: Understand; **A**: Apply; **An**: Analyse; **E**: Evaluate; **C**: Create*			

	Program Outcomes & Program Specific Outcomes Correlation Matrix										
	PO								**PSO**		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**1**	**2**	**3**
1	3	2		1				1			
2	3	2	2	1				1			
3	3	3	3	2				1			
4	2	2	2	3				1			
5	2	3	3	3	1			1			
Correlation [3 – High, 2 -Medium, 1 – Low]											

TEACHING AND ASSESSMENT SCHEME									
Teaching Scheme / Week					**Credit**	**Hours / Semester**	**Examination Scheme**		
							Practical		
L	**T**	**J**	**P**	**S**	**C**		**CIA**	**ESE**	**Total**
0	1	0	3	0	2	60	50	50	100

***L**: Lecture (One unit is of one-hour duration), **T**: Tutorial (One unit is of one-hour duration), **P**: Practical (One unit is of one-hour duration), **J**: Project (One unit is of one-hour duration), **S**: Self-Learning & Team Work (One unit is of one-hour duration), **CIA**: Continuous Internal Assessment, **ESE**: End Semester Examination*

SYLLABUS (Major Topics)			
Module	Title	Major Topics	Hours
1	Object Oriented Concepts	Java Basics, classes, objects, constructors, Access Specifiers (public, private, protected, friendly), Access Modifiers, overloading methods, recursion, nested and inner classes	**12**
2	Inheritance and Arrays	Inheritance, Polymorphism- method overriding, dynamic method dispatch, abstract and final classes. Interfaces. Arrays and Strings: One dimensional arrays, Multidimensional arrays, exploring String class and methods.	**10**
3	Packages and Exception Handling	Packages-Built-in and User-defined, Introduction to java.util package – Vector, Scanner, StringTokenizer, Collections Framework- Introduction to Collections, ArrayList, LinkedList, HashMap, HashSet, Exception Handling- try-catch blocks, multiple catches, finally, throw, throws and custom exceptions.	**12**
4	Multithreading & Data Handling	Input / Output Basics – Streams – Byte streams and Character streams – Reading and Writing Console – Reading and Writing Files. Multithreading: Creating threads via Thread class and Runnable Interface, Synchronization and Inter-thread communication.	**12**
5	GUI programming with Java	GUI Programming with Java: The AWT class hierarchy, introduction to Swing, Swing Vs AWT, hierarchy for swing components. Containers: JFrame, JApplet, JDialog, JPanel, overview of some swing components: JButton, JLabel, JTextField, JTextArea, simple applications. Layout management: Layout manager types, border, grid and flow.	**12**

SUGGESTED LEARNING RESOURCES

Text Book			
Sl. No.	Title of Book	Author	Publication
1	Java: The Complete Reference	Herbert Schildt.	Tata McGraw-Hill Edition, 13th Edition, 2024.
2	An introduction to Object-oriented programming with Java	C. Thomas Wu	Tata McGraw-Hill Publishing company Ltd.

Reference			
Sl. No.	Title of Book	Author	Publication
1	Java 2 Programming Black Book",	Steven Holzner.	
2	The JAVA programming language	K. Arnold and J. Gosling	Pearson Education.
3	Core Java: An Integrated Approach	Dr. R. Nageswara Rao.	

Web Resource	
1	https://www.w3resource.com/java-tutorial/
2	https://www.youtube.com/watch?v=b35mlSPOlJg
3	https://www.youtube.com/watch?v=7v2OnUti2eM
4	https://www.youtube.com/watch?v=YMAwgRwjEOQ
5	https://www.youtube.com/watch?v=7wpFNKnCpiQ
6	https://www.edx.org/course/object-oriented-programming-in-java-2
7	https://www.coursera.org/learn/object-oriented-java

8	https://nptel.ac.in/courses/106/105/106105191/

Detailed Syllabus *(Self-learning if any to be marked)*					
Module	Major Topic & Sub Topic	Mode of Delivery	CO	Learning Domain Level	Hrs
1	Need for OOP paradigm, Procedural approach vs. Object-Oriented approach.	L	CO1	U	1
	Object Oriented concepts Java Basics: Java Design goal - Features of Java Language	L	CO1	U	1
	Data types, variables, Operators, expressions, control Statements, Type conversion and casting	L	CO1	A	
	Concepts of - classes, objects, Constructors, Access Specifiers	L	CO1	A	1
	Access Modifiers (static, final, abstract, native, synchronized)	L	CO1	A	1
	Overloading methods, recursion, Nested and inner classes	L	CO1	A	
2	Inheritance, Polymorphism- method overriding, dynamic method dispatch	L	CO2	A	1
	abstract and final classes. Interfaces	L	CO2	A	1
	One dimensional arrays, Multidimensional arrays, Exploring String class and methods.	L	CO2	A	1
3	Packages-Built-in and User-defined	L	CO3	A	1
	Introduction to java.util package – Vector, Scanner, StringTokenizer	L	CO3	A	1
	Collections Framework- Introduction to Collections, ArrayList, LinkedList, HashMap, HashSet,	L	CO3	A	2
	Exception Handling- try-catch blocks, multiple catches, finally, throw, throws and custom exceptions.	L	CO3	A	1
4	Input / Output Basics – Streams – Byte streams and Character streams – Reading and Writing Console – Reading and Writing Files.	L	CO4	A	2
	Multithreading: Creating threads via Thread class and Runnable Interface, Synchronization and Inter-thread communication.	L	CO4	A	2
5	GUI Programming with Java: The AWT class hierarchy, introduction to Swing, Swing Vs AWT, hierarchy for swing components.	L	CO5	A	2
	Containers: JFrame, JApplet, JDialog, JPanel, overview of some swing components: JButton, JLabel, JTextField, JTextArea, simple applications	L	CO5	A	2
	Layout management: Layout manager types, border, grid and flow.	L	CO5	A	1

PRACTICAL SYLLABUS				
Objective	Topic	CO	Learning Domain Level	Hrs
To understand Java program structure and implement basic programs using Java syntax	Writing simple Java programs demonstrating Java basics and program structure.	CO1	A	2
To design and develop programs using classes, objects, and constructors.	Creating Java programs using classes and objects.		A	2
	Implementing default and parameterized constructors		A	
To apply access specifiers, access modifiers, and method overloading in Java programs	Programs demonstrating access specifiers (public, private, protected, default).		An	2
	Programs illustrating access modifiers.		An	
	Implementing method overloading with different parameter lists.		An	
To implement recursive methods and nested/inner classes to solve programming problems.	Writing Java programs using recursion (factorial, Fibonacci, etc.).		An	2
	Developing programs using nested classes.		An	

	Implementing programs using inner classes.		An	
To implement inheritance, method overriding, and dynamic method dispatch in Java programs.	Programs demonstrating single and multilevel inheritance.	CO2	A	2
	Implementation of method overriding.		A	
	Programs illustrating dynamic method dispatch.		A	
To design Java programs using abstract classes, final classes, and interfaces.	Developing programs using abstract classes.		A	2
	Programs demonstrating final classes and final methods.		A	
	Implementing interfaces and multiple inheritance using interfaces.		A	
To develop programs using one-dimensional and multidimensional arrays.	Programs using one-dimensional arrays (searching, sorting, aggregation).		A	2
	Programs using multidimensional arrays (matrix operations).		A	
To explore and apply Java String class methods in problem-solving.	Programs exploring the String class and commonly used String methods.		A	
To create and use built-in and user-defined packages in Java programs.	Programs using built-in packages	CO3	A	2
	Creation and use of user-defined packages		A	
To apply classes from the java.util package for input handling and data processing.	Programs using Vector, Scanner, and StringTokenizer		A	2
To implement collection classes for efficient data storage and manipulation.	Introduction to Collections Framework		A	2
	Programs using ArrayList and LinkedList		A	
	Programs using HashMap and HashSet		A	
To handle runtime errors using Java exception handling mechanisms, including custom exceptions.	Programs using try–catch and multiple catch blocks		A	2
	Programs using finally, throw, and throws		A	
	Creation and use of custom exceptions		A	
To understand Java I/O stream hierarchy and perform console input and output operations.	Programs demonstrating basic input and output streams	CO4	A	2
	Reading and writing data through console		A	
To implement file handling using byte streams and character streams.	Programs using byte streams for file input and output		A	2
	Programs using character streams for file reading and writing		A	
To create and manage multiple threads using the Thread class and Runnable interface.	Creating threads using Thread class		A	2
	Creating threads using Runnable interface		A	
To apply synchronization and inter-thread communication mechanisms in multithreaded programs.	Programs demonstrating thread synchronization		A	2
	Programs illustrating inter-thread communication		A	
To understand the AWT and Swing class hierarchies and distinguish between AWT and Swing.	Study of AWT class hierarchy.	CO5	C	3
	Introduction to Swing		C	
	Comparison of Swing vs AWT		C	
	Swing component hierarchy		C	
To design GUI applications using Swing containers, components, and layout managers.	Programs using containers: JFrame, JApplet, JDialog, JPanel		C	3
	Programs using components: JButton, JLabel, JTextField, JTextArea		C	
	Programs using Flow, Border, and Grid layout managers		C	
To develop simple event-driven GUI applications for effective user interaction.	Simple GUI applications with event handling- Minor project		C	3

ASSESSMENT PATTERN		
Assessment	**Mark**	
Continuous Internal Assessment		**50**
13. Internal Examination for theory	10	
14. Internal Examination for Lab	10	
15. Continuous Lab Evaluation		20
j. Maintenance of daily lab record and GitHub management	7	
k. Regular class viva	6	
l. Timely completion of day to day tasks	7	
16. Learning Activity	--	
17. Regularity	5	
18. Course Project	5	
End Semester Examination		**50**
Total		**100**

End Semester Examination Pattern:

Maximum Marks: 50			
Verification of Daily program record and Git Repository			5 marks
Viva			10 marks
Problem solving difficulty level, one or more questions may be given)	Flowchart / Algorithm / Structured description of problem to explain how the problem can be solved / Interface Design	15%	35 marks
	Program correctness	50%	
	Code efficiency	15%	
	Formatted output and pushing to remote Git repository	20%	
Total Marks			**50 marks**

COURSE DESCRIPTION							
Regulation	**2025**	**L-T-J-P-S**	**0-1-1-2-0**	**Version**	**25/0**	**Credits**	**2**
(L- Lecture, T-Tutorial, J-Project, P-Practical, S-Self-learning & Team Work)							

Course Code	Course Name	Course Category
A250201/CA230U	**ADVANCED DBMS LAB**	**PC**
Pre-requisite		
Basic knowledge of Database Management Systems (DBMS), SQL concepts, and fundamentals of programming.		

COURSE OBJECTIVES	
1	To design and implement relational databases using SQL.
2	To apply PL/SQL programming concepts, including triggers, cursors, and stored procedures.
3	To understand and configure NoSQL databases such as MongoDB or Cassandra.
4	To perform CRUD operations and advanced data manipulation in NoSQL environments.
5	To design databases in local and cloud environments using real-world tools.

COMPETENCY STATEMENT (CC)	
CC1	Demonstrate proficiency in designing, managing, and deploying relational and NoSQL databases using SQL, PL/SQL, and cloud platforms, incorporating query optimisation, application integration, and collaborative project practices.

COURSE OUTCOMES (CO)			
CO	**CO Statement**	**CC Mapping**	**Cognitive (C)**
CO1	Design and build relational database systems and demonstrate competence in data modeling, schema creation, and implementation.	CC1	**C**
CO2	Apply PL/SQL programming to process and automate relational databases.	CC1	**C**
CO3	Compare relational and non-relational databases and configure NoSQL systems.	CC1	**C**
CO4	Apply CRUD operations and retrieve data efficiently in a NoSQL environment.	CC1	**C**
CO5	Get familiarised with the architecture of distributed file systems and perform NoSQL administration tasks.	CC1	**C**
CO6	Design NoSQL databases on cloud platforms using real-time requirements.	CC1	**A**
Cognitive (Revised blooms Level): *- **R**: Remember; **U**: Understand; **A**: Apply; **An**: Analyse; **E**: Evaluate; **C**: Create*			

	Program Outcomes & Program Specific Outcomes Correlation Matrix										
	PO								**PSO**		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**1**	**2**	**3**
CO1	3	2	3	2	2	1	1	1			
CO2	2	2	2	1	–	–	–	–			
CO3	2	2	2	2	–	1	1	1			
CO4	2	2	3	1	2	1	1	1			
CO5	3	2	2	–	1	1	–	1			
CO6	3	2	3	1	2	1	–	1			
Correlation [3 – High, 2 -Medium, 1 – Low]											

TEACHING AND ASSESSMENT SCHEME									
Teaching Scheme / Week					Credit	Hours / Semester	Examination Scheme		
							Practical		
L	T	J	P	S	C		CIA	ESE	Total
0	1	1	2	0	2	60	50	50	100

***L**: Lecture (One unit is of one-hour duration), **T**: Tutorial (One unit is of one-hour duration), **P**: Practical (One unit is of one-hour duration), **J**: Project (One unit is of one-hour duration), **S**: Self-Learning & Team Work (One unit is of one-hour duration), **CIA**: Continuous Internal Assessment, **ESE**: End Semester Examination*

PRACTICAL SYLLABUS

Objectives	Topic	COs	Learning Domain Level (C)	Hours
SQL Database Design	1. Creation of a database using DDL commands, including integrity constraints. 2. Create an application to apply Data Manipulation Language (DML) commands to modify the database. 3. Apply DCL and TCL commands to impose restrictions on databases. 4. Create an application to retrieve data from databases using SELECT and VIEWS. 5. Create an application to use JOIN for query optimisation.	CO1	C	10
PL/SQL Programming	Construct PL/SQL code for sample databases using: 1. Cursors 2. Triggers 3. Stored Procedures 4. Functions	CO2	C	10
NoSQL Fundamentals	1. Compare relational and non-relational databases. 2. Understand the installation and configuration of NoSQL Databases.	CO3	C	6
NoSQL Data Design	1. Creating and managing collections, CRUD operations, aggregation, and indexing 2. Build sample collections/documents to perform query operations.	CO4	C	10
NoSQL Administration	1. Backup, security, monitoring, user and role management. 2. Build sample collections/documents to perform the shell commands like replica set, indexing etc.	CO5	C	6
Cloud Deployment	Deploying NoSQL in AWS DynamoDB / Google Bigtable / Azure CosmosDB	CO6	A	8
Project Work	Develop sample applications using any of the front-end tools and NoSQL: 1. Group micro project to develop an application using any database and front-end integration.	CO4, CO5	C	10

SUGGESTED LEARNING RESOURCES

Text Book			
Sl. No.	Title of Book	Author	Publication
1	*Database System Concepts*	Abraham Silberschatz, Henry F. Korth, S. Sudarshan	McGraw-Hill, 6th Edition, 2011
2	*Next Generation Databases: NoSQL, NewSQL, and Big Data*	Guy Harrison	Apress, 2015

Reference			
Sl. No.	Title of Book	Author	Publication
1	Database Management Systems	Raghu Ramakrishnan, Johannes Gehrke	McGraw-Hill, 3rd Edition, 2014
2	HBase: The Definitive Guide	Lars George	O'Reilly Media, 2011
3	Professional NoSQL	Shashank Tiwari	Wiley, 2011
4	MongoDB Administrator's Guide	Cyrus Dasadia	Packt Publishing, 2017
5	Cassandra: The Definitive Guide	Eben Hewitt, Jeff Carpenter	O'Reilly Media, 2010

Web Resource	
1	https://nptel.ac.in/courses/106/105/106105175
2	https://www.edx.org/course/databases-5-sql
3	https://www.coursera.org/learn/introduction-mongodb
4	https://www.edureka.co/cassandra
5	https://couchdb.apache.org/
6	https://nptel.ac.in/courses/106/105/106105175
7	https://aws.amazon.com/dynamodb

ASSESSMENT PATTERN		
Assessment		**Mark**
Continuous Internal Assessment		**50**
1. Internal Examination		15
2. Continuous Lab Evaluation		20
a. Maintenance of daily lab record and GitHub management	7	
b. Regular class viva	6	
c. Timely completion of day-to-day tasks	7	
3. Learning Activity		-
4. Regularity		5
5. Course Project		10
End Semester Examination		**50**
Total		**100**

Semester Examination Pattern:

Maximum Marks: 50			
Verification of Daily program record and Git Repository			5 marks
Viva			10 marks
Problem solving (Based on difficulty level, one or more questions may be given)	Flowchart / Algorithm / Structured description of problem to explain how the problem can be solved / Interface Design	15%	35 marks
	Program correctness	50%	
	Code efficiency	15%	
	Formatted output and pushing to remote Git Repository	20%	
		Total Marks	**50 marks**

COURSE DESCRIPTION							
Regulation	**2025**	**L-T-J-P-S**	**1-0-0-3-0**	**Version**	**25/0**	**Credits**	**2**
(L- Lecture, T-Tutorial, J-Project, P-Practical, S-Self-learning & Team Work)							

Course Code	Course Name	Course Category
A250201/CA230V	**NETWORKING AND SYSTEM ADMINISTRATION LAB**	**PC**
Pre-requisite		
NIL		

COURSE OBJECTIVES	
1	To develop hands-on experience in Linux system administration and networking.
2	To familiarize learners with essential network configuration commands and tools.
3	To enable automation of routine system and network tasks through shell scripting.
4	To build skills in troubleshooting, connectivity testing and basic security setup.
5	To integrate the knowledge of network protocols and tools for practical applications.

COMPETENCY STATEMENT (CC)	
CC1	Learners will be able to install, configure, and manage Linux-based networked environments and develop scripts for system and network automation.

COURSE OUTCOMES (CO)			
Course Outcomes (CO): At the end of this course, learners will be able to:			
CO	**CO Statement**	**CC Mapping**	**Cognitive (C)**
CO1	Identify and configure essential hardware and operating system components for desktop and networked environments.	CC1	A
CO2	Demonstrate proficiency with Linux command-line tools for system and file management.	CC1	A
CO3	Write shell scripts using variables, loops and conditional constructs.	CC1	A
CO4	Apply network configuration commands to test connectivity, routing, and basic firewall setup.	CC1	A
CO5	Troubleshoot basic network issues and document configurations, results using Git.	CC1	A
Cognitive (Revised bloom's Level): *- **R**: Remember; **U**: Understand; **A**: Apply; **An**: Analyse; **E**: Evaluate; **C**: Create*			

	Program Outcomes & Program Specific Outcomes Correlation Matrix										
	PO								**PSO**		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**1**	**2**	**3**
1	3	2	2					2			
2	3	2	2					2			
3	3	3	2					2			
4	3	3	2					2			
5	3	3	3					2			
Correlation [3 – High, 2 -Medium, 1 – Low]											

TEACHING AND ASSESSMENT SCHEME									
Teaching Scheme / Week					Credit	Hours / Semester	Examination Scheme		
							Practical		
L	T	J	P	S	C		CIA	ESE	Total
1	0	0	3	0	2	60	50	50	100

***L**: Lecture (One unit is of one-hour duration), **T**: Tutorial (One unit is of one-hour duration), **P**: Practical (One unit is of one-hour duration), **J**: Project (One unit is of one-hour duration), **S**: Self-Learning & Team Work (One unit is of one-hour duration), **CIA**: Continuous Internal Assessment, **ESE**: End Semester Examination*

SYLLABUS (Major Topics)			
Module	Title	Major Topics	Hours
1	System Setup and Configuration	Identify major hardware components, specification of desktop and server systems, install Linux (Ubuntu) on VirtualBox, user creation and permissions.	10
2	Linux Commands and File Management	Study of basic Linux commands, file hierarchy and permissions, system logs in /var/log.	10
3	Shell Scripting Fundamentals	Bash syntax, Variables, Control constructs, Command-line arguments, File backup and monitoring.	10
4	Networking Commands and Configuration	Network commands – ping, traceroute, nslookup, ip, netstat, arp, Configure static/dynamic IP, Subnet mask and CIDR.	10
5	Troubleshooting and Reporting	Troubleshoot connectivity issues, Analyze routing paths, maintain Git-based log of scripts and configurations.	10

SUGGESTED LEARNING RESOURCES

Text Book			
Sl. No.	Title of Book	Author	Publication
1	UNIX and Linux System Administration Handbook	Evi Nemeth, Garth Snyder, Trent R. Hein, Ben Whaley, and Dan Mackin	5th Edition Pearson/Addison-Wesley Professional.
2	Linux Command Reference Shell Commands from A to Z	Michael Kofler	ISBN 978-1-4932-2750-1
3	Unix Shell Programming	Yashavant P. Kanetkar	BPB Publications
4	Introduction to Linux and Shell Scripting	Amalorpavam G., K. R. Venugopal, M. T. Somashekara	Khanna Publishing House
5	A Textbook of Computer Network	Dr. Sanjay Sharma	S.K. Kataria & Sons
6	100 Shell programs in Unix	Suresh Kumar S.	PHI Learning Pvt. Ltd., New Delhi

Reference			
Sl. No.	Title of Book	Author	Publication
1	The Practice of System and Network Administration, Volume 1	Thomas A. Limoncelli, Christina J. Hogan, Strata Chalup	Addison-Wesley Professional
2	Network Warrior	Gary Donahue	O'Reilly
3	How Linux Works: What Every Superuser Should Know	Brian Ward	3rd Edition (April 2021) published by No Starch Press.

Web Resource	
1	https://www.geeksforgeeks.org/linux-commands
2	https://tldp.org/LDP/Bash-Beginners-Guide/html/
3	https://www.tutorialspoint.com/linux_admin
4	https://tldp.org/LDP/abs/html/
5	https://linuxize.com/
6	https://www.digitalocean.com/community/tutorials

Detailed Syllabus *(Self-learning if any to be marked)*

Module	Major Topic & Sub Topic	Mode of Delivery	CO	Learning Domain Level	Hrs
1	Identification of major hardware components of desktop and server systems	L	CO1	U	2
	Overview of Linux installation and virtualization concepts	L	CO1	U	2
	User accounts, roles and permission concepts in Linux	L	CO1	U	1
2	Basic Linux commands for directory and file operations	L	CO2	U	2
	File viewing, search and archiving commands	L	CO2	U	1
	Linux file hierarchy and system log structure	L	CO2	U	1
	File permissions and ownership concepts	L	CO2	U	1
3	Shell Scripting Concepts: Introduction to shell scripting and Bash syntax	L	CO3	U	2
	Variables, conditional statements and loops	L	CO3	U	1
	Command-line arguments and script execution flow	L	CO3	U	1
4	Network diagnostic and monitoring commands	L	CO4	U	2
	IP addressing concepts, subnetting and CIDR	L	CO4	U	1
	Basics of routing and connectivity analysis	L	CO4	U	1
5	Common network faults and troubleshooting methodology	L	CO5	U	2
	Introduction to firewall and basic security concepts	L	CO5	U	1
	Version control concepts for configuration documentation using Git hub	L	CO5	U	1

PRACTICAL SYLLABUS

Objective	Topic	CO	Learning Domain Level	Hrs
System setup and user management	Ubuntu installation on VirtualBox.	CO1	A	4
	User creation and permission management.	CO1	A	3
Linux file and command operations	Directory and file commands.	CO2	A	4
	File permissions and ownership.	CO2	A	3
Shell scripting and automation	Scripts using loops and conditions.	CO3	A	4
	File backup and monitoring.	CO3	A	4
Network configuration and testing	Network commands .	CO4	A	5
	Configure static IP and subnet mask.	CO4	A	3
Troubleshooting and documentation	Network issue identification and resolution.	CO5	A	5
	Git-based documentation and reporting.	CO5	A	3

ASSESSMENT PATTERN	
Assessment	**Mark**
Continuous Internal Assessment	**50**
19. Internal Examination for theory	10
20. Internal Examination for Lab	10

21. Continuous Lab Evaluation		25
m. Maintenance of daily lab record and GitHub management	9	
n. Regular class viva	7	
o. Timely completion of day-to-day tasks	9	
22. Learning Activity	--	
23. Regularity	5	
24. Course Project		
End Semester Examination		**50**
Total		**100**

End Semester Examination Pattern:

Maximum Marks: 50			
Verification of Daily program record and Git Repository			5 marks
Viva			10 marks
Problem solving difficulty level, one or more questions may be given)	Flowchart / Algorithm / Structured description of problem to explain how the problem can be solved / Interface Design	15%	35 marks
	Program correctness	50%	
	Code efficiency	15%	
	Formatted output and pushing to remote Git repository	20%	
Total Marks			**50 marks**