MAR ATHANASIUS COLLEGE OF ENGINEERING

(Govt. Aided Autonomous Institution, Established in 1961)

Kothamangalam, Kerala, India - 686666

MCA

BRIDGE COURSE SYLLABUS - 2024

Department of Computer Applications

Course Structure	
Courses	**Duration**
Mathematics & Statistics	20 Hours
Digital Fundamentals & Computer Architecture	20 Hours
Operating Systems	20 Hours
C Programming	28 Hours
Data Structures	32 Hours

End Course Examination Pattern		
Assessment	**Duration**	**Max. Marks**
Theory	3 Hours	60
Practical	2 Hours	50

M24CA1R 001	Bridge Course	L	T	P	J	S	Credit	Year of Introduction
		22	0	8	0	30	Nil	2024

Preamble:

A bridge course serves as a crucial academic pathway designed to ease the transition into the demanding and dynamic field of computer science. Tailored to address foundational knowledge gaps and ensure a comprehensive understanding of core concepts, the bridge course acts as a bridge between the students' prior educational background and the advanced requirements of the MCA program. It typically covers essential topics such as Mathematics, Basics of Digital Fundamentals and Computer Architecture, Operating systems, Basics of C Programming and Data Structures.

Prerequisite: Nil

Course Outcomes:

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

CO No.	Course Outcomes	Cognitive Knowledge Level
CO 1	Understand and apply Single Variables Calculus, Linear Algebra, Combinatorics and Statistics in practical problems.	**Apply**
CO 2	Understand the fundamental principles underlying digital fundamentals including binary number system, conversion techniques and operations, facilitating effective representation and manipulation of digital data and also gain insight into the basic architecture of computers.	**Understand**
CO 3	Gain in depth knowledge of operating systems, covering GUI, CUI, application and system software, boot processes, and hardware components, as well as various OS functionalities and classifications.	**Understand**
CO 4	Acquire fundamental programming skills essential for software development and mastering C as a foundational language, enables them to flexibly adapt to various technological domains.	**Apply**
CO 5	Explore data structures and algorithms, emphasizing complexity categorization, Array, Stack, Queue, and Linked List operations, mastering Binary Tree traversal Sorting and Searching algorithms.	**Apply**

Assessment Pattern

An end course examination that covers the entire content of the bridge course will be conducted to assess overall understanding and retention. The end course examination will have two parts – a written examination and a practical examination. Written examination will be of 3 hours duration with maximum 60 marks and practical examination will be of 2 hours duration with maximum 50 marks. The practical examination will have two questions one moderate level question on problem solving using C and another one on Data Structures. Class participation and attendance might be a factor in the evaluation process.

Syllabus

Module 1: Mathematics and Statistics [20 Hours]
Review of basic single variable calculus: Functions, Limit, Derivatives, Integrals. **Linear Algebra:** Matrices -Special matrices, Transpose of a matrix, Operations on matrices – Addition, Subtraction, Scalar multiplication, Determinant, Minor, Cofactor, Adjoint of a matrix, Inverse of a matrix, Linear equation, Nonlinear equation, Row Echelon form, Rank of a matrix. **Combinatorics:** Sum and Product Rules, Permutations, Combinations. **Measures of Dispersion:** Range, Mean deviation, Quartile deviation, Standard deviation, Skewness, Kurtosis, Moments.
Module 2: Digital Fundamentals and Computer Architecture [20 Hours]
Number Systems: Introduction, Decimal number systems, Binary number systems conversion, Octal number system, Hexa decimal number systems conversion. Binary Arithmetic- Binary addition and Binary Subtraction, Binary multiplication, Binary division. BCD codes and BCD arithmetic, Representation of signed numbers, Floating point operations, Error detection and correction codes. **PC Architecture:** Introduction, Components of Mother Board, Input output devices, Hard disk overview-Disk Geometry, SSD. Secondary storage devices, CD family and DVD, Analog and digital signals, Transmission impairments.
Module 3: Operating Systems [20 Hours]
Introduction to Operating Systems: Basic Hardware & Memory- Ram, Rom, CPU, Hard disk, Mother Board, SMPS, Cache Memory, Virtual Memory, Registers, Buffers, GUI & CUI, Application S/W, System S/W, Booting Process, BIOS, POST, Bootstrap loader, Kernel. **Functions of Operating System**: Types of operating system- Batch, Multiprogramming, Multi-Tasking, Multi-Processing, Real-Time. **Concept of a Process:** Process States, Process Control Block, Context Switch, Thread, Multi-Thread. CPU Scheduling criteria- CPU scheduling algorithms-FCFS, SJFS, SRTF, Round Robin, Priority Scheduling.
Module 4: Basics of Programming [28 Hours]
Overview of C: Constants, variables, and data types, managing input/ output, operators and expressions, decision statements and loops, functions, single and multi-dimensional arrays, structure, union, files, and pointers.
Module 5: Data Structures [32 Hours]
Introduction to Data Structures and Algorithms: Introduction, Classification, Algorithm. Arrays Introduction, Insertion Algorithms, Deletion Algorithms. Stack - Introduction, Insertion Algorithms, Deletion Algorithms. Queue - Introduction, Insertion Algorithm, Deletion Algorithm. Linked List - Introduction, Singly Linked List, Doubly Linked List, Circular Linked List. Trees - Introduction & Terminologies, Binary Tree - Introduction, Traversal. Sort - Bubble Sort, Selection Sort, Insertion Sort, Merge Sort. Search - Linear Search, Binary Search. Graph - Introduction, Terminologies. Sets - Introduction, Terminologies. **Implementation:** Array Insertion, Array Deletion Stack operations, Queue Operations, Bubble sort.

Reference Books:

1. Ian Jacques. Mathematics for Economics and Business. 9th ed. Pearson, 2019.
2. Swapan Kumar Chakraborty Bikash Kanti Sarkar "Discrete Mathematics", Oxford
3. L. R. Potti "Probability and Statistics", Yamuna Publications
4. Floyd, "Digital Fundamentals", Pearson Education, 11th Edition (2021).
5. Hamacher, Vranesic & Zaky, "Computer Organization",6th Edition(2012), McGrawHill.
6. Silberschatz, Galvin, Gagne "Operating System Principles", Wiley, Seventh Edition (2006)
7. Tanenbaum, Andrew S, "Modern Operating Systems", Prentice Hall India Learning Private Limited, Third Edition (2009)
8. Brian Kernighan and Dennis Ritchie, "The C Programming Language", Prentice Hall (1988).
9. Byron Gottfried, "Schaum's Outline of Programming with C", McGraw-Hill Education, 2nd Edition (1996).
10. Cormen T.H., Leiserson C.E, Rivest R.L. and Stein C, Introduction to Algorithms, Prentice Hall India, New Delhi, 2004
11. D.Samantha, Classic Data structures, Prentice Hall India, New Delhi,2005

Course Contents and Lecture Schedule

Sl.No	Mathematics and Statistics [20 Hours]	No of hours
1	Functions	1
2	Limit	1
3	Derivatives	1
4	Integrals	1
5	Special matrices	1
6	Transpose of a matrix	1
7	Operations on matrices – Addition, Subtraction, Scalar multiplication	1
8	Determinant, Minor	1
9	Cofactor, Adjoint of a matrix	1
10	Inverse of a matrix	1
11	Linear equation, Nonlinear equation, Row Echelon form	1
12	Rank of a matrix	1
13	Sum and Product Rules	1
14	Permutations	1
15	Combinations	1
16	Range, Mean deviation	1
17	Quartile deviation	1
18	Standard deviation	1
19	Skewness	1
20	Kurtosis, Moments	1
Total Hours		**20**

Sl No	Digital fundamentals and Computer architecture [20 Hours]	No of hours
1	Introduction to number systems	1
2	Decimal number systems, Binary number systems conversion	1
3	Octal number system, Hexa decimal number systems conversion	1
4	Binary addition and Binary Subtraction	1
5	Binary multiplication, Binary division	2
6	BCD codes and BCD arithmetic	2
7	Representation of signed numbers	1
8	Floating point operations	2
9	Error detection and correction codes.	2
10	Introduction to computers, Overview of PC architecture	1
11	Components of Mother Board	2
12	Input output devices	1
13	Hard disk overview, Disk Geometry, SSD	1
14	Secondary storage devices, CD family and DVD	1
15	Analog and digital signals, Transmission impairments	1
	Total Hours	**20**

Sl No	Operating Systems [20 Hours]	No of hours
1	Basic Hardware & Memory- Ram, Rom, CPU, Hard Disk.	1
2	Mother Board, SMPS, Cache Memory.	1
3	Virtual Memory, Registers, Buffers.	1
4	Introduction to OS - GUI & CUI, application S/W, System S/W.	1
5	Booting Process, BIOS, POST.	1
6	Bootstrap loader, Kernel.	1
7	Functions of Operating System.	2
8	Batch Processing, Multiprogramming, Multi-Tasking, Multi-Processing, Real Time.	1
9	Concept of a Process, Process States.	2
10	Process Control Block, Context Switch.	1
11	Thread, Multi-thread.	1
12	CPU Scheduling Criteria, CPU Scheduling Algorithms.	1
13	CPU Scheduling Algorithms-FCFS.	2
14	CPU Scheduling Algorithms-SJFS.	1
15	CPU Scheduling Algorithms- SRTF.	1

16	CPU Scheduling algorithms- Round Robin.	1
17	CPU Scheduling algorithms- Priority Scheduling.	1
	Total Hours	**20**

Sl No	Basics of Programming -Theory Portions [8 Hours]	No of hours
1	Overview of C: constants, variables and data types, managing input/ output, operators and expressions	1
2	Decision Statements and Loops	1
3	Functions, recursive functions	1
4	Single dimensional arrays	1
5	Two dimensional arrays	1
6	Structure and Union	1
7	Pointers and array manipulations	1
8	Files	1
	Total Hours	**8**

Sl No	Basics of Programming -List of Experiments [20 Hours Lab]	No of hours
1	Write basic C programs using command line arguments.	2
2	Write programs that implement decision statements like if-else and switch.	2
3	Write programs that employ looping constructs and nested loops.	2
4	Write programs that use functions to implement a specific task.	2
5	Write programs that use functions with recursive statements.	2
6	Write programs that manipulate single dimensional arrays.	2
7	Write programs that use two-dimensional arrays.	2
8	Write programs using structures and union.	2
9	Write programs that include pointers with arrays.	2
10	Write programs using files.	2
	Total Hours	**20**

Sl.No	Data Structures - Theory Portions [20 Hours]	No of hours
1	Introduction to Data structures and algorithms.	1
2	Classification of Data structures.	1
3	Arrays-Introduction.	1
4	Array-Insertion Algorithms.	1
5	Array-Deletion Algorithms.	1
6	Stack-Introduction, Insertion Algorithms.	1
7	Stack-Deletion algorithms.	1
8	Queue- Introduction, Insertion Algorithm.	1
9	Queue- Deletion Algorithm.	1
10	Linked List- Introduction, Singly Linked List	1
11	Doubly Linked List	1
12	Circular Linked List.	1
13	Trees-Introduction & Terminologies	1
14	Binary tree-introduction	1
15	Binary Tree -Traversal	1
16	Bubble Sort, Selection Sort	1
17	Insertion sort, Merge sort	1
18	Linear Search, Binary search	1
19	Graph-Introduction, Terminologies	1
20	Sets- Introduction, Terminologies	1
	Total Hours	**20**

Sl.No	Data Structures - List of Experiments [12 Hours Lab]	No of hours
1	Write a Menu Driven Program to perform Array Insertion algorithm.	2
2	Write a Menu Driven Program to perform Array Deletion algorithm	2
3	Write a Menu Driven Program to perform Stack operations	2
4	Write a Menu Driven Program to Perform Queue Operations	2
5	Write a Menu Driven Program to perform Bubble sort and Selection Sort	2
6	Write a Menu Driven Program to perform Binary Search & Linear Search	2
	Total Hours	**12**

CO Assessment Questions

Course Outcome 1
1. Differentiate $f(x)=(2x^2+1)^2$. 2. Find the inverse of A and show that AA^{-1} is an identity matrix. $A=\begin{bmatrix} 5 & 2 \\ -7 & -3 \end{bmatrix}$ 3. A box contains 4 red balls, 5 green balls, and 6 white balls. A ball is drawn at random from the box. Find the probability that the ball is (a) Green (b) White (c) Blue.
Course Outcome 2
1. Convert the Decimal number $(59.85)_{10}$ in to Binary. 2. Perform BCD arithmetic (a) 99+99 (b) 153-149. **3.** Description about the Input Output devices.
Course Outcome 3
1. Explain the booting process of an Operating System. 2. Explain different states of process with a neat diagram 3. Explain FCFS CPU Scheduling Algorithm.
Course Outcome 4
1. Implement a C program to determine the grade of a student based on their percentage score, using a given grading criteria. 2. Create a recursive C function to calculate the sum of digits of a given integer. 3. Implement a C program to calculate the sum of elements in each column of a matrix.
Course Outcome 5
1. What is data structure and explain its classification? 2. Describe Binary Tree and explain its different traversals. 3. Compare Binary search and Linear Search.

Model Question Paper

QP CODE:_____ Pages:__

Reg No.: _____ Name:_____

MAR ATHANASIUS COLLEGE OF ENGINEERING (AUTONOMOUS)
KOTHAMANGALAM

Bridge Course Examination

Max. Marks: 60 Time: 3 Hours

- This question paper has Four Sections.
- Each section contains Two Parts – Part A and Part B.
- In Part A there are 3 questions of 3 marks each (all questions are to be answered).
- In Part B there are 2 questions of 6 marks each (one question is to be answered).

SECTION 1: Mathematics and Statistics [15 Marks]

PART A (3 x 3 = 9 Marks)

1. Differentiate $f(x)=(2x^2+1)^2$.
2. Find the inverse of A and show that AA^{-1} is an identity matrix.

$$A=\begin{bmatrix} 5 & 2 \\ -7 & -3 \end{bmatrix}$$

3. A box contains 4 red balls, 5 green balls, and 6 white balls. A ball is drawn at random from thebox. Find the probability that the ball is: (a) Green (b) White (c) Blue.

PART B (1 x 6 = 6 Marks)

4. Find the eigen value and eigen vectors for the matrix, A = $\begin{bmatrix} 1 & 2 \\ 5 & 4 \end{bmatrix}$

OR

5. (a) Patricia has to choose 5 marbles from 12 marbles. In how many ways can she choosethem? (3 Marks)

   (b) In how many ways can we arrange the letters in the word TEETH? (3 Marks)

SECTION 2: Digital Fundamentals & Computer Architecture (15 Marks)

PART A (3 x 3 = 9 Marks)

1. Convert the Decimal number $(59.85)_{10}$ in to Binary.
2. Perform the following binary arithmetic operations:

   (a) 83-16 (b) 115/5 c. 101000*101000

3. Perform BCD arithmetic: (a) 99+99 (b) 153-149.

PART B (1 x 6 = 6 Marks)

4. Detailed description about the components of Mother board.

OR

5. What are transmission impairments. How it will affect in Analog signals.

SECTION 3: Operating Systems (15 Marks)

PART A (3 x 3 = 9 Marks)

1. Differentiate process and program.
2. What is a process control block?

3. Define Deadlocks.

PART B (1 x 6 = 6 Marks)

4. How interrupts are managed by operating system? Explain.

OR

5. MOVE AX, 21H
   MOVE X, 21H
   ADD AX, BX
   MOVE 80H, AX
   END

   Consider the above statement as a process. Write the state of the process, when each instruction is executed.

SECTION 4 – C Programming & Data Structures (15 Marks)

PART A (3 x 3 = 9 Marks)

1. Differentiate actual arguments and formal arguments.
2. List the applications of stack.
3. Write an algorithm for queue insertion.

PART B (1 x 6 = 6 Marks)

4. Explain the deletion procedure of Binary Search Tree with examples.

OR

5. Explain the implementation of ID and 2D arrays?

MAR ATHANASIUS COLLEGE OF ENGINEERING
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Thiruvananthapuram

SEMESTER – 1
SYLLABUS

Master of Computer Applications (MCA)

2024

M24CA1C101	Mathematical Foundations for Computing & Statistical Approaches	L	T	P	J	S	Credit	Year of Introduction
		3	1	0	0	3	4	2024

Preamble:

Enables problem solving skills, logical thinking, data analysis.

Prerequisite: Nil

Course Outcomes:

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

CO No	Course Outcomes	Cognitive Knowledge Level
CO 1	Apply the concepts of sets and relation in practical problems	Apply
CO 2	Solve number theory problems and problems related to recurrence relations	Apply
CO 3	Analyze and solve graph-related problems in various disciplines	Apply
CO 4	Solve system of linear equations and problems on diagonalization of matrices	Apply
CO 5	Apply the concept of probability, correlation and regression in practical problems	Apply

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO 1	3	3	2					1
CO 2	3	3	2					1
CO 3	3	3	2					1
CO 4	3	3	2					1
CO 5	3	3	2					1

Assessment Pattern

Mathematical Foundations for Computing & Statistical Approaches			
Bloom's Category	Continuous Assessment Tests		End Semester Examination (Marks%)
	Test 1 (Marks%)	Test 2 (Marks%)	
Remember	20	20	10
Understand	20	20	40
Apply	60	60	50
Analyse	XX	XX	XX
Evaluate	XX	XX	XX
Create	XX	XX	XX

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
100	40	60	3 Hours

Continuous Internal Evaluation (Out of 40 Marks)

Continuous Assessment Test 1 (Module 1 and Module2) : 10 Marks

Continuous Assessment Test 2 (Module 3 and Module4) : 10 Marks

Assignment/Tutorials/Seminars : 12 Marks

Attendance : 8 Marks

Continuous Assessment Test Pattern (Out of 50 Marks)

There will be two parts - Part A and Part B.

Part A contains 5 questions carrying 2 marks each.

Part B contains 5 questions carrying 8 marks each.

The duration of the exam is two hours.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, carrying 2 marks each. Part B contains 7 questions out of which 5 questions to be answered. (Minimum 1 question from each module and maximum 2 questions from any 2 modules). Each question in Part B carries 8 marks and can have maximum 2 sub-divisions.

SYLLABUS

MODULE 1 [8 Hours]

Set Theory: Sets, Set Operations, Relations, Classification of relations, Equivalence Relations, Closures of Relations, Matrix Representation of Relations, Partial Ordering, Functions.

Self-Study: Functions - Ceil, Floor, Remainder Theorem, Venn Diagram, Principle of Inclusion and Exclusion, n-ary Relations.

MODULE 2 [10 Hours]

Number Theory: Division Algorithm, Euclidean Algorithm, Congruences, Properties of Congruences, Linear Congruences, Chinese Remainder Theorem.

First Order Linear Homogeneous and Non-Homogeneous Recurrence Relation, Second Order Linear Homogeneous Recurrence Relations.

Self-Study: Pigeonhole Principles, Fibonacci Numbers and Euclid's Algorithm, Diophantine Equation.

MODULE 3 [8 Hours]

Graph Theory: Directed and Undirected graph, Complete graph, Regular graph, Bipartite graph. Matrix representation of graphs – Incidence and Adjacency matrices. Euler graph - Euler path, Euler Circuit. Hamiltonian graph, Shortest-Path Problems, Planar graphs and Non-planar graphs, Graph Coloring.

Self-Study: Isomorphism, Connectivity, Path, Circuit, Walk, Binary Tree, Spanning Tree, Cut-Sets, Cut-Vertices.

MODULE 4 [9 Hours]

Linear Algebra: Systems of linear equations in three variable, Coefficient matrix, Augmented matrix, Fundamental Theorem of Non-Homogeneous Linear System, Homogeneous linear system, Solution of linear system by Gauss Elimination Method and Back Substitution, Gauss-Jordan Elimination. Matrix Eigen Value Problem - Determination of Eigen values and Eigen vectors, Diagonalization of matrix.

Self-Study: Elementary Row Operations, Row Equivalent Systems, Quadratic forms and their Canonical forms, Nature of Quadratic forms.

MODULE 5 [10 Hours]

Probability: Baye's Theorem, Random variables, Discrete Probability Distributions - Discrete Uniform Distribution. Continuous Probability Distributions - Continuous Uniform Distribution, Normal Distribution. Scatter Diagrams. Fitting a straight line, Fitting a parabola,

Linear correlation and regression, Karl's Pearson's Coefficient of Correlation, Spearman's rank correlation coefficient.

Self - Study**:** Bivariate data, Principle of least squares, Binomial distribution. Standard Normal Distribution.

Reference Books:

1. Rosen, Kenneth H. Discrete Mathematics and Its Applications. 8th ed., McGraw-Hill Education, (2018)
2. David M. Burton, "Elementary Number Theory", McGraw-Hill, 7th Edition (2012).
3. Ralph P Grimaldi, "Discrete and Computational Mathematics: An applied introduction", Pearson Education, 5th Edition, (2007).
4. Erwin Kreyszig, "Advanced Engineering Mathematics", 10th ed., Wiley. (2019)
5. Gupta S.C and Kapoor V. K, "Fundamentals of Mathematical Statistics", Sultan Chand and Sons 11th edition.(2021)
6. C. Liu, "Elements of Discrete Mathematics: A Computer Oriented Approach", McGraw-Hill, 4th Edition (2012).
7. Moore, D.S., McCabe, G. P., & Craig, B. A." Introduction to the Practice of Statistics " (10th ed.). W. H. Freeman. (2020)
8. Montgomery, D. C., & Runger, G. C. "Applied Statistics and Probability for Engineers" (7th ed.). John Wiley & Sons. (2023)
9. Veerarajan, T., Probability and Random Processes (4th ed.). McGraw-Hill Education. (2018)
10. Grewal, B. S. "Higher Engineering Mathematics" (44th ed.). Khanna Publishers. (2020).

Online Resources:

1. https://www.youtube.com/watch?v=wGLTV8MgLlA&list=PLU6SqdYcYsfJ27O0dvuMwafS3X8CecqUg
2. https://www.youtube.com/watch?v=cj-Im1Dg37Q&list=PLU4tRlorU5wVA9y8BUmm0vzkP4m04yjEg
3. https://www.youtube.com/watch?v=L6gWhJ6YULY&t=80s
4. https://www.youtube.com/watch?v=5eKDQmTzX2A&list=PLxCzCOWd7aiG0M5FqjyoqB20Edk0tyzVt
5. https://www.youtube.com/watch?v=xqKc-P4BoPY
6. https://www.youtube.com/watch?v=ePxt8lMqxc4

7. https://www.youtube.com/watch?v=DtNbBPfDoL8&t=1104s
8. https://www.youtube.com/watch?v=UnzbuqgU2LE
9. https://www.youtube.com/watch?v=V3iEsLPAD68&list=PLU6SqdYcYsfIaokdZTmptaf-PK7s-B0ju
10. https://www.youtube.com/watch?v=lBB4stn3exM&list=PLU6SqdYcYsfLeej_640C9vsR5FgmUF5Up

Course Contents and Lecture Schedule

No	Topics	No. of Lecture/ Tutorial Hours
Module 1 [8 Hours]		
1.1	Sets, Set Operations	**2**
1.2	Relations, Classification of relations	**1**
1.3	Equivalence Relations, Closures of Relations	**1**
1.4	Matrix Representation of Relations	**1**
1.5	Partial Ordering	**1**
1.6	Functions	**2**
Module 2 [10 Hours]		
2.1	Division Algorithm, Euclidean Algorithm	**1**
2.2	Congruences, Properties of Congruences	**1**
2.3	Linear Congruences	**1**
2.4	Chinese Remainder Theorem.	**1**
2.5	First Order Linear Homogeneous	**3**
2.6	Non-Homogeneous Recurrence Relation	**1**
2.7	Second Order Linear Homogeneous Recurrence Relations	**2**
Module 3 [8 Hours]		
3.1	Directed and Undirected graph, Complete graph, Regular graph	**1**
3.2	Bipartite graph	**1**
3.3	Matrix representation of graphs – Incidence and Adjacency matrices	**1**
3.4	Euler graph - Fleury's Algorithm	**1**
3.5	Hamilton circuits and Paths	**1**

3.6	Shortest-Path Problems	**1**
3.7	Planar graphs and Non-planar graphs	**1**
3.8	Graph Coloring	**1**
Module 4 [9 Hours]		
4.1	Systems of linear equations in three variables	**1**
4.2	Coefficient matrix, Augmented matrix	**1**
4.3	Fundamental Theorem of Non-Homogeneous Linear System	**1**
4.4	Homogeneous linear system	**1**
4.5	Solution of linear system by Gauss Elimination Method and Back Substitution	**2**
4.6	Gauss-Jordan Elimination	**1**
4.7	Matrix Eigen Value Problem - Determination of Eigen values and Eigen vectors	**1**
4.8	Diagonalization of matrix	**1**
Module 5 [10 Hours]		
5.1	Baye's Theorem	**1**
5.2	Random variables, Discrete Probability Distributions - Discrete Uniform Distribution	**2**
5.3	Continuous Probability distributions - Continuous Uniform Distribution	**2**
5.4	Normal distribution	**1**
5.5	Scatter diagrams, Fitting a straight line	**1**
5.6	Fitting a parabola	**1**
5.7	Linear correlation and regression, Karl's Pearson's Coefficient of Correlation	**1**
5.8	Spearman's rank correlation coefficient	**1**
Total Hours		**45**

CO Assessment Questions

Course Outcome 1 (CO1)

1. Define equivalence relation with suitable example. (L2)
2. Find the transitive closure of the relation {(1,3), (3,2), (2,4), (3,1), (4,1) on (1,2,3,4)} using Warshall's algorithm. (L3)
3. Let f,g:R R be defined by f(x)= x+1, g(x)= $2x^2$+3, find fog and gof. Is fog = gof ? (L3)

Course Outcome 2 (CO2)

1. Define Division Algorithm (L1)
2. Compute GCD (1575, 231) using Euclidean Algorithm. (L3)
3. Solve the Recurrence Relation $a_n+a_{n-1}-6a_{n-2}=0$ where $a_0= -1$, $a_1=8$. (L3)

Course Outcome 3 (CO3)

1. Define Hamilton cycle and Euler circuit with example. (L2)
2. Show that $K_{3,3}$ is non-planar. Define planar graph. State Kuratowski's theorem. (L3)
3. Prove that a connected graph G is an Euler graph if all vertices of G are of even degree. (L2)

Course Outcome 4 (CO4)

1. Solve A= $\begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{bmatrix}$ using RREF. (L3)
2. Find the Eigen values and Eigen vectors of $\begin{bmatrix} 1 & 2 & 3 \\ 0 & -2 & 6 \\ 0 & 0 & -3 \end{bmatrix}$ (L3)
3. Find k in the matrix (L3)

$$\left(\begin{array}{ccc|c} 1 & -2k & 1 & -2k \\ 0 & 2(k+1)(k-1) & -(k-1) & 2k+1 \\ 0 & 0 & (k-1)(k+2) & (k+2) \end{array}\right)$$

Course Outcome 5 (CO5)

1. It is estimated that 50% of emails are spam emails. Some software has been applied to filter these spam emails before they reach your inbox. A certain brand of software claims that it can detect 99% of spam emails, and the probability for a false positive (a non-spam email detected as spam) is 5%. Now if an email is detected as spam, then what is the probability that it is in fact a non-spam email? (L3)

2. Fit a straight line to the data given below. (L3)

X	5	10	15	20	25
Y	16	19	23	26	30

3. Find coefficient of correlation from the following data. (L3)

Age	43	21	25	42	57	59
Glucose Level	99	65	79	75	87	81

Model Question Paper

QP CODE: Pages: 2

Reg No. :……. Name:…….

MAR ATHANASIUS COLLEGE OF ENGINEERING (AUTONOMOUS), KOTHAMANGALAM

FIRST SEMESTER MCA DEGREE EXAMINATION, DECEMBER 2024

Course Code: M24CA1C101

Course Name: MATHEMATICAL FOUNDATIONS FOR COMPUTING & STATISTICAL APPROACHES

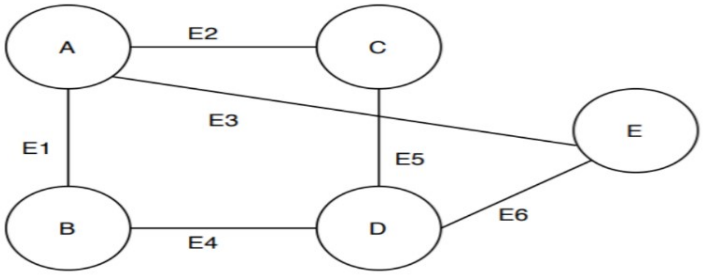
Max. Marks: 60 Duration: 3 Hours

PART A

Answer all questions. Each question carries 2 marks.

1. If $A = \{1,2,3,4\}$ give an example of a relation $\Re$ on A that is
   a. Reflexive and symmetric, but not transitive.
   b. Reflexive and transitive, but not symmetric.
2. Consider a relation $\Re$ on $A = \{1,2,3\}$ whose matrix representation is given. Determine its inverse. $M\mathscr{R} = \begin{bmatrix} 1 & 0 & 0 \\ 1 & 1 & 1 \\ 0 & 0 & 1 \end{bmatrix}$
3. Using Euclidean algorithm find gcd(1769, 2378)
4. Solve the recurrence relation $an = 5an{-}1 + 6an{-}2$

5. Check whether the given graph is bipartite graph.



6. Define a planar graph with examples.

7. Solve A=[4 8 3 6 1 9 2 5 7 | using REF

8. Solve x+y+z = -3, 3x+y-2z= -2 , 2x+4y+7z=7

9. Roll a six faced fair die. Find the probability that an even number appear on the top.

10. An average electric bulb lasts for 300 days with a standard deviation of 50 days. Assume that bulb life is normally distributed, what is the probability that the electric bulb will last at most 365 days.

PART B

Answer any five questions. Each question carries 8 marks.

11. Draw the directed graphs of the relations R={(1,1),(1,3), (2,1), (2,3), (2,4), (3,1), (3,2), (4,1)} and S={(1,3), (1,4), (2,1), (2,2), (2,3), (3,1),(3,3), (4,1), (4,3)}.Use these graphs to draw the graphs of R^{-1}, S^{-1}, R^c, S^c.

12. Find the solution for the following set of congruent equations using Chinese Remainder theorem, x ≡ 2mod(3) x ≡ 3mod(5) x ≡ 2mod(7)

13. a) Prove that a non-empty connected graph G is Eulerian if and only if its vertices are all of even degree. (5 marks)

b) Represent the Konigsberg bridge problem by means of a graph. Does it have a solution? Justify. (3 marks)

14. Find the Eigen values and Eigen vectors of $\begin{vmatrix} 2 & 0 & 0 \\ 0 & 4 & 5 \\ 0 & 4 & 3 \end{vmatrix}$

15. Solve the following system of linear equations by Gauss Elimination method,

$$\begin{aligned} x_1 - x_2 + x_3 &= 0 \\ -x_1 + x_2 - x_3 &= 0 \\ 10\,x_2 + 25\,x_3 &= 90 \\ 20\,x_1 + 10\,x_2 &= 80 \end{aligned}$$

16. Employ the method of least squares to fit a parabola $y = a + bx + cx^2$ to the following data (x, y): (−1,2), (0,0), (0,1), (1,2)

17. Compute Spearman's rank correlation coefficient r for the following data

Person	A	B	C	D	E	F	G	H	I	J
Rank in Statistics	9	10	6	5	7	2	4	8	1	3
Rank in Income	1	2	3	4	5	6	7	8	9	10

M24CA1C 102	Digital Fundamentals and Computer Architecture	L	T	P	J	S	Credit	Year of Introduction
		3	1	0	0	3	4	2024

Preamble:

Digital Fundamentals and computer Architecture is a foundational course designed to provide students with a comprehensive understanding of the fundamental principles of digital systems and computer architecture. The course encompasses topics ranging from basic digital logic to the architecture of modern computer systems. Students will gain theoretical knowledge to analyse and design digital circuits and understand the organization and operation of computer systems.

Prerequisite:

Understanding of mathematical concepts- sets and functions, Number systems and their properties, Binary arithmetic.

Course Outcomes:

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

CO No	Course Outcomes	Cognitive Knowledge Level
CO 1	Apply Boolean algebra and Karnaugh map simplification techniques to design and optimize digital circuits.	Apply
CO 2	Apply the principles of combinational and sequential circuits, demonstrating the ability to design and implement complex digital systems.	Apply
CO 3	Understand the unique design characteristics involving computer architecture, conventions in processor logic design, and the organization of input/output systems.	Understand
CO 4	Understand the organization and structure of different memory types, including addressing schemes and data storage formats.	Understand
CO 5	Understand the architecture, components and capabilities of Raspberry Pi and Arduino platforms.	Understand

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO 1	3	3	2	1	1			1
CO 2	3	3	2	1	1			1
CO 3	1	1	1	1	1			1
CO 4	2	2	1		1			1
CO 5	1	1	2	1	2	1		2

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination (Marks%)
	Test 1 (Marks %)	Test 2 (Marks %)	
Remember	12	20	16
Understand	40	80	50
Apply	48	XX	34
Analyze	XX	XX	XX
Evaluate	XX	XX	XX
Create	XX	XX	XX

Mark Distribution

Total Marks	CIE marks	ESE marks	ESE Duration
100	40	60	3 Hours

Continuous Internal Evaluation (Out of 40 Marks)

Continuous Assessment Test 1 (Module1 and Module2) : 10 Marks

Continuous Assessment Test 2 (Module 3 and Module 4) : 10 Marks

Assignment/Tutorials/Seminars : 12 Marks

Attendance : 8 Marks

Continuous Assessment Test Pattern (out of 50 marks):

There will be two parts - Part A and Part B.

Part A contains 5 questions carrying 2 marks each.
Part B contains 5 questions carrying 8 marks each.
The duration of the examination is two hours

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, carrying 2 marks each. Part B contains 7 questions out of which 5 questions to be answered. (Minimum 1 question from each module and maximum 2

questions from any 2 modules). Each question in Part B carries 8 marks and can have maximum 2 sub- divisions.

SYLLABUS

Module 1 [9 Hours]

Logic Gates: Representation of signed numbers, 1's complement and 2's complement. Logic gates - AND, OR, NOT, NAND, NOR, Exclusive gates.

Boolean algebra: Basic laws and theorems, Boolean functions, Truth table, Minimization of SOP and POS expressions. Minimization of Boolean function using Karnaugh map method - Don't care combinations, Realization using logic gates.

Self-Study: Sum of products and product of sums expressions, Standard forms of Boolean expressions, Universal Gates.

Module 2[11 Hours]

Combinational Circuits: Half adder, Full adder, Decoder, Encoder, Multiplexer, Demultiplexer.

Sequential circuit: Clocking, Flip flops - SR, JK, D, T, Mater Slave flip flops. Registers-Serial in serial out, Serial in parallel out, Parallel in serial out, Parallel in parallel out registers. Counters - Synchronous and asynchronous counters , UP/DOWN counters.

Self-Study: Subtractor circuit, Parity bit generator, Edge triggering, Level triggering.

Module 3 [11 Hours]

Computer abstractions and technology: Introduction, Computer architecture, Instruction set principles – Introduction, classifying instruction set architectures, Addressing Modes.

The Processor: Introduction, Logic design conventions - Building a data path, a simple implementation scheme. An overview of pipelining - Structural hazards Data hazards, Control hazards.

I/O organization - Accessing I/O devices, Interrupts - handling multiple devices, Direct memory access.

Self-Study: Register organization, Bus structures, Reduced Instruction Set Computer.

Module 4 [8 Hours]

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.

Self-Study: Memory hierarchy, Shared memory concepts, Memory Bus architecture, Memory addressing.

Module 5 [6 Hours]

Introduction to single board computers: Raspberry Pi-Introduction, technology, versions, architecture, applications, software installation and configuration, writing simple programs. Arduino- introduction to Arduino environment, architecture, applications.

Self-study: Programming languages for single board computers, Operating systems on SBC's.

Reference Books:

1. Floyd, "Digital Fundamentals", Pearson Education, 11th Edition (2021).(Module 1 & 2)
2. J.Hennessy and D.Patterson, "Computer Organization and Design: The Hardware/Software Interface", 6th Edition (2021). (Module 3 & 4)
3. J. Hennessy and D. Patterson, "Computer Architecture, A quantitative approach", 6th Edition. ((2017). Module 3).
4. Hamacher, Vranesic & Zaky, "Computer Organization",6th Edition(2012), McGrawHill.
5. Morris Mano, "Digital logic and Computer design", Pearson Education, 5th Edition (2017).
6. Raspberry Pi Hardware Reference: By Warren W.Gay, published by Apress Berkeley, CA, 2nd edition 2019(Module 5).

Online Resources:

1. https://www.raspberrypi.com/resources/learn/
2. https://www.arduino.cc/

Course Contents and Lecture Schedule

No	Topic	No. of Lecture/ Tutorial Hours
Module 1 [9 Hours]		
1.1	Representation of signed numbers, 1's complement and 2's complement.	1
1.2	Logic gates - AND, OR, NOT, NAND, NOR, X OR, X NOR.	1
1.3	Boolean algebra - Basic laws and theorems.	1
1.4	Boolean functions - truth table.	1
1.5	Minimization of SOP and POS expressions.	2
1.6	Minimization of Boolean function using Karnaugh map method.	2
1.7	Don't care combinations, Realization using logic gates.	1
Module 2 [11 Hours]		
2.1	Combinational Circuits - Half adder, Full Adder	1
2.2	Decoder, Encoder.	1
2.3	Multiplexers, Demultiplexers.	1
2.4	Sequential circuit - Clocking, R S Flip flops.	1
2.5	JK Flip flops.	1
2.6	D & T Flip flops.	1
2.7	Master slave flip flops	1
2.8	Registers - Serial in serial out, Serial in parallel out.	1
2.9	Parallel in serial out, Parallel in parallel out registers	1
2.10	Counters - Asynchronous counters, Synchronous counters.	1
2.11	UP/DOWN counters.	1
Module 3 [11 Hours]		
3.1	Computer abstractions and technology - Introduction, Computer architecture	1
3.2	Instruction set principles – Introduction, classifying instruction set architectures.	2

3.3	Addressing Modes	1
3.4	The Processor - Introduction, Logic design conventions.	1
3.5	Building a data path, a simple implementation scheme.	1
3.6	An overview of pipelining, Structural hazards - Data hazards - Control hazards.	2
3.7	I/O organization - Accessing I/O devices, interrupts - handling multiple devices.	2
3.8	Direct memory access.	1
Module 4 [8 Hours]		
4.1	The Memory System – basic concepts, semiconductor RAM memories – organization.	1
4.2	Static and dynamic RAM	1
4.3	Structure of larger memories	1
4.4	Semiconductor ROM memories, Speed, size and cost	1
4.5	Cache memory – mapping functions.	1
4.6	Replacement algorithms	1
4.7	Virtual memory – paging concepts	1
4.8	Segmentation.	1
Module 5 [6 Hours]		
5.1	Raspberry Pi-Introduction, technology, versions, applications.	1
5.2	Raspberry Pi Architecture	1
5.3	software installation and configuration.	1
5.4	Writing simple programs.	1
5.5	Arduino- introduction to Arduino environment, applications.	1
5.7	Arduino Architecture	1
	Total Hours	**45**

Course Outcome 3 (CO3)

Co Assessment Questions

Course Outcome 1 (CO1)

1. Represent -50 in Sign Magnitude, 1's complement and 2's complement. (L3)
2. Prove that (A+B) (A+C) =A+BC. (L2)
3. Minimize the Boolean Expression f(A, B,C) = Σm(2,3,4,6,7) using K-map. (L3)

Course Outcome 2 (CO2)

1. Implement decimal to BCD Encoder. (L2)
2. Convert RS flip flop to JK Flip flop. (L3)
3. Implement mod-3 asynchronous counter. (L3)

Course Outcome 3 (CO3)

1. Describe the code sequence of C=A+B in Single Accumulator organization. (L2)
2. Draw a single data path representation for R-type instruction. (L2)
3. Explain any one of the bus arbitration schemes in DMA. (L2)

Course Outcome 4 (CO4)

1. Draw a SRAM Cell and explain how the read and write operations are performed. (L2)
2. Illustrate different cache mapping techniques with neat diagrams. (L2)
3. How the virtual address is converted into real address in a paged virtual memory system. (L2)

Course Outcome 5 (CO5)

1. Explain the architecture of Raspberry Pi. (L2)
2. Illustrate the application of single board computers. (L2)
3. Describe Arduino environment. (L2)

Model Question Paper

QP CODE: Pages: 2

Reg No…… Name: ……..

MAR ATHANASIUS COLLEGE OF ENGINEERING (AUTONOMOUS), KOTHAMANGALAM

FIRST SEMESTER M.C.A DEGREE EXAMINATION, DECEMBER 2024

Course Code: M24CA1C 102

Course Name: Digital Fundamentals and Computer Architecture

Max. Marks: 60 Duration: 3 Hours

PART A

Answer all questions. Each question carries 2 marks.

1. Express the number -170 in Sign Magnitude, 1's Complement and 2's complement notation.
2. Convert the expression A'BC'+AB'D+A'BC'D into standard SOP form.
3. Construct a full adder circuit and explain how four-bit addition is performed.
4. What is race around condition in JK flip flop. How it overcome?
5. Explain different types of pipeline hazards.
6. What is an addressing mode? Mention the addressing modes used for the branch and jump instructions.
7. Description about Paging concept and explain the importance of page tables.
8. Write short notes on memory operation write back and write through protocols.
9. Describe the applications of Raspberry Pi and Arduino boards.
10. What operating systems are commonly used with Raspberry Pi, and why?

PART B

Answer any five questions. Each question carries 8 marks.

11. a. Minimize the Boolean expression f(ABCD)=∑m (1,2,3,5,8,9,10) +d (0,4,6,7,12,14) using K map and realize it using compact logic circuits. (5 marks)

    b. Simplify the Boolean expression A'BC+AB'C'+AB'C+ABC. (3 marks)

12. Mention any four applications of shift registers. (2 marks)

    b. Describe the working of Parallel in Serial Out registers. (6 marks)

13. Draw the state diagram and logic diagram of a 3 bit up down counter.

14. Explain the various classification of instruction set architecture, illustrate With an example.

15. a. What is Direct Memory Access? Explain two types of bus arbitration Schemes. (4 marks)

    b. Diagrammatically explain the Daisy Chain arrangement for handling simultaneous arrivals of interrupt requests. (4 marks)

16 a. Elaborate the various cache memory mapping techniques with an example. (4 marks)

    b. What is virtual memory? Explain the process of address translation. (4 marks)

17. Elaborate the architectural structure of the Raspberry Pi with GPIO layout.

M24CA1C103	Advanced Software Engineering	L	T	P	S	Credit	Year of Introduction
		3	1	0	3	4	2024

Preamble:

Objective of this course is to understand industry practices on how software systems are designed, built, delivered and maintained. Each module helps to gain in-depth understanding of each phase in the process. This course should be taken with an objective to ensure student's industry-readiness by bridging theoretical knowledge and skills gained from the other courses with the practices covered in this course.

Prerequisite: Basic Programming knowledge.

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

CO No.	Course Outcomes	Cognitive Knowledge Level
CO 1	Understand software engineering principles and various development models. Prepare requirement documents.	Apply
CO 2	Understand coding standards and quality control in software. Apply version control in software engineering.	Apply
CO 3	Understand advanced approaches in software design and development	Understand
CO 4	Apply software industry practices and testing principles.	Apply
CO 5	Understand CI/CD techniques in Software development.	Understand

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO 1	3	3	2	1		3	1	1
CO 2	1			3	1	1		2
CO 3	2	2	3	2	1	1		2
CO 4	1	1		2		2	1	2
CO 5				3	2	2	1	3

Assessment Pattern

Online Resources	Online Resources		
Bloom's Category	Continuous Assessment Tests		End Semester Examination (Mark %)
	Test 1 (Mark %)	Test 2 (Mark %)	
Remember	24	24	34
Understand	60	60	50
Apply	16	16	16
Analyse	XX	XX	XX
Evaluate	XX	XX	XX
Create	XX	XX	XX

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
100	40	60	3 Hours

Continuous Internal Evaluation (Out of 40 Marks)

Continuous Assessment Test 1 (Module 1 and Module 2) : 10 Marks

Continuous Assessment Test 2 (Module 3 and Module 4) : 10 Marks

Assignment/Tutorials/Seminars : 12 Marks

Attendance : 8 Marks

Continuous Assessment Test Pattern (Out of 50 Marks):

There will be two parts - Part A and Part B.

Part A contains 5 questions carrying 2 marks each.

Part B contains 5 questions carrying 8 marks each.

The duration of the exam is two hours

End Semester Examination Pattern: There will be two parts, Part A and Part B. Part A contains 10 questions with 2 questions from each module, carrying 2 marks each. Part B contains 7 questions out of which 5 questions to be answered. (Minimum 1 question from each module and maximum 2 questions from any 2 modules). Each question in Part B carries 8 marks and can have maximum 2 sub- divisions.

SYLLABUS

MODULE 1 [12 Hours]

Introduction to Software Engineering: Software Engineering, Characteristics of Software. Life cycle of a software system: Requirement Gathering and Analysis, software design, development, testing, deployment, Maintenance.

Project planning phase: project objectives, scope of the software system, empirical estimation models, COCOMO, staffing and personnel planning.

Software Engineering models: Predictive software engineering models, model approaches, prerequisites, predictive and adaptive waterfall, waterfall with feedback (Sashimi), incremental waterfall, V model; Prototyping and prototyping models.

Software requirements specification: Eliciting Software requirements, Requirement specifications, Software requirements engineering concepts, Requirements modelling, Requirements documentation. Use cases and User stories.

Self-Study: Case study on Preparation of an SRS for a system (Eg: Library Management System)

MODULE 2 [8 Hours]

Programming Style Guides and Coding Standards: Literate programming and Software documentation. Documentation generators, Javadoc, phpDocumentor.

Version control systems basic concepts: Concept of Distributed version control system and Git; Setting up Git; Core operations in Git version control system using command line interface (CLI): Clone a repository; View history; Modifying files; Branching; Push changes, Clone operation, add, commit, log, diff commands, conflict resolution. Pushing changes to the master; Using Git in IDEs and UI based tools.

Software Quality: Understanding and ensuring requirements specification quality, design quality, quality in software development, conformance quality.

Self-Study: Hands-on GIT Version control system – submit the procedure for adding a file, cloning files etc.

MODULE 3 [9 Hours]

Design Patterns: Basic concepts of Design patterns, selection of design pattern, Creational patterns, Structural patterns, Behavioral patterns. Concept of Anti-patterns.

Unit testing and Unit Testing frameworks: the xUnit Architecture, Writing Unit Tests using at least one of Junit (for Java), unittest (for Python) or phpdbg (PHP). Writing tests with Assertions, defining and using Custom Assertions, single condition tests, testing for expected errors, Abstract test.

Self-Study: Familiarize any one of the testing tools – write five test cases for unit test.

MODULE 4 [8 Hours]

Concepts of Agile Development methodology: Scrum Framework.

Software testing principles: Program inspections, Program walkthroughs, Program reviews. Blackbox testing- Equivalence class testing, Boundary value testing, Decision table testing, Pair-wise testing, State transition testing, Use-case testing. White box testing- control flow testing, Data flow testing. Regression testing, Testing automation, Testing non-functional requirements, Defect life cycle.

Self-Study: Consider a scenario of 10 story points and draw a burn down chart for a sprint.

MODULE 5 [8 Hours]

Software Configuration Management: Using version control, managing dependencies, managing software configuration, Managing build and deployment environments.

Continuous Integration: Prerequisites for continuous integration, Essential practices.

Continuous Delivery: Principles of Software delivery, Introduction and concepts.

Build and deployment automation, learn to use Ansible for configuration management.

Test automation (as part of continuous integration), Learn to set up test automation cases using Robot Framework.

Reference Books:

1. Philip A. Laplante, “What Every Engineer Should Know about Software Engineering”, CRC Press, 2023
2. Murali Chemuturi, “Mastering Software Quality Assurance: Best Practices, Tools and Technique for Software Developers”, J Ross Publishing, 2010

3. Ben Straub, Scott Chacon, “Pro Git”, 2nd Edition, Apress, 2014
4. Erich Gamma et. al., “Design Patterns: Elements of Reusable Object-Oriented Software”, Addison-Wesley, 2009
5. Vaskaran Sarcar, “Java Design Patterns: A Hands-On Experience with Real-World Examples”, Apress, 2022
6. Alistair Cockburn and Robert Cecil Martin, “Agile Software Development: The Cooperative Game” (2nd edition), Addition Wesley, 2006
7. Ken Schwaber , “Agile Software Development with Scrum”, Pearson, 2002
8. Lisa Crispin, “Agile Testing: A Practical Guide for Testers and Agile Teams”, Adison Wesley, 2009
9. Paul Hamill, “Unit Test Frameworks”, O'Reilly Media, 2004
10. Glenford J. Myers, et. al., “The Art of Software Testing”, Wiley, 2011
11. Lee Copeland, “A Practitioner's Guide to Software Test Design”, Artech House Publishers, 2003

Online Resources

1. https://www.baeldung.com/junit
2. https://www.tutorialspoint.com/software_testing_dictionary/black_box_testing.htm
3. https://www.geeksforgeeks.org/software-engineering-system-configuration-management/
4. https://martinfowler.com/articles/continuousIntegration.html
5. https://robotframework.org/robotframework/latest/RobotFrameworkUserGuide.html

Course Contents and Lecture Schedule

No	Topic	No. of Lecture/ Tutorial Hours
	Module 1[12 Hours]	
1.1	Introduction, Software Engineering, Characteristics of Software	1
1.2	Requirement Gathering and Analysis	2
1.3	Software design	1
1.4	Development and Testing	1
1.5	Deployment and Maintenance	1
1.6	Project planning phase: project objectives, scope of the software	1

	system, Empirical estimation models	
1.7	COCOMO, staffing and personnel planning.	1
1.8	Software Engineering models: Predictive software engineering models, model approaches, prerequisites	1
1.9	predictive and adaptive waterfall, waterfall with feedback (Sashimi), incremental waterfall, V model; Prototyping and prototyping models.	1
1.10	Software requirements specification, Eliciting Software requirements, Requirement specifications,	1
1.11	Software requirements engineering concepts, Requirements modelling, Requirements documentation. Use cases and User stories	1
	Module 2 [8 Hours]	
2.1	Programming Style Guides and Coding Standards; Literate programming and Software documentation	1
2.2	Documentation generators, Javadoc, phpDocumentor	1
2.3	Version control systems basic concepts; Concept of Distributed version control system and Git	1
2.4	Setting up Git; Core operations in Git	1
2.5	version control system using command line interface (CLI): Clone a repository; View history; Modifying files; Branching; Push changes,	1
2.6	Clone operation, add, commit, log, diff commands, conflict resolution.	1
2.7	Pushing changes to the master; Using Git in IDEs and UI based tools.	1
2.8	Software Quality: Understanding and ensuring requirements specification quality, design quality, quality in software development, conformance quality.	1
	Module 3[9 Hours]	
3.1	Design Patterns: Basic concepts of Design patterns, selection of design pattern	1
3.2	Creational patterns	1
3.3	Structural patterns	1
3.4	Behavioral patterns	1
3.5	Concept of Anti-patterns.	1
3.6	Unit testing and Unit Testing frameworks, The xUnit Architecture, Writing Unit Tests using at least one of Junit (for Java),	1
3.7	unittest (for Python) or phpdbg (PHP).	1
3.8	Writing tests with Assertions, defining and using Custom	1

	Assertions	
3.9	Single condition tests, testing for expected errors, Abstract test	1
	Module 4 [8 Hours]	
4.1	Concepts of Agile Development methodology	1
4.2	Scrum Framework	2
4.3	Software testing principles, Program inspections, Program walkthroughs, Program reviews;	1
4.4	Blackbox testing: Equivalence class testing, Boundary value testing, Decision table testing, Pairwise testing, State transition testing, Use-case testing	1
4.5	White box testing: control flow testing, Data flow testing.	1
4.6	Defect life cycle	1
4.7	Regression testing, Testing automation; Testing non-functional requirements.	1
	Module 5 [8 Hours]	
5.1	Software Configuration Management: Using version control,	1
5.2	Managing dependencies, Managing software configuration,	1
5.3	Managing build and deployment environments.	1
5.4	Continuous Integration: Prerequisites for continuous integration,	1
5.5	Essential practices.	1
5.6	Continuous Delivery: Principles of Software delivery, Introduction and concepts.	1
5.7	Build and deployment automation, learn to use Ansible for configuration management.	1
5.8	Test automation (as part of continuous integration), Learn to set up test automation cases using Robot Framework.	1
	Total Hours	**45**

CO Assessment Questions

Course Outcome 1 (CO1)

1. Write the any two characteristics of software. (L1)
2. Differentiate predictive and iterative models. (L2)
3. Write an SRS for a Library Management System. (L3)

Course Outcome 2 (CO2)

1. What is product documentation? (L2)
2. What are snapshots of project in version control system? (L2)
3. With necessary commands, explain how you can view the commit history? (L3)

Course Outcome 3 (CO3)

1. Write Short notes on antipatterns. (L2)
2. What is single condition test? (L1)
3. How design patterns are selected? Explain creational patterns. (L2)

Course Outcome 4 (CO4)

1. What is a burndown chart? (L2
2. Write a short note on program walkthrough. (L2
3. Consider the following user stories:-(L3)

   Story 1 :- A Login Page for the administrator of a Hospital
   Story 2 :- Registration of a patient.
   Story 3 :- Entering X-ray image.
   Story 4 :- X-ray billing system
   Story 5 :- Pharmacy billing system.

   Select a base-line story from the above user stories and assign 10(ten) as its story point. How will you assign story points for remaining stories?

Course Outcome 5 (CO5)

1. Why version control system is important in continuous delivery? (L2)
2. With a diagram, explain how continuous integration and continuous deployment is related. (L2)
3. In ABC software solutions Pvt Ltd. multiple developers are working on an important feature update of Product X. How version control system helps the company in the aspect of continuous integration? (L3)

Model Question Paper

QP CODE: Pages: 02

Reg No.:……. Name: ……

MAR ATHANASIUS COLLEGE OF ENGINEERING (AUTONOMOUS), KOTHAMANGALAM

FIRST SEMESTER MCA DEGREE EXAMINATION, DECEMBER 2024

Course Code: M24CA1C103

Course Name: Advanced Software Engineering

Max. Marks: 60 Duration: 3 Hours

PART A

Answer all questions. Each question carries 2 marks.

1. Why is Software Engineering important? (2)
2. What are the desired requirements of a good software engineering model? (2)
3. What is the purpose of a version control system? (2)
4. Write the different ways to fix commits in Git. (2)
5. What is anti-pattern? (2)
6. What is an abstract test? (2)
7. Distinguish between black box testing and white box testing. (2)
8. Draw a model Sprint Backlog for the login module of a simple web portal. (2)
9. Write a short note on release candidate. (2)
10. Differentiate continuous delivery and continuous deployment. (2)

PART B

Answer any five questions. Each question carries 8 marks.

11. Prepare a basic Software Requirements Specification for Savings Bank accounts. (8)
12. How do you create, switch and view branches in Git? explain how to merge commits between branches. (8)
13. Explain the important design patterns. (8)
14. Differentiate Black box testing and White box testing. Give appropriate example for each for “only black box testing is possible” and “necessary to do white box testing” scenarios. (8)
15. What is a deployment pipeline? Explain the anatomy of a deployment pipeline with a neat diagram. Comment on the various stages of a deployment pipeline. (8)
16. How is Use Case different from User Stories? Enlist the advantage of each. (8)
17. You have cloned a repository which was then modified by another developer. You make changes locally and try to execute push. What are the possible outputs? How will you solve the problems, if any? (8)

M24CA1C104	Advanced Data Structures	L	T	P	J	S	Credit	Year of Introduction
		3	1	0	0	3	4	2024

Preamble:

This course aims to provide you with a solid foundation in arrays, sorting, searching, hashing, complexity analysis, sets, trees, and graphs empowering you to tackle complex computational problems with confidence and efficiency. By mastering these topics, you will develop essential skills that are applicable across various domains of computer science, software engineering, and beyond. Get ready to embark on an exciting journey into the fascinating world of Advanced data structures.

Prerequisite:

Before enrolling in the "Advanced Data Structures" course, it is recommended that students have: Basic Programming Proficiency, Understanding about Basic Data Structures, Algorithmic Thinking, Mathematical Foundation, Problem-Solving Skills, Critical Thinking and Analytical Skills.

Course Outcomes:

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

CO. No	Course Outcomes	Cognitive Knowledge Level
CO 1	Understand the fundamental data structures like Arrays, Stacks, Queues, and Linked Lists, including their variants. understand different sorting algorithms to evaluate the efficiency across different problem scenarios.	Apply
CO 2	Apply Asymptotic notations and complexity analysis to evaluate the growth of functions and determine the complexity of algorithms. Implement Sets, and Disjoint Sets data structures using Bit Strings, and understand the representation and operations of these data structures. Understand Hashing and Collision resolution techniques.	Apply
CO 3	Analyze advanced tree structures, including Balanced Binary Search Trees, Red-Black Trees, and B-Trees. They will also be able to apply B-Trees for efficient data storage and retrieval, and grasp the basics of Splay Trees and Suffix Trees.	Analyze

CO 4	Analyze advanced heap structures, such as Mergeable Heaps, Binomial Heaps, and Fibonacci Heaps.	Analyze
CO 5	Analyze various advanced graph algorithms for solving complex computational problems.	Analyze

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO 1	3	3	2	2	1	1	1	
CO 2	3	3	2	2	1	1	1	2
CO 3	3	3	3	2	1	1	1	2
CO 4	3	3	3	2	1	1	1	2
CO 5	3	3	3	2	1	1	1	2

Assessment Pattern

Bloom's Category	**Computer Applications**		
	Continuous Assessment Tests		**End Semester Examination (Marks %)**
	Test 1 (Marks %)	**Test 2 (Marks %)**	
Remember	36	28	23
Understand	32	20	17
Apply	32	20	33
Analyse	XX	32	27
Evaluate	XX	XX	XX
Create	XX	XX	XX

Mark distribution

Total Marks	CIE marks	ESE marks	ESE Duration
100	40	60	3 hours

Continuous Internal Evaluation Pattern (Out of 40 marks)

- Continuous Assessment Test 1(Module 1 and Module 2) : 10 Marks
- Continuous Assessment Test 2 (Module 3 and Module 4) : 10 Marks
- Assignment/Tutorials/Seminars : 12 Marks
- Attendance : 8 Marks

Continuous Assessment Test Pattern (out of 50 marks)

There will be two parts - Part A and Part B.

Part A contains 5 questions carrying 2 marks each.

Part B contains 5 questions carrying 8 marks each.

The duration of the examination is two hours

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, carrying 2 marks each. Part B contains 7 questions out of which 5 questions to be answered. Minimum 1 question from each module and maximum 2 questions from any 2 modules). Each question in Part B carries 8 marks and can have maximum 2 sub- divisions.

SYLLABUS

Module 1 [10 Hours]

Basic Data Structures: Arrays and Its representation, Applications of Stack, Circular Queue, Priority Queue, Circular Doubly Linked List, Header Linked List.

Sorting: Quick Sort, Radix Sort, Heap Sort, and Counting Sort.

Self Study: Double Ended Queue, Applications of Linked List, Create an application/Animations for various sorting methods.

Module 2 [10 Hours]

Hashing: Introduction of Hashing, Hash Function, Collision Resolution Techniques in Hashing - Separate Chaining, Open Addressing.

Algorithm: Analysis of Algorithms, Big-O Notation, Different Complexity Functions.

Set Data Structure: Representation of Sets, Set Implementation Using Bit String.

Disjoint Sets: Representations, Union, and Find Algorithms.

Self Study: Applications of Hashing, Analysis of Different Sorting Algorithms.

Module 3 [11 Hours]

Advanced Tree Structures: Binary Search Tree, Balanced Binary Search Trees - Traversal, Insertion. Red-Black Trees - Properties of Red Black Trees, Insertion, Deletion, B-Trees - Basic Operations on B-Trees – Insertion and Deletion, Introduction to Splay Trees and Suffix Trees.

Self-Study: Binary Expression Tree, Create Binary Expression Tree from expression.

Module 4 [6 Hours]

Heap: Max Heap, Min Heap, Mergeable Heaps and Operations, Binomial Tree, Binomial Heaps, Binomial Heap Operations- Create, Find, Union, Insert, Extract, Delete, Decrease the key Value. Fibonacci Heaps, Fibonacci Heap Operations- Create, Insert, Merge, Extract the minimum Element, Deletion.

Self-Study: Applications of Binomial Heap, and Fibonacci Heap.

Module 5 [8 Hours]

Advanced Graph Structures: Representation of Graphs, Depth First Search, Breadth First Search, Topological Sorting, Strongly Connected Components, and Biconnected Components. Minimum Cost Spanning Tree- Introduction, Prim's Algorithm, Kruskal's Algorithm. Shortest Path Finding Algorithms – Dijkstra's Single Source Shortest Paths Algorithm.

Self-Study: 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.

Reference Books:

1. Cormen T.H., Leiserson C.E, Rivest R.L. and Stein C, Introduction to Algorithms, Prentice Hall India, New Delhi, 2010 .
2. D.Samantha, Classic Data structures, Prentice Hall India, New Delhi,2009.

Web Resources:

1. https://www.programiz.com/dsa/stack
2. https://www.geeksforgeeks.org/queue-data-structure/
3. https://www.upgrad.com/blog/sorting-in-data-structure-with-examples/

4. https://www.javatpoint.com/hashing-in-data-structure
5. https://www.geeksforgeeks.org/applications-advantages-and-disadvantages-of-set/
6. https://www.tutorialspoint.com/time-and-space-complexity-in-data-structure
7. https://www.scholarhat.com/tutorial/datastructures/avl-tree-in-data-structures
8. https://www.javatpoint.com/daa-red-black-tree
9. https://www.baeldung.com/cs/b-tree-data-structure

Course Contents and Lecture Schedule

NO	Topic	No. of Lecture/ Tutorial Hours
Module 1 [10 Hours]		
1.1	Arrays and its representation.	2
1.2	Applications of Stack.	2
1.3	Queue-Circular queue.	1
1.4	Priority Queue.	1
1.5	Circular Doubly Linked List, Header Linked List.	1
1.6	Quick Sort.	1
1.7	Heap Sort.	1
1.8	Radix Sort, Counting sort.	1
Module 2 [10 Hours]		
2.1	Introduction of Hashing, Hash Function.	1
2.2	Collision Resolution Techniques in Hashing, Separate Chaining.	1
2.3	Open Addressing.	1
2.4	Analysis of Algorithms, Big-O notation.	1
2.5	Different complexity functions.	2
2.6	Representation of Sets.	1
2.7	Set implementation using Bit String.	1

2.8	Disjoint Sets representations.	1
2.9	Disjoint Sets- Union, Find algorithms.	1
Module 3 [11 Hours]		
3.1	Binary Search Tree	1
3.2	Balanced Binary Search Trees-Traversal.	1
3.3	Balanced Binary Search Trees-Insertion.	1
3.4	Properties of Red Black Trees.	1
3.5	Red Black Tree Insertion.	1
3.6	Red Black Trees Deletion.	2
3.7	Basic operations on B-Trees, and Insertion.	1
3.8	B-Tree Deletion.	1
3.9	Introduction to Splay Trees and Suffix Trees.	1
3.10	Introduction to Splay Trees and Suffix Trees.	1
Module 4 [6 Hours]		
4.1	Max heap, Min heap, Mergeable Heaps.	1
4.2	Binomial Heaps.	1
4.3	Binomial Heap operations.	1
4.4	Fibonacci Heaps.	1
4.5	Fibonacci Heap operations.	2
Module 5 [8 Hours]		
5.1	Representation of graphs.	1
5.2	Depth First Traversal, and Breadth First Traversals.	1
5.3	Topological Sorting.	1
5.4	Strongly Connected Components.	1
5.5	Biconnected Components.	1
5.6	Prim's Algorithm.	1
5.7	Kruskal' Algorithm.	1
5.8	Dijikstra's single source shortest paths algorithm.	1
	Total	**45 Hours**

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO1):

1. Basic Data Structures and Sorting
2. How do Arrays differ from Linked Lists in terms of memory allocation? (L1)
3. Explain row major representation and column major representation of a 2-d Array. Given an Array, Arr[1……10][1……15] with base value 5000 and the size of each element is 2 Byte in memory. Find the address of Arr[8][6] with the help of row-major order, and column major order. (L2)
4. Discuss the advantages and limitations of using advanced sorting algorithms like Heap Sort &r Radix Sort with example (L3)

Course Outcome 2 (CO2):

1. Hashing, Algorithmic Complexity, and Set Data Structures
2. Analyze Linear search and find the best case, average case, and worst-case complexities of Linear search (L3)
3. Evaluate the time and space complexities of different Hashing techniques, such as open addressing and chaining, and analyse how these complexities impact the performance of hash table operations under various load factors and collision resolutions. (L4)
4. Explain the concept of Disjoint Sets and discuss various representations for implementing them. (L2)

Course Outcome 3 (CO3):

1. Advanced Tree Structures
2. Define Binary Search Tree with an example (L2)
3. Create a Red-Black Tree with the following elements as its nodes:

   10, 30, 40, 50, 60, 70, 80, 5, 15, 25, 35, 45, 55, 8, 18, 28. (L3)
4. Compare and contrast the performance of various balancing strategies, such as AVL trees, Red-Black Trees, and Splay trees, in terms of time complexity. (L4)

Course Outcome 4 (CO4):

1. Advanced Heap structures
2. What is Max Heap? Explain with example. (L2)
3. Describe Fibonacci heap. Write the procedure of extract the minimum element from the Fibonacci heap with example (L3)
4. How do the characteristics of a Binomial Tree impact its efficiency and performance compared to other tree structures? Provide a detailed analysis with examples demonstrating the advantages and disadvantages of Binomial trees. (L4)

Course Outcome 5 (CO5): Advanced Graph Structures

1. Explain the concept of Topological Sorting. In what types of graphs is it applicable? (L2)
2. Demonstrate the process of identifying Strongly Connected Components from a graph and explain their significance within the graph structure." (L3)
3. Explain the working principle of Dijkstra's algorithm. Provide a step-by-step explanation of how the algorithm finds the shortest paths from a vertex to all other vertices in a weighted graph. (L3)

Model Question Paper

QP CODE: **Pages: 2**

Reg No : …….. **Name: ……...**

MAR ATHANASIUS COLLEGE OF ENGINEERING (AUTONOMOUS)
KOTHAMANGALAM
First Semester M.C.A Degree Examination, December 2024
Course Code: M24CA1C104
Course Name: ADVANCED DATA STRUCTURES

Max. Marks: 60 **Duration: 3 hours**

PART A
Answer all questions. Each question carries 2 marks.

1. List 6 applications of Stack?
2. Describe Radix sort.
3. Describe the components of a Hash table and discuss the role of Hash functions in Hashing.
4. Define the concept of a Bit String and explain how it can be used to represent Sets efficiently.
5. Define Binary Search Tree with an example.

6. Describe Splay Tree with example.
7. What is Max Heap? Explain with example.
8. Write the characteristics of Binomial Tree with example.
9. Explain the concept of Topological Sorting. In what types of graphs is it applicable?
10. What are Strongly Connected Components in a graph? How are they identified?

PART B

Answer any five questions. Each question carries 8 marks.

11. Explain row major representation and column major representation of a 2-d array. Given an Array, Arr[1……10][1……15] with base value 5000 and the size of each element is 2 Byte in memory. Find the address of Arr[8][6] with the help of row-major order, and column major order.
12. Explain complexity of an algorithm. Provide examples of algorithms with different time complexities (e.g., constant time, linear time, quadratic time) and discuss their implications in terms of algorithmic efficiency.
13. What is an AVL tree? Create an AVL tree using the following data set:

    10,20,30,8,7,5,25,15,12,26,28,28.
14. Explain Red Back Tree deletion procedure with example.
15. Describe Fibonacci heap. Write the procedure of extract the minimum element from the Fibonacci heap with example.
16. Write Prim's algorithm. Trace the algorithm using example data set.
17. Explain the working principle of Dijkstra's algorithm. Provide a step-by-step explanation of how the algorithm finds the shortest paths from a vertex to all other vertices in a weighted graph.

M24CA1B105	Web Development Lab	L	T	P	J	S	Credit	Year of Introduction
		1	0	2	2	4	3	2024

Preamble: The aim of this course is to make the students gain practical knowledge for developing web applications.

Prerequisite: Basic understanding of computer programming and database concepts.

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

Co No	Course Outcomes	Cognitive Knowledge Level
CO 1	Create visually appealing and well-structured web pages that effectively communicate information, provides rich and engaging experiences using HTML and CSS.	Create
CO 2	Create dynamic elements, handle user input and manipulate the content of web pages in real-time which provides a dynamic and interactive web pages that captivate users and deliver immersive digital experiences using JavaScript	Create
CO 3	Create robust web applications with dynamic content, user authentication, data persistence and real-time updates, empowering developers to build feature-rich applications that meet the demands of modern web development using Node.js and MYSQL	Create
CO 4	Create web applications with modular, maintainable and scalable codebases, fostering productivity, collaboration using components, Hooks in React	Create
CO 5	Create responsive and interactive web applications that offer smooth navigation, optimal performance and a seamless user experience using Router, Fragments and Map in React.	Create

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO 1	3	3	3	3	2	1	1	1
CO 2	3	3	3	3	2	1	1	1
CO 3	3	3	3	3	2	1	1	1
CO 4	3	3	3	3	2	1	1	1
CO 5	3	3	3	3	2	1	1	1

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
100	60	40	3 Hours

Continuous Internal Evaluation (Out of 60 Marks)

Attendance : 10 Marks

Test 1 (Lab) : 15 Marks

Test 2 (Lab) : 15 Marks

Continuous Evaluation : 20 Marks

End Semester Examination (Out of 40 Marks)

Problem solving : 15Marks

Viva : 5 Marks

Git repository : 5Marks

Micro Project/Course Based Project : 15 Marks

The project for Project Based Course shall be done individually.

SYLLABUS

Module 1 [10 Hours]

Markup Language (HTML): Introduction to Html, Elements and Attributes, Table, Forms.

Cascading Style Sheet (CSS): Introduction to CSS, Inline, Internal and External, Box Model, floats, flexbox and grids.

Self -Study: Text formatting, Lists, iframes, Anchors, Span, Div, Borders, Margins, Padding.

Module 2 [8 Hours]

JavaScript: Data types and Variables, Functions, Objects, Document Object Model, Event Handling, Asynchronous Programming.

Self -Study: Operators-Expressions and Statements. Array, String, Date, Math related Objects.

Module 3 [11 Hours]

NodeJS: Introduction to NodeJS, Http Module, NPM, MYSQL- DDL and DML. Server-Side Applications, Authentication and Authorization.

Self -Study: Express.js, File System, URL Modules, Events, Drop Table.

Module 4 [12 Hours]

React Basics: Introduction to React, Lists and Keys, Components-Dynamic and Reusable, Hooks- useState, useEffect, useContext, Redux.

Self -Study: JSX, State, Props, Controlled and Uncontrolled Components, Lifecycle Methods.

Module 5 [13 Hours]

Advanced React: Routing and Navigation, Bootstrap, Fragments, Map Method, Server-Side Rendering.

Self -Study: Angular CLI, Forms and Validation, Decorators, Components, Binding, Testing.

Lab Schedule

Sl. No	Topics	No of Hours
1	Design a web page using html [input tag- text, number, checkbox, radio, submit]	2
2	Design a web page using form and table tag	2
3	Design a web page using Box Model and Floats	2
4	Design a web page using Grid and CSS	2
5	Design interactive pages using function in javascript	3
6	Design interactive pages using Event Handling in javascript	3
7	Using Http modules in node.js send and receive messages.	3
8	Perform DDL and DML using node,js and MYSQL	3
9	Design a web page using lists in React	2
10	Design a web page using components in React	3
11	Design a web page using Hooks in React	2
12	Perform navigation using React Router	3

13	Design a web page using React Bootstrap	4
14	Design a web page using React Fragments	2
15	Design a web page using React Map Method	2
Total Hours		**54**

Micro Project Topics

1. **Personal Portfolio Website:** Create a personal portfolio website showcasing your projects, skills and experiences using HTML, CSS, JavaScript, Node.js, React.js

   Description: A personal portfolio website where users can showcase their projects, skills and experiences.

   It typically includes sections such as About Me, Projects, Skills, Resume and Contact.

   Use Case Scenarios:

   - A user visits the website to learn more about a developer's skills and past projects.
   - An employer or recruiter explores the portfolio to assess a developer's suitability for a job position.
   - A developer updates the portfolio to add new projects or skills.

2. **To do List Application:** Develop a Todo list application where users can add, delete and mark tasks as completed. Implement it using HTML, CSS, JavaScript, Node.js, React.js

   Description: A Todo list application where users can create, edit and delete tasks. Tasks can be categorized, prioritized and marked as completed.

   Use Case Scenarios:

   - A user creates a new task to remind themselves of an upcoming deadline.
   - A user marks a task as completed after finishing the associated work.
   - A user deletes a task that is no longer relevant.

3. **E-commerce Product Catalog**: Build a simple e-commerce product catalog where users can browse through products, view details and add items to their cart. Use HTML, CSS, JavaScript, Node.js, React.js

   Description: An e-commerce product catalog where users can browse through a

collection of products, view details and add items to their cart for purchase.

Use Case Scenarios:

- A shopper searches for a specific product using the search functionality.
- A shopper adds items to their cart and proceeds to checkout.
- A shopper views product details such as price, description and images.

4. **Blogging Platform:** Develop a blogging platform where users can create, edit, and delete blog posts. Implement user authentication and authorization using Node.js, React.js

   Description: A platform for creating and sharing blog posts. Users can create, edit and delete posts, as well as comment on posts by other users**.**

   Use Case Scenarios:

   - A user creates a new blog post to share their thoughts or experiences.
   - A reader leaves a comment on a blog post to provide feedback or ask questions.
   - An admin deletes inappropriate comments or blog posts.

5. **Weather Forecast Application:** Create a weather forecast application that displays current weather conditions and forecasts for different locations. Use HTML, CSS, JavaScript, Node.js, React.js

   Description: A weather forecast application that provides users with current weather conditions and forecasts for specific locations. Users can search for weather information by city or zip code.

   Use Case Scenarios:

   - A user checks the weather forecast before planning a trip or outdoor activity.
   - A traveller looks up the weather conditions at their destination before packing.
   - A user receives weather alerts for severe weather events in their area.

Recipe Finder: Build a recipe finder application where users can search for recipes based on ingredients or cuisine. Utilize React for the frontend and integrate with a recipe API for fetching data.

Description: A recipe finder application where users can search for recipes based on ingredients, cuisine or dietary preferences. The application displays recipes along with ingredients and cooking instructions.

Use Case Scenarios:

• A user searches for recipes using ingredients they have on hand.

• A home cook explores recipes from different cuisines to try something new.

• A user filters recipes by dietary preferences such as vegetarian, gluten-free or vegan.

6. **Social Media Dashboard:** Develop a social media dashboard that aggregates data from multiple social media platforms (e.g., Twitter, Facebook) and displays analytics such as follower count, likes and shares. Use React.js / Angular.js, Node.js.

Description: A dashboard that aggregates data from multiple social media platforms (e.g., Twitter, Facebook, Instagram) and displays analytics such as follower count, likes, shares and comments.

Use Case Scenarios:

• A social media manager monitors engagement metrics across different social media platforms.

• A marketing team analyzes the performance of their social media campaigns.

• An influencer tracks their followers and engagement trends over time.

7. **Online Quiz Platform**: Create an online quiz platform where users can take quizzes on different topics and receive instant feedback on their performance. Use HTML, CSS, JavaScript, Node.js, React.js

Description: An online quiz platform where users can take quizzes on various topics. Users can select quizzes from a list of available topics, answer questions and receive instant feedback on their performance.

Use Case Scenarios:

• A student prepares for an upcoming exam by taking practice quizzes on different subjects.

• A teacher creates quizzes to assess students' understanding of course material.

• A quiz enthusiast challenges themselves with quizzes on a wide range of topics.

8. **Real-time Chat Application:** Build a real-time chat application that allows users to communicate with each other in real-time.

Description: A real-time chat application that allows users to communicate with each

other in real-time. Users can create chat rooms, send messages, and view message history.

Use Case Scenarios:

- Chat with each other to stay connected and share updates.
- Colleagues collaborate on work projects by discussing ideas and sharing files.
- Communities discuss common interests and engage in group conversations.

9. **Task Management System**: Develop a task management system where users can create projects, assign tasks, set deadlines and track progress. Use Angular.js / React.js, Node.js

   Description: A task management system where users can create projects, assign tasks to team members, set deadlines, and track progress. Users can prioritize tasks, add comments and attach files.

   Use Case Scenarios:

   • A project manager creates a new project and assigns tasks to team members.

   • Team members update task status, add comments, and attach relevant documents.

   • Stakeholders track project progress and view reports to identify bottlenecks or delays.

Reference Books:

1. "Learning Web Design: A Beginner's Guide to HTML, CSS, JavaScript, and Web Graphics" by Jennifer Robbins
2. "Eloquent JavaScript: A Modern Introduction to Programming" by Marijn Haverbeke
3. "Node.js Web Development" by David Herron
4. "React.js Essentials" by Artemij Fedosejev
5. "Angular Development with TypeScript" by Yakov Fain and Anton Moiseev

Online Resources:

1. https://developer.mozilla.org/en-US/docs/Web/HTML
2. https://www.youtube.com/watch?v=OpWjt_wbV4E
3. https://www.youtube.com/watch?v=xR-dcJNRyVs
4. https://www.youtube.com/watch?v=eILUmCJhl64&t=161s
5. https://angular.io/guide/testing

Co Assessment Questions

Course Outcome 1 (CO 1)

1. Create a Registration Form [Id, Name, Qualification, Mark Percentage, Address, Phone number] for applying a Course. (L6)
2. Generate Sessional Marks for a particular semester using html table. [Roll No, Name, Subject1 Subject2, Subject3, Total] (L6)
3. Prepare your Resume / Curriculum Vitae [use Box Model, Floats] (L6)
4. Display sales items with description [use Grid] (L6)

Course Outcome 2 (CO 2)

1. Write a JavaScript function to compute the factors of a positive integer. (L3)
2. Given two numbers, return true if the sum of both numbers is less than 100. Otherwise return false. (L3)
3. Create an event listener (on click) using JavaScript to change the color of a button. (L6)

Course Outcome 3 (CO 3)

1. Using HTTP modules in node.js send and receive messages. (L3)
2. Create a Product table with pid, pname, qty and price (L6)
3. Retrieve, Update, Delete data in MYSQL (L3)

Course Outcome 4 (CO 4)

1. Use React functional component called "Person" that receives a "name" prop and displays "Hello, [name]." (L3)
2. Develop a component called “Counter” that displays a number and has two buttons, one for incrementing the number and one for decrementing it. (L6)
3. Build a custom hook called useKeyPress that listens for a specific key press.and returns a boolean indicating whether that key is currently pressed. (L6)
4. Develop a React component that renders a list of items. Implement an event handler that allows users to remove items from the list when a "Delete" button is clicked. (L6)

Course Outcome 5 (CO 5)

1. Create a React Router application to handle routes that do not match any defined routes. (L6)
2. Create MACE web site using React Bootstrap. (L6)
3. Create a product list using map method. (L6)

M24CA1L106	Programming Lab	L	T	P	J	S	Credit	Year of Introduction
		1	0	3	0	4	3	2024

Preamble: This course develops logical thinking and problem-solving skills using the Python programming language and unveils the fundamentals of writing programs. Students are able to do testing and debugging of code written in Python.

Prerequisite: Basics of programming.

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

Course Outcome		Cognitive Knowledge Level
CO 1	Implement coding standards. Understands and implements Python programming language constructs - basic and collection data types, string manipulations, decision making statements, looping constructs and functions.	Apply
CO 2	Build modules and packages – built-in and user defined packages. Write data to files and form regular expressions for effective search operations on strings and files.	Apply
CO 3	Implement object-oriented programming constructs and perform exception handling.	Apply
CO 4	Solve problems using python libraries – Numpy, Pandas, SciPy and Matplotlib.	Apply
CO5	Utilize WTForms in Flask to design web pages.	Apply

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO 1	3	3	3	2			1	3
CO 2	3	3	3	2	1		1	3
CO 3	3	3	3	2	1		1	3
CO 4	3	3	3	3	1	2	2	3
CO 5	3	3	3	3	2	2	2	3

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
100	60	40	3 Hours

Continuous Internal Evaluation (Out of 60 Marks)

Attendance : 10 Marks

Test 1 (Theory) : 15 Marks

Test 2 (Lab) : 15 Marks

Continuous Evaluation : 20 Marks

End Semester Examination (Out of 40 Marks)

Problem solving : 30 Marks

Viva : 5 Marks

Git repository : 5 Marks

SYLLABUS

Module 1 [12 Hours]

Introduction: Introduction to coding standards, variables and expressions, operators, input statements, data types, Collection data types - Accessing and manipulations of tuple, list, set, dictionary and strings.

Decision making statements and loops: if statement, if-else statement, nested-if statements, Looping constructs - for loop, while loop and nested loops.

Functions: Definition, types of arguments, lambda functions, recursive functions.

Self-Study: String Manipulations.

Module 2 [10 Hours]

Modules and Packages: Creating modules, import statements, built-in packages, creating user-defined packages.

File Handling: Creating and accessing text files, Regular Expressions - Introduction, match and search functions, re patterns, character classes, repetition cases, retrieving data from a file using regular expression statements.

Self-Study: Built-in standard library modules viz., math, datetime and sys.

Module 3 [10 Hours]

Objected Oriented Programming: Creating classes and objects, data hiding, built-in class attributes, inheritance, method overriding, operator overloading.

Exception handling: Built-in exceptions, handling exceptions, raising exceptions, user-defined exceptions.

Self-Study: Fundamental concepts of Object Oriented Programming, Assertions.

Module 4 [8 Hours]

Numpy arrays: The Numpy library, Ndarray, basic operations (indexing, slicing, shape/reshape, join, split, search, sort, filter), reading and writing array data on files.

Pandas: Series, DataFrames and analyzing data.

SciPy: Introduction to sub-packages – integrate, optimize and stats

Matplotlib: Creating line plots, bar plots, scatter plots and histograms.

Self-Study: pandas.plotting module.

Module 5 [7 Hours]

Flask: Introduction to Flask, overview of Flask framework, understanding Flask's role in web development, WTForms to design web pages.

Self-Study: Client-Server model and HTTP protocol, web framework and their role in web development.

Lab Schedule

Sl. No.	Topics	No. of Hours
1	Write programs using sequence data types – tuple, list and strings – slicing and traversing through the sequence.	4
2	Write programs using collection data types – set and dictionary – slicing, sorting and manipulations using type specific methods.	2
3	Write programs using branching statements, looping constructs and nested loops.	4
4	Write programs using functions, recursive functions and lambda	4

	functions.	
5	Write programs using built-in packages.	2
6	Write programs to read from and write to files.	2
7	Write programs that search a specific pattern from a file using regular expressions	4
8	Write programs using classes and methods.	4
9	Write programs that implement operator overloading using classes.	4
10	Write programs that implement inheritance, method overriding and base class constructors.	4
11	Write programs using python libraries – Numpy, Pandas and Scipy.	4
12	Write programs for plotting figures using Matplotlib library.	2
13	Design web pages using WTForms in Flask.	7
	Total Hours	45

Reference books:

1. Charles Dierbach, "Introduction to Computer Science using Python", Wiley, 3rd Edition (2019).
2. Downey, A. et al., "How to think like a Computer Scientist: Learning with Python", John Wiley, 3rd Edition (2020).
3. Dr. Charles R Severance, "Python for everybody: Exploring data using Python 3" (2016). (Module 1,2,3) http://do1.dr-chuck.com/pythonlearn/EN_us/pythonlearn.pdf
4. Jake VanderPlas, "Python Data Science Handbook", O'Reilly Media, 2nd Edition (2022). (Module 4)
5. Jeeva Jose, "Taming Python by Programming", Khanna Publishers, New Delhi (2018). (Modules 1,2,3)
6. Miguel Grinberg, "The flask mega-tutorial" (2020). (Module 5)
7. Wesley J. Chun, "Core Python Applications Programming", Pearson Education, 3rd Edition (2016).

Online Resources:

1. The joy of computing using Python (NPTEL) https://archive.nptel.ac.in/courses/106/106/106106182/
2. Programming in Python (Swayam) https://onlinecourses.swayam2.ac.in/cec22_cs20/preview

3. Python 3 – Programming (Coursera) https://www.coursera.org/specializations/python-3-programming
4. Python for everybody (Coursera) https://www.coursera.org/specializations/python
5. Numpy – official website https://numpy.org
6. Pandas – official website https://pandas.pydata.org/
7. Flask Documentation https://flask.palletsprojects.com/en/3.0.x/
8. Python exercises, practice, solution https://www.w3resource.com/python-exercises/

CO Assessment Questions

Course Outcome 1 (CO 1)

1. Write a program to count the occurrences of (a) each word in a line of text (b) character frequency in a sentence. (L3)
2. Write a program to get a string from the user (a) replace all occurrences of first character with '$', except first character (b) Create a string from given string where first and last characters exchanged. (L3)
3. Write a program to find (a) the factorial of a number (b) Generate Fibonacci series of N terms (c) Find the sum of all items in a list. (L3)
4. Write recursive functions to (a) find the factorial of a number (b) find the nth Fibonacci number (c) find the sum of an integer list (d) find the sum of first N whole numbers (e) reverse a string. (L3)

Course Outcome 2 (CO 2)

1. Create a package graphics with modules rectangle, circle and sub-package 3D-graphics with modules cuboid and sphere. Include methods to find area and perimeter of respective figures in each module. Write programs that finds area and perimeter of figures by different importing statements. (Include selective import of modules and import * statements) (L3)
2. Write a Python program to read a file line by line and store it into a list. (L3)
3. Write a program to copy odd lines of one file to other. (L3)
4. Perform file Manipulations – (a) Find the lengthiest line in a file (b) Extract all phone numbers from a file (c) Extract patterns from a file (d) Remove all comment lines from a file. (L3)

Course Outcome 3 (CO 3)

1. Create a Bank account with members account number, name, type of account and balance. Write constructor and methods to deposit at the bank and withdraw an amount from the bank. (L3)

2. Create a class Rectangle with private attributes length and width. Overload '<' operator to compare the area of 2 rectangles. (L3)
3. Create a class Publisher (name). Derive class Book from Publisher with attributes title and author. Derive class Python from Book with attributes price and no_of_pages. Write a program that displays information about a Python book. Use base class constructor invocation and method overriding. (L3)

Course Outcome 4 (CO 4)

1. Write a program to perform element-wise trigonometric functions (sin, cos, tan) on an array. (L3)
2. Write a program to insert row at a given position in pandas DataFrame. (L3)
3. Write a program to generate 1000 random samples from a normal distribution with mean 10 and standard deviation 3, then plot a histogram of these values. (L3)
4. Write a program to display a bar chart, horizontal bar and pie chart of the sample data in Ndarray. (L3)
5. Write a program to perform numerical optimization to find the minimum of a given function using SciPy's optimization routines and visualize the optimization path. (L3)

Course Outcome 5 (CO 5)

1. Create a login page using Flask. (L3)
2. Create a registration page using Flask. (L3)
3. Create Contact Us using WTForms in Flask. (L3)

M24CA1L107	Advanced Data Structures Lab	L	T	P	J	S	Credit	Year of Introduction
		1	0	3	0	4	3	2024

Preamble:

This is the companion course of Advanced Data Structures and provides the students hands-on experience of the advanced data structures which will boost up the knowledge and confidence of students in applying these techniques while dealing with real life computing problems.

Prerequisite:

Basic Data Structures, Knowledge of any programming language, preferably 'C'.

Course Outcomes:

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

CO. No	Course Outcomes	Cognitive Knowledge Level
CO 1	Acquire hands-on experience in solving problems related to merging sorted arrays, circular queues, singly linked stacks, and doubly linked lists.	Apply
CO 2	Develop problem-solving skills by applying tree algorithms and to solve a variety of programming challenges and exercises.	Apply
CO 3	Apply sets in algorithmic problem-solving and facilitate the design of efficient solutions across various domains.	Apply
CO 4	Apply Prim's and Kruskal's algorithms for graphs, as well as Breadth-First Search and Depth-First Search algorithms for traversing and analyzing graphs. This will enable them to efficiently solve a variety of graph-related problems.	Apply
CO 5	Apply advanced graph algorithms including topological sort, identification of strongly connected components in directed graphs, and Dijkstra's single source shortest paths algorithm to solve complex real-world problems efficiently and effectively, demonstrating a deep understanding of graph theory and algorithmic principles.	Apply

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO 1	3	2	2	2	1	1	1	
CO 2	3	3	2	2	1	1	1	2
CO 3	3	2	2	2	1	1	1	2
CO 4	3	2	3	2	1	1	1	2
CO 5	3	2	3	2	1	1	1	2

Mark distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
100	60	40	3 Hours

Continuous Internal Evaluation (Out of 60 Marks)

- Attendance : 10 Marks
- Test 1 (Lab) : 15 Marks
- Test 2 (Lab) : 15 Marks
- Continuous Evaluation : 20 Marks

End Semester Examination (Out of 40 Marks)

- Problem Solving : 30 Marks
- Viva : 5 Marks
- Git Repository : 5 Marks

SYLLABUS

Module 1 [9 Hours]

Single Linked List operations- Creation, Insertion, Deletion, Traversal, Count. Singly Linked Stack-- Creation, Insertion, Deletion, Traversal, Count. Doubly Linked List- Creation, Insert

operations through beginning, Insert operations through end, Delete operations from beginning, Delete operations from end, Traversal from beginning, Traversal from end, Display from both side, Count number of elements. Circular Queue- Creation, Insertion, Deletion, Display, Count number of elements.

Self-Study: Programs- implementation applications of stack, Circular Linked List, Circular Doubly Linked List.

Module 2 [8 Hours]

Binary Tree-Creation, Insertion, Deletion, Traversal-Inorder traversal, Preorder Traversal, Postorder traversal, Binary Search Trees- Creation, Insertion, Deletion, Find, Traversal-Inorder traversal, Preorder Traversal, Postorder traversal.

Self-Study: Programs-AVL Tree, Red Black Tree.

Module 3 [6 Hours]

Set operations-Union, Intersection and Difference using Bit String, Disjoint Sets and the associated operations (create, union, find).

Self-Study: Use the disjoint set data structure to solve the problem of finding the connected components in a graph.

Module 4 [12 Hours]

Minimum cost spanning tree using Prim's Algorithm, Minimum cost spanning tree using Kruskal's algorithm, Implementation of BFS algorithm, Implementation of DFS algorithm.

Self-Study: Modify your BFS implementation to also print the shortest path from the start vertex A to every other vertex in the graph.

Module 5 [10 Hours]

Topological Sort, Strongly connected Components, Dijkstra's single source shortest path algorithm.

Self-Study: Program-Biconnected components in a graph.

List of Experiments

SI No	Topic	No. of Hours
1.	Single Linked List operations- Creation, Insertion, Deletion, Traversal, Count.	2
2.	Singly Linked Stack-- Creation, Insertion, Deletion, Traversal, Count.	2
3.	Doubly Linked List- Creation, Insert operations through beginning, Insert operations through end, Delete operations from beginning, Delete operations from end, Traversal from beginning, Traversal from end, Display from both side, Count number of elements.	2
4.	Circular Queue- Creation, Insertion, Deletion, Display, Count number of elements.	3
5.	Binary Tree-Creation, Insertion, Deletion, Traversal-Inorder traversal, Preorder Traversal, Postorder traversal.	4
6.	Binary Search Trees- Creation, Insertion, Deletion, Find, Traversal-Inorder traversal, Preorder Traversal, Postorder traversal.	4
7.	Set operations (Union, Intersection and Difference) using Bit String.	2
8.	Disjoint Sets and the associated operations (create, union, find).	4
9.	Prim's Algorithm for finding the minimum cost spanning tree.	4
10.	Kruskal's algorithm for finding the minimum cost spanning tree using the Disjoint set data structure.	4
11.	Implement BFS Algorithm.	2
12.	Implement DFS Algorithm.	2
13.	Implement Topological Sort.	2
14.	Finding the Strongly connected Components in a directed graph.	4
15.	Dijkstra's single source shortest path algorithm.	4
	Total Hours	**45**

Reference Books:

1. Cormen T.H., Leiserson C.E, Rivest R.L. and Stein C, Introduction to Algorithms, Prentice Hall India, New Delhi, 2010
2. D.Samantha, Classic Data structures, Prentice Hall India, New Delhi,2009

Online Resources:

1. https://www.digitalocean.com/community/tutorials/stack-in-c
2. https://www.programiz.com/dsa/circular-queue
3. https://www.geeksforgeeks.org/how-to-create-a-linked-list-in-c/
4. https://www.javatpoint.com/prim-algorithm
5. https://www.javatpoint.com/kruskal-algorithm-in-c

CO ASSESSMENT QUESTIONS

Course Outcome 1:

1. Write a program to perform Single Linked List operations. (L3)
2. Write a program to perform Doubly Linked List operations. (L3)
3. Write a program to perform Circular Queue operations. (L3)

Course Outcome 2 (CO2):

1. Write a program to perform Binary Tree traversal (L3)
2. Binary Search Trees- Insertion, Deletion, Search (L3)
3. Write a program to perform Red Black Tree Insertion operations (L3)

Course Outcome 3 (CO3):

1. Write a program to perform Set operations (Union, Intersection and Difference) using Bit String. (L3)
2. Write a program to perform Disjoint Sets and the associated operations (create, union, find). (L3)
3. Write a program to perform Kruskal's algorithm using the Disjoint set data structure (L3)

Course Outcome 4 (CO4):

1. Write a program to perform Prim's algorithm. (L3)
2. Write a program to perform DFS algorithm. (L3)
3. Write a program to perform BFS algorithm. (L3)

Course Outcome 5 (CO5):

1. Write a program to perform Topological Sort. (L3)
2. Write a program to find the Strongly connected Components in a directed graph. (L3)
3. Write a program to perform Dijkstra's single source shortest paths algorithm. (L3)

M24CA1N108	Research Methodology and Publication Ethics	L	T	P	J	S	Credit	Year of Introduction
		1	0	0	0	1	0	2024

Preamble:

This course is designed to provide the students with essential knowledge about research process and publications ethics.

Prerequisite:

Basic research concepts and academic writing skills.

Course Outcomes:

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

	Course Outcome	Cognitive Knowledge Level
CO 1	Understand the key concepts and skills related to the research process, review several journals and formulate a research problem.	Apply
CO 2	Learn the importance of ethics in research and uphold research integrity in the future academic pursuits.	Apply
CO 3	Effectively write thesis manuscripts and understands the significance of impact factor and other measures of scholarly impact.	Apply
CO 4	Understand publication ethics, misconduct, and open access initiatives.	Apply

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO 1		3		2	2		1	2
CO 2					2		2	1
CO 3				2	2		2	2
CO 4					2		3	2

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
50	50	0	-

Continuous Internal Evaluation (Out of 50 Marks)

- Course based task/Seminars/Quiz : 15 marks
- Test : 15 marks
- Case Study Report : 10 marks
- Attendance : 10 marks

The duration of the examination is two hours

SYLLABUS

MODULE 1 [3 Hours]

Meaning of research: Types of research, Research process, Objectives and research design.

Self-Study: Data collection, Data analysis, interpretation of results, validation of results, and Formulation of a research problem.

Case study: Identify minimum five high impact open-access journals and perform literature review.

MODULE 2 [3 Hours]

Ethics of Research: Ethics with respect to science and research, Intellectual honesty and research integrity.

Self-Study: Scientific misconducts - Falsification, Fabrication, and Plagiarism.

Case study: Analyze a real-world example of scientific misconduct and produce a report.

MODULE 3 [3 Hours]

Guidelines for writing thesis: Guidelines for writing the abstract, introduction, methodology, results and discussion, conclusion sections of a manuscript.

Self-Study: Impact factor - validity, merits, limitations. Other measurements of impact: h-index - advantages, criticism of h-index, modification of h-index.

Case study: Calculate impact factor and h-indices for selected articles and analyze their correlation with measures of impact and present the findings.

MODULE 4 [3 Hours]

Publication ethics: Definition, introduction and importance, Open access publications and initiatives.

Self-Study: Publication misconduct - definition, concept, problems that lead to unethical behavior.

Case study: Discussion on ethical implications of publication misconduct, like, plagiarism.

Teaching Plan

Sl. No.	Topic	No. of Lecture/ Tutorial Hours
MODULE 1 [3 Hours]		
1.1	Types of research – quantitative, qualitative and mixed methods.	**1**
1.2	Research process and objectives of research	**1**
1.3	Key components of research design, practical applications and example	**1**
MODULE 2 [3 Hours]		
2.1	Ethical decision-making models	**1**
2.2	Core principles of intellectual honesty	**1**
2.3	Research integrity	**1**
MODULE 3 [3 Hours]		
3.1	Guidelines for writing a manuscript	**2**
3.2	Measurements of impact – citation counts, h-index, impact factor	**1**
MODULE 4 [3 Hours]		
4.1	Importance of publication ethics	**1**
4.2	Open access publications – principles, types, benefits, challenges and considerations of open access	**1**
4.3	Publication misconduct – types, consequences and impact	**1**
Total Hours		**12**

Reference books:

1. C R Kothari, “Research Methodology”, New Age International publishers (2019).
2. Francis C. Dane, “Research Methodology”, Brooks/Cole Publishing Company, California (2011).
3. R Panneerselvam, “Research Methodology”, Prentice Hall International (2014).

MAR ATHANASIUS COLLEGE OF ENGINEERING
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Thiruvananthapuram

SEMESTER - II
SYLLABUS

Master of Computer Applications (MCA)

2024

M24CA1C201	Advanced Computer Networks		L	T	P	J	S	Credit	Year of Introduction
			3	1	0	0	3	4	2024

Preamble:

This course intends to provide a comprehensive understanding of data communication and networking, covering a wide range of topics essential for modern network professionals. Students will learn fundamental concepts such as data communication, network protocols, and traffic analysis. Furthermore, they will explore advanced topics including Software-Defined Networking, Virtualized Network Functions and network security mechanisms.

Prerequisite:

Basic understanding of digital fundamentals and operating systems recommended.

Course Outcomes:

After completion of the course the student will be able to

CO No.	Course Outcome	Cognitive Knowledge Level
CO 1	Learn the terminologies and concepts of data communication, network protocol stacks and switched networks.	Apply
CO 2	Understand and analyze link and physical layer functionalities, LAN architectures and connecting devices.	Apply
CO 3	Comprehend TCP and UDP, IPv4 addressing, compare and contrast various routing algorithms and network layer security.	Apply
CO 4	Understand the fundamentals of wireless and mobile networking including WiFi, Bluetooth, GSM cellular networks and Mobile IP.	Understand
CO 5	Comprehend client server architecture, Software Defined Networking, Virtualized Network Function concepts, network management and various traffic analysis tools.	Understand

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO 1			1				1	2
CO 2	1	1	1				1	2
CO 3	1	1	1	2			1	2
CO 4	2	1	1	2	2		2	2
CO 5	2	2	2	2	2	2	2	2

Assessment Pattern

Bloom's Category	Advanced Data Communication and Networks		
	Continuous Assessment Tests		End Semester Examination (% Marks)
	Test 1 (% Marks)	Test 2 (% Marks)	
Remember	20	20	20
Understand	40	40	40
Apply	40	40	40
Analyse	XX	XX	XX
Evaluate	XX	XX	XX
Create	XX	XX	XX

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
100	40	60	3 Hours

Continuous Internal Evaluation (Out of 40 Marks):

- Continuous Assessment Test 1 (Module 1 and Module 2) : 10 Marks
- Continuous Assessment Test 2 (Module 3 and Module 4) : 10 Marks
- Assignment / Tutorials / Seminars : 12 Marks
- Attendance : 8 Marks

Continuous Assessment Test Pattern (Out of 50 Marks):

There will be two parts - Part A and Part B.

Part A contains 5 questions carrying 2 marks each.

Part B contains 5 questions carrying 8 marks each.

The duration of the examination is two hours

End Semester Examination Pattern:

There will be two parts, Part A and Part B. Part A contains 10 questions with 2 questions from each Module, carrying 2 marks each. Part B contains 7 questions out of which 5 questions to be answered. (Minimum 1 question from each Module and maximum 2 questions from any 2 Modules). Each question in Part B carries 8 marks and can have maximum 2 sub-divisions.

SYLLABUS

Module 1 [10 Hours]

Data Communication: Basic communication model and its characteristics, Digital and analog data transmission, Data encoding – Line coding and Block coding schemes, Modulation techniques – ASK, FSK, PSK.

Networking Abstracts: Network protocol architecture, ISO-OSI reference model – layer functionalities, Internet TCP/IP protocol stack, Switched networks – Circuit switched, Packet switched and Virtual circuits.

Self-Study: Guided and Unguided transmission media.

Module 2 [12 Hours]

Link Layer and Physical Layer: Functionalities – physical addressing and framing, Error Control - Parity, CRC, Checksum, Hamming code, Multiple Access protocols - Random access, Controlled access, Multiplexing - FDM, TDM. IEEE 802.3 Ethernet - physical implementation and MAC frame format. Connecting devices – Transparent and Spanning tree bridges, Routers.

Self-Study: Structure of Ethernet switches and routers.

Module 3 [11 Hours]

Transport Layer and Network Layer Security: Connection oriented and connection-less services, Transmission Control Protocol and User Datagram Protocol – characteristics, reliability mechanisms, performance considerations. Flow Control - Go-back N and Selective Repeat sliding window protocols and Congestion control mechanisms. IP Addressing - IPv4 Classful addressing, Subnet masking and Packet format. Unicast routing algorithms – Link-State and Distance Vector routing, Routing protocols – RIP and OSPF. SSL for secure web communication – handshake process and vulnerabilities, IPSec for secure IP communication and firewalls – types, Network Address Translation management.

Self-Study: Classless addressing, IPv6.

Module 4 [6 Hours]

Wireless and Mobile Networking: IEEE 802.11 WiFi – architecture and components, physical implementation, modes of operation, frame format and addressing, Bluetooth – architecture, protocol stack, inquiry and paging procedures, device discovery, connection establishment, profiles and BLE, Mobile Networking – Cellular network architecture, Mobile IP – components, tunneling mechanism and mobility management - handover initiation and detection techniques.

Self-Study: 5G technology

Module 5 [6 Hours]

Application layer: Client-Server architecture – SMTP and DNS, Software-Defined networking – architecture, OpenFlow protocol and SDN Controllers, Virtualized Network Functions concepts – network virtualization, technologies, classification based on functionalities, SNMP for network management – architecture, managers and agents, operations, traps and notification, use cases, Traffic analysis tools – Wireshark, tcpdump – packet capture, filtering and analysis.

Self-Study: Peer-to-peer file sharing networks.

Reference Books:

1. Andrew S Tanenbaum, "Computer Networks", Pearson Education, 6th Edition (2022).
2. Behrouz A Forouzan and Firouz Mosharraf, "Computer Networks: A top down Approach", McGraw Hill Education, 1st Edition (2023).
3. Behrouz A Forouzan, "Data Communications and Networking", McGraw Hill Education, 6th Edition (2022).
4. James F Kurose and Keith W Ross, "Computer Networking: A Top - Down Approach", Pearson Education; 8th Edition (2021).
5. Kevin R Fall and W Richard Stevens, "TCP/IP Illustrated, Volume 1 -The Protocols", Pearson Education, 2nd Edition (2014).
6. Larry Peterson and Bruce Davie, "Computer Networks, A systems Approach", Morgan Kaufmann Publishers, 6th Edition (2020).
7. Uyless Black, "Computer Networks: Protocols, Standards and Interface", Prentice Hall India Learning Private Limited, 8th Edition (2015).
8. William Stallings, "Foundations of Modern Networking: SDN, NFV, QoE, IoT, and Cloud", Pearson Education, 1st Edition (2022)
9. Walter Goralski, "The Illustrated Network: How TCP/IP Works in a Modern Network", Morgan Kaufmann Publications, 2nd Edition, (2017).

Online Resources:

1. Peter L Dordal, "An introduction to Computer Networks" (2023)
   http://intronetworks.cs.luc.edu/current2/ComputerNetworks.pdf
2. Computer Networks and Internet Protocol (NPTEL)
   https://archive.nptel.ac.in/courses/106/105/106105183/
3. The bits and bytes of computer networking (Coursera)
   https://www.coursera.org/learn/computer-networking

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
MODULE 1 [10 Hours]		
1.1	Basic communication model, its characteristics, digital and analog data transmission, network types and topology	1
1.2	Data Encoding – line coding and block coding schemes	2
1.3	Modulation techniques – ASK, FSK, PSK	2
1.4	Network protocol architecture, ISO-OSI Reference model, functionalities of different layers	2
1.5	Internet TCP/IP protocol stack, overview of protocols	1
1.6	Switched networks – Circuit switched, Packet switched and Virtual Circuits	2
MODULE 2 [12 Hours]		
2.1	Physical Addressing and Framing	1
2.2	Error Control – Parity, CRC, Checksum, Hamming Code	2
2.3	Media Access Control – Random Access protocols	2
2.4	Media Access Control – Controlled Access protocols	2
2.5	Multiplexing – FDM, TDM	1
2.6	IEEE 802.3 Ethernet – physical implementation, MAC – Frame format	2
2.7	Connecting devices – Transparent and spanning tree bridges, routers	2
MODULE 3 [11 Hours]		
3.1	Connection oriented and connection-less services, TCP and UDP – Characteristics, reliability mechanisms, performance considerations	1
3.2	Flow Control – Stop and wait, Go-back N sliding window protocols	1
3.3	Flow Control – Selective Repeat sliding window protocols, timing diagrams	1
3.4	Congestion control mechanism	1
3.5	Internet Protocol – IPv4 Addressing, subnet masking, packet format.	2
3.6	Unicast Routing algorithms – Link-State and Distance Vector	1
3.7	Unicast Routing Protocols – RIP, OSPF	2
3.8	SSL – handshake process and vulnerabilities, IPSec modes and protocols	1
3.9	Firewall – types, Network Address Translation, management	1
MODULE 4 [6 Hours]		
4.1	IEEE 802.11 Standards, WiFi Architecture and Components, physical layer implementation	1
4.2	IEEE 802.11 MAC layer – modes of operation, frame format and addressing	1
4.3	Bluetooth – Architecture, protocol stack, Inquiry and paging procedures, device discovery and connection establishment, profiles, BLE	2
4.4	GSM Architecture	1
4.5	Mobile IP – Components, tunneling mechanism. Mobility management – handover initiation and detection mechanisms.	1
MODULE 5 [6 Hours]		

5.1	Client Server Architecture – SMTP and DNS	2
5.2	Software Defined Networking – Architecture, OpenFlow protocol, SDN Controllers	1
5.3	Virtualized Network Functions – Network virtualization, technologies, classification based on functionalities	1
5.4	SNMP – Architecture, managers and agents, operations, Traps and notifications, use cases	1
5.5	Traffic Analysis Tools – Wireshark, tcpdump – packet capture, filtering and analysis.	1
Total Hours		**45**

CO Assessment Questions

Course Outcome 1 (CO1)

1. Draw and explain Manchester and Differential Manchester data encoding schemes for the data stream 10110010. (L3)
2. Compare ISO-OSI and TCP/IP reference models. (L2)
3. Explain the set-up phase of virtual circuits. (L1)

Course Outcome 2 (CO2)

1. What are the benefits of CRC in network communication? Compute CRC for the dataword 1010 using divisor, $x^3 + 1$. How the receiver does determines an error if the dataword received is 1011? (L3)
2. How is bandwidth and multiplexing related? Substantiate your answer with FDM. (L2)
3. Draw the flow chart of Binary exponential back-off algorithm and explain for, k = 1, 2, 3. (L3)

Course Outcome 3 (CO3):

1. Compare Go-back N and Selective Repeat ARQ. Draw timing diagram for the given sequence of events. Frame 0 lost, Frame 1 delivered, ACK 2 lost, Frame 2 damaged for m = 3. (L3)
2. Why is it necessary to keep the load below the network capacity? Illustrate throughput as a function of load with a graph. Give a plausible solution to alleviate the above scenario. (L2)
3. Discuss the intra domain routing protocol suitable for small autonomous system. (L2)

Course Outcome 4 (CO4):

1. Illustrate the two mode of medium access in IEEE 802.11. How the contention and contention-free modes coexist? (L2)
2. With a neat diagram explain Bluetooth architecture. (L1)
3. Discuss how GSM addresses the challenges of interoperability and global roaming in mobile networks. (L2)

Course Outcome 5 (CO5):

1. Represent a typical mail scenario with MTA and MAA. Explain the significance of SMTP as a Client/Server architecture protocol. (L2)
2. Discuss the concept of Software-Defined Networking (SDN) and its significance in modern network architectures. (L2)
3. Explain the role of Simple Network Management Protocol (SNMP) in network management and monitoring. (L2)

Model Question Paper

QP CODE: Pages: 02

Reg No.: ……. Name: …….

MAR ATHANASIUS COLLEGE OF ENGINEERING (AUTONOMOUS), KOTHAMANGALAM

SECOND SEMESTER M.C.A. DEGREE EXAMINATION, DECEMBER 2024

Course Code: M24CA1C201

Course Name: ADVANCED COMPUTER NETWORKS

Max. Marks: 60 Duration: 3 Hours

PART A

Answer all questions. Each question carries 2 marks.

1. Explain 4B/5B block coding scheme.
2. Explain the functionalities of network support layers in OSI reference model.
3. What are the reasons for the popularity of checksum in error detection? Compute checksum for the 16-bit data word, 11001010 10010101.
4. Draw and explain IEEE 802.3 Ethernet frame format. Why is the minimum frame length set to 64 bytes?
5. Write the routing algorithm that uses flooding strategy to share link state.

6. Explain Stop-and-Wait ARQ. Why sequence numbers used in Stop-and-Wait is limited to 0 and 1.
7. Explain the significance of GSM (Global System for Mobile Communications) in the evolution of mobile communication technologies.
8. What is the content of address fields in a wireless LAN frame for To DS = 0 and From DS = 1? Draw a BSS and explain.
9. List out and explain the functionalities of different DNS records.
10. What is the importance of network management in modern IT infrastructures?

PART B

Answer any five questions. Each question carries 8 marks.

11. List and explain the layers of the Internet model and their functions.
12. What is a Virtual circuit? Explain the connection management in Virtual circuit with suitable diagrams.
13. Write a short note on:
    a. Collision based multiple access protocol [4 Marks]
    b. Token based multiple access protocol [4 Marks]
14. Define routing. Explain the process of link state routing with OSPF protocol.
15. What is the congestion policy adopted by TCP? How the congestion window growth is regulated for various network scenarios?
16. Compare and contrast SDN with traditional networking approaches, highlighting the key differences in terms of network control, programmability, and flexibility. Explain how SDN separates the control plane from the data plane, enabling centralized network management and automation.
17. What is Bluetooth? Explain the various layers of Bluetooth with a neat diagram.

M24CA1C 202	Advanced Database Management System	L	T	P	J	S	Credit	Year of Introduction
		3	1	0	0	3	4	2024

Preamble:

This course serves as a comprehensive exploration of foundational principles, techniques, and best practices essential for effective database design, management, and optimization. Through a combination of theoretical knowledge and hands-on practical exercises, students will gain the skills necessary to design, implement, and manage robust database systems tailored to meet diverse application requirements.

Prerequisite:

Familiarity with basic mathematical concepts such as set theory, logic, and algebra is beneficial, as these concepts are fundamental to understanding relational algebra and normalization principles.

Course Outcomes:

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

CO. No	Course Outcomes	Cognitive Knowledge Level
CO 1	Apply the foundational principles of relational database system, analyses ER features and develop skills in designing relational databases performing relational algebra operations to retrieve and manipulate data efficiently.	Apply
CO 2	Design and implement normalized database schemas, ensuring adherence to normalization principles and best practices in database design.	Apply
CO 3	Understand the concept of transactions in database systems, including the potential conflicts that may arise during transaction execution and Implement concurrency control prevent data anomalies and deadlocks.	Understand
CO 4	Understand and analyze different file organization and indexing strategies to optimize data storage and retrieval performance in database systems.	Understand
CO 5	Evaluate different non-relational database technologies based on specific use cases and design database using appropriate NoSQL databases to meet application requirements effectively.	Apply

Mapping of Course Outcomes with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO 1	1	3	2	1	1	1		2
CO 2	3	2	2	2	1	1		2
CO 3	2	1	1	1	2	2		2
CO 4	2	2	1	1	2	2		1
CO 5	1	1	2	2	3	2		2

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination (Marks%)
	Test 1 (Marks %)	Test 2 (Marks %)	
Remember	20	20	16
Understand	40	60	34
Apply	40	20	50
Analyze	XX	XX	XX
Evaluate	XX	XX	XX
Create	XX	XX	XX

Mark Distribution

Total Marks	CIE marks	ESE marks	ESE Duration
100	40	60	3 Hours

Continuous Internal Evaluation (Out of 40 Marks)

- Continuous Assessment Test 1 (Module 1 and Module 2) : 10 Marks
- Continuous Assessment Test 2 (Module 2 and Module 3) : 10 Marks
- Assignment/Tutorials/Seminars : 12 Marks
- Attendance : 8 Marks

Continuous Assessment Test Pattern (Out of 50 Marks):

There will be two parts - Part A and Part B.

Part A contains 5 questions carrying 2 marks each.

Part B contains 5 questions carrying 8 marks each.

The duration of the examination is two hours

End Semester Examination Pattern:

There will be two parts, Part A and Part B. Part A contains 10 questions with 2 questions from each Module, carrying 2 marks each. Part B contains 7 questions out of which 5 questions to be answered. (Minimum 1 question from each Module and maximum 2 questions from any 2 Modules). Each question in Part B carries 8 marks and can have maximum 2 sub- divisions.

SYLLABUS

Module 1 [10 Hours]

Database Modelling: Introduction, Purpose of Database System, View of data, Data Abstraction, Instances and Schemas, Data Models, Database Languages, Database Architecture, Database Users and Administrators.

Entity Relationship model: Entity Set, Relationship Set, Attributes, Key Constraints, Mapping cardinalities, E-R Diagrams- Basic structure, Complex attributes, Roles, Non binary relationship sets, Weak Entity Set, Design using ER. Extended ER Features-Specialization, Generalization, Attribute inheritance, Constraints on generalization, Aggregation.

Relational Model: Structure of Relational Database, Database Schema, Keys, The Relational Algebra- Fundamental Operations, Additional relational algebra operations. Relational Query Language.

Self-Study: Case Studies in ER Model- Online Book store, Banking Schema, University Database, Hospital Management Systems, Social Media Network ER Model.

Module 2 [9 Hours]

Database Design: Need for Normalization, Functional Dependencies, Inference Rules for Functional Dependencies, Minimal set of Functional Dependencies, The Normalization Process, Conversion to First Normal Form, Conversion to Second Normal Form, Conversion to Third Normal Form, Higher Level Normal Forms: Boyce/Codd Normal Form, Fourth Normal Form, Join dependencies and Fifth Normal Form, Normalization and Database Design. Improving the Design – Surrogate Key Considerations.

Self-Study: Case Studies in Normalization- Present case studies of database designs from different industries or domains and analyse how normalization principles were applied. Discuss the benefits, drawbacks, and lessons learned from each case study.

Module 3 [9 Hours]

Transaction Management and Concurrency Control: Transaction, Transaction Properties, Transaction States, Conflicts in transaction-Lost Updates, Uncommitted Data, Inconsistent Retrievals. The Scheduler, Serializability. Concurrency Control with Locking Methods- Lock Granularity, Lock Types, Two Phase Locking to Ensure Serializability, Concurrency Control with Timestamping Methods, Concurrency Control with Optimistic Methods. Deadlocks – Deadlock detection, Deadlock Prevention-Wait/Die and Wait/Wound Schemes. Database Recovery Management, Transaction Recovery, Transaction Management with SQL.

Self-Study: Case Study- Provide a case study of transaction management in a banking

system. Discuss how transactions are used to perform operations such as fund transfers, account withdrawals, and balance inquiries while ensuring data consistency and integrity.

Module 4 [8 Hours]

Data Storage: File Organization- Sequential, Heap, Hash File, B+ Tree, Indexed sequential Access Methods.

Indexing and Hashing: Basic concept, Dense Index, Sparse Index, Multilevel Index. Hashing-

Static Hashing, Dynamic Hashing. RAID.

Self-Study: Case studies of database file storage implementations in various industries (e.g., e-commerce, healthcare, finance), Challenges and solutions encountered in large-scale database file storage environments.

Module 5 [9 Hours]

Advanced Database Design: Bigdata and Distributed Databases- Homogeneous and heterogeneous Databases, Distributed Data Storage, Distributed Transactions, XML schemas.

Next Generation Databases: Nonrelational Database, Handling semi-structured and unstructured data, Partitioning strategies - Replication and Sharding, CAP Theorem.

NoSQL Database: Key Value Stores, Document Oriented Database, Column-Family Stores, Graph Database. MongoDB- Features and architecture, Document based data model, Collections, Documents, Fields, CRUD operations in MongoDB. Cassandra, Hbase.

Self-study: Bigdata storage and processing technologies, Scalability and performance optimization in Distributed database.

Reference Books:

1. Abraham Silberschatz, Henry F. Korth, S. Sudarshan," *Database System Concepts*", McGraw Hill Education, 8th Edition, 2021. (Module 1 &3)
2. Ramez Elmasri, Shamkant B.Navathe, " *Fundamentals of Database Systems* ", Pearson Education, 8th Edition, 2016. (Module 1&3)
3. Rob, Peter and Carlos Coronel, "*Database Principles: Fundamentals of Design, Implementation and Management*", 13th Edition, 2022. (Module 2)
4. Raghu Ramakrishnan and Johannes Gehrke, "*Database Management Systems*", McGraw Hill, 4th Edition (2021). (Module 4)
5. Guy Harrison, "*Next Generation Databases: NoSQL, NewSQL, and Big Data*", Apress, 1st Edition, 14 December 2015. (Module 5)

Online Resources:

1. Introduction to Databases (nptel) https://nptel.ac.in/courses/106/106/106106220/
2. Database Design (nptel) https://nptel.ac.in/courses/106/106/106106093/
3. Database Systems Concepts & Design

   https://www.udacity.com/course/database-systems-concepts-design--ud150

Course Contents and Lecture Schedule

NO	Topic	No. of Lecture/ Tutorial Hours
Module 1 [10 Hours]		
1.1	Database Introduction, Purpose of Database System, Data Abstraction, Instances and Schemas.	1
1.2	Data Models, Database Languages, Database Architecture	1
1.3	Entity Set, Relationship Set, Key Constraints, Mapping cardinalities	1
1.4	E-R Diagrams- Basic structure, Complex attributes, Roles.	1
1.5	Non-binary relationship sets, Weak Entity Set, Design using ER	1
1.6	Extended ER Features-Specialization, Generalization Attribute inheritance,	1
1.7	Constraints on generalization, Aggregation	1
1.8	Structure of Relational Database, Database Schema, Keys	1
1.9	The Relational Algebra- Fundamental Operations, Additional relational algebra operations,	1
1.10	SQL, Query Optimization.	1
Module 2 [9 Hours]		
2.1	Need for Normalization, Functional Dependencies, Inference Rules for Functional Dependencies	1
2.2	Minimal set of Functional Dependencies	1
2.3	The Normalization Process, Conversion to First Normal Form, Conversion to Second Normal Form.	1
2.4	Conversion to Third Normal Form.	1
2.5	Higher Level Normal Forms: Boyce/Codd Normal Form.	1
2.6	Fourth Normal Form.	1
2.7	Join dependencies and Fifth Normal Form	1
2.8	Normalization and Database Design	1
2.9	Improving the Design – Surrogate Key Considerations	1
Module 3 [9 Hours]		
3.1	Transaction, Transaction Properties, Transaction States	1
3.2	Conflicts in transaction-Lost Updates, Uncommitted Data, Inconsistent Retrievals	1
3.3	The Scheduler, Serializability.	1
3.4	Concurrency Control with Locking Methods- Lock Granularity, Lock Types.	1

3.5	Two Phase Locking to Ensure Serializability	1
3.6	Concurrency Control with Timestamping Methods	1
3.7	Concurrency Control with Optimistic Methods	1
3.8	Deadlocks –Deadlock detection, Deadlock Prevention-Wait/Die and Wait/Wound Schemes	1
3.9	Recovery Management, Transaction Recovery, TCL.	1
Module 4 [8 Hours]		
4.1	File Organization- Sequential file organization.	1
4.2	Heap, Hash File, B+ Tree file organization.	1
4.3	Indexed sequential Access Methods.	1
4.4	Indexing basic concept, Dense Index, Sparse Index.	1
4.5	Multilevel Index.	1
4.6	Hashing-Static Hashing,.	1
4.7	Dynamic Hashing	1
4.8	RAID	1
Module 5 [10 Hours]		
5.1	Bigdata and Distributed Databases- Homogeneous and heterogeneous Databases.	1
5.2	Distributed Data Storage	1
5.3	Distributed Transactions, XML schemas.	1
5.4	Nonrelational Database, Handling semi-structured and unstructured data.	1
5.5	Partitioning strategies - Replication and Sharding, CAP Theorem.	1
5.6	NoSQL-Key Value Stores, Document Oriented Database.	1
5.7	Column-Family Stores, Graph Database.	1
5.8	MongoDB- Features and architecture, Document based data model, Collections, Documents, Fields.	1
5.9	CRUD operations in MongoDB, Cassandra, Hbase.	1
	Total hours	**45**

Co Assessment Questions

Course Outcome 1 (CO1)

1. Explain the generalization constraint in ER model with specific example. (L3)
2. Explain the basic operations of relational algebra. (L2)
3. Generate Primary key, candidate key and super key set of attributes EmpID, Name Address. (L3)

Course Outcome 2 (CO2)

1. Draw the functional dependency diagram of the attributes Project No, Project Name, Emp No, Emp Name, Job class, Charge of Hours, Hours billed, Total charge. (L3)
2. Describe the inference rules related with functional dependency. (L2)

3. Distinguish BCNF and 3NF using the attributes student ID, Subject code, Staff ID and grade also draw the functional dependency diagram. (L3)

Course Outcome 3 (CO3)

1. Discuss the ACID properties of transaction. (L2)
2. Explain concurrency control with Timestamping methods. (L2)
3. Brief description about Database recovery management system. (L2)

Course Outcome 4 (CO4:

1. Differentiate static and dynamic hashing. (L2)
2. Distinguish RAID 2 and RAID 3 levels. (L2)
3. How is dense index different from sparse index? (L2)

Course Outcome 5 (CO5)

1. Distinguish homogeneous and heterogeneous database with example. (L3)
2. Create a document-oriented database. (L3)
3. Illustrate CRUD operations in Mongo DB. (L2)

Model Question Paper

QP CODE: Pages:2

Reg No.: ……. Name: ……..

MAR ATHANASIUS COLLEGE OF ENGINEERING (AUTONOMOUS), KOTHAMANGALAM

SECOND SEMESTER M.C.A DEGREE EXAMINATION, DECEMBER 2024

Course Code: M24CA1C 202

Course Name: Advanced database Management System

Max. Marks: 60 Duration: 3 Hours

PART A

Answer all questions. Each question carries 2 marks.

1. Explain any three mapping constraints used in the ER Model using appropriate examples.
2. Consider the relation R (A, B, C, D, E, F) with the FDs {AB->C, BC->AD, D->E, CF Compute {A, B} +
3. Explain the inference rules (Armstrong's Axioms) for Functional dependency.
4. Differentiate between BCNF and 3NF with an example.
5. Define deadlock and discuss any two strategies for managing deadlocks.
6. What is a transaction log? Why is it used for?
7. Explain the various RAID levels with appropriate diagrams.
8. Differentiate between Dense index and Sparse index with example.
9. Explain HBase and Cassandra
10. Discuss about the process of sharding and replication in MongoDB

PART B

Answer any five questions. Each question carries 8 marks.

11. Write briefly on any six advantages of database approach over conventional file-based approach.
12. Draw an E-R diagram of a library database with entities Book, Publisher, Staff and Readers. Assign Significant relationship between the entities. Use meaningful names for entities and relationships. Also, there should be an ISA relationship in the diagram.
13. Explain the Minimal Cover algorithm. Given a relation M (p, Q, R, S, T, U) with FDs, E={P->R, PQ->R, R->SU, RS->U, TR->PQ}, Compute the minimal cover of E.
14. Explain the condition for table is said to be in 1NF, 2NF,3NF. Illustration with example.

15. Explain the transaction recovery process. Differentiate the deferred-write and write-through transaction recovery procedures.

16. Describe the steps of query processing and evaluate the query processing cost of primary index with equality on key and non-key attribute.

17. Consider a scenario where a company is experiencing rapid growth in its customer base and needs to efficiently manage large volumes of customer data, including profiles, purchase history, and interactions. As a database administrator, you are tasked with selecting and implementing a suitable NoSQL database solution to meet the company's evolving needs.

M24CA1C203	Advanced Operating System	L	T	P	J	S	Credit	Year of Introduction
		3	1	0	0	3	4	2024

Preamble:

In the realm of computer science and technology, understanding the complexities of operating systems (OS) is essential for students aspiring to navigate the digital landscape. This course outlines a comprehensive exploration of advanced operating systems, delving into fundamental concepts, synchronization mechanisms, distributed systems, multiprocessor environments, virtualization, real-time operating systems, and database systems.

Prerequisite:

Before delving into the Modules outlined in this syllabus, students should have a basic of programming concepts, operating system fundamentals such as processes, and a basic understanding of networking principles. This foundational knowledge will provide students with the necessary background to comprehend the advanced topics covered in the course.

Course Outcomes:

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

CO. No	Course Outcomes	Cognitive Knowledge Level
CO 1	Analyzing and implementing advanced synchronization mechanisms in operating systems, including process control, multithreading, and solutions to complex synchronization problems such as the Critical Section Problem, Dining Philosophers Problem, and Readers-Writers Problem.	Apply
CO 2	Apply skills in analyzing, designing, and implementing distributed operating systems, using synchronization algorithms for mutual exclusion, and implementing access control mechanisms to ensure system security.	Apply
CO 3	Apply skills in designing, implementing, and evaluating distributed resource management systems, including distributed file systems and load distribution algorithms, while effectively addressing challenges in distributed computing environments.	Apply
CO 4	Understand multiprocessor operating systems, virtualization technologies, and real-time operating systems, and address the complexities and challenges of modern computing environments effectively.	Understand

CO 5	Analyzing, designing, and implementing concurrency control mechanisms in database systems, including lock-based and timestamp-based algorithms, ensuring transaction serializability and data consistency.	Apply

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO 1	3	3	2	3	2	1		
CO 2	3	3	2	3	2	1	2	2
CO 3	3	3	3	3	2	1		2
CO 4	3	3	3	3	2	1		2
CO 5	3	3	3		2	1		2

Assessment Pattern

Bloom's Category	**Computer Applications**		
	Continuous Assessment Tests		**End Semester Examination (Marks %)**
	Test 1 (Marks %)	**Test 2 (Marks %)**	
Remember	28	28	23
Understand	20	20	17
Apply	20	20	33
Analyse	32	32	27
Evaluate	XX	XX	XX
Create	XX	XX	XX

Mark distribution

Total Marks	CIE marks	ESE marks	ESE Duration
100	40	60	3 Hours

Continuous Internal Evaluation Pattern (Out of 40 marks):

- Continuous Assessment Test 1(Module 1 and Module 2) : 10 Marks
- Continuous Assessment Test 2 (Module 3 and Module 4) : 10 Marks
- Assignment/Tutorials/Seminars : 12 Marks
- Attendance : 8 Marks

Continuous Assessment Test Pattern (out of 50 marks):

There will be two parts - Part A and Part B.
Part A contains 5 questions carrying 2 marks each.
Part B contains 5 questions carrying 8 marks each.
The duration of the examination is two hours

End Semester Examination Pattern:

There will be two parts, Part A and Part B. Part A contains 10 questions with 2 questions from each Module, carrying 2 marks each. Part B contains 7 questions out of which 5 questions to be answered. (Minimum 1 question from each Module and maximum 2 questions from any 2 Modules). Each question in Part B carries 8 marks and can have maximum 2 sub-divisions.

SYLLABUS

Module 1 [12 Hours]

Overview: Functions of Operating System, Types of Advanced Operating Systems.

Synchronization Mechanisms: Processes, Process state transition diagram, Process Control Block, Thread, multithreading, Process synchronisation, Race condition, The Critical Section Problem, Solution to the Critical Section Problem, Peterson's solution, Semaphores.

Other Synchronization Problems: The Dining Philosophers Problem, Producer-Consumer Problem, Readers-Writers Problem, Monitors.

Self-Study: Scheduling Algorithms, Dead lock.

Module 2 [12 Hours]

Distributed Operating Systems: Distributed computing, Issues in Distributed Operating System, Communication primitives, Lamport's logical clock, Causal Ordering of Messages.

Distributed Mutual Exclusion: Classification, Requirements, Measuring performance, Lamport's Algorithm, Ricart–Agrawala algorithm, Suzuki-Kasami's Broadcast algorithm.

Security: Potential Security Violations, Access Matrix Model and Implementation, The Access Control list.

Self-Study: Role of '*' symbol in access matrix.

Module 3 [6 Hours]

Distributed Resource Management: Mechanisms for Building Distributed File Systems, Distributed shared memory, The Central-Server Algorithm, Migration Algorithm, The Read-Replication Algorithm, The Full-Replication Algorithm, Issues in Load Distributing, Types of Load Distribution Algorithms, Load Balancing v/s Load Sharing , Preemptive v/s Non-Preemptive Transfer, Components of Load Distributing Algorithm, Sender Initiated Algorithm, Receiver- Initiated Algorithm.

Self-Study: Analyzing case studies of real-world distributed systems and identifying the resource management strategies employed.

Module 4 [8 Hours]

Multiprocessor operating system: Basic Multiprocessor System Architectures-Tightly Coupled versus Loosely Coupled Systems, Shared memory multiprocessor models, Interconnection Networks, Structures of Multiprocessor Operating Systems, The design issues of multiprocessor operating systems, Virtualization, Types of Hypervisors, Full virtualization, Para virtualization.

Real time operating system: Introduction, Characteristics, Types, Application of Real time Operating System.

Self-Study: Memory Virtualization I/O Virtualization.

Module 5 [7 Hours]

Database Systems: Requirements of a Database Operating System, Problem of Concurrency Control, Serializability, Basic Synchronization Primitives for Concurrency Control- Lock Based Algorithms-Static Locking, Two-Phase Locking (2PL), Time Stamp Based Algorithms- Basic Timestamp Ordering Algorithm, Thomas Write Rule (TWR), Multiversion Timestamp Ordering Algorithm, Conservative Timestamp Ordering Algorithm, Optimistic Algorithms.

Self-Study: Computer security and database security.

Reference Books:

1. Mukesh Singhal,Niranjan G. Shivaratri "Advanced Concepts in Operating Systems, Distributed, Database, and Multiprocessor Operating Systems, Tata McGraw-Hill 2001.
2. Andrew S. Tanenbaum "Modern Operating Systems", Third Edition, Prentice Hall,2012.

Online Resources:

1. https://www.classcentral.com/course/udacity-advanced-operating-systems-10164.
2. https://www.geeksforgeeks.org/semaphores-in-process-synchronization/
3. https://www.tutorialspoint.com/what-is-a-multiprocessing-operating-system
4. https://www.windriver.com/solutions/learning/rtos

Course Contents and Lecture Schedule

NO	Topic	No. of Lecture/Tutorial Hours
Module 1 [12 Hours]		
1.1	Functions of Operating System.	1
1.2	Types of Advanced Operating Systems.	1
1.3	Processes, Process state transition diagram.	1
1.4	Process Control Block.	1
1.5	Thread, multithreading.	1
1.6	Process synchronisation, Race condition.	1
1.7	The Critical Section Problem, Solution to the Critical Section Problem.	1
1.8	Peterson's solution.	1
1.9	Semaphores.	1
1.10	The Dining Philosophers Problem.	1
1.11	The Producer-Consumer Problem.	1
1.12	The Readers-Writers Problem, Monitors.	1
Module 2 [12 Hours]		
2.1	Distributed computing, Issues in Distributed Operating System.	1
2.2	Communication primitives.	1
2.3	Lamport's logical clock.	1
2.4	Causal Ordering of Messages.	1
2.5	Distributed Mutual Exclusion-Classification, Requirements.	1
2.6	Distributed Mutual Exclusion- Measuring Performance.	1
2.7	Lamport's Algorithm.	1
2.8	Ricart–Agrawala Algorithm.	1
2.9	Suzuki-Kasami's Broadcast Algorithm.	1
2.10	Potential Security Violations.	1
2.11	Access Matrix Model and Implementation.	1
2.12	The Access Control list.	1
Module 3 [6 Hours]		
3.1	Mechanisms for Building Distributed File Systems, Distributed shared memory.	1
3.2	The Central-Server Algorithm, Migration Algorithm, The Read-Replication Algorithm.	1
3.3	Issues in Load Distributing, Types of Load Distribution Algorithms.	1
3.4	Load Balancing v/s Load Sharing , Pre-emptive v/s Non- Pre-emptive Transfer.	1

3.5	Components of Load Distributing Algorithm.	1
3.6	Sender Initiated Algorithm, Receiver- Initiated Algorithm.	1
Module 4 [8 Hours]		
4.1	Basic Multiprocessor System Architectures-Tightly Coupled versus Loosely Coupled Systems.	1
4.2	Shared memory multiprocessor models.	1
4.3	Interconnection Networks.	2
4.4	Structures of Multiprocessor Operating Systems, The design issues of multiprocessor operating systems.	1
4.5	Virtualization, Types of Hypervisors, Full virtualization, Para virtualization.	1
4.6	Real time operating system - Introduction, Characteristics.	1
4.7	Real time operating system- Types, Application.	1
Module 5 [7 Hours]		
5.1	Requirements of a database operating system, Problem of Concurrency Control.	1
5.2	Serializability.	1
5.3	Basic Synchronization Primitives for Concurrency Control.	1
5.4	Lock Based Algorithms.	1
5.5	Lock Based Algorithms-Static Locking, Two-Phase Locking.	1
5.6	Time Stamp Based Algorithms- Basic Timestamp Ordering Algorithm, Thomas Write Rule (TWR).	1
5.7	Time Stamp Based Algorithms- Multiversion Timestamp Ordering Algorithm, Conservative Timestamp Ordering Algorithm, Optimistic Algorithms.	1
	Total	**45 Hours**

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO1):

1. Diagram a process state transition diagram and identify the different states a process can transition through. (L2)
2. Compare and contrast various solutions to the Dining Philosophers Problem, considering factors such as fairness and deadlock avoidance. (L2)
3. Design a comprehensive synchronization mechanism for a distributed operating system that addresses both mutual exclusion and deadlock avoidance, considering factors such as fault tolerance and scalability. (L3)

Course Outcome 2 (CO2):

1. Explain Lamport's logical clock and its role in achieving causality in distributed systems. (L2)
2. Compare the Ricart–Agrawala algorithm and Suzuki-Kasami's Broadcast algorithm in terms of their effectiveness and efficiency in distributed mutual exclusion. (L2)
3. Evaluate the effectiveness of Access Matrix Model and Access Control Lists, in preventing unauthorized access and ensuring data security in distributed systems. (L3)

Course Outcome 3 (CO3):

1. Explain different types of load distribution algorithms. (L2)
2. Discuss the functionality of the Migration Algorithm and its benefits in dynamic resource management. (L2)
3. Analyze the advantages and disadvantages of sender-initiated and receiver-initiated load distribution algorithms, considering factors such as message overhead and system scalability. (L3)

Course Outcome 4 (CO4):

1. How can virtualization be used to improve resource utilization in a multiprocessor system? (L2)
2. Compare and contrast the design issues of multiprocessor operating systems with those of single-processor operating systems. (L2)
3. Compare tightly coupled and loosely coupled multiprocessor systems. (L3)

Course Outcome 5 (CO5):

1. Define the concept of serializability in a database system. (L2)
2. Compare and contrast lock-based and timestamp-based concurrency control algorithms. (L2
3. Analyze the correctness provided by the Thomas Write Rule (TWR) in a timestamp ordering algorithm. (L3)

Model Question Paper

QP CODE: **Pages: 2**

Reg No :…… **Name:……**

MAR ATHANASIUS COLLEGE OF ENGINEERING (AUTONOMOUS)

KOTHAMANGALAM

SECOND SEMESTER M.C.A DEGREE EXAMINATION, DECEMBER 2024

Course Code: M24CA1C203

Course Name: ADVANCED OPERATING SYSTEMS

Max. Marks: 60 **Duration: 3 hours**

PART A

Answer all questions. Each question carries 2 marks.

1. Identify and illustrate a race condition with a relevant example.
2. Explain the structure and purpose of a process control block (PCB)

3. Describe the classification of Mutual Exclusion algorithm
4. Describe synchronization delay with an example
5. Describe the Central-Server Algorithm.
6. Describe Adaptive load distribution algorithms
7. What is the role of a hypervisor in a virtualized environment?
8. Briefly describe one characteristic of a real-time operating system
9. Define the term "serializability" in the context of database transactions.
10. What is the main advantage of using optimistic concurrency control compared to lock-based approaches?

PART B

Answer any five questions. Each question carries 8 marks.

11. Compare and contrast the implementation and functionality of counting semaphores and binary semaphores in concurrent programming, provide specific examples of scenarios where each type would be most suitable.
12. Elaborate on Peterson's solution algorithm, provide a detailed explanation alongside a practical example to illustrate its functioning.
13. How does Suzuki-Kasami's Broadcast Algorithm address the issue of distributed mutual exclusion in a network?
14. Evaluate the effectiveness of Access Matrix Model and Access Control Lists, in preventing unauthorized access and ensuring data security in distributed systems.
15. Explain Sender-Initiated Algorithms with a neat diagram.
16. Distinguish between tightly coupled and loosely coupled multiprocessor systems. Explain the key architectural differences between these two types of systems.
17. Explain Multiversion Timestamp Ordering Algorithm.

M24CA1B205	Object Oriented Programming Lab	L	T	P	J	S	Credit	Year of Introduction
		1	0	2	2	4	3	2024

Preamble:

This course enables the students to understand the concepts of object-oriented programming using Java and to develop applications using these paradigms.

Prerequisite:

Knowledge of any computer programming.

Course Outcomes:

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

CO No	Course Outcomes	Cognitive Knowledge Level
CO 1	Apply object-oriented programming concepts to solve problems using classes, objects, methods (both static and non-static), constructors, access modifiers, nested and inner classes, method overloading, arrays, inheritance, interfaces, abstract classes and dynamic method dispatch.	Apply
CO 2	Create and manage custom packages to enhance code modularity and reuse, perform exception handling to ensure that programs are robust, reliable and are able to manage unexpected conditions.	Apply
CO 3	Apply multithreading concepts by creating and managing threads using the thread class and runnable interface, implements synchronization and inter-thread communication and master file handling with input/output streams and techniques for serialization and deserialization.	Apply
CO 4	Apply JDBC to connect to databases and perform CRUD operations and utilize design patterns in Java.	Apply
CO 5	Develop standalone applications using Spring Boot, with a strong foundation in its auto-configuration and starter dependency features. It also provides an overview of other Java frameworks such as Spring MVC, Spring JDBC, and Hibernate, to gain a broader perspective on the Java ecosystem.	Apply

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO 1	3	3	3	3	3	1	1	1
CO 2	3	3	3	3	3	1	1	1
CO 3	3	3	3	3	3	1	1	1
CO 4	3	3	3	3	3	1	1	1
CO 5	3	3	3	3	3	1	1	1

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
100	60	40	3 Hours

Continuous Internal Evaluation (Out of 60 Marks)

- Attendance : 10 Marks
- Test 1 (Theory) : 15 Marks
- Test 2 (Lab) : 15 Marks
- Continuous Evaluation : 20 Marks

End Semester Examination (Out of 40 Marks)

- Problem Solving : 15Marks
- Viva : 5 Marks
- Git Repository : 5 Marks
- Micro Project/Course Based Project : 15 Marks

The project for Project Based Course shall be done individually.

SYLLABUS

Module 1 [14 Hours]

Object Oriented Concepts: Classes and Objects, Static and Non-Static Methods, Constructors, Access Modifiers, Nested and Inner Classes, Method Overloading, Arrays, Inheritance, Interfaces, Abstract classes, Dynamic Method Dispatch.

Self-Study: Static and Non-Static Variables, Type Casting, Flow Control, Operators, Math Class, String Handling- String Operations.

Module 2 [12 Hours]

Packages and Exception Handling: Packages-Built-in and User-defined, Collections Framework- Introduction to Collections, ArrayList, LinkedList, HashMap, HashSet, Exception Handling- try-catch blocks, multiple catches, finally, throw, throws and custom exceptions.

Self-Study: Tree Map, Tree Set, Iterators and Generics, Comparators, Stack.

Module 3 [10 Hours]

Multithreading: Creating threads via Thread class and Runnable Interface, Synchronization and Inter-thread communication.

File Handling (I/O): Input/output Streams, FileInputStream, FileOutputStream, Buffered Streams, Serialization and Deserialization.

Self-Study: Thread lifecycle, wait(), notify(), notifyAll(), working with files**.**

Module 4 [8 Hours]

Java Database Connectivity (JDBC): Introduction to JDBC, Connecting to Databases, CRUD operations using JDBC.

Design Patterns in Java: Introduction to Design Patterns, Factory Method Pattern, Abstract Factory Pattern.

Self-Study**:** Result Sets, Prepared Statements, Transactions, Singleton, Prototype.

Module 5 [10 Hours]

Introduction to Java Frameworks: Overview about Java Frameworks- Spring Framework, Hibernate, Apache Struts. Benefits of using Frameworks, Spring MVC, Spring JDBC-Managing Database Connections and Performing Operations using Spring JDBC.

Spring Boot: Introduction to Spring Boot, Building Standalone Applications with Spring Boot, Auto-configuration and Spring Boot Starter Dependencies.

Self-Study**:** Builder, Adapter and Observer Patterns, RESTful Web Services-creating RESTful APIs with Spring Boot.

Lab Schedule

Sl. No	Topics	No of Hours
1	Program using static method and non-static method	**4**
2	Program for object creation, constructor, this keyword	**2**
3	Program demonstrating Method Overloading and Arrays	**2**
4	Program for Inheritance, Interfaces	**4**
5	Program for Abstract classes, Dynamic Method Dispatch	**2**
6	Program using Built-in and User-defined Packages	**2**
7	Program to demonstrate Array List, LinkedList	**4**
8	Program to demonstrate HashMap, HashSet	**2**
9	Program using Exception Handling	**4**
10	Program to demonstrate Thread class	**2**
11	Program to demonstrate Runnable Interface	**2**
12	Program using inter-thread communication	**2**
13	Program to demonstrate Input/output Streams	**2**

14	Program using Serialization and Deserialization	**2**
15	Program using JDBC	**4**
16	Program using design patterns	**2**
17	Program for factory**,** abstract factory	**2**
18	Program for managing Database Connections	**2**
19	Program using Spring MVC	**2**
20	Program for building standalone applications with Spring Boot	**2**
21	Program for performing Operations using Spring JDBC	**2**
22	Program for Spring Boot Starter Dependencies	**2**
	Total Hours	**54**

Micro Project Topics

1. To-Do List Application:

A Todo List Application allows users to manage their tasks efficiently. Users can add tasks with descriptions and deadlines, mark tasks as complete, edit or delete tasks and organize them into categories or priorities.

2. Calculator:

A Calculator project involves creating a program that performs basic arithmetic operations such as addition, subtraction, multiplication and division.

You can extend it to include advanced functionalities like handling parentheses, supporting decimal numbers, implementing scientific functions (square root, exponentiation, trigonometric functions), and handling error cases (division by zero, invalid input). This project will focus on parsing mathematical expressions, implementing algorithms for each operation, and designing a user interface for input and output.

3. Library Management System:

A Library Management System helps librarians manage books, patrons and transactions efficiently. In this project, you'll design a system where librarians can add new books to the library, update book information (title, author, genre, availability), manage patron records (add new patrons, issue and return books) and generate reports (e.g., overdue books, popular genres). This project involves designing classes to represent books, patrons, and transactions, implementing methods for book and patron management, and creating a user interface for interaction.

4. Student Record System:

A Student Record System helps educational institutions manage student information, grades and attendance records.Design a system where administrators can add new students, update student details (e.g., name, grade level), delete students and generate reports based on criteria like grades or attendance. This project involves creating classes to represent students, courses, grades and attendance records, implementing methods for student management and designing a user interface for administrators to interact with the system.

5.Banking System:

A Banking System simulates basic banking operations such as account creation, deposits, withdrawals, fund transfers and balance inquiries. Users can create bank accounts, deposit money into their accounts, withdraw cash, transfer funds between accounts, and view their account balance and transaction history. This project involves designing classes to represent bank accounts, implementing methods for transaction processing and creating a user interface for customers to interact with the banking system.

6. Weather Forecast Application

A Weather Application provides users with current weather conditions, forecasts and weather alerts based on their location input. Integrate a weather API to fetch real-time weather data and display it to users in a user-friendly interface. This project involves making HTTP requests to the weather API, parsing JSON responses, extracting relevant weather information and designing a graphical interface to present the weather data to users.

7. Quiz or Trivia Game:

A Quiz or Trivia Game challenges users with questions on various topics and tracks their scores. Design a game where users can select quiz categories, answer multiple-choice questions within a time limit and receive feedback on their answers. This project involves creating question sets for different categories, implementing scoring logic, managing user input and designing a user interface for gameplay.

8. Expense Tracker:

An Expense Tracker helps users manage their finances by recording expenses, categorizing spending, setting budgets and generating expense reports. Design an application where users can input their expenses, categorize them (e.g., food, transportation, entertainment), set budget limits for each category and view visualizations or reports to track their spending habits. This project involves designing classes to

represent expenses and categories, implementing methods for expense management and creating a user interface for interaction.

9. Chat Application:

A Chat Application enables real-time communication between users through text messages.

Create a program where users can join chat rooms, send and receive messages, view message history, and receive notifications for new messages. This project involves implementing client-server communication using sockets or a web framework, managing user connections, handling message routing and designing a user interface for chatting.

10. Employee Management System:

An Employee Management System helps businesses manage employee records, payroll and performance evaluations. Design a system where administrators can add new employees, update employee details (e.g., name, position, salary), manage payroll (calculate salaries, deductions, and bonuses) and generate reports (e.g., employee performance, payroll summary). This project involves designing classes to represent employees, departments and payroll records, implementing methods for employee management and creating a user interface for administrators to interact with the system.

Reference Books :

1. Herbert Schildt**.** "*Java: The Complete Reference*", 13th Edition, 2024.
2. Dr. R. Nageswara Rao. "Core Java: *An Integrated Approach",* 13th Edition, 2023.
3. Steven Holzner." *Java 2 Programming Black Book*", 2001
4. Thomas Wu. "*An Introduction to Object-Oriented Programming with Java*", 5th Edition, 2009.
5. Cay S. Horstmann and Gary Cornell. "*Core Java Volume I: Fundamentals*", 12th Edition, 2021.
6. Narayanaswamy Balakrishnan. "Mastering Java Design Patterns", 2016.
7. Tony Bevis." *Java Design Pattern Essentials*" ,2015.
8. James W. Cooper." *Java Design Patterns: A Tutorial*", 2000.
9. Mike Keith and Merrick Schincariol. "*Pro JPA 2 in Java EE 8: An In-Depth Guide to Java Persistence API",*2nd Edition, 2018.
10. Felipe Gutierrez. "*Pro Spring Boot 3: An In-Depth Guide to the Spring Boot Framework*", 2023.
11. Mark Heckler. "Spring Boot: Up and Running: Building Cloud Native Java and Kotlin Applications", 2021.
12. David M. Buchmann, "*Spring Boot: A Complete Guide*", 2020.
13. Christian Bauer, Gavin King." *Java Persistence with Hibernate*", 2nd Edition, 2015.
14. Dave Newton." Apache Struts 2 Web Application Development", 2013.

Online Resources:

1. https://www.w3resource.com/java-tutorial/
2. https://nptel.ac.in/courses/106/105/106105191/

3. https://www.coursera.org/learn/object-oriented-java
4. https://www.edx.org/course/object-oriented-programming-in-java-2
5. https://www.youtube.com/watch?v=7wpFNKnCpiQ
6. https://www.youtube.com/watch?v=b35mlSPOlJg
7. https://www.youtube.com/watch?v=7v2OnUti2eM
8. https://www.youtube.com/watch?v=YMAwgRwjEOQ
9. https://www.youtube.com/watch?v=Ia90r-SrKZk&list=PLsyeobzWxl7qbKoSgR5ub6jolI8-ocxCF&index=2
10. https://www.youtube.com/watch?v=rVOmSrCSdGE&list=PL0zysOflRCelmjxj-g4jLr3WKraSU_e8q&index=2

Co Assessment Questions

Course Outcome 1 (CO 1)

1. Create a static method for accepting inputs and display the values using a non-static method. [Use Single class] (L3)
2. Define a class 'Rank' with data members Rollno, Name and Marks. Create objects of the class and find the ranks. (L3)
3. Create CPU with attribute price. Create inner class Processor (no. of cores, manufacturer) and static nested class RAM (memory, manufacturer). Create an object of CPU and print information of Processor and RAM. (L3)
4. Area of different shapes using overloaded functions. (L3)
5. Create a class 'Person' with data members Name, Gender, Address, Age and a constructor to initialize the data members and another class 'Employee' that inherits the properties of class Person and also contains its own data members like Empid, Company_name, Qualification, Salary and its own constructor. Create another class 'Teacher' that inherits the properties of class Employee and contains its own data members like Subject, Department, Teacherid and contain constructors and methods to display the data members. Use array of objects to display details of 'N' teachers. (L3)
6. Create an interface having prototypes of functions area() and perimeter(). Create two classes Circle and Rectangle which implements the above interface. Create a menu driven program to find area and perimeter of objects. (L3)

Course Outcome 2 (CO 2)

1. Create an Arithmetic package that has classes and interfaces for the 4 basic arithmetic operations. Test the package by implementing all operations on two given numbers. (L3)
2. Find the average of N positive integers, raising a user defined exception for each negative input. (L3)
3. Develop a custom exception class named OrderNotFoundException that extends RuntimeException. Implement a REST controller with an endpoint that throws this exception if an order is not found. (L3)

Course Outcome 3 (CO 3)

1. Implement a Java program with a shared resource (e.g., a counter) accessed by multiple threads. Use synchronization to ensure that only one thread can access the resource at a time and update its value. (L3)
2. Implement a producer-consumer scenario using threads. The producer thread should produce items and add them to a shared queue, while the consumer thread should consume items from the queue. Use wait() and notify() for inter-thread communication. (L3)
3. Write a Java program to read from a file and write to a file using FileInputStream and FileOutputStream. Create a text file, read its content, and then write the content to a new file (L3)

Course Outcome 4 (CO 4)

1 Implement a Java program that performs CRUD operations (Create, Read, Update, Delete) on a User table in a MySQL database. Include methods for inserting a new user, retrieving all users, updating a user's information and deleting a user by ID. (L3)

2 Implement the Factory Method Pattern in Java. Create an abstract class Product with concrete implementations ConcreteProductA and ConcreteProductB. Implement a Creator class with a factory method that returns instances of Product. (L3)

Course Outcome 5 (CO 5)

1. Create a method using Spring JDBC that inserts multiple student records into a Student table. (L3)
2. Create a Spring MVC application where users can search for products by name. The controller should query the database and return a list of matching products to be

displayed on the view page. (L3)

3. Write a Spring Boot application that connects to a MySQL database and retrieves data using a custom SQL query defined in a repository method.(L3)

4. Create a new Spring Boot project with the following dependencies: (L3)

   Spring Boot Starter Web

   Spring Boot Starter Data JPA

   H2 Database

   Spring Boot Actuator

   Explore Auto-Configuration:

   Run the application and access the /actuator/beans endpoint to observe the default auto-configured beans.

   Identify and document at least five key beans that have been auto-configured by Spring Boot, explaining their roles in the application.

   Customize Auto-Configuration:

   Modify the application. properties file to change the default configuration of the Data Source (e.g., configure H2 to run in file mode or change to a different database like MySQL).

   Exclude the Data Source Auto Configuration class from the auto-configuration in your Spring Boot Application class.

5. Create a Spring Boot project using Spring Initializer with the Spring Boot Starter Web, Spring Boot Starter Data JPA, Spring Boot Starter Thyme leaf, and H2 Database dependencies. (L3)

M24CA1L206	Advanced Database Lab	L	T	P	J	S	Credit	Year of Introduction
		1	0	3	0	4	3	2024

Preamble:

This course aims to provide students with hands-on experience and practical skills in implementing advanced concepts and techniques in both relational and non-relational database systems. Through a series of guided exercises and projects, students will deepen their understanding of database design, optimization, and administration, while also exploring emerging trends and technologies in the field.

Prerequisite:

Proficiency in basic database concepts, SQL, programming languages.

Course Outcomes:

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

Course Outcome		Cognitive Knowledge Level
CO 1	Design and implement relational databases, write complex SQL queries, and effectively manipulate database data to meet organizational needs.	Create
CO 2	Develop, optimize, and manage PL/SQL programs to enhance and maintain robust database-driven applications.	Apply
CO 3	Design NoSQL databases to efficiently process and store unstructured data, meeting the demands of modern data-driven applications.	Create
CO 4	Utilize NoSQL databases for performing CRUD operations, aggregation, and regular expression-based queries, enhancing their ability to handle diverse data requirements in modern application development.	Apply
CO5	Employ NoSQL databases, utilizing shell commands for functionalities such as sharding and replication, as well as creating user roles tailored for managing unstructured data effectively.	Apply

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO 1	3	2	2	2	2	2		1
CO 2	2	2	1		1	2		1
CO 3	2	2	1	2	3	2		2
CO 4	2	2	1	1	1	2		2
CO 5	2	2	1		1	2		1

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
100	60	40	3 Hours

Continuous Internal Evaluation (Out of 60 Marks)

- Attendance : 10 Marks
- Test 1 (Lab) : 15 Marks
- Test 2 (Lab) : 15 Marks
- Continuous Evaluation : 20 Marks

End Semester Examination (Out of 40 Marks)

- Problem solving : 30Marks
- Viva : 5 Marks
- Git repository : 5Marks

SYLLABUS

Module 1 [7 Hours]

Overview of the SQL Query Language: Data Definition Language-Create table construct, Integrity constraints in Create table, Data Manipulation Language- Domain types in SQL, Basic query structure, The Select Clause, The From Clause, The Where Clause, String operations, Ordering the display of tuples, Set operations, Logical operations, Aggregate functions, Nested subqueries, Set Membership, Set Comparison, Join operations, Modification of the database.

DCL statements, TCL statements.

Self-Study: Dual function, Query optimization, Index Tuning.

Module 2 [10 Hours]

PL/SQL: Basic structure of PL/SQL block, Input-Output statements, PL/SQL Loop, Branching, Functions, Procedure-parameter mode and description, Trigger- Statement level trigger, Record level trigger.

Self-Study: Coding standards, Code optimization, Code security.

Module 3 [10 Hours]

NoSQL Database: Installation and configuration of any one of the NoSQL databases- MongoDB/ Cassandra/ HBase/ CouchDB/ Amazon DynamoDB/ Redis etc., Designing Databases using NoSQL, Data types and structures, Query Processing- Performing CRUD operations, Retrieving Data from a NoSQL database.

Self-Study: Performance tuning and scaling, Security and best practices.

Module 4 [10 Hours]

MongoDB Query Processing: Working with Arrays- Array datatype in MongoDB, Querying and updating arrays, Array operators. Usage of aggregate functions- Aggregation pipeline stages, Regular Expressions-Pattern matching strings.

Self-Study: Conditional operators, Comparison operators, Update operators.

Module 5 [8 Hours]

NoSQL Administration: Create users and roles, NoSQL shell commands- Sharding key selection, Setting up sharded cluster. Replication- Setting up replica set, Read and write concerns. Partitioning, Indexing.

Self-Study: Back up and recovery, Authentication and authorization.

Lab Schedule

Sl. No.	Topics	No. of hours
1	Creation of a database using DDL commands including integrity constraints.	1
2	Create an application to apply Data Manipulation Language (DML) commands to modify the database	1
3	Apply DCL and TCL commands to impose restrictions on databases.	1
4	Create an application to retrieve data from databases using Pattern matching.	1
5	Execute DML statements with nested operations, set operations, aggregate functions.	2
6	Create an application to use joins for query optimization.	1
7	Write PL/SQL block performing Loop and Branch operations	2
8	Write PL/SQL function to perform string operations.	2
9	Write PL/SQL procedure to perform database operations.	2
10	Execute Row level Trigger to perform database operations.	2
11	Execute statement level Trigger to perform database operations.	2
12	Understand the installation and configuration of NoSQL Databases	2
13	Build sample collections/documents to perform query operations	4
14	Perform CRUD operations in MongoDB	4
15	Querying Documents with Array operations	2
16	Perform Querying using Aggregate operations	4
17	Perform Querying using Regular Expressions	4
18	Creation of user roles and permissions to manage database access.	2
19	Build sample collections/documents to perform the shell commands like Sharding and Replica set	2
20	Perform Indexing Operations.	2
21	Local Deployment NoSQL(MongoDB)and Front-End: PHP/Java/Python	2
	Total Hours	**45**

Reference books

1. Abraham Silberschatz, Henry F. Korth, S. Sudarshan," ***Database System Concepts***", McGraw Hill Education, 6th Edition (2011).
2. Guy Harrison, "***Next Generation Databases: NoSQL, NewSQL, and Big Data***",
3. Apress, 1st Edition (14 December 2015).
4. Shashank Tiwari. Professional NoSQL. John Wiley and Sons. ISBN: 978-0-470-
5. 94224-6.
6. MongoDB Administrator's Guide, Cyrus Dasadia, October 2017, Packet
7. Publishing ISBN: 9781787126480.
8. Cassandra: The Definitive Guide Distributed Data at Web Scale, 1st Edition, Eben
9. Hewitt, Jeff Carpenter, O'Reilly Media; November 2010

Online Resources

1. Database Management System https://nptel.ac.in/courses/106/105/106105175/
2. Introduction to MongoDB https://www.coursera.org/learn/introduction-mongodb.
3. NoSQL systems https://www.coursera.org/learn/nosql-databases.
4. https://www.mongodb.com/docs/manual/introduction/.

Co Assessment Questions

Course Outcome1 (CO1)

1. Execution of Data Control Languages (grant, revoke) (L3)
2. Execute DML statements Pattern Matching using Customer table (id, name, address, city, country, age, salary) (L3)
3. Create a database and perform nested operations, set operations, aggregate functions. (L6)

Course Outcome **2 (CO2)**

1. Write a PL/SQL function to compute square of set of values and insert these values into table squares (value number (3), square value number (10)). (L3)
2. A Procedure called Deposit is created and stored in database. Create the table customer (A/c no, balance) and update the balance using the procedure Deposit. (L3)

3. Execute statement level trigger. (L3)

Course Outcome 3 (CO3)

1. Create database Vehicle in MONGODB and make Collection with ame "Vehicle Details" and perform CRUD operations. (L6)
2. Perform pattern matching operations in MongoDB. (L3)
3. Perform Query retrieval using find operators. (L3)

Course Outcome 4 (CO4)

1. Insert a document into the “Projects” collection where the “team members” field is an array containing names of team members and perform querying (L3)
2. Group the documents in the ‘orders’ collection by ‘status’ and calculate the total number of orders and the total amount for each status. Perform querying using aggregate operations. (L3)
3. Retrieve all documents in the “emails” collection where the ‘email’ field contains the domain "gmail.com" using a regular expression. (L3)

Course Outcome 5 (CO5)

1. Create a new user with read-only access to the sales data database and sales collection. (L3)
2. Create a role that allows a user to create and manage indexes in the ‘orders’ collection but not to read or write documents. (L3)
3. Create a shard key for the ‘orders’ collection to evenly distribute data across shards based on customer ID. (L3)

M24CA1L207	Operating Systems Lab	L	T	P	J	S	Credit	Year of Introduction
		1	0	3	0	4	3	2024

Preamble:

In recognition of the ever-evolving world of technology and the growing need for computer literacy, this course is designed to equip learners with a foundational understanding of computer hardware, operating systems, and essential Linux commands. Through a combination of theoretical knowledge and practical exercises, this course aims to empower individuals to navigate the digital landscape with confidence.

Prerequisite:

Basic understanding of computer programming, Internet and operating systems

Course Outcomes:

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

CO. No	*Course Outcomes*	*Cognitive Knowledge Level*
CO 1	Acquire knowledge and skills necessary to identify and describe various computer hardware components, gain practical experience in installing and configuring various operating systems, thereby enabling them to effectively manage and customize system setups to meet specific user requirements.	Apply
CO 2	Empower the Linux terminal environment using essential commands, and understand the key concepts of file management and user administration within a Linux system.	Apply
CO 3	Manage shared resources and understand process synchronization by finding software solutions for Peterson's algorithm and semaphores.	Apply
CO 4	Understand scripting concepts like variables, conditional statements (if/else), looping constructs (for/while), and handling command-line arguments passed to the scripts.	Apply
CO 5	Proficient in essential Linux network administration commands, diagnose network issues, manage resources, configure firewalls for LAN security, and perform basic network operations.	Apply

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO 1	3	2	2	3	2	1		2
CO 2	3	2	2	3	2	1		2
CO 3	3	3	2	3	2	1		2
CO 4	3	2	2	3	2	1		2
CO 5	3	3	2	3	2	1	1	2

Mark distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
100	60	40	3 hrs

Continuous Internal Evaluation (Out of 60 Marks)

- Attendance : 10 Marks
- Test 1 (Lab) : 15 Marks
- Test 2 (Lab) : 15 Marks
- Continuous Evaluation : 20 Marks

End Semester Examination (Out of 40 Marks)

- Problem Solving : 30 Marks
- Viva : 5 Marks
- Git Repository : 5 Marks

SYLLABUS

Module 1 [11 Hours]

Physical identification of major components of a computer, Specifications of desktop and server class computers. Installation of common operating systems for desktop and server use.

Self-Study: Setting and removing BIOS, and Windows passwords.

Module 2 [12 Hours]

Study of a terminal based text editor such as Vim or Emacs, Cursor operations, Manipulate text, Search for patterns, Global search and replace, Familiarity with basic Linux commands, File system hierarchy in a common Linux distribution, File and device permissions, Study of system configuration files in /etc, Familiarizing log files for system events, User activity and network events.

Self-Study: What is the significance of the chmod, chown, and chgrp commands in Linux? Provide examples of how to change the owner and group of a file.

Module 3 [8 Hours]

Software solutions for Peterson solution, Semaphore, Producer-Consumer problem, Readers – Writers problem.

Self-Study: Write a program to create process and thread.

Module 4 [8 Hours]

Shell scripting: Study bash syntax, Variables, Control constructs such as if, for, while, and command line arguments passed to shell scripts, Study of startup scripts, Login and logout scripts, Familiarity with system scripts is expected.

Self-Study: Write function programs in shell scripting.

Module 5 [6 Hours]

Introduction to command line tools for networking: IPv4 networking, Network commands-ping, route traceroute, lookup, ip, Setting up static and dynamic IP addresses, Concept of Subnets, CIDR address schemes, Subnet masks, iptables, Setting up a firewall for LAN, Application layer (L7) proxies.

Self-Study: Describe the purpose of the traceroute command and how it differs from ping. How can traceroute be useful in diagnosing network issues?

Reference Books:

1. Mukesh Singhal,Niranjan G. Shivaratri "Advanced Concepts in Operating Systems, Distributed, Database, and Multiprocessor Operating Systems, Tata McGraw-Hill 2001.
2. Andrew S. Tanenbaum "Modern Operating Systems", Third Edition, Prentice Hall,2012.

Web Resources:

1. https://www.classcentral.com/course/udacity-advanced-operating-systems-10164.
2. https://www.geeksforgeeks.org/semaphores-in-process-synchronization/
3. https://www.tutorialspoint.com/what-is-a-multiprocessing-operating-system
4. https://www.windriver.com/solutions/learning/rtos

List of Experiments

SI No	Topic	No. of Hours
1	Identify the following components and provide a brief description of each. Set1: Central Processing Unit (CPU), Motherboard, Random Access Memory (RAM), Hard Disk Drive (HDD), Solid State Drive (SSD), Power Supply Unit, Graphics Processing Unit, Cooling Fan, Heat Sink, Optical Drive (CD/DVD/Blu-ray), Network Interface Card, Set2: Wi-Fi Adapter, Bluetooth Adapter, USB Flash Drive, External Hard Drive, External Optical Drive, Graphics Card, Sound Card, TV Tuner Card, RAID Controller Card, Network Switch, Router, Modem, Firewall, Interactive Whiteboard, UPS, Surge Protector, Front Panel USB Ports. Set3: RAM Slots, SATA Ports, PCIe Slots, Northbridge Chipset, Southbridge ,Chipset, BIOS Chip, CMOS Battery, Jumper Pins, DisplayPort Cable, HDMI Cable, DVI Cable, VGA Cable, USB Cable, Ethernet Cable, SATA Cable, Power Cable, VR Headset, Capacitive Stylus, Graphics	6
2	Write specification for Desktop computer.	1
3	Write specification for Web server.	1
4	Install windows 10.	1
5	Install Ubuntu Virtual Box.	1
6	Set Dual Boot Operating System (windows+Ubantu).	1
7	Do the following commands on the terminal. 1. man 2. ls, echo, read 3. more, less, cat 4. cd, mkdir, pwd, find 5. mv, cp, rm ,tar 6. wc, cut, paste 7. head, tail, grep, expr 8. chmod, chown 9. Redirections, Piping 10. useradd, usermod, userdel 11. Passwd, df, top, ps, ssh, scp 12. ssh-keygen, ssh-copy-id	6
8	Study of a terminal based text editor Vim, and perform the operations such as cursor operations, manipulate text, search for patterns, global search and replace.	2
9	Understand the file or directory structure of Linux. [root, bin, boot, dev, etc, home, media, log, mnt, lib]	2

10	What is file or directory permission and how it is implemented in Linux?	2
11	Write a c program for Peterson solution to the critical section problem.	2
12	Write a C program for semaphore to critical section problem.	2
13	Write a C program to simulate producer-consumer problem using semaphores.	2
14	Write a C program to simulate Readers – Writers problem.	2
15	Shell scripting: study bash syntax, variables, control constructs such as if, for, while, command line arguments passed to shell scripts. Study of startup scripts, login and logout scripts, Familiarity with system scripts is expected.	8
16	Do the following commands Ipconfig, ping, tracert/traceroute, nslookup , netstat, arp, wget / curl, CIDR, subnetmask, iptables, mtr, cp, hostname, setting up a firewall for LAN, net view	6
	Total Hours	**45**

CO ASSESSMENT QUESTIONS

Course Outcome 1:

1. Write specification for Desktop computer. (L2)
2. Install windows 10 (L3)
3. Set Dual Boot Operating System (windows+Ubantu) (L3)

Course Outcome 2 (CO2):

1. Understand terminal based text editor Vim (L2)
2. Understand the file or directory structure of Linux. (L2)
3. Execution of terminal commands (L3)

Course Outcome 3 (CO3):

1. Write a c program for Peterson solution to the critical section problem. (L3)
2. Write a C program for semaphore to critical section problem. (L3)
3. Write a C program to simulate producer-consumer problem using semaphores. (L3)

Course Outcome 4 (CO4):

1. Write a scripting program to find prime numbers between a range. (L3)
2. Write a scripting program to check for an Armstrong number. (L3)
3. Write a scripting program to find sum of first n numbers (L3)

Course Outcome 5 (CO5):

1. Check internet connectivity is available/not by using any network command. (L3)
2. Display the full TCP/IP configuration information for all network adapters. (L3)
3. Display the path of a packet goes through from the source to destination. (L3)

M24CA1N208	Personality Development Through Life Enlightenment Skills	L	T	P	J	S	Credit	Year of Introduction
		1	0	0	0	1	0	2024

Preamble:

A comprehensive course designed to equip the students with the essential skills and knowledge to prosper in today's professional environment. From cultivating self-awareness to fostering positive relationships, each Module provide valuable insights and actionable strategies to help the students develop and master Emotional Intelligence competencies.

Prerequisite:

Basic English proficiency.

Course Outcomes:

After completion of the course the students are be able to:

	Course Outcome	Cognitive Knowledge Level
CO 1	Communicate effectively in various contexts, leading to clearer understanding and improved interpersonal relationships.	Apply
CO 2	Apply strategies necessary to work collaboratively in teams, fostering synergy and achieving common goals efficiently.	Apply
CO 3	Develop their emotional intelligence, empowering oneself to inspire and motivate others and lead effectively towards achieving positive results.	Apply
CO 4	Skillfully maneuver through interviews with comprehensive preparation.	Apply

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO 1						1	1	2
CO 2		2	2		3	1	1	1
CO 3		1	1		3	1	1	2
CO 4					2	1	1	

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
50	50	0	-

Continuous Internal Evaluation (Out of 50 Marks)

Course based task/Seminars/Quiz	:	15 marks
Test	:	15 marks
Activity Report	:	10 marks
Attendance	:	10 marks

SYLLABUS

Module 1 [3 Hours]

Communication skills: Interpersonal communication – different communication styles, their strengths and weaknesses, Active listening skills and questioning styles. Group discussions and technical communication for clearer understanding. Resume preparation tips.

Self-Study: English Aptitude.

Activity: Sample Resume, Job Application letters.

Module 2 [3 Hours]

Teamwork and Collaboration: Critical and creative thinking – process of effectively solving problems. Collaboration – Stages of team development, Methods of collaboration to improve teamwork, Specific behaviors that enhance or damage collaboration.

Self-Study: Leadership qualities to effectively lead teams and contribute positively to group dynamics.

Activity: Participate in team meetings.

Module 3 [3 Hours]

Emotional Intelligence: Intra- and interpersonal skills required for emotional intelligence, Self-awareness, Self-management, Social awareness and Social acceleration.

Self-Study: The body and the way it communicates.

Activity: Team game on managing stress.

Module 4 [3 Hours]

Interview: Interview preparation strategies, Behavioral interview techniques – STAR method, Technical interview preparations – Solving coding challenges.

Self-Study: Case interview preparation.

Activity: Mock interview.

Teaching Plan

Sl. No.	Topic	No. of Lecture/ Tutorial Hours
Module 1 [3 Hours]		
1.1	Interpersonal communication – different communication styles, their strengths and weaknesses, active listening skills and questioning styles	1
1.2	Group discussions and technical communication	1
1.3	Resume preparation	1
Module 2 [3 Hours]		
2.1	Critical and creative thinking – process of effectively solving problems	1
2.2	Collaboration – stages of team development, methods of collaboration to improve teamwork, specific behaviors that enhance or damage collaboration	2
Module 3 [3 Hours]		
3.1	Intra- and interpersonal skills required for emotional intelligence	1
3.2	Self-awareness, self-management, social awareness and social acceleration	2
Module 4 [3 Hours]		
4.1	Interview preparation strategies, behavioral interview techniques – STAR method	1
4.2	Technical interview preparations – solving coding challenges	2
	Total Hours	**12**

Reference books:

1. Ashraf Rizvi, “Effective Technical Communication”, Tata McGraw Hill Education 2nd Edition (2017).
2. Dale Carnegie, “How to win friends and influence people”, Simon and Schuster (2011).
3. T. Bharathi, M. Hariprasad and V. Prakasam, “Personality Development and Communicative English”, Neelkamal publications, 1st Edition (2009).
4. Travis Bradberry and Jean Greaves, “Emotional Intelligence 2.0”, Talent Smart (2009).

Online Resources:

1. https://www.indiabix.com/interview/
2. https://www.sawaal.com/technical-questions-and-answers.html
3. https://www.linkedin.com/learning/developing-your-emotional-intelligence-22196221

M24CA1E204A	Statistical Methods in Decision Making	L	T	P	J	S	Credit	Year of Introduction
		3	1	0	0	3	4	2024

Preamble:

In today's data-driven world, the ability to analyze, interpret, and make informed decisions based on data is essential for professionals in all fields, especially for those in computer applications and information technology. This course is designed to equip students with a comprehensive understanding of statistical techniques and their practical applications in decision-making processes. Through this course, students will gain expertise in various statistical methods, from data collection and visualization to advanced topics such as probability distributions, hypothesis testing, and regression analysis.

Prerequisite:

Basic knowledge of probability and statistics.

Course Outcomes:

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

CO. No	Course Outcomes	Cognitive Knowledge Level
CO 1	Design and implement effective data collection strategies, and utilize appropriate graphical methods to analyze and summarize data for informed decision-making.	Apply
CO 2	Apply numerical methods to describe data and summarize bivariate data to uncover relationships and trends for data-driven insights.	Apply
CO 3	Apply concepts of probability and probability distributions to analyze data and make informed decisions under conditions of uncertainty.	Apply
CO 4	Apply sampling methods, construct confidence intervals, and perform hypothesis testing to make data-driven inferences and conclusions.	Apply
CO 5	Apply regression analysis, time series analysis, and optimization modeling to analyze data trends, make forecasts, and optimize decision-making processes.	Apply

Mapping of course outcomes with program outcomes

	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO 1	3	3	1	3	2	-	1	3
CO 2	3	3	1	3	2	-	1	3
CO 3	3	3	2	3	2	-	1	3
CO 4	3	3	2	3	2	-	1	3
CO 5	3	3	3	3	2	1	1	3

Assessment Pattern

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

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
100	40	60	3 Hours

Continuous Internal Evaluation (Out of 40 Marks)

- Continuous Assessment Test 1 (Module 1 and Module 2) : 10 Marks
- Continuous Assessment Test 2 (Module 3 and Module 4) : 10 Marks
- Assignment/Tutorials/Seminars : 12 Marks
- Attendance : 8 Marks

Continuous Assessment Test Pattern (Out of 50 Marks):

There will be two parts - Part A and Part B.

Part A contains 5 questions carrying 2 marks each.

Part B contains 5 questions carrying 8 marks each.

The duration of the examination is two hours

End Semester Examination Pattern:

There will be two parts, Part A and Part B. Part A contains 10 questions with 2 questions from each Module, carrying 2 marks each. Part B contains 7 questions out of which 5 questions to be answered. (Minimum 1 question from each Module and maximum 2 questions from any 2 Modules). Each question in Part B carries 8 marks and can have maximum 2 sub-divisions.

SYLLABUS

Module 1 [6 Hours]

The Role of Statistics and the Data Analysis Process: Introduction, Role of Variability, Statistics and the Data Analysis Process, Types of Data, Simple Graphical Displays.

Data Collection: Observation and Experimentation, Sampling, Comparative Experiments, Experimental Design, Designing Surveys.

Graphical Methods for Describing Data: Categorical Data - Comparative Bar Charts and Pie Charts, Numerical Data - Stem-and-Leaf Displays, Numerical Data - Frequency Distributions and Histograms, Displaying Bivariate Numerical Data.

Self-Study: Activity 3.1 and 3.2 mentioned in Ref. 1

Module 2 [6 Hours]

Numerical Methods for Describing Data: Describing the Center of a Data Set, Describing Variability in a Data Set, Summarizing a Data Set using Boxplots, Interpreting Center and Variability - Chebyshev's Rule, The Empirical Rule and *z* Scores.

Summarizing Bivariate Data: Correlation, Linear Regression, Fitting a Line to Bivariate Data, Assessing the Fit of a Line, Nonlinear Relationships and Transformations, Logistic Regression.

Self-Study: Activity 4.2 and 5.2 mentioned in Ref. 1

Module 3 [9 Hours]

Probability: Probability Basics, Distribution of a Single Random Variable, Distribution of Two Random Variables, Independent Random Variables.

Probability Distributions: The Normal Distribution, Applications of the Normal Distribution, The Binomial Distribution, Applications of the Binomial Distribution, The Poisson Distribution, The Exponential Distribution.

Decision Making under Uncertainty: Elements of Decision Analysis, Sensitivity Analysis, Decision Trees, Bayes' Rule, Multistage Decision Problems.

Self-Study: Activity 6.3 and 7.2 mentioned in Ref. 1

Module 4 [12 Hours]

Sampling and Sampling Distributions: Methods for Selecting Random Samples, Estimation and Estimation Error, Sampling Distribution of the Sample Mean, The Central Limit Theorem, Sample Size Determination.

Confidence Interval Estimation: Sampling Distributions - The t Distribution, Confidence Interval for a – Mean, Total, Proportion, Standard Deviation, Confidence Interval for the Difference between Means, Confidence Interval for the Difference between Proportions, Controlling Confidence Interval Length, Sample Size for Estimation of the Mean.

Hypothesis Testing: Concepts in Hypothesis Testing, Hypothesis Tests for a Population Mean, Tests for Normality, Chi-Square Test for Independence, One-Way ANOVA.

Self-Study: Activity 8.1, 9.1 and 10.1 mentioned in Ref. 1

Module 5 [12 Hours]

Regression Analysis: Scatterplots - Graphing Relationships, Correlations - Indicators of Linear Relationships, Simple Linear Regression, Multiple Regression, Inferences about the Regression Coefficients, Multicollinearity, The Partial F Test, Outliers, Prediction.

Time Series Analysis and Forecasting: Forecasting Methods, Testing for Randomness, Regression-Based Trend Models, The Random Walk Model, Autoregression Models, Moving Averages, Exponential Smoothing, Seasonal Models.

Optimization Modeling: Introduction to Optimization, A Two-Variable Product Mix Model, Sensitivity Analysis, Properties of Linear Models, Infeasibility and Unboundedness, Optimization Models - Worker Scheduling Models, Blending Models, Logistics Models, Transportation Models, Financial Models.

Self-Study: Activity 14.1 and 15.1 mentioned in Ref. 1

Reference Books:

1. Roxy Peck, Chris Olsen, Jay L. Devore, "Introduction to Statistics and Data Analysis", 4th Edition, Brooks/Cole, Cengage Learning, 2012. (Module I & II)
2. S. Christian Albright, Wayne L. Winston, Christopher J. Zappe, "Data Analysis and Decision Making", 4th Edition, South-Western, Cengage Learning, 2011 (Module III, IV & V)
3. Ken Black, "Business Statistics for Contemporary Decision Making", 6th Edition, Wiley Publications, 2010
4. Richard I. Levin, David S. Rubin, "Statistics for Management", 7th Edition, Pearson Education, 2011
5. Prem. S. Mann, "Introductory Statistics", Wiley Publications, 2013
6. Srivatsava TN & Shailaja Rego, "Statistics for Management", Tata McGraw Hill, 2008
7. Ken Black, "Applied Business Statistics", 7th Edition, Wiley India Edition, 2012
8. Anderson D.R., Sweeney D.J. and Williams T.A., "Statistics for Business and Economics", 11th edition, Thomson (South - Western) Asia, Singapore, 2012
9. N. D. Vohra, "Business Statistics", Tata McGraw Hill, 2012

Online Resources:

1. https://onlinecourses.nptel.ac.in/noc21_mg02/preview, Data Analysis and Decision Making - I, By Prof. Raghu Nandan Sengupta, IIT Kanpur
2. https://onlinecourses.nptel.ac.in/noc22_mg03/preview, Data Analysis and Decision

Making - II, By Prof. Raghu Nandan Sengupta, IIT Kanpur

3. https://onlinecourses.nptel.ac.in/noc23_mg78/preview, Data Analysis and Decision Making - III, By Prof. Raghu Nandan Sengupta, IIT Kanpur

Course Contents and Lecture Schedule

NO	Topic	No. of Lecture / Tutorial Hours
Module 1 [6 Hours]		
1.1	Introduction, Role of Variability, Statistics and the Data Analysis Process	**1**
1.2	Types of Data, Simple Graphical Displays	**1**
1.3	Observation and Experimentation, Sampling	**1**
1.4	Comparative Experiments, Experimental Design, Designing Surveys	**1**
1.5	Categorical Data - Comparative Bar Charts and Pie Charts, Numerical Data - Stem-and-Leaf Displays	**1**
1.6	Numerical Data - Frequency Distributions and Histograms, Displaying Bivariate Numerical Data	**1**
Module 2 [6 Hours]		
2.1	Describing the Center of a Data Set, Variability in a Data Set, Summarizing a Data Set	**1**
2.2	Interpreting Center and Variability - Chebyshev's Rule, the Empirical Rule and *z* Scores	**2**
2.3	Correlation & Linear Regression	**1**
2.4	Fitting a Line to Bivariate Data, Assessing the Fit of a Line	**1**
2.5	Nonlinear Relationships and Transformations, Logistic Regression	**1**
Module 3 [9 Hours]		
3.1	Probability Basics, Distribution of a Single Random Variable	**1**
3.2	Distribution of Two Random Variables	**1**
3.3	Independent Random Variables	**1**
3.4	The Normal Distribution, Applications of the Normal Distribution	**1**
3.5	The Binomial Distribution, Applications of the Binomial Distribution	**1**
3.6	The Poisson Distribution	**1**
3.7	The Exponential Distribution	**1**
3.8	Elements of Decision Analysis, Sensitivity Analysis, Decision Trees	**1**
3.9	Bayes' Rule, Multistage Decision Problems	**1**
Module 4 [12 Hours]		
4.1	Methods for Selecting Random Samples, Estimation and Estimation Error	**1**
4.2	Sampling Distribution of the Sample Mean	**1**

4.3	The Central Limit Theorem, Sample Size Determination	**1**
4.4	Sampling Distributions - The t Distribution	**1**
4.5	Confidence Interval for a – Mean, Total, Proportion, Standard Deviation	**1**
4.6	Confidence Interval for the Difference between Means, Confidence Interval for the Difference between Proportions	**2**
4.7	Controlling Confidence Interval Length, Sample Size for Estimation of the Mean	**1**
4.8	Concepts in Hypothesis Testing, Hypothesis Tests for a Population Mean	**1**
4.9	Tests for Normality	**1**
4.10	Chi-Square Test for Independence	**1**
4.11	One-Way ANOVA	**1**
Module 5 [12 Hours]		
5.1	Regression Analysis, Graphing Relationships using Scatterplots, Correlation as indicators of Linear Relationships	**1**
5.2	Simple Linear Regression, Multiple Regression	**1**
5.3	Inferences about the Regression Coefficients, Multicollinearity	**1**
5.4	The Partial F Test, Outliers, Prediction	**1**
5.5	Time Series Analysis Introduction and Forecasting Methods, Testing for Randomness, Regression-Based Trend Models	**1**
5.6	The Random Walk Model, Autoregression Models	**1**
5.7	Moving Averages, Exponential Smoothing, Seasonal Models	**1**
5.8	Introduction to Optimization, A Two-Variable Product Mix Model	**1**
5.9	Sensitivity Analysis	**1**
5.10	Properties of Linear Models, Infeasibility and Unboundedness	**1**
5.11	Optimization Models - Worker Scheduling Models, Blending Models	**1**
5.12	Logistics Models, Transportation Models, Financial Models	**1**
Total Hours		**45**

CO Assessment Questions

Course Outcome 1 (CO1)

1. Differentiate between univariate data and multivariate data with suitable examples. (L2)
2. In a survey of 100 people who had recently purchased motorcycles, data on the following variables were record ed: Gender of purchaser, Brand of motorcycle purchased, Number of previous motorcycles owned by purchaser, Telephone area code of purchaser and

Weight of motorcycle as equipped at purchase.

3. Which of these variables are categorical?
4. Which of these variables are discrete numerical?
5. Which type of graphical display would be an appropriate choice for summarizing the gender data, a bar chart or a dotplot?
6. Which type of graphical display would be an appropriate choice for summarizing the weight data, a bar chart or a dotplot? (L3)
7. The accompanying data on annual maximum wind speed (in meters per second) in Hong Kong for each year in a 45-year period were given in an article that appeared in the journal *"Renewable Energy" (March, 2007).* Use the annual maximum wind speed data to construct a histogram. Is the histogram approximately symmetric, positively skewed, or negatively skewed? Would you describe the histogram as unimodal, bimodal, or multimodal?

   30.3, 39.0, 33.9, 38.6, 44.6, 31.4, 26.7, 51.9, 31.9, 27.2, 52.9, 45.8, 63.3, 36.0, 64.0, 31.4, 42.2, 41.1, 37.0, 34.4, 35.5, 62.2, 30.3, 40.0, 36.0, 39.4, 34.4, 28.3, 39.1, 55.0, 35.0, 28.8, 25.7, 62.7, 32.4, 31.9, 37.5, 31.5, 32.0, 35.5, 37.5, 41.0, 37.5, 48.6, 28.1 (L3)

Course Outcome 2 (CO2)

1. Explain why the standard deviation is a useful measure of variability. How does it relate to the mean and the data points in a set? (L2)
2. Explain Chebyshev's Rule and how it differs from the Empirical Rule. (L2)
3. Describe a scenario where a nonlinear transformation (e.g., logarithmic, exponential) would be necessary to model the relationship between two variables accurately. Provide a hypothetical example with the transformed regression equation. (L3)

Course Outcome 3 (CO3)

1. Describe what a joint probability distribution is and how it differs from a marginal probability distribution. Provide an example. (L2)
2. A factory produces light bulbs with a 2% defect rate. If a quality control inspector randomly selects 20 bulbs, what is the probability that exactly 1 bulb is defective? (L3)
3. A company must decide whether to invest in a new technology. The initial investment is $100,000. There is a 50% chance that the technology will succeed, in which case the company will earn $300,000. If it fails, the company will earn nothing. The company can

also choose to do a market survey first, costing $20,000, which will provide perfect information about the technology's success. Construct a decision tree and determine whether the company should invest directly, conduct the market survey first, or not invest at all. (L3)

Course Outcome 4 (CO4)

1. Describe the difference between a confidence interval and a point estimate. Why are confidence intervals preferred in reporting statistical results? (L2)
2. What is a p-value in hypothesis testing? How do you interpret the p-value in relation to the significance level (α)? (L2)
3. A research study aims to estimate the average blood pressure of adults in a certain region. A random sample of 50 adults is taken, and their blood pressures are measured. The sample mean blood pressure is found to be 120 mmHg with a sample standard deviation of 10 mmHg. Calculate a 95% confidence interval for the population mean blood pressure. (L3)

Course Outcome 5 (CO5)

1. When conducting hypothesis tests on regression coefficients, what are the null and alternative hypotheses? How do p-values help in making decisions about the significance of regression coefficients? (L2)
2. What is sensitivity analysis and why is it conducted in optimization modeling? Discuss one method commonly used to perform sensitivity analysis on optimization models. (L2)
3. You have been provided with a dataset containing information about the monthly sales revenue and advertising expenditure for a retail company over the past year. Apply correlation analysis to determine the strength and direction of the relationship between monthly sales revenue and advertising expenditure. Based on your findings, provide recommendations to the company on how they can optimize their advertising strategy to maximize sales revenue. (L3)

Model Question Paper

QP Code:……. **Pages:……..**

Reg No.: …… **Name: …….**

MAR ATHANASIUS COLLEGE OF ENGINEERING (AUTONOMOUS), KOTHAMANGALAM

SECOND SEMESTER MCA DEGREE EXAMINATION, <Month, Year>

Course Code: M24CA1E204A

Course Name: STATISTICAL METHODS IN DECISION MAKING

Max. Marks: 60 **Duration: 3 Hours**

PART A

Answer all questions. Each question carries 2 marks.

1. Give a brief definition of the terms: *Descriptive Statistics* and *Inferential Statistics*.
2. As part of a curriculum review, the computer applications department would like to select a simple random sample of 20 of last year's 300 graduates to obtain information on how graduates perceived the value of the curriculum. Suggest two different methods that might be used to select the sample.
3. Given a data set: 4, 8, 6, 5, and 10, calculate the range, variance, and standard deviation.
4. How can you interpret the spread and symmetry of a data set from its boxplot?
5. Define what is meant by a probability distribution of a discrete random variable. Give an example of such a distribution.
6. Define the binomial distribution. What are the key assumptions that must be met for a distribution to be considered binomial?
7. Explain the difference between simple random sampling and stratified sampling.
8. What is the Central Limit Theorem and why is it important in the context of sampling distributions?
9. What does a correlation coefficient close to -1 indicate about the relationship between two variables?
10. How do outliers affect the results of regression analysis?

PART B

Answer any five questions. Each question carries 8 marks.

11. A report has given the following estimates of the percentage of homes in a country that had only wireless phone service at 6-month intervals from June 2005 to December 2008.

Date	Percent with Only Wireless Phone Service
June 2005	7.3
December 2005	8.4
June 2006	10.5

December 2006	12.8
June 2007	13.6
December 2007	15.8
June 2008	17.5
December 2008	20.2

Construct a time-series plot for these data and describe the trend in the percent of homes with only wireless phone service over time. Has the percent increased at a fairly steady rate?

12. A data set has a mean of 50 and a standard deviation of 8. Calculate the z-scores for the following values: 34, 50, and 66. Interpret what each z-score indicates about the data point's position relative to the mean.
13. A medical test for a certain disease has a 95% sensitivity (true positive rate) and a 90% specificity (true negative rate). The prevalence of the disease in the population is 2%. If a person tests positive, what is the probability that they actually have the disease? Use Bayes' Rule to calculate this probability.
14. Explain how the t-distribution is used in confidence interval estimation for a population mean. Under what circumstances is it appropriate to use the t-distribution instead of the normal distribution?
15. A manufacturer wants to estimate the proportion of defective items in a production batch. A random sample of 200 items is taken, and 20 of them are found to be defective. Calculate a 90% confidence interval for the population proportion of defective items.
16. What are financial models and how are they used in optimization? Discuss the applications of financial optimization models in investment portfolio management and risk assessment.
17. An e-commerce company wants to understand the factors that influence customer satisfaction with their website. Apply multiple regression analysis using variables such as page load time, website design, customer support responsiveness, and product variety as predictor variables. Identify the significant predictors of customer satisfaction and provide recommendations to the company on how they can improve the website experience for customers.

M24CA1E204B	Data Visualization and Predictive Analytics	L	T	P	J	S	Credit	Year of Introduction
		3	1	0	0	3	4	2024

Preamble:

In the rapidly evolving field of data science, the ability to accurately predict future trends and effectively communicate insights through data visualization is crucial. This course is designed to develop a comprehensive understanding of predictive modeling techniques and the principles of effective data visualization. This course will empower students to transform raw data into actionable insights, enhancing their ability to make data-driven decisions in various professional contexts.

Prerequisite:

Basic knowledge of probability and statistics.

Course Outcomes:

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

CO. No	Course Outcomes	Cognitive Knowledge Level
CO 1	Differentiate predictive analytics from other analytical approaches, apply the CRISP-DM process, prepare data for predictive modeling, and to summarize and interpret single and multivariate data sets.	Apply
CO 2	Interpret item sets and association rules, apply descriptive modelling techniques such as principal component analysis and clustering algorithms, and address common issues in data preparation and model interpretation.	Apply
CO 3	Develop and implement predictive models using various techniques, such as decision trees, logistic regression, neural networks, K-nearest neighbor, Naïve Bayes, and linear regression, and assess the performance of these models using appropriate evaluation methods.	Apply
CO 4	Apply principles of data visualization to distinguish between exploratory and explanatory analysis, choose effective visual representations, and create informative visualizations using Python or R.	Apply
CO 5	Identify and eliminate visual clutter using Gestalt principles, optimize designs to capture audience attention with pre-attentive attributes, and apply designer perspectives to create clear and effective visualizations.	Apply

Mapping of course outcomes with program outcomes

	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO 1	3	3	2	3	2	-	2	3
CO 2	3	3	3	3	2	-	2	3
CO 3	3	3	3	3	2	-	2	3
CO 4	3	3	3	3	2	2	3	3
CO 5	3	3	3	3	2	2	3	3

Assessment Pattern

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

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
100	40	60	3 Hours

Continuous Internal Evaluation (Out of 40 Marks)

- Continuous Assessment Test 1 (Module 1 and Module 2) : 10 Marks
- Continuous Assessment Test 2 (Module 3 and Module 4) : 10 Marks
- Assignment/Tutorials/Seminars : 12 Marks
- Attendance : 8 Marks

Continuous Assessment Test Pattern (Out of 50 Marks):

There will be two parts - Part A and Part B.

Part A contains 5 questions carrying 2 marks each.

Part B contains 5 questions carrying 8 marks each.

The duration of the Examination is two hours

End Semester Examination Pattern:

There will be two parts, Part A and Part B. Part A contains 10 questions with 2 questions from each Module, carrying 2 marks each. Part B contains 7 questions out of which 5 questions to be answered. (Minimum 1 question from each Module and maximum 2 questions from any 2 Modules). Each question in Part B carries 8 marks and can have maximum 2 sub-divisions.

SYLLABUS

Module 1 [12 Hours]

Overview of Predictive Analytics: Analytics vs. Predictive Analytics, Predictive Analytics vs. Business Intelligence, Predictive Analytics vs. Statistics, Predictive Analytics vs. Data Mining, Challenges in Using Predictive Analytics, Predictive Analytics Processing Steps-CRISP-DM, Defining Data for Predictive Modelling, Defining the Target Variable, Defining Measures of Success for Predictive Models.

Data: Single Variable Summaries, Data Visualization in One Dimension, Data Visualization in Two or Higher Dimensions, The Value of Statistical Significance.

Data Preparation: Variable Cleaning, Feature Creation.

Self-Study: Case Studies "Recovering Lapsed Donors" and "Fraud Detection" described in Ref.: 1

Module 2 [12 Hours]

Itemsets and Association Rules: Concepts and Terminology, Parameter Settings, Data Formats, Measures for Selecting Rules, Deploying Association Rules, Problems with Association Rules, Building Classification Rules from Association Rules.

Descriptive Modeling: Data Preparation Issues with Descriptive Modeling, Principal Component Analysis, Clustering Algorithms, The K-Means Algorithm, The Kohonen SOM Algorithm.

Interpreting Descriptive Models: Standard Cluster Model Interpretation, Problems with Interpretation Methods, Identifying Key Variables in Forming Cluster Models, Cluster Prototypes, Cluster Outliers.

Self-Study: Implement PCA, K-Means and Kohonen SOM algorithms using Python or R.

Module 3 [9 Hours]

Predictive Modeling: Decision Trees, Logistic Regression, Neural Networks, K-Nearest Neighbor, Naïve Bayes - The Naïve Bayes Classifier, Regression Models, Linear Regression.

Assessing Predictive Models: Batch Approach to Model Assessment, Percent Correct Classification, Rank-Ordered Approach to Model Assessment, Assessing Regression Models.

Self-Study: Implement Decision Tree, Logistic Regression, K-NN, Naïve Bayes Classifier and Linear Regression using Python or R.

Module 4 [6 Hours]

Data Visualization: Understanding the Context, Distinction between Exploratory and Explanatory Analysis, Explanatory Analysis and Communication, Whom, What and How to Communicate, Consulting for Context, Storyboarding.

Choosing an Effective Visual: Infographics, Simple Text, Tables, Heatmap, Graphs, Points, Lines, Bars, Area, Graph Types to be Avoided – Pie chart, Donut charts, 3D, Secondary y-axis.

Self-Study: Practice these visualization techniques using Python or R.

Module 5 [6 Hours]

Identifying and Eliminating Cutter: Cognitive Load, Clutter, Gestalt Principles of Visual Perception - Proximity, Similarity, Enclosure, Closure, Continuity, and Connection, Lack of Visual Order, Alignment, White space, Non-strategic use of Contrast, Decluttering.

Audience's Attention: Human Memory, Pre-attentive Attributes - Size, Color, Outline, Bold, Italics, Spacing, Underline, Position on Page, Pre-attentive Attributes in Text and Graphs.

Designer's Perspective: Affordances, Accessibility, Aesthetics, Acceptance.

Self-Study: Review various model visuals from different domains and analyse the thought process and design choices that led to its creation.

Reference Books:

1. Dean Abbott, "Applied Predictive Analytics: Principles and Techniques for the Professional Data Analyst", 1st Edition, Wiley Publications, 2014 (Module I, II & III)
2. Cole Nussbaumer Knaflic, "Storytelling with Data: A Data Visualization Guide for Business Professionals", Wiley Publications, 2015 (Module IV & V)
3. Ashish Kumar, "Learning Predictive Analytics with Python", Packt Publishing
4. Richard V. McCarthy, Mary M. McCarthy, Wendy Ceccucci, Leila Halawi, "Applying Predictive Analytics: Finding Value in Data", Springer Nature, 2019
5. Hayden Van Der Post, "Predictive Analytics: Predict with Python", Reactive Publishing, 2020

6. Eric Siegel, "Predictive Analytics: The Power to Predict Who Will Click, Buy, Lie, or Die", Wiley Publications, 2016
7. Cole Nussbaumer Knaflic, "Storytelling with Data: Let's Practice", Wiley Publications, 2020
8. Dr. Ossama Embarak "Data Analysis and Visualization Using Python" Apress Media, 2018
9. Phuong Vo.T.H, Martin Czygan, Ashish Kumar, Kirthi Raman, "Python: Data Analytics and Visualization", Packt Publishing, 2017

Online Resources:

1. https://onlinecourses.swayam2.ac.in/imb20_mg19/preview, Predictive Analytics by Dinesh Kumar, Indian Institute of Management Bangalore (IIMB)
2. https://onlinecourses.nptel.ac.in/noc23_ma46/preview, Predictive Analytics - Regression and Classification by Prof. Sourish Das, Chennai Mathematical Institute
3. https://onlinecourses.nptel.ac.in/noc19_mg42/preview, Practitioners Course in Descriptive, Predictive and Prescriptive Analytics by Prof. Deepu Philip, Prof. Amandeep Singh Oberoi, IIT Kanpur
4. https://freevideolectures.com/course/4041/nptel-introduction-to-learning-analytics/11, Data Visualization, Prof. Prof. Ramkumar Rajendran, IIT Bombay

Course Contents and Lecture Schedule

NO	Topic	No. of Lecture / Tutorial Hours
Module 1 [12 Hours]		
1.1	Analytics vs. Predictive Analytics, Predictive Analytics vs. Business Intelligence	1
1.2	Predictive Analytics vs. Statistics, Predictive Analytics vs. Data Mining	1
1.3	Challenges in Using Predictive Analytics	1
1.4	Predictive Analytics Processing Steps: CRISP-DM	1
1.5	Defining Data for Predictive Modelling, Defining the Target Variable	1
1.6	Defining Measures of Success for Predictive Models	1
1.7	Single Variable Summaries	1
1.8	Data Visualization in One Dimension	1
1.9	Data Visualization in Two or Higher Dimensions	1
1.10	The Value of Statistical Significance	1
1.11	Variable Cleaning	1
1.12	Feature Creation	1

Module 2 [12 Hours]		
2.1	Concepts and Terminology in Association Rules	1
2.2	Parameter Settings, Data Formats	1
2.3	Measures for Selecting Rules, Deploying Association Rules	1
2.4	Problems with Association Rules, Building Classification Rules from Association Rules	2
2.5	Data Preparation Issues with Descriptive Modeling	1
2.6	Principal Component Analysis	1
2.7	The K-Means Algorithm	1
2.8	The Kohonen SOM Algorithm.	1
2.9	Standard Cluster Model Interpretation, Problems with Interpretation Methods	1
2.10	Identifying Key Variables in Forming Cluster Models	1
2.11	Cluster Prototypes, Cluster Outliers	
Module 3 [9 Hours]		
3.1	Decision Trees	1
3.2	Logistic Regression	2
3.3	Neural Networks	1
3.4	K-Nearest Neighbor	1
3.5	Naïve Bayes - The Naïve Bayes Classifier	1
3.6	Regression Models, Linear Regression	1
3.7	Batch Approach to Model Assessment, Percent Correct Classification, Rank-Ordered Approach to Model Assessment	1
3.8	Assessing Regression Models	1
Module 4 [6 Hours]		
4.1	Data Visualization: Understanding the Context, Distinction between Exploratory and Explanatory Analysis	1
4.2	Explanatory Analysis and Communication, Whom, What and How to Communicate	1
4.3	Consulting for Context, Storyboarding	1
4.4	Infographics, Simple Text, Tables, Heatmap	1
4.5	Graphs, Points, Lines, Bars, Area	1
4.6	Graph Types to be Avoided – Pie chart, Donut charts, 3D, Secondary y-axis	1
Module 5 [6 Hours]		
5.1	Identifying and Eliminating Cutter: Cognitive Load, Clutter	1
5.2	Gestalt Principles of Visual Perception - Proximity, Similarity, Enclosure, Closure, Continuity, and Connection	1
5.3	Lack of Visual Order, Alignment, White space, Non-strategic use of Contrast, Decluttering	1
5.4	Audience's Attention: Human Memory, Pre-attentive Attributes - Size, Color, Outline, Bold, Italics, Spacing, Underline, Position on Page, Pre-attentive Attributes in Text and Graphs	2
5.5	Designer's Perspective: Affordances, Accessibility, Aesthetics, Acceptance	1
	Total Hours	**45**

CO Assessment Questions

Course Outcome 1 (CO1)

1. Compare and contrast the objectives of analytics and predictive analytics. How do they differ in terms of their focus, methodologies, and outcomes? (L2)
2. Discuss the limitations of single variable summaries in capturing the complete picture of a dataset. How can outliers and skewed distributions affect the interpretation of summary statistics? (L2)
3. Imagine you're working with a dataset containing information about stock prices, trading volumes, and market sentiment indicators for multiple companies over a specified time period. Apply data visualization techniques in two or higher dimensions to create a heatmap displaying correlations between different pairs of variables (e.g., correlation between stock prices and trading volumes, correlation between market sentiment indicators and stock prices). Analyze the heatmap to identify any strong correlations or dependencies that could influence investment decisions or portfolio management strategies. (L3)

Course Outcome 2 (CO2)

1. Compare and contrast the concepts of support, confidence, and lift in association rule mining. Discuss how each measure contributes to the identification and evaluation of meaningful patterns in transactional data. (L2)
2. Discuss common data preparation issues encountered in descriptive modeling tasks, such as data cleaning, missing value imputation, and feature scaling. Explain how these issues can impact the performance and interpretability of descriptive models. (L2)
3. Consider a dataset containing gene expression data from cancer patients. Apply the Kohonen Self-Organizing Map (SOM) algorithm to visualize patterns and clusters in the gene expression profiles. Describe the process of training a SOM, interpret the resulting map, and discuss how the identified clusters can be used to gain insights into the molecular subtypes of cancer and guide personalized treatment strategies. (L3)

Course Outcome 3 (CO3)

1. Explain the concept of entropy in the context of decision trees. (L2)
2. Describe the Laplace smoothing technique and its relevance in Naïve Bayes. (L2)

3. Imagine you are a healthcare analyst studying the factors influencing patient readmission rates to hospitals. Apply logistic regression to build a predictive model that identifies the risk factors associated with higher likelihood of readmission. Interpret the coefficients of the logistic regression model and discuss how the model can be used to assess and mitigate readmission risks. (L3)

Course Outcome 4 (CO4)

1. Define explanatory analysis in the context of data visualization. (L1)
2. How does a heatmap visualize data, and in what contexts is it most useful? (L2)
3. Imagine you are preparing a report on employee productivity metrics for the HR department. The report aims to highlight trends in productivity over time and across different departments. Apply your knowledge of graph types to be avoided and select appropriate visualizations to represent the productivity data. Justify your choices by explaining why certain graph types are unsuitable for this specific dataset and audience. (L3)

Course Outcome 5 (CO5)

1. When conducting hypothesis tests on regression coefficients, what are the null and alternative hypotheses? How do p-values help in making decisions about the significance of regression coefficients? (L2)
2. What is sensitivity analysis and why is it conducted in optimization modeling? Discuss one method commonly used to perform sensitivity analysis on optimization models. (L2)
3. You have been provided with a dataset containing information about the monthly sales revenue and advertising expenditure for a retail company over the past year. Apply correlation analysis to determine the strength and direction of the relationship between monthly sales revenue and advertising expenditure. Based on your findings, provide recommendations to the company on how they can optimize their advertising strategy to maximize sales revenue. (L3)

Model Question Paper

QP Code:……. Pages:……..

Reg No.: ……. Name: …….

MAR ATHANASIUS COLLEGE OF ENGINEERING (AUTONOMOUS), KOTHAMANGALAM

SECOND SEMESTER MCA DEGREE EXAMINATION, <Month, Year>

Course Code: M24CA1E204B

Course Name: DATA VISUALIZATION AND PREDICTIVE ANALYTICS

Max. Marks: 60 Duration: 3 Hours

PART A

Answer all questions. Each question carries 2 marks.

1. Define single variable summaries and explain their significance in data analysis. Provide examples of common single variable summaries used in descriptive statistics.
2. Define data cleaning and explain its importance in the data preparation process.
3. How can overfitting affect the quality of association rules?
4. What are some limitations or challenges associated with the K-Means algorithm?
5. Describe the structure of a basic feedforward neural network.
6. How is the value of K chosen in KNN?
7. Write the difference between exploratory and explanatory analysis in data visualization.
8. What are the drawbacks of using 3D graphs for data presentation?
9. What is cognitive load in the context of data visualization?
10. What role do aesthetics play in the acceptance of data visualizations by audiences?

PART B

Answer any five questions. Each question carries 8 marks.

11. Explore the concept of feature engineering and its iterative nature. How does domain knowledge influence the selection and creation of features? Provide examples of feature engineering strategies tailored to specific domains or predictive tasks.
12. Describe the role of principal component analysis (PCA) in data preparation for descriptive modeling. Explain how PCA helps reduce the dimensionality of datasets while preserving as much variance as possible.
13. You are given a dataset containing information about customer demographics,

purchasing behavior, and satisfaction ratings for a retail company. Describe the data preparation steps you would undertake before performing descriptive modeling to understand customer preferences and behaviors. Discuss how you would handle missing values, outliers, and categorical variables in the dataset, and justify your choices.

14. You are working for a marketing department of a retail company and tasked with predicting customer purchase behavior based on demographic and transactional data. Using decision tree analysis, create a predictive model to identify key factors influencing purchase decisions. Evaluate the performance of the decision tree model and discuss the insights gained from analyzing the decision rules.
15. Imagine you are a healthcare analyst studying the factors influencing patient readmission rates to hospitals. Apply logistic regression to build a predictive model that identifies the risk factors associated with higher likelihood of readmission. Interpret the coefficients of the logistic regression model and discuss how the model can be used to assess and mitigate readmission risks.
16. You are tasked with presenting quarterly sales data to the company's board of directors. Considering the audience's preferences for concise and visually appealing information, propose the most effective visual format for presenting the sales data. Justify your choice by discussing the advantages of the selected visual format over other options.
17. Imagine you are creating a presentation to communicate quarterly sales performance to company executives. Apply your understanding of pre-attentive attributes and human memory to design an attention-grabbing slide that highlights key insights and trends in the sales data. Discuss the rationale behind your choice of visual elements and layout to maximize audience engagement and retention.

M24CA1E204C	Data, Text And Web Mining	L	T	P	J	S	Credit	Year of Introduction
		3	1	0	0	3	4	2024

Preamble:

This course intends to provide fundamental principles, tasks, methods, and techniques in the field of data mining. Students will develop a comprehension of the data mining process and its associated challenges, explore diverse data mining techniques, and apply the techniques in solving data mining problems using data mining tools and systems. The course also cover major text and web mining techniques, aimed at developing skills in effectively extracting useful information from the data.

Prerequisite:

It is recommended to have an understanding of Python programming, databases and fundamental algorithms.

Course Outcomes:

After completion of the course the students are able to:

CO No.	Course Outcome	Cognitive Knowledge Level
CO 1	Understand and apply data mining and knowledge discovery techniques, effectively manage and preprocess data and utilize advanced visualization techniques to analyze and interpret large datasets.	Apply
CO 2	Learn the characteristics of data warehousing, design and implement data warehouse schemas, comprehend data warehouse architecture and perform multidimensional data analysis.	Apply
CO 3	Master data mining techniques like association rule mining, classification and clustering. Gain hands-on experience in Python using Scikit-learn and MLxtend libraries for practical implementation.	Apply
CO 4	Understand the fundamentals of web mining principles for effective web information retrieval.	Understand
CO 5	Gain a comprehensive understanding of text mining and natural language processing techniques.	Understand

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO 1	2	2	2					3
CO 2	2	2	2	1			1	3
CO 3	2	2	2	1	1	2	1	3
CO 4	1	1	1	1	1	2	1	3
CO 5	1	1	1		1	2	1	3

Assessment Pattern

Bloom's Category	**Data, Text and Web Mining**		
	Continuous Assessment Tests		**End Semester Examination (Marks %)**
	Test 1 (Marks %)	**Test 2 (Marks %)**	
Remember	**20**	**40**	**20**
Understand	**40**	**60**	**60**
Apply	**40**	XX	**20**
Analyse	XX	XX	XX
Evaluate	XX	XX	XX
Create	XX	XX	XX

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
100	40	60	3 Hours

Continuous Internal Evaluation (Out of 40 Marks):

- Continuous Assessment Test 1(Module1 and Module 2) : 10 Marks
- Continuous Assessment Test 2 (Module3 and Module 4) : 10 Marks
- Assignment / Tutorials / Seminars : 12 Marks
- Attendance : 8 Marks

Continuous Assessment Test Pattern (Out of 50 Marks):

There will be two parts - Part A and Part B.

Part A contains 5 questions carrying 2 marks each.

Part B contains 5 questions carrying 8 marks each.

The duration of the examination is two hours.

End Semester Examination Pattern:

There will be two parts, Part A and Part B. Part A contains 10 questions with 2 questions from each Module, carrying 2 marks each. Part B contains 7 questions out of which 5 questions to be answered. (Minimum 1 question from each Module and maximum 2 questions from any 2 Modules). Each question in Part B carries 8 marks and can have maximum 2 sub-divisions.

SYLLABUS

MODULE 1 [8 Hours]

Introduction: Data mining and knowledge discovery, Data mining functionalities, Classification of data mining systems, Data mining task primitives, Integration of data mining systems.

Data: Types of data, Data sources, Data quality management. Data Preprocessing - Data cleaning, Descriptive data characterization, Data integration and transformation, Dimensionality reduction, Feature subset selection and Binarization. Exploratory Data Analysis - Data visualization techniques, Techniques for visualizing higher dimensional data, Data visualization using Orange.

Self-Study: Ethical and social implications of data mining.

MODULE 2 [6 Hours]

Data Warehousing and OLAP: Characteristics and benefits of a data warehouse, Online Transaction Processing (OLTP), Data warehouse design – schema design, fact and dimension tables, Data modeling. Data warehouse architecture – Three-tier data warehouse architecture, infrastructure and metadata, OLAP server architectures, OLAP operations. ETL processes – Extracting data from various sources, transforming to a suitable format and loading to a target system for analysis, Best practices for efficient data integration and management.

Self-Study: Multidimensional data analysis t-Distributed Stochastic Neighbor Embedding (t-SNE).

MODULE 3 [10 Hours]

Data Mining Techniques: Frequent itemset mining methods – Apriori algorithm, Generating association rules from frequent itemsets, Mining frequent itemsets without candidate generation. Classification - Decision tree induction, Bayesian classification, Rule based algorithms, Support Vector Machines, Neural networks. Clustering – k-Means, Hierarchical algorithms. Python implementation using scikit-learn and MLxtend.

Self-Study: Regression models.

MODULE 4 [11 Hours]

Web Mining: Semantic web, Information retrieval and web search – Information retrieval models, Webpage preprocessing, Inverted index, Latent semantic indexing.

Web search and semantic web mining: Meta search – Combining multiple rankings, Web spamming, Semantic search, Semantic annotation of web resources.

Web crawling: Basic crawler algorithm, Implementation issues, web scraping for data

acquisition, tools for web scraping – Beautiful Soup, ParseHub.

Web usage mining: Discovery and analysis of web usage patterns, Recommender systems and Collaborative filtering.

Self-Study: Vector space model – TFIDF.

MODULE 5 [10 Hours]

Text Mining: Unstructured text, Preprocessing for text mining, Episode rule discovery for texts, Hierarchy of categories, Document clustering, Information extraction, Zero-shot and few-shot learning, AutoML for text mining.

Natural Language Processing: Lexical networks and ontologies, Part-of-Speech and Sense Tagging, Parsing and knowledge representation, Profiles, Personalization, Collaboration, Opinion mining, NLTK library, Word2Vec technique.

Self-Study: Data mining applications.

Reference Books:

1. Alex Berson and Stephen Smith, "Data Warehousing, Data Mining & OLAP", McGraw Hill Education (2017). (Module 2)
2. Bing Liu, "Web Data Mining - Exploring Hyperlinks, Contents and Usage Data", Springer, 2nd Edition (2011).
3. BPB Editorial Board, "Data Mining", BPB publications, 1st Edition (2004).
4. Dushyant Singh Sengar and Vikash Chandra, "Modern Data Mining with Python", BPB Publications, 1st Edition (2021).
5. Jiawei Han, Micheline Kamber and Jian Pei, "Data Mining – Concepts and Techniques", Morgan Kaufmann publishers, 3rd Edition (2012).
6. Margaret H Dunham, "Data Mining – Introductory and Advanced topics", Prentice Hall. (Module IV)
7. Pang-Ning Tan, Michael Steinbach and Vipin Kumar, "Introduction to Data Mining", Pearson Education, 2nd Edition (2019). (Module I)
8. Ricardo Baeza-Yates and Berthier Ribeiro-Neto, "Modern Information Retrieval", Addison-Wesley, 2nd Edition (2011). (Module V)

Online Resources:

1. Christopher Manning, Prabhakar Raghavan. and Hinrich Schutze, "Introduction to Information Retrieval", Cambridge UP Online edition (2009). (DTW)

   https://www.academia.edu/27076940/An_Introduction_to_Information_Retrieval

2. Matthew A Russell, "Mining the social web: Data Mining Facebook, Twitter, LinkedIn, Google+, GitHub and more", O'Reilly, 2nd Edition (2013). (DTW)

   https://pdfroom.com/books/mining-the-social-web-data-mining-facebook-twitter-linkedin-google-github-and-more/KkM5rELO2E3/download

Course Contents and Lecture Schedule

No	Topic	No. of Lecture/ Tutorial Hours
MODULE 1 [8 Hours]		
1.1	Data mining functionalities, Classification of data mining systems	1
1.2	Data mining task primitives, Integration of data mining systems	1
1.3	Types of data, Data sources, Data quality management	1
1.4	Data cleaning, Descriptive data characterization	1
1.5	Data integration and transformation	1
1.6	Dimensionality reduction, Feature subset selection and Binarization	1
1.7	Data visualization techniques, Techniques for visualizing higher dimensional data	1
1.8	BigData visualization using Power BI	1
MODULE 2 [6 Hours]		
2.1	Characteristics and benefits of a data warehouse, Online Transaction Processing (OLTP)	1
2.2	Data warehouse design – schema design, fact and dimension tables	1
2.3	Data modeling	1
2.4	Three-tier data warehouse architecture, infrastructure and metadata	1
2.5	OLAP server architectures, OLAP operations	1
2.6	ETL processes	1
MODULE 3 [10 Hours]		
3.1	Frequent item set mining methods – Apriori algorithm, Generating association rules from frequent item sets	2
3.2	Mining frequent item sets without candidate generation	1
3.3	Decision tree induction, Bayesian classification	2
3.4	Rule based algorithms, Support Vector Machines	1
3.5	Neural networks	1
3.6	k-Means algorithm	1
3.7	Hierarchical algorithms	1
3.8	Python implementation using scikit-learn and MLxtend	1
MODULE 4 [11 Hours]		
4.1	Semantic web, Information retrieval models	1

4.2	Webpage preprocessing	1
4.3	Inverted index, latent semantic indexing	1
4.4	Meta search – combining multiple rankings	1
4.5	Web spamming	1
4.6	Semantic search, Semantic annotation of web resources	1
4.7	Basic crawler algorithm, implementation issues	1
4.8	Web scraping for data acquisition, tools for web scraping – Beautiful Soup, ParseHub	2
4.9	Discovery and analysis of web usage patterns	1
4.10	Recommender systems and Collaborative filtering	1
MODULE 5 [10 Hours]		
5.1	Unstructured text, preprocessing for text mining	1
5.2	Episode Rule Discovery for texts	1
5.3	Hierarchy of categories, document clustering – similarity-based approaches	1
5.4	Information extraction, zero-shot and few-shot learning	1
5.5	AutoML for text mining	1
5.6	Lexical Networks and Ontologies, Part- of- Speech and Sense Tagging	2
5.7	Parsing and Knowledge Representation	1
5.8	Profiles, Personalization, Collaboration	1
5.9	Opinion mining, NLTK library, Word2Vec technique	1
	Total Hours	**45**

CO Assessment Questions

Course Outcome 1 (CO1)

1. Explain the main functionalities of data mining systems and how they contribute to knowledge discovery in databases. (L2)
2. Discuss advanced techniques to represent complex relationships and patterns, addressing challenges of high dimensionality, taking customer transaction data from an E-commerce platform as an example. Propose methods to extract actionable insights from the visualizations. (L3)
3. Apply data cleaning, integration and transformation techniques to a dataset collected from multiple sources. Provide a detailed description of each preprocessing step performed and justify your choice. (L2)

Course Outcome 2 (CO2)

1. How would you leverage the characteristics and benefits of a data warehouse to address specific business challenges? (L2)
2. Discuss the importance of data modeling in the context of designing a data warehouse architecture. Explain how it contribute to the efficiency, flexibility and usability of the data warehouse for analytical purposes. (L3)

3. Discuss the advantages and limitations of different OLAP server architectures and propose strategies for selecting the most suitable architecture based on specific business requirements and data characteristics. (L3)

Course Outcome 3 (CO3)

1. Illustrate the process of hierarchical clustering and how it constructs a hierarchy of clusters through successive merging or splitting. (L2)
2. Describe the role of attribute selection measures, Information Gain and Gini Index, highlighting their importance in selecting the most informative attributes of splitting with a suitable example. (L3)
3. Utilizing the Apriori algorithm, design a step-by-step approach to mine frequent item sets from a transaction dataset containing customer purchase histories. Demonstrate the algorithm's execution to identify the frequent item sets with a minimum support threshold of 0.2. (L3)

Course Outcome 4 (CO4)

1. Explain the concept of semantic web and its significance in organizing and structuring web resources to enable machine understanding and interoperability. (L2)
2. Explain HTML parsing and stemming techniques for web page indexing. (L2)
3. Discuss the basic algorithm for web crawling. (L1)

Course Outcome 5 (CO5)

1. Explain the significance in identifying and extracting structured knowledge from unstructured text data. (L2)
2. How AutoML techniques automate the model selection and optimization process? (L2)
3. Explain the process of parsing and knowledge representation in natural language processing. (L2)

Model Question Paper

QP CODE: Pages: 02

Reg No.: ……. Name: …….

MAR ATHANASIUS COLLEGE OF ENGINEERING (AUTONOMOUS), KOTHAMANGALAM

SECOND SEMESTER M.C.A. DEGREE EXAMINATION, DECEMBER 2024

Course Code: M24CA1E204C

Course Name: DATA, TEXT AND WEB MINING

Max. Marks: 60 Duration: 3 Hours

PART A

Answer all questions. Each question carries 2 marks.

1. How do data mining functionalities contribute to the extraction of useful patterns from large datasets?
2. Explain the various techniques used in data cleaning.
3. What are the primary operations of OLAP? How do they facilitate multidimensional data analysis in data warehousing?
4. Describe the multidimensional data model and explain its significance in facilitating OLAP operations for interactive data analysis.
5. Write Apriori algorithm for mining frequent item sets and explain how it generates association rules from the frequent item sets.
6. How SVM finds the optimal decision boundary?
7. Explain how semantic annotations enable semantic web mining and knowledge discovery.
8. Explain the advantages and challenges of meta-search compared to individual search engines.
9. Explain the process of document clustering in text mining. What is the objective of grouping similar documents together?
10. What is the role of lexical networks and ontologies in organizing lexical knowledge and facilitating semantic understanding?

PART B

Answer any five questions. Each question carries 8 marks.

11. Can data mining systems can be integrated into existing organizational infrastructures and workflows? Discuss the challenges and considerations involved in data integration and explain how integration enhances the effectiveness and utility of data mining systems.
12. Explain the architecture of a three-tier data warehousing system. How each tier contribute to the overall functionality and performance of the data warehousing environment?

13. Discuss the key components and principles of decision tree induction in classification including tree pruning techniques. Compare and contrast the advantages and limitations of decision tree induction with Naïve Bayesian classification.
14. Explain the extraction of if-then rules from decision tree. How rule based algorithms utilize these rules for classification tasks and how they interpret the decision logic embedded within the rules?
15. Explain how Beautiful Soup can be used for web scraping in Python? Describe the basic steps involved in extracting specific information from a web page.
16. Explain the basic crawler algorithm used in web crawling. How web crawlers navigate the web by following hyperlinks from one web page to another, recursively collecting and indexing web pages for further processing?
17. How parsing and knowledge representation techniques are utilized in NLP tasks? Explain the role of parsing algorithms in analyzing the grammatical structure of sentences and parsing them into syntactic components.

M24CA1E204D	Cloud Computing	L	T	P	J	S	Credit	Year of Introduction
		3	1	0	0	3	4	2024

Preamble:

The primary goal of this course is to provide a comprehensive understanding of cloud computing's fundamental concepts and infrastructure. It covers the evolution and characteristics of cloud computing, and delves into various service models (IaaS, PaaS, SaaS) and deployment models (public, private, hybrid, community clouds). The course also examines virtualization technologies, cloud service providers, and the architecture of data centers. It emphasizes cloud application design principles, scalability, elasticity, and fault tolerance. Additionally, the course explores advanced topics such as edge computing, AI, blockchain, and the ethical and legal considerations in cloud computing.

Prerequisite:

Basic knowledge on computer architecture and networking.

Course Outcomes:

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

CO. No	Course Outcomes	Cognitive Knowledge Level
CO 1	Understand the basic structure of cloud computing	Understand
CO 2	Understand cloud computing architecture and principles	Understand
CO 3	Understand advanced cloud computing platforms used in the industry	Understand
CO 4	Apply CI/CD pipelines in cloud application deployment	Apply
CO 5	Understand advanced tools and technologies in cloud computing.	Understand

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO 1	2	2	2	1	3	1	1	
CO 2	2	2	2	1	3	1	1	
CO 3	2	2	2	1	3	2	1	2
CO 4	2	2	2	1	3	2	1	2
CO 5	2	2	2	1	3	1		1

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination (Marks%)
	Test 1 (Marks %)	Test 2 (Marks %)	
Remember	60	24	24
Understand	40	60	60
Apply	XX	16	16
Analyze	XX	XX	XX
Evaluate	XX	XX	XX
Create	XX	XX	XX

Mark Distribution

Total Marks	CIE marks	ESE marks	ESE Duration
100	40	60	3 Hours

Continuous Internal Evaluation (Out of 40 Marks)

- Continuous Assessment Test 1(Module 1 and Module 2) : 10 Marks
- Continuous Assessment Test 2 (Module 3 and Module 4) : 10 Marks
- Assignment/Tutorials/Seminars : 12 Marks
- Attendance : 8 Marks

Continuous Assessment Test Pattern (Out of 50 Marks):

There will be two parts - Part A and Part B.
Part A contains 5 questions carrying 2 marks each.
Part B contains 5 questions carrying 8 marks each.
Duration of the examination is two Hours

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each Module, carrying 2 marks each. Part B contains 7 questions out of which 5 questions to be answered. (Minimum 1 question from each Module and maximum 2 questions from any 2 Modules). Each question in Part B carries 8 marks and can have maximum 2 sub- divisions.

SYLLABUS

Module 1 [12 Hours]

Overview and Infrastructure of Cloud Computing: Overview of Cloud Computing, Evolution of Cloud Computing, Characteristics of Cloud Computing - Service Models: IaaS, PaaS, SaaS.

Deployment Models: Public, Private, Hybrid, Community Clouds, Virtualization Technologies, Cloud Service Providers, Data Centers and Infrastructure as a Service (IaaS), Networking in the Cloud.

Storage Technologies: Object, Block, File Storage, Security and Compliance in Cloud

Infrastructure.

Self-Study: Familiarise any on cloud computing platform AWS, Azure and GCT.

Module 2 [8 Hours]

Cloud Reference Architecture: Components, Patterns and Best practices, Cloud Frameworks, AWS Well-Architected Framework. Design Principles for Cloud Applications - Microservices, Serverless computing and Containerization. Scalability, Elasticity, and High Availability, Load Balancing, Auto-scaling and Redundancy, Fault Tolerance and Resilience.

Self-Study: Compare Cloud Architectures of AWS, Azure and GCT.

Module 3 [9 Hours]

Introduction to Platform as a Service (PaaS): Components of PaaS Providers, AWS- Elastic Beanstalk, Lambda. Google Cloud-App Engine, Cloud Functions, Kubernetes Engine. Microsoft Azure- App Service, Functions, Kubernetes Service. Containerization and Orchestration, Docker, Kubernetes, Serverless Computing, AWS Lambda, Azure Functions, Google Cloud Functions.

Big Data and Analytics in the Cloud: Introduction, Cloud-Based Services, Data Analytics Tools, Use Cases.

Self-Study: Create a virtual machine and try to install software.

Module 4 [10 Hours]

Cloud Applications Development and Management: Software Development Lifecycle in the Cloud, DevOps Practices, Continuous Integration and Continuous Deployment (CI/CD), Cloud-native Applications Development, Cloud Resource Management, Cloud Cost Management & Optimization, Understanding cloud billing models, Cost tracking and analysis tools.

Self-Study: Strategies for optimizing cloud spending, Rightsizing instances and resources, Reserved instances and savings plans.

Module 5 [6 Hours]

Advanced Topics in Cloud Computing: Emerging Trends in Cloud Computing, Edge Computing and Internet of Things (IoT), Artificial Intelligence and Machine Learning in the Cloud, Blockchain Technology in the Cloud, Ethical and Legal Considerations in Cloud Computing.

Self-Study: Security implementations in cloud computing.

Reference Books:

1. Thomas Erl, Zaigham Mahmood, Ricardo Puttini, "Cloud Computing: Concepts, Technology & Architecture", Prentice Hall, 1st Edition, 2013(Module 1 and 3)
2. Rajkumar Buyya, James Broberg, Andrzej M. Goscinski, "Cloud Computing: Principles and Paradigms", Wiley, 1st Edition,2011(Module 1)
3. Bill Wilder, "Cloud Architecture Patterns: Using Microsoft Azure", O'Reilly Media, 1st Edition, 2012(Module 2)
4. Michael J. Kavis, "Architecting the Cloud: Design Decisions for Cloud Computing Service Models (SaaS, PaaS, and IaaS)", Wiley, 1st Edition, 2014(Module 2)
5. Rajkumar Buyya, Christia Becchiola, S. Thamari Selvi "Mastering Cloud Computing: Foundations and Applications Programming, Morgan Kaufmann, Illustrated Edition, 2013(Module 3 & 5)
6. Judith S. Hurwitz, Robin Bloor, Marcia Kaufman, Fern Halper, "Cloud Computing for Dummies", For Dummies, 1st Edition, 2010(Module 4)
7. Martin Kleppmann, "Designing Data-Intensive Applications: The Big Ideas Behind Reliable, Scalable, and Maintainable Systems", O'Reilly Media, 1st Edition, 2017(Module 4)
8. K Anitha Kumari, G Sudha Sadasivam, D Dharani, M Nirangana Murthy "Edge Computing Fundamentals, Advances and Applications", CRC Press, 1st Edition, 2022(Module 5)
9. Michael Miller, "The Internet of Things: How Smart TVs, Smart Cars, Smart Homes, and Smart Cities Are Changing the World", Que Publishing, 1st Edition, 2015(Module 5)
10. M. Sudheep Elayidom, Sarith Divakar, Lija Mohan,Tanmay Kumar Pandey and Shubham Agarwal " Cloud computing and bigdata: From the basics to practical usecases, first edition July 2024, Cengage learning (Module 5)
11. Daniel Drescher, "Blockchain Basics: A Non-Technical Introduction in 25 Steps", Apress, 1st Edition, 2017(Module 5)

Online Resources:

1. Cloud Computing(NPTEL) https://nptel.ac.in/courses/106105167
2. Cloud Computing and Distributed Systems(NPTEL)

   https://onlinecourses.nptel.ac.in/noc21_cs1

Course Contents and Lecture Schedule

NO	Topic	No. of Lecture/Tutorial Hours
Module 1 [12 Hours]		
1.1	Introduction to Cloud Computing	2
1.2	Evolution of Cloud Computing	1
1.3	Characteristics of Cloud Computing	1
1.4	Service Models: IaaS, PaaS, SaaS	2
1.5	Deployment Models: Public, Private	1
1.6	Hybrid, Community Clouds	1
1.7	Virtualization Technologies Cloud Service Providers	1

1.8	Data Centers and Infrastructure as a Service (IaaS)	1
1.9	Networking in the Cloud Storage Technologies: Object, Block, File Storage	1
1.10	Security and Compliance in Cloud Infrastructure	1
Module 2 [8 Hrs]		
2.1	Introduction to Cloud Reference Architecture: Components	1
2.2	Patterns and Best Practices	1
	Cloud Frameworks-AWS Well-Architected Framework	1
2.3	Design Principles for Cloud Applications: Introduction and Microservices	1
2.4	Serverless computing	1
	Containerization	1
2.5	Scalability, Elasticity, and High Availability, Load Balancing, Auto-scaling and Redundancy	1
2.6	Fault Tolerance and Resilience	1
Module 3 [9 Hours]		
3.1	Introduction to Platform as a Service (PaaS): Components of PaaS Providers	1
3.2	AWS: Elastic Beanstalk, Lambda	1
3.3	Google Cloud: App Engine, Cloud Functions, Kubernetes Engine	1
3.4	Microsoft Azure: App Service, Functions, Kubernetes Service.	1
3.5	Containerization and Orchestration: Docker	1
3.6	Kubernetes	1
3.7	Serverless Computing: AWS Lambda, Azure Functions, Google Cloud Functions	1
3.8	Big Data and Analytics in the Cloud: Introduction, Cloud-Based Services	1
3.9	Data Analytics Tools, Use Cases	1
Module 4 [10 Hours]		
4.1	Cloud Applications Development and Management: Software Development Lifecycle in the Cloud	1
4.2	DevOps Practices	1
4.3	Continuous Integration and Continuous Deployment (CI/CD)	1
4.4	Cloud-native Applications Development	1
4.5	Cloud Resource Management	2
4.6	Cloud Cost Management & Optimization	1
4.7	Understanding cloud billing models	2
4.8	Cost tracking and analysis tools	1
Module 5 [6 Hours]		
5.1	Advanced Topics in Cloud Computing: Emerging Trends in Cloud Computing	2
5.2	Edge Computing and Internet of Things (IoT)	1
5.3	Artificial Intelligence and Machine Learning in the Cloud	1

5.4	Blockchain Technology in the Cloud	1
5.5	Ethical and Legal Considerations in Cloud Computing	1
	Total Hours	**45**

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO1):

1. Write a short note on the characteristics cloud computing. (L2)
2. Explain PaaS. (L2)
3. How Infrastructure as a Service is related to Data Centers? Explain. (L2)

Course Outcome 2 (CO2):

1. What are the design principles of cloud computing? (L2)
2. How load balancing implemented in cloud computing? (L2)
3. With a diagram, explain cloud reference architecture. (L2)

Course Outcome 3 (CO3):

1. Write a short note on Lambda in AWS. (L2)
2. Explain data analytics tools used in cloud computing. (L2)
3. With a diagram, explain the components of Google cloud. (L2)

Course Outcome 4 (CO4):

1. Explain the software development life cycle in cloud computing. (L2)
2. Write short notes on the billing models in cloud computing. (L2)
3. An organisation ABC is concerned about the raising cost of running applications in the cloud. Develop a plan to optimise the cloud cost which includes,
   a. Identifying and eliminating wasteful cloud resource usage.
   b. Utilizing cost management tools and practices to maintain budget adherence.

   Also propose a long-term strategic document to ensure sustainable cost efficiency. (L3)

Course Outcome 5 (CO5):

1. Write a short note on complex event processing. (L2)
2. What is stream processing? (L2)
3. How security and privacy implemented in cloud computing? Explain. (L2)

Model Question Paper

QP CODE: Pages: 02

Reg No.:…… Name: ……

MAR ATHANASIUS COLLEGE OF ENGINEERING (AUTONOMOUS), KOTHAMANGALAM
SECOND SEMESTER M.C.A DEGREE EXAMINATION, DECEMBER 2024
Course Code: M24CA1E204D
Course Name: Fundamentals of Cloud Computing
Max. Marks: 60 Duration: 3 Hours

PART A
Answer all questions. Each question carries 2 marks.

1. Write a short note on the main service models of cloud computing.
2. Differentiate public and private clouds.
3. Explain elasticity in cloud architecture.
4. Write a short note on serverless computing.
5. What are the uses of Kubernetes in cloud service providers?
6. Write a short note on dockers.
7. Is there any relevance of version control system in continues deployment? Justify your answer.
8. What are the mechanisms used for managing cost in cloud?
9. Write a short note on stream processing.
10. Explain complex event processing.

PART B
Answer any five questions. Each question carries 8 marks.

11. Compare and contrast IaaS, PaaS and SaaS service models with an example.
12. What is a data center? What are the roles of data centers? Explain the infrastructure of data centers.
13. With the help of a diagram, explain the components of the cloud reference architecture.
14. With a proper architecture diagram, explain the components of AWS cloud.
15. Explain the DevOps practices in cloud computing.

16. An organisation ABC is concerned about the rising cost of running applications in the cloud. Develop a plan to optimise the cloud cost which includes,
    i. Identifying and eliminating wasteful cloud resource usage.
    ii. Utilizing cost management tools and practices to maintain budget adherence.

    Also propose a long-term strategic document to ensure sustainable cost efficiency.
17. How blockchain technology can be implemented in distributed system? Explain

M24CA1E204E	Distributed Computing	L	T	P	J	S	Credit	Year of Introduction
		3	1	0	0	3	4	2024

Preamble:

The primary goal of this course is to provide a comprehensive understanding of cloud computing's fundamental concepts and infrastructure of distributed computing. Students will progress to understanding distributed systems architecture, cloud integration, distributed algorithms, and various cloud platforms and tools. The course will provide an overall idea on topics such as edge computing, Internet of Things, blockchain, and emerging trends in distributed computing and cloud technology.

Prerequisite:

Basic knowledge on computer architecture and networking.

Course Outcomes:

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

CO. No	Course Outcomes	Cognitive Knowledge Level
CO 1	Understand the basic structure of cloud computing	Understand
CO 2	Understand cloud computing architecture and principles	Understand
CO 3	Apply distributed algorithms in designing resilient distributed system.	Apply
CO 4	Understand cloud computing and its role in distributed computing environments with modern platforms.	Understand
CO 5	Understand advanced tools and technologies in cloud computing.	Understand

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO 1	2			1	2	1	1	
CO 2	2	1	1	1	1	1	1	
CO 3	2	3	3	2	2	1		2
CO 4			1	3				1
CO 5			1	3	1	1		1

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End SemesterExamination (Marks%)
	Test 1 (Marks %)	Test 2 (Marks %)	
Remember	60	24	24
Understand	40	60	60
Apply	XX	16	16
Analyze	XX	XX	XX
Evaluate	XX	XX	XX
Create	XX	XX	XX

Mark distribution

Total Marks	CIE marks	ESE marks	ESE Duration
100	40	60	3 Hours

Continuous Internal Evaluation (Out of 40 Marks)

- Continuous Assessment Test 1 (Module 1 and Module 2) : 10 Marks
- Continuous Assessment Test 2 (Module 2 and Module 3) : 10 Marks
- Assignment/Tutorials/Seminars : 12 Marks
- Attendance : 8 Marks

Continuous Assessment Test Pattern (Out of 50 Marks):

There will be two parts - Part A and Part B.
Part A contains 5 questions carrying 2 marks each.
Part B contains 5 questions carrying 8 marks each.
The Duration of the examination is two hours

End Semester Examination Pattern:

There will be two parts, Part A and Part B. Part A contains 10 questions with 2 questions from each Module, carrying 2 marks each. Part B contains 7 questions atof which 5 questions to be answered. (Minimum 1 question from each Module and maximum 2 questions from any 2 Modules). Each question in Part B carries 8 marks and can have maximum 2 sub- divisions.

SYLLABUS

Module 1 [12 Hours]

Overview and Infrastructure of Cloud Computing: Overview of Cloud Computing, Evolution of Cloud Computing, Characteristics of Cloud Computing - Service Models: IaaS, PaaS, SaaS.

Deployment Models: Public, Private, Hybrid, Community Clouds, Virtualization Technologies, Cloud Service Providers, Data Centers and Infrastructure as a Service (IaaS), Networking in the Cloud.

Storage Technologies: Object, Block, File Storage, Security and Compliance in Cloud Infrastructure.

Self-Study: Familiarise any on cloud computing platform AWS, Azure and GCT.

Module 2 [8 Hours]

Cloud Reference Architecture: Components, Patterns and Best practices, Cloud Frameworks, AWS Well-Architected Framework, Design Principles for Cloud Applications - Microservices, Serverless computing and Containerization. Scalability, Elasticity, and High Availability, Load Balancing, Auto-scaling and Redundancy, Fault Tolerance and Resilience.

Self-Study: Compare Cloud Architectures of AWS, Azure and GCT.

Module 3 [12 Hours]

Distributed Computing: Introduction to Distributed System, Architecture, Principles of Distributed Computing, Synchronization and Coordination

Consensus Algorithms: Paxos, Raft, Cryptographic Consensus Algorithms, Proof of Work, Proof of Stake, Delegated Proof of Stake, Practical Byzantine Fault Tolerance.

Fault Tolerance Mechanisms.

Self-Study: Challenges in Distributed Computing

Module 4 [7 Hours]

Cloud Platforms and Tools for Distributed Computing: Cloud Service Models - IaaS, PaaS, SaaS. Popular Cloud Providers - AWS, Google Cloud, Microsoft Azure, Middleware Technologies.

Message Brokers and Queuing Systems, Distributed Data Structures, Distributed File Systems, Distributed Databases, Containerization and Orchestration.

Self-Study:

Module 5 [6 Hours]

Advanced Topics in Cloud Computing: Emerging Trends in Cloud Computing, Edge Computing and Internet of Things (IoT), Artificial Intelligence and Machine Learning in the Cloud, Blockchain Technology in the Cloud, Ethical and Legal Considerations in Cloud Computing.

Self-study: Security Implementations in cloud computing.

Reference Books:

1. Thomas Erl, Zaigham Mahmood, Ricardo Puttini, "Cloud Computing: Concepts, Technology & Architecture", Prentice Hall, 1st Edition, 2013(Module 1)
2. Rajkumar Buyya, James Broberg, Andrzej M. Goscinski, "Cloud Computing: Principles and Paradigms", Wiley, 1st Edition,2011(Module 1)
3. Bill Wilder, "Cloud Architecture Patterns: Using Microsoft Azure", O'Reilly Media, 1st Edition, 2012(Module 2)
4. Michael J. Kavis, "Architecting the Cloud: Design Decisions for Cloud Computing Service Models (SaaS, PaaS, and IaaS)", Wiley, 1st Edition, 2014(Module 2)
5. Andrew S. Tanenbaum, Maarten Van Steen, "Distributed Systems: Principles and Paradigms", Pearson, 2nd Edition, 2006(Module 3)
6. Wan Fokkink, "Distributed Algorithms: An Intuitive Approach", The MIT Press, 2nd Edition, 2013(Module 3)
7. Judith S. Hurwitz, Robin Bloor, Marcia Kaufman, Fern Halper, "Cloud Computing for Dummies", For Dummies, 1st Edition, 2010(Module 4)
8. Martin Kleppmann, "Designing Data-Intensive Applications: The Big Ideas Behind Reliable, Scalable, and Maintainable Systems", O'Reilly Media, 1st Edition, 2017(Module 4)
9. K Anitha Kumari, G Sudha Sadasivam, D Dharani, M Nirangana Murthy “Edge Computing Fundamentals, Advances and Applications”, CRC Press, 1st Edition, 2022(Module 5)
10. Michael Miller, "The Internet of Things: How Smart TVs, Smart Cars, Smart Homes, and Smart Cities Are Changing the World", Que Publishing, 1st Edition, 2015(Module 5)
11. Daniel Drescher, "Blockchain Basics: A Non-Technical Introduction in 25 Steps", Apress, 1st Edition, 2017(Module 5)

Online Resources:

1. Cloud Computing and Distributed Systems(NPTEL) https://onlinecourses.nptel.ac.in/noc21_cs1

Course Contents and Lecture Schedule

NO	Topic	No. of Lecture/Tutorial Hours
Module 1 [12 Hours]		
1.1	Introduction to Cloud Computing	2
1.2	Evolution of Cloud Computing	1
1.3	Characteristics of Cloud Computing	1
1.4	Service Models: IaaS, PaaS, SaaS	2
1.5	Deployment Models: Public, Private	1
1.6	Hybrid, Community Clouds	1
1.7	Virtualization Technologies Cloud Service Providers	1
1.8	Data Centers and Infrastructure as a Service (IaaS)	1
1.9	Networking in the Cloud Storage Technologies: Object, Block, File Storage	1
1.10	Security and Compliance in Cloud Infrastructure	1

Module 2 [8 Hrs]		
2.1	Introduction to Cloud Reference Architecture: Components	1
2.2	Patterns and Best Practices	1
	Cloud Frameworks-AWS Well-Architected Framework	1
2.3	Design Principles for Cloud Applications: Introduction and Microservices	1
2.4	Serverless computing	1
	Containerization	1
2.5	Scalability, Elasticity, and High Availability, Load Balancing, Auto-scaling and Redundancy	1
2.6	Fault Tolerance and Resilience	1
Module 3 [12 Hours]		
3.1	Introduction to Distributed System,	1
3.2	Architecture, Principles of Distributed Computing,	2
3.3	Synchronization and Coordination	1
3.4	Consensus Algorithms : Paxos	1
3.5	Raft	1
3.6	Cryptographic Consensus Algorithms	1
3.7	Proof of Work	1
3.8	Proof of Stake	1
3.9	Delegated Proof of Stake	1
3.10	Practical Byzantine Fault Tolerance.	1
3.11	Fault Tolerance Mechanisms.	1
Module 4 [7 Hours]		
4.1	Cloud Platforms and Tools for Distributed Computing : Cloud Service Models - IaaS, PaaS, SaaS	1
4.2	Popular Cloud Providers: AWS, Google Cloud, Microsoft Azure	1
4.3	Middleware Technologies	1
4.4	Message Brokers and Queuing Systems	1
4.5	Distributed Data Structures, Distributed File Systems, Distributed Databases	2
4.6	Containerization and Orchestration	1
Module 5 [6 Hours]		
5.1	Advanced Topics in Cloud Computing: Emerging Trends in Cloud Computing	2
5.2	Edge Computing and Internet of Things (IoT)	1
5.3	Artificial Intelligence and Machine Learning in the Cloud	1
5.4	Blockchain Technology in the Cloud	1
5.5	Ethical and Legal Considerations in Cloud Computing	1
	Total Hours	**45**

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO1):

1. Write a short note on the characteristics cloud computing. (L2)
2. Explain PaaS. (L2)
3. How Infrastructure as a Service is related to Data Centers? Explain.(L2)

Course Outcome 2 (CO2):

1. What are the design principles of cloud computing? (L2)
2. What fault tolerance? (L2)
3. With a diagram, explain cloud reference architecture. (L2)

Course Outcome 3 (CO3):

1. What is the role of a message broker in distributed computing? (L2)
2. Write a short note on distributed file system. (L2)
3. Imagine you're designing a distributed system for a global e-commerce platform. Explain how you would incorporate fault tolerance mechanisms to ensure reliability and robustness. Compare and contrast the various consensus algorithms, recommending the most suitable algorithm for your system and justifying your choice. (L3)

Course Outcome 4 (CO4):

1. What is stream processing? (L2)
2. What is Complex Event Processing? (L2)
3. How blockchain technology can be implemented in distributed system? Explain. (L2)

Course Outcome 5 (CO5):

1. Write a short note on complex event processing. (L2)
2. What is stream processing? (L2)
3. How security and privacy implemented in cloud computing? Explain. (L2)

Model Question Paper

QP CODE: Pages:02

Reg No.: ……. Name:……..

MAR ATHANASIUS COLLEGE OF ENGINEERING (AUTONOMOUS), KOTHAMANGALAM
SECOND SEMESTER M.C.A DEGREE EXAMINATION, DECEMBER 2024
Course Code: M24CA1E204E

Course Name: Distributed Computing

Max. Marks: 60 Duration: 3 Hours

PART A
Answer all questions. Each question carries 2 marks.

1. Write a short note on the main service models of cloud computing.
2. Differentiate public and private clouds.
3. Explain elasticity in cloud architecture.
4. Write a short note on consensus algorithms.
5. Which are the synchronization mechanisms used in distributed systems? Explain.
6. What is CAP theorem?
7. With an example, explain distributed file systems.
8. What is middleware?
9. Write a short note on stream processing.
10. Explain complex event processing.

PART B
Answer any five questions. Each question carries 8 marks.

11. Compare and contrast IaaS, PaaS and SaaS service models with an example.
12. What is a data center? What are the roles of data centers? Explain the infrastructure of data centers.
13. Write a short note on the resilience in cloud architecture. Discuss the significance of it also.
14. With an example, explain the fault tolerance mechanism in distributed system.
15. Imagine you're designing a distributed system for a global e-commerce platform. Explain how you would incorporate fault tolerance mechanisms to ensure reliability and robustness. Compare and contrast the various consensus algorithms,

recommending the most suitable algorithm for your system and justifying your choice.?

16. Compare AWS and Google Cloud in terms of services and tools they offer.
17. How blockchain technology can be implemented in distributed system? Explain

M24CA1E204F	Cloud Cost Management & Optimization	L	T	P	J	S	Credit	Year of Introduction
		3	1	0	0	3	4	2024

Preamble:

This course gives insights to the principles for achieving sustainable growth by following the best practices of cloud cost management, optimized resource allocation, enhanced visibility, control, operational efficiency and strategic decision-making.

Prerequisite:

Basic knowledge in computer architecture and networking

Course Outcomes:

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

CO No	Course Outcomes	Cognitive Knowledge Level
CO 1	Understanding of cloud computing fundamentals, cloud adoption, deployment and management in the organizations.	Understand
CO 2	Understanding of cloud billing models, optimize cloud costs and decision making.	Understand
CO 3	Understand how to track, analyze and manage cloud costs, ensure financial efficiency and strategic alignment with organizational goals.	Understand
CO 4	Apply best practices to optimize cloud spending for effectively manage cloud infrastructure.	Apply
CO 5	Understand cloud cost governance and policies, managing costs efficiently in multi-cloud and hybrid environments, optimize costs for serverless architectures, utilize machine learning and AI for accurate cost prediction and optimization, anticipate and adapt to future trends in cloud cost management.	Understand

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO 1	2	2	2	3	2	2	2	2
CO 2	2	2	2	3	2	2	2	2
CO 3	2	2	2	3	2	2	2	2
CO 4	2	2	2	3	3	2	2	2
CO 5	2	2	2	3	2	2	2	2

Assessment Pattern

Cloud Cost Management & Optimization			
Bloom's Category	Continuous Assessment Tests		End Semester Examination (Marks%)
	Test 1 (Marks%)	Test 2 (Marks%)	
Remember	12	8	7
Understand	88	76	80
Apply	XX	16	13
Analyse	XX	XX	XX
Evaluate	XX	XX	XX
Create	XX	XX	XX

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
100	40	60	3 Hours

Continuous Internal Evaluation (Out of 40 Marks)

- Continuous Assessment Test 1 (Module 1 and Module2) : 10 Marks
- Continuous Assessment Test 2 (Module 3 and Module 4) : 10 Marks
- Assignment/Tutorials/Seminars : 12 Marks
- Attendance : 8 Marks

Continuous Assessment Test Pattern (Out of 50 Marks)

There will be two parts-Part A and Part B.

Part A contains 5 questions carrying 2 marks each.

Part B contains 5 questions carrying 8 marks each.

The duration of the examination is two hours

End Semester Examination Pattern:

There will be two parts, Part A and Part B. Part A contains 10 questions carrying 2 marks each. Part B contains 7 questions from each Module out of which 5 questions to be answered (Minimum 1 question from each Module and maximum 2 questions from any 2 Modules). Each question carries 8 marks and can have maximum 2 sub-divisions.

SYLLABUS

MODULE 1 [10 Hours]

Overview of Cloud Computing: Evolution of Cloud Computing, Characteristics of Cloud Computing, Service Models- IaaS, PaaS, SaaS, Deployment Models-Public, Private, Hybrid, Community Clouds.

Infrastructure for Cloud Computing, Virtualization Technologies, Cloud Service Providers, Data Centers and Infrastructure as a Service (IaaS), Networking in the Cloud, Storage Technologies- Object, Block, File Storage, Security and Compliance in Cloud Infrastructure.

Self-Study: Containerization and Orchestration, Data Encryption and Key Management.

MODULE 2 [8 Hours]

Cloud Billing Models: Types of Cloud Pricing Models- On-demand, Reserved, Spot, Billing Metrics and Units- Compute, Storage, Data Transfer, Pricing Comparison Across Cloud Providers, Cost Management Tools and Dashboards.

Self-Study: Cloud Cost Components, Cost Allocation, Cloud Cost Allocation Tools and Platforms.

MODULE 3 [10 Hours]

Cost Tracking and Analysis: Cost Allocation Tags and Labels, Granular Cost Analysis- Service-level, Resource-level, Cost Reporting and Visualization Techniques, Forecasting and Budgeting.

Self-Study: Cloud Cost Analysis Tools and Platforms, Analyzing Cost Trends and Patterns, Cloud Cost Forecasting Tools and Platforms.

MODULE 4 [10 Hours]

Cloud Cost Optimization Strategies: Strategies for Optimizing Cloud Spending, Rightsizing Instances and Resources, Autoscaling and Elasticity, Spot Instances and Savings Plans, Resource Utilization and Efficiency, Cost Optimization Best Practices.

Self-Study: Reserved Instances and Savings Plans, Spot Instances and Preemptible VMs.

MODULE 5 [7 Hours]

Cloud Cost Management: Cloud Cost Governance and Policies, Managing Costs in Multi-cloud and Hybrid Environments, Cost Optimization for Serverless Architectures, Machine Learning and AI for Cost Prediction and Optimization, Future Trends in Cloud Cost Management & Optimization.

Self-Study: Cost Governance Platform, Cost Optimization Automation- Automation Tools and

Services, Implementation Strategies, Compliance Features and Tools.

Reference Books:

1. "Cloud Computing: Concepts, Technology & Architecture" by Thomas Erl, Ricardo Puttini, and Zaigham Mahmood - Published by Pearson (oreilly) in May 2013.
2. "Cloud Financial Management Guide: How to Plan, Organize and Control Cloud Operations Costs" by John R. Griffith, published in its 1st edition in July 2021
3. "Cloud Cost Optimization: Methods and Strategies for Reducing Costs in the Cloud" by Mike Amundsen, published in its 1st edition in May 2022
4. "Practical Guide to Cloud Cost Management" by Timothy Chou, published in its 1st edition in November 2021
5. "Cloud Cost Management: Effective Strategies for Optimizing Cloud Costs" by Ravi Madabhushanam, (2023)
6. "Optimizing Cloud Costs: Implementing Effective Governance, DevOps, and IT Financial Management" by Ajay Budhraja, (2023)

Online Resources:

1. https://www.youtube.com/watch?v=sswLpKeAoxs
2. https://www.youtube.com/watch?v=leDfPdXHDzs
3. https://www.youtube.com/watch?v=KQYnPXvq8jI
4. https://www.youtube.com/watch?v=6wqGFva6gZA
5. https://www.youtube.com/watch?v=OKYJCHHSWb4

Course Contents and Lecture Schedule

SL. No	Topics	No. of Lecture/Tutorial Hours
Module 1 [10 Hours]		
1.1	Overview of Cloud Computing	1
1.2	Evolution of Cloud Computing	1
1.3	Characteristics of Cloud Computing	1
1.4	Service Models and Deployment Models	1
1.5	Community Clouds	1
1.6	Infrastructure for Cloud Computing	1
1.7	Virtualization Technologies	1
1.8	Cloud Service Providers, Data Centers and Infrastructure as a Service (IaaS)	1

1.9	Networking in the Cloud, Storage Technologies- Object, Block, File Storage	1
1.10	Security and Compliance in Cloud Infrastructure	1
Module 2 [8 Hours]		
2.1	Cloud Billing Models	1
2.2	Types of Cloud Pricing Models- On-demand, Reserved, Spot	2
2.3	Billing Metrics and Units- Compute, Storage	2
2.4	Data Transfer	1
2.5	Pricing Comparison Across Cloud Providers	1
2.6	Cost Management Tools and Dashboards	1
Module 3 [10 Hours]		
3.1	Cost Tracking and Analysis	1
3.2	Cost Allocation Tags and Labels	2
3.3	Granular Cost Analysis	1
3.4	Service-level	1
3.5	Resource-level	1
3.6	Cost Reporting and Visualization Techniques	2
3.7	Forecasting	1
3.8	Budgeting	1
Module 4 [10 Hours]		
4.1	Strategies for Optimizing Cloud Spending	1
4.2	Rightsizing Instances and Resources	1
4.3	Autoscaling and Elasticity	2
4.4	Spot Instances and Savings Plans	2
4.5	Resource Utilization and Efficiency	2
4.6	Cost Optimization Best Practices	2
Module 5 [7 Hours]		
5.1	Advanced Topics in Cloud Cost Management & Optimization	1
5.2	Cloud Cost Governance and Policies	1

5.3	Managing Costs in Multi-cloud and Hybrid Environments	1
5.4	Cost Optimization for Serverless Architectures	2
5.5	Machine Learning and AI for Cost Prediction and Optimization	1
5.6	Future Trends in Cloud Cost Management & Optimization	1
	Total Hours	**45**

CO Assessment Questions

Course Outcome 1 (CO1)

1. What are the main service models of cloud computing? (L2)
2. What are the differences between public and private IP addresses in cloud networks? (L2)
3. How do cloud providers ensure the security of data in transit and at rest? (L2)

Course Outcome 2 (CO2)

1. How is the pricing model structured for cloud services? (L2)
2. What tools are available for managing and optimizing cloud costs? (L2)
3. How do cost management tools help in budgeting and forecasting cloud expenses? (L2)

Course Outcome 3 (CO3)

1. What are the primary components of a cost tracking and analysis system? (L2)
2. What types of reports are typically generated by cost tracking tools? (L2)
3. How do cost management tools handle multi-cloud cost tracking and reporting? (L2)

Course Outcome 4 (CO4)

1. How do cloud providers determine the pricing of Spot Instances? (L2)
2. How autoscaling policies configured to ensure compliance with security standards? (L2)
3. Implement autoscaling and elasticity to optimize cloud costs in hospital management system. (L6)

Course Outcome 5 (CO5)

1. What are the security considerations associated with cloud cost governance (L2)
2. What are the benefits of using a multi-cloud strategy for cost management? (L2)
3. How can organizations ensure low latency in serverless applications? (L2)

Model Question Paper

QP CODE: Pages: 2

Reg No. :…….. Name:…….

MAR ATHANASIUS COLLEGE OF ENGINEERING (AUTONOMOUS), KOTHAMANGALAM

THIRD SEMESTER MCA DEGREE EXAMINATION, DECEMBER 2024

Course Code: M24CA1E204F

Course Name: Cloud Cost Management & Optimization

Max. Marks: 60 Duration: 3 Hours

PART A

Answer all questions. Each question carries 2 marks.

1. What are the common challenges associated with cloud computing?
2. How Virtual Private Network is used to connect to cloud resources?
3. What are the strategies for monitoring and managing cloud resources?
4. What are the cost implications of moving from an on-premises to a cloud infrastructure?
5. What are the methods for tagging and categorizing cloud resources to ensure accurate cost allocation?
6. How cost tracking tools are used to identify underutilized resources?
7. How Spot Instances differ from On-Demand Instances?
8. What strategies can be used to optimize resource utilization in cloud environments?
9. How organizations can develop and implement cloud cost governance policies?
10. How can organizations ensure low latency in serverless applications?

PART B

Answer any five questions. Each question carries 8 marks.

11. Explain how cloud providers ensure data durability and availability in their storage services?
12. How can detailed billing reports help in understanding cloud expenses?
13. How do cost management tools handle multi-cloud cost tracking and reporting?
14. Explain elasticity in cloud computing, and how does it differ from scalability?
15. How AI and machine learning influence autoscaling techniques?
16. Explain how autoscaling and elasticity can be used in organizations for optimizing the costs?
17. Explain the common challenges faced when managing costs in multi-cloud and hybrid environments?

M24CA1E204G	Optimization Techniques	L	T	P	J	S	Credit	Year of Introduction
		3	1	0	0	3	4	2024

Preamble:

Through a combination of theoretical understanding and practical implementation, this course aims to equip students with the analytical capabilities and problem-solving aptitude necessary for addressing real-world operational complexities across diverse industries.

Prerequisite:

A strong mathematical background coupled with problem-solving skills and critical thinking abilities are essential prerequisites for successfully navigating through the topics covered in this course on Operations Research.

Course Outcomes:

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

CO. No	Course Outcomes	Cognitive Knowledge Level
CO 1	Apply techniques for formulating and solving Linear Programming problems, including graphical methods, simplex methods, and artificial variables. Demonstrate an understanding of degeneracy resolution, duality formation, and the dual simplex method, and apply these concepts effectively in real-world optimization scenarios.	Apply
CO 2	Apply methods such as the North-West Corner Rule, Vogel's Approximation, and the MODI method to formulate and solve Transportation Problems. Additionally, identify and resolve issues like degeneracy, unbalanced problems, and transshipment scenarios to ensure optimized transportation solutions in various logistical contexts.	Apply
CO 3	Apply techniques such as the Hungarian Method and the Branch-and-Bound Technique to formulate and solve Assignment Problems. Additionally, address challenges like unbalanced assignments and specialized scenarios such as the Traveling Salesman Problem.	Apply
CO 4	Apply techniques such as the Critical Path Method (CPM), Project Evaluation and Review Techniques (PERT), and cost considerations to construct and analyze project networks, identify critical paths, and optimize project schedules and resource allocations.	Apply

CO 5	Apply mathematical models and principles to analyze queuing systems and strategic interactions, optimizing system performance and making informed decisions in various contexts.	Apply

Mapping of course outcomes with program outcomes

	PO1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO 1	3	2	2	3	2	1		2
CO 2	3	2	2	3	2	1		2
CO 3	3	3	2	3	2	1		2
CO 4	3	2	2	3	2	1		2
CO 5	3	3	2	3	2	1	1	2

Assessment Pattern

Bloom's Category	**Computer Applications**		
	Continuous Assessment Tests		**End Semester Examination (Marks %)**
	Test 1 (Marks %)	**Test 2 (Marks %)**	
Remember	36	36	36
Understand	36	36	36
Apply	28	28	28
Analyse	XX	XX	XX
Evaluate	XX	XX	XX
Create	XX	XX	XX

Mark distribution

Total Marks	CIE marks	ESE marks	ESE Duration
100	40	60	3 hours

Continuous Internal Evaluation Pattern (Out of 40 marks):

- Continuous Assessment Test 1 (Module 1 and Module 2) : 10 Marks
- Continuous Assessment Test 2 (Module 2 and Module 3) : 10 Marks
- Assignment/Tutorials/Seminars : 12 Marks
- Attendance : 8 Marks

Continuous Assessment Test Pattern (out of 50 marks):

There will be two parts - Part A and Part B.
Part A contains 5 questions carrying 2 marks each.
Part B contains 5 questions carrying 8 marks each.
The duration of the Examination is two Hours

End Semester Examination Pattern:

There will be two parts, Part A and Part B. Part A contains 10 questions with 2 questions from each Module, carrying 2 marks each. Part B contains 7 questions out of which 5

questions to be answered. (Minimum 1 question from each Module and maximum 2 questions from any 2 Modules). Each question in Part B carries 8 marks and can have maximum 2 sub-divisions.

SYLLABUS

Module 1: Linear Programming [10 Hours]

Introduction, - Formulation of a Linear Programming Problem - Solution of a Linear Programming Problem by Graphical Method. Solution of a Linear Programming Problem by Simplex method - Artificial variables techniques-Two Phase Method and Big-M method, Degeneracy- Method to resolve Degeneracy, Duality in Linear Prgramming: formation of dual problems, Definition of the dual problem, Dual Simplex method.

Self-Study: software tools like MATLAB, and Python can be used to experiment with solving LP problems computationally.

Module 2: Transportation Problem [9 Hours]

Formulation, Definitions, Optimal Solution- North-West Corner Rule, Matrix Minima, Vogel's Approximation Methods. Optimality Test- MODI method, Balanced Transportation problem, Unbalanced Transportation problem - Degeneracy in Transportation Problem, Stepping stone method, Transshipment model.

Self-Study: Practice solving problems regularly to reinforce your understanding of the concepts and techniques involved.

Module 3: Assignment problem [9 Hours]

Introduction, Formulation, Types of Assignment Problem, Hungarian Method, Unbalanced assignment problem, Maximization in Assignment Problem- Traveling Salesman problem. Branch-and-Bound Technique, Air crew assignment problem, Prohibited Assignment Problem.

Self-Study: Implement algorithms and techniques in programming languages like Python to gain practical experience.

Module 4: Network scheduling by PERT/CPM [9 Hours]

Introduction, Basic terms, Rules of Network construction, Fulkerson's Rule, Time Analysis, Critical Path Method (CPM)-Forward pass calculation, Backward pass calculation, Project Evaluation and Review Techniques (PERT), Cost consideration in CPM/Pert- Project cost, Cost slope, Time-Cost optimization algorithm.

Self-Study: Implementing algorithms and techniques in software tools like Microsoft Project or project management software can provide practical experience.

Module 5: Queuing Theory & Game Theory [8 Hours]

Introduction, Queuing Systems-the input, The service mechanism, The queue discipline, Customer's behaviour, Kendall's notation for representing queuing models, Classification of queuing models.

Game Theory: Introduction, Payoff, Types of Games, The max-min min-max principle, Pure Strategies- Game with Saddle Point, Mixed Strategies- Games without Saddle Point.

Self-Study: Implementing queuing models and solving game theory problems using software tools like Python or MATLAB can provide practical experience.

References

1. S Kalavathy "Operations Research" Vikas Publishing House PVT Ltd
2. S.D.Sharma – "Operations Research" , Kedarnath, Ramnath 2015.
3. S.S. Rao,"Engineering Optimization: Theory and Practice", New Age International P**VT** Ltd.

Web Resources:

1. https://www.geeksforgeeks.org/linear-programming/
2. https://www.shiksha.com/online-courses/articles/linear-programming-problem/
3. https://kanchiuniv.ac.in/coursematerials/OperationResearch.pdf
4. https://technologyadvice.com/blog/information-technology/critical-path-method/
5. https://www.investopedia.com/terms/q/queuing-theory.asp

Course Contents and Lecture Schedule

NO	Topic	No. of Lecture/Tutorial hours
Module 1 [10 Hours]		
1.1	Introduction, - Formulation of a Linear Programming Problem.	1
1.2	Solution of a Linear Programming Problem by Graphical Method.	1
1.3	Solution of a Linear Programming Problem by Simplex method.	1
1.4	Artificial variables techniques: Two Phase Method and Big-M method.	2
1.5	Degeneracy: Method to resolve Degeneracy.	2
1.6	Duality in Linear Programming: Formation of dual problems, Definition of the dual problem.	1
1.7	Dual Simplex method.	2
Module 2 [9 Hours]		
2.1	Transportation Problem-Formulation, Definitions.	1
2.2	North -West Corner Rule.	1
2.3	Matrix Minima.	1
2.4	Vogel's Approximation Methods.	1
2.5	MODI method.	1
2.6	Balanced Transportation problem.	1

2.7	Unbalanced Transportation problem.	1
2.8	Degeneracy in Transportation Problem.	1
2.9	Stepping stone method, Transshipment model.	1
Module 3 [9 Hours]		
3.1	Assignment problem-Introduction.	1
3.2	Formulation, Types of Assignment Problem.	1
3.3	Hungarian Method.	1
3.4	Unbalanced assignment problem.	1
3.5	Maximization in Assignment Problem.	1
3.6	Traveling Salesman problem.	1
3.7	Branch-and-Bound Technique.	1
3.8	Air crew assignment problem.	1
3.9	Prohibited Assignment Problem.	1
Module 4 [9 Hours]		
4.1	Network Scheduling By PERT/CPM- Introduction	1
4.2	Basic terms, Rules of Network Construction.	1
4.3	Fulkerson's Rule, Time Analysis.	1
4.4	Critical Path Method (CPM).	1
4.5	Forward pass calculation.	1
4.6	Backward pass calculation.	1
4.7	Project evaluation and review techniques (PERT).	1
4.8	Cost consideration in CPM/Pert: project cost, cost slope.	1
4.9	Time-Cost optimization algorithm.	1
Module 5 [8 Hours]		
5.1	Queuing Theory Introduction, Queuing Systems-the input, the service mechanism.	1
5.2	The queue discipline, customer's behavior.	1
5.3	Kendall's notation for representing queuing models.	1
5.4	Classification of queuing models.	1
5.5	Game Theory: Introduction, Payoff.	1
5.6	Types of Games, the max-min min-max principle.	1
5.7	Pure Strategies: Game with Saddle Point.	1
5.8	Mixed Strategies: Games without Saddle Point.	1
	Total Hours	**45**

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO1):

1. What is the main objective of linear programming? (L2)
2. How can degeneracy be resolved in linear programming problems? (L2)
3. Solve the following linear programming problem graphically: Maximize $Z=3x+4yZ=3x+4y$ subject to the constraints $2x+y\leq 82x+y\leq 8$, $x+2y\leq 6x+2y\leq 6$, and $x,\geq 0x,y\geq 0$. (L3)

Course Outcome 2 (CO2):

1. Explain the key principles behind Vogel's Approximation Method (L2)
2. Describe the MODI (Modified Distribution) method and its role in determining optimality in transportation problems. (L2)
3. Use the North-West Corner Rule to find the initial feasible solution for a transportation problem with the following supply and demand values:

   Supply: Factory A = 150 units, Factory B = 200 units, Factory C = 180 units Demand: Warehouse X = 120 units, Warehouse Y = 180 units, Warehouse Z = 200 units (L3)

Course Outcome 3 (CO3):

1. What challenges are typically encountered in air crew assignment problems? (L2)
2. What is the primary purpose of assignment problems in decision-making processes? (L2)
3. How does the Branch-and-Bound technique contribute to improving the efficiency of solving assignment problems compared to other methods, and what are its key algorithmic steps. (L3)

Course Outcome 4 (CO4):

1. Discuss one advantage of using PERT in project scheduling. (L2)
2. Describe the forward pass calculation in the Critical Path Method (CPM). (L2)
3. Draw a network diagram for a simple project involving three tasks: A, B, and C. Task A must be completed before task B can start, and task B must finish before task C can begin. Apply the rules of network construction to ensure accuracy. (L3)

Course Outcome 5 (CO5):

1. Explain Kendall's notation used to represent queuing models. (L2)
2. Define payoff in the context of game theory and give an example. (L2)
3. In a zero-sum game, Player A has three possible strategies with payoffs as follows: 2, 4, and 6. Player B's payoffs for the same strategies are: 1, 3, and 5. Determine the optimal strategy for each player. (L3)

Model Question Paper

QP CODE: **Pages: 2**

Reg No :…….. **Name: …….**

MAR ATHANASIUS COLLEGE OF ENGINEERING (AUTONOMOUS)
KOTHAMANGALAM

SECOND SEMESTER M.C.A DEGREE EXAMINATION, DECEMBER 2024

Course Code: M24CA1E204G

Course Name: Optimization Techniques

Max. Marks: 60 **Duration: 3 hours**

PART A

Answer all questions. Each question carries 2 marks.

1. What is the main objective of linear programming?
2. How can degeneracy be resolved in linear programming problems?
3. Explain the key principles behind Vogel's Approximation Method
4. Describe the key components of a transshipment model.
5. What is the primary purpose of assignment problems in decision-making processes?
6. What challenges are typically encountered in air crew assignment problems?
7. Describe the forward pass calculation in the Critical Path Method (CPM).
8. Discuss one advantage of using PERT in project scheduling.
9. Explain Kendall's notation used to represent queuing models.
10. Define payoff in the context of game theory and give an example.

PART B

Answer any five questions. Each question carries 8 marks.

11. Solve the following linear programming problem graphically: Maximize $Z=3x+4yZ=3x+4y$ subject to the constraints $2x+y\leq 82x+y\leq 8$, $x+2y\leq 6x+2y\leq 6$, and $x,\geq 0x,y\geq 0$.
12. Apply the Two Phase Method to solve the following linear programming problem with artificial variables: Maximize $Z=2x+3yZ=2x+3y$ subject to the constraints $x+y\leq 4x+y\leq 4$, $2x-y\geq 22x-y\geq 2$, and $x,\geq 0x,y\geq 0$.
13. Use the North-West Corner Rule to find the initial feasible solution for a transportation problem with the following supply and demand values: Supply: Factory A = 150 units, Factory B = 200 units, Factory C = 180 units Demand: Warehouse X = 120 units, Warehouse Y = 180 units, Warehouse Z = 200 units
14. Describe the MODI (Modified Distribution) method and its role in determining optimality in transportation problems
15. How does the Branch-and-Bound technique contribute to improving the efficiency of solving assignment problems compared to other methods, and what are its key algorithmic steps.

16. Draw a network diagram for a simple project involving three tasks: A, B, and C. Task A must be completed before task B can start, and task B must finish before task C can begin. Apply the rules of network construction to ensure accuracy.
17. In a zero-sum game, Player A has three possible strategies with payoffs as follows: 2, 4, and 6. Player B's payoffs for the same strategies are: 1, 3, and 5. Determine the optimal strategy for each player.

M24CA1E204H	Object Oriented Modelling &Design	L	T	P	J	S	Credit	Year of Introduction
		3	1	0	0	3	4	2024

Preamble:

This course covers the principles and practices of object-oriented modeling and design, emphasizing the use of UML (Unified Modeling Language) and various design patterns. Students will learn to analyze, design, and implement complex software systems through a systematic object-oriented approach.

Prerequisite:

Basic knowledge of programming in an object-oriented language and familiarity with software engineering principles.

Course Outcomes:

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

CO. No	Course Outcomes	Cognitive Knowledge Level
CO 1	Understand and apply fundamental object-oriented concepts along with modeling techniques for effective software development, including iterative and agile methodologies.	Apply
CO 2	Apply UML Use Case Diagrams, understanding their purpose and benefits, and proficiently utilizing both basic elements such as actors, use cases, and relationships and advanced elements, including extends, includes, and generalization.	Apply
CO 3	Apply UML sequence diagrams, including system sequence diagrams and complex interaction scenarios, using appropriate notation and elements such as lifelines, messages, activations, and interaction fragments.	Apply
CO 4	Apply Class Diagrams, utilizing basic and advanced elements and relationships like inheritance, generalization, dependencies, realizations, association classes, derived properties, and constraints.	Apply
CO 5	Apply UML Activity Diagrams, mastering basic and advanced elements to model various scenarios including decision points, exception handling, interruptible regions, loops, iterations, sub-activities, and hierarchical structures for organizing complex workflows.	Apply

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO 1	1	1	3	2	3	3	1	2
CO 2	1	1	3	2	3	3	1	2
CO 3	1	1	3	2	3	3	1	2
CO 4	1	1	3	2	3	3	1	2
CO 5	1	1	3	2	3	3	1	2

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End SemesterExamination (Marks%)
	Test 1 (Marks %)	Test 2 (Marks %)	
Remember	20	20	16
Understand	40	40	34
Apply	40	40	50
Analyze	XX	XX	XX
Evaluate	XX	XX	XX
Create	XX	XX	XX

Mark Distribution

Total Marks	CIE marks	ESE marks	ESE Duration
100	40	60	3 Hours

Continuous Internal Evaluation (Out of 40 Marks)

- Continuous Assessment Test 1 (Module 1 and Module 2) : 10 Marks
- Continuous Assessment Test 2 (Module 2 and Module 3) : 10 Marks
- Assignment/Tutorials/Seminars : 12 Marks
- Attendance : 8 Marks

Continuous Assessment Test Pattern (Out of 50 Marks):

There will be two parts - Part A and Part B.
Part A contains 5 questions carrying 2 marks each.
Part B contains 5 questions carrying 8 marks each.
The duration of the Examination is two hours

End Semester Examination Pattern:

There will be two parts, Part A and Part B. Part A contains 10 questions with 2 questions from each Module, carrying 2 marks each. Part B contains 7 questions outof which 5 questions to be answered. (Minimum 1 question from each Module and maximum 2 questions from any 2 Modules). Each question in Part B carries 8 marks and can have maximum 2 sub- divisions.

SYLLABUS

Module 1 [8 Hours]

Object Oriented Concepts: Introduction, Object and classes, Encapsulation, Inheritance, Polymorphism, Abstraction, Links and associations, Generalization, Aggregation.

Modeling Concepts: Object oriented analysis and design, Overview of the software development cycle, Software development process, Iterative and Evolutionary Development, Agile Modeling.

Self-Study: Best practices for modeling and implementing OOP concepts using UML, Case Studies of Real-World Systems, Model-Driven Development.

Module 2 [9 Hours]

UML: Introduction, Domain Models, UML diagrams- Use Case, Sequence, Class, Activity, State, and Deployment diagrams. Tools for UML modeling.

Use Case Diagrams: Purpose and benefits of use case modeling, Basic Elements of Use Case Diagrams- Actors, Use cases, Relationships. Advanced Elements and Relationships- Extends and includes relationships, Generalization of actors and use cases.

Self-Study: Use Case Scenarios and Flows, Handling exceptions and special cases, Writing detailed use case narratives, Case studies of successful use case modelling.

Module 3 [9 Hours]

UML Interaction Diagram: System sequence diagram, Sequence diagram notation, Components of sequence diagrams- lifelines, messages, activations. Sequence diagram elements- Actors and objects,

Synchronous and asynchronous messages, Return messages and self-calls, Lifeline and activation boxes, Interaction fragments- alternatives(alt),options(opt),loops(loop). Handling complex interactions with nested fragments, Modeling concurrent interactions.

Self-Study: Case Studies and Real-World Applications, Best Practices and Common Pitfalls, Overview of tools for creating sequence diagrams.

Module 4 [10 Hours]

Class Diagram: Basic elements of class diagram-classes, Attributes and methods, Visibility. Relationships in Class Diagrams- Associations, Multiplicity and roles, Aggregation and composition.

Inheritance and Generalization- Generalization and specialization, Inheritance notation in UML, Abstract classes and interfaces. Advanced Class Diagram Concepts- Dependencies, Realizations, Association classes, Derived properties and constraints, Cardinality- Common

Multiplicity Notations.

Self-Study: Reviewing and refining class diagrams, Overview of tools for creating class diagrams, Application of class diagrams in various domains.

Module 5 [9 Hours]

Activity Diagrams: Basic Elements of Activity Diagrams- Activities, Actions, Control flow, Decision Points and Branching, Advanced Elements and Notation- Modeling Complex Scenarios, Exception handling, Interruptible regions, Loops and iterations. Sub activities and Hierarchical Diagrams- Partitioning large diagrams into smaller manageable units, Using activity partitions to organize complex workflows.

Sate Chart Diagrams: Types of States, State Transitions, Actions and Activities. Advanced Features of State Chart Diagrams- Composite States, State Hierarchies and Decomposition.

Deployment Diagrams: Fundamental Concepts of Deployment Diagrams- Nodes and Artifacts, Communication Paths.

Self-study: Analyzing activity diagrams from real-world systems, Integrating Deployment Diagrams with Other UML Diagrams.

Reference Books:

1. Applying UML and Patterns: An Introduction to Object-Oriented Analysis and Design and Iterative Development" by Craig Larman,3rd Edition,2004. (Module 2,3,4,5)
2. A. Bahrami, Object-Oriented System Development. New York: McGraw-Hill, 1999.(Module 1)
3. Michael Blaha, James Rumbaugh: Object-Oriented Modeling and Design with UML, 2nd Edition, Pearson Education / PHI, 2005.
4. Grady Booch et al: Object-Oriented Analysis and Design with Applications, 3rd Edition, Pearson, 2007.
5. Simon Bennett, Steve McRobb and Ray Farmer: Object-Oriented Systems Analysis and Design Using UML, 4th Edition, Tata McGraw-Hill, 2010.
6. Martin. UML Distilled: A Brief Guide to the Standard Object Modeling Language. Addison-Wesley, 2003

Online Resources:

1. https://www.uml.org/.
2. https://www.tutorialspoint.com/object_oriented_analysis_design/index.htm.
3. https://www.khanacademy.org/computing/computer-programming/programming #object-oriented- design.

Course Contents and Lecture Schedule

NO	Topic	No. of Lecture/Tutorial Hours
Module 1 [8 Hours]		
1.1	Object and classes, Encapsulation, Inheritance, Polymorphism, Abstraction	1
1.2	Links and associations	1
1.3	Generalization, Aggregation.	1
1.4	Object oriented analysis and design.	1
1.5	Overview of the software development cycle.	1
1.6	Software development process	1
1.7	Iterative and Evolutionary Development.	1
1.8	Agile Modelling	1
Module 2 [9 Hours]		
2.1	UML Introduction, Domain Models.	1
2.2	UML diagrams	1
2.3	Tools for UML modelling.	1
2.4	Purpose and benefits of use case modelling.	1
2.5	Basic Elements of Use Case Diagrams- Actors, Use cases, Relationships.	2
2.6	Advanced Elements and Relationships- Extends and includes relationships.	2
2.7	Generalization of actors and use cases.	1
Module 3 [9 Hours]		
3.1	System sequence diagram.	1
3.2	Sequence diagram notation.	1
3.3	Components of sequence diagrams- lifelines, messages, activations.	1
3.4	Sequence diagram elements- Actors and objects.	1
3.5	Synchronous and asynchronous messages.	1
3.6	Return messages and self-calls.	1
3.7	Lifeline and activation boxes.	1
3.8	Interaction fragments, Modelling concurrent interactions.	1
3.9	Handling complex interactions with nested fragments	1
Module 4 [10 Hours]		
4.1	Basic elements of class diagram.	1
4.2	Relationships in Class Diagrams- Associations.	1
4.3	Multiplicity and roles, Aggregation and composition.	1
4.4	Generalization and specialization.	1
4.5	Inheritance notation in UML.	1
4.6	Abstract classes and interfaces.	1
4.7	Advanced Class Diagram Concepts- Dependencies.	1
4.8	Realizations, Association classes	1
4.9	Derived properties and constraints.	1
4.10	Cardinality- Common Multiplicity Notations.	1

Module 5 [9 Hours]		
5.1	Basic Elements of Activity Diagrams.	1
5.2	Advanced Elements and Notation- Modelling Complex Scenarios	1
5.3	Exception handling, Interruptible regions.	1
5.4	Loops and iterations.	1
5.5	Sub activities and Hierarchical Diagrams.	1
5.6	Partitioning large diagrams into smaller manageable units.	1
5.7	Types of States, State Transitions, Actions and Activities.	1
5.8	Advanced Features of State Chart Diagrams	1
5.9	Deployment Diagrams, Nodes and Artifacts, Communication Paths.	1
	Total Hours	**45**

CO Assessment Questions

Course Outcome 1 (CO1)

1. What is a design pattern and why are design patterns important in object-oriented design? (L2)
2. Define UML and explain its purpose in software development. (L2).
3. Using an iterative development approach, outline the steps you would take to develop a new feature for a mobile banking application. Explain how you would incorporate feedback and testing into your process. (L3)

Course Outcome 2 (CO2)

1. What is a domain model and what role does it play in the analysis phase of software development? (L2).
2. What are the advanced elements and relationships in use case diagrams, such as extends and includes relationships? (L2)
3. Given a scenario of an online shopping system, create a use case diagram that includes actors such as Customer, Admin, and Payment System. Include at least three use cases and relevant relationships. (L3)

Course Outcome 3 (CO3)

1. What are the key components typically included in a system sequence diagram? (L2)
2. Differentiate between actors and objects in the context of sequence diagrams. (L2)
3. Construct a sequence diagram for a movie ticket booking system that uses an option (opt) fragment to represent the optional step of applying a discount code before

confirming the booking. (L3)

Course Outcome 4 (CO4)

1. Explain the different types of visibility in class diagrams and provide an example for each. (L2)
2. What does multiplicity indicate in the context of class diagrams, and why is it important? (L2)
3. For an online booking system, develop a class diagram that includes an association class Booking Detail between Customer and Booking. Define the attributes and methods for the association class (L3).

Course Outcome 5 (CO5)

1. Explain how to model complex scenarios using activity diagrams. (L2)
2. What are state chart diagrams and what role do they play in modeling system behavior? (L2)
3. Develop a deployment diagram for a distributed banking application that includes multiple nodes representing different branches, central servers, and ATMs. Show the artifacts deployed on each node and the communication paths for transaction processing. (L3)

Model Question Paper

QP CODE: Pages: 2

Reg No.: ……. Name:……

MAR ATHANASIUS COLLEGE OF ENGINEERING (AUTONOMOUS), KOTHAMANGALAM

SECOND SEMESTER M.C.A DEGREE EXAMINATION, DECEMBER 2024

Course Code: M24CA1E204H

Course Name: Object Oriented Modelling &Design

Max. Marks: 60 Duration: 3 Hours

PART A

Answer all questions. Each question carries 2 marks.

1. Describe the purpose of the Unified Modeling Language (UML) in software development.
2. Explain the "extends" relationship in use case diagrams and provide an example.
3. What is the "includes" relationship in use case diagrams and how is it used? Provide an example.
4. Explain the notation used in sequence diagrams to represent lifelines and messages.
5. Explain the difference between synchronous and asynchronous messages in sequence diagrams.
6. Describe the concept of associations in class diagrams.
7. Differentiate between aggregation and composition in class diagrams. Provide an example for each.
8. Describe the purpose of exception handling in activity diagrams and provide an example.
9. How do state diagrams help in modeling the behavior of a system?
10. What is a deployment diagram and what is its main purpose in UML?

PART B

Answer any five questions. Each question carries 8 marks.

11. Develop a domain model for a car rental system. Include major entities such as Car, Customer, Rental, and Payment, and illustrate their relationships.
12. Given a scenario, create a use case diagram that captures the key functionalities of an e-commerce system.
13. Create a sequence diagram for a food delivery application that includes a loop (loop) interaction fragment to represent the process of iterating through available delivery options until a suitable one is found.

14. Construct a class diagram for a project management application with classes such as Project, Task, and Resource. Include derived properties and constraints to enforce business rules, such as a task's start date must be after the project's start date.
15. What is cardinality in the context of class diagrams, and what are some common multiplicity notations used? Given a scenario of a hotel reservation system, draw an activity diagram that represents the process of booking a room, including actions such as searching for availability, selecting a room, and making a payment.
16. Draw a state chart diagram for a microwave oven that includes states such as Idle, Cooking, Paused, and Completed. Include state transitions triggered by events like Start, Pause, Resume, and Stop.
17. Design a deployment diagram for a cloud-based customer relationship management (CRM) system. Indicate the physical nodes, software artifacts, and their relationships.

M24CA1E204I	Human Computer Interaction	L	T	P	J	S	Credit	Year of Introduction
		3	1	0	0	3	4	2024

Preamble:

In this digitally interconnected world, understanding how humans interact with computers and other digital devices is very crucial. This course Human-Computer Interaction (HCI) acts as an intersection of computer science, behavioural sciences, design, and several other disciplines, providing a holistic approach to the study of human and machine interaction. In this course, students will explore the fundamental principles, theories, and methodologies that govern the design, evaluation, and implementation of interactive computing systems.

Prerequisite:

Nil

Course Outcomes:

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

CO. No	Course Outcomes	Cognitive Knowledge Level
CO 1	Comprehend the principles underlying HCI and their significance in designing effective and user-friendly interfaces.	Understand
CO 2	Analyze various frameworks used in HCI and design interactions by applying principles of ergonomics to design interactions.	Apply
CO 3	Analyze and apply golden rules and heuristics for interface design to identify and address common usability issues.	Apply
CO 4	Apply principles of dialog semantics to understand the meaning and flow of interactions within a system.	Apply
CO 5	Analyze and Design non-WIMP, natural, and multimodal interfaces, including touch, gesture, voice, and tangible interaction paradigms.	Apply

Mapping of course outcomes with program outcomes

	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO 1	3	3	3	3	2	1	1	3
CO 2	3	3	3	2	2	1	1	3
CO 3	3	3	3	2	2	1	1	3
CO 4	3	3	3	2	2	1	1	3
CO 5	3	3	3	3	2	1	1	3

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination (Marks%)
	Test 1 (Marks %)	Test 2 (Marks %)	
Remember	20	20	20
Understand	60	60	60
Apply	20	20	20
Analyze	XX	XX	XX
Evaluate	XX	XX	XX
Create	XX	XX	XX

Mark distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
100	40	60	3 hours

Continuous Internal Evaluation (Out of 40 Marks)

- Continuous Assessment Test 1 (Module 1 and Module 2) : 10 Marks
- Continuous Assessment Test 2 (Module 3 and Module 4) : 10 Marks
- Assignment/Tutorials/Seminars : 12 Marks
- Attendance : 8 Marks

Continuous Assessment Test Pattern (Out of 50 Marks):

There will be two parts - Part A and Part B.

Part A contains 5 questions carrying 2 marks each.

Part B contains 5 questions carrying 8 marks each.

The duration the examination is two hours.

End Semester Examination Pattern:

There will be two parts, Part A and Part B. Part A contains 10 questions with 2 questions from each Module, carrying 2 marks each. Part B contains 7 questions out of which 5 questions to be answered. (Minimum 1 question from each Module and maximum 2 questions from any 2 Modules). Each question in Part B carries 8 marks and can have maximum 2 sub-divisions.

SYLLABUS

Module 1 [6 Hours]

Introduction: What is HCI, Principles of HCI.

Human Factors: Human Information Processing, Sensation and Perception of Information, Human Body Ergonomics.

HCI Design: The Overall Design Process, Interface Selection Options, Wire-Framing, Simple HCI Design Example.

Self-Study: Review the Lab Exercises Micro Projects done in "M24CA1B105 -Web Development Lab" and analyse the basic HCI principles and HCI Design Process

Module 2 [10 Hours]

The Interaction: Introduction, Models of Interaction, Frameworks and HCI, Ergonomics, Interaction Styles, Elements of WIMP Interface, Interactivity.

Interaction Design Basics: The process of Design, User Focus, Scenarios, Navigation Design, Screen Design and Layout, Iteration and prototyping.

Self-Study: Review the Lab Exercises Micro Projects done in "M24CA1B105 -Web Development Lab" and analyse the Interaction Frameworks and WIMP Interfaces used in those works.

Module 3 [10 Hours]

HCI in the Software Process: The Software Life Cycle, Usability Engineering, Iterative Design and Prototyping, Design Rationale.

Design Rules: Principles to Support Usability, Standards, Guidelines, Golden Rules and Heuristics, HCI Patterns.

Evaluation Techniques: Evaluation, Goals of Evaluation, Evaluation through Expert Analysis, Evaluation through User Participation, How to choose an Evaluation Method.

Self-Study: Review the Lab Exercises Micro Projects done in "M24CA1B105 -Web Development Lab" and analyse the Interaction Frameworks and WIMP Interfaces used in those works.

Module 4 [8 Hours]

Dialog Notations and Design: What is Dialog, Dialog Design Notations, Diagrammatic Notations, Textual Dialog Notations, Dialog Semantics, Dialog Analysis and Design.

Modelling Rich Interaction: Status–Event Analysis, Rich Contexts, Low Intention and Sensor-Based Interaction.

Self-Study: Review the Lab Exercises Micro Projects done in "M24CA1B105 -Web Development Lab" and design the dialogs systematically.

Module 5 [11 Hours]

Latest Trends in HCI: Non-WIMP/Natural/Multimodal Interfaces, Mobile and Handheld Interaction, High-End Cloud Service and Multimodal Client Interaction, Natural/Immersive/Experiential Interaction.

Ubiquitous Computing and Augmented Realities: Ubiquitous Computing Applications, Virtual and Augmented Reality, Information and Data Visualisation.

Hypertext, Multimedia, and the World Wide Web: Understanding Hypertext, Finding Things, Web Technology and Issues, Static Web Content, Dynamic Web Content.

Self-Study: Analyse popular Websites, Mobile Apps, VR Interfaces and IoT Systems using the concepts learned in this course.

Reference Books:

1. Gerard Jounghyun Kim, "Human–Computer Interaction Fundamentals and Practice", CRC Press, 2015
2. Alan Dix, Janet Finlay, "Human Computer Interaction", Third Edition, Pearson Education.
3. Preece J., Rogers Y, Sharp H., "Human Computer Interaction", Addison - Wesley, 1994.
4. Martin G. Helander, Thomas. K. Landauer, "Handbook of Human Computer Interaction", Second Edition, Elsevier 1997
5. B.Shneiderman, "Designing The User Interface", Addison Wesley, 2000.

Online Resources:

1. https://onlinecourses.nptel.ac.in/noc19_cs86/preview
2. https://www.interaction-design.org/courses/hci-foundations-of-ux-design/
3. https://www.coursera.org/courses?query=human%20computer%20interaction
4. https://www.udemy.com/course/human-computer-interaction-machine-learning

Course Contents and Lecture Schedule

NO	Topic	No. of Lecture / Tutorial hours
Module 1 [6 Hours]		
1.1	What HCI, Principles of HCI	1
1.2	Human Information Processing, Sensation and Perception of Information	1
1.3	Human Body Ergonomics	1
1.4	Overall Design Process	1
1.5	Interface Selection Options	1
1.6	Wire-Framing, Simple HCI Design Example	1
Module 2 [10 Hours]		
2.1	The Interaction - Introduction	1
2.2	Models of Interaction	1
2.3	Frameworks and HCI	1
2.4	Ergonomics	1
2.5	Interaction Styles	1
2.6	Elements of WIMP Interface	1
2.7	Interactivity	1
2.8	The process of Design, User Focus, Scenarios	1
2.9	Navigation Design, Screen Design and Layout	1
2.10	Iteration and prototyping	1
Module 3 [10 Hours]		
3.1	The Software Life Cycle, Usability Engineering	1
3.2	Iterative Design and Prototyping	1
3.3	Design Rationale	1
3.4	Principles to Support Usability	1
3.5	Standards & Guidelines	1
3.6	Golden Rules and Heuristics	1
3.7	HCI Patterns	1
3.8	Evaluation and Goals of Evaluation	1
3.9	Evaluation through Expert Analysis and User Participation	1
3.10	How to choose an Evaluation Method	1
Module 4 [8 Hours]		
4.1	What is Dialog	1
4.2	Dialog Design Notations	1
4.3	Diagrammatic Notations	1
4.4	Textual Dialog Notations	1
4.5	Dialog Semantics	1
4.6	Dialog Analysis and Design	1
4.7	Status–Event Analysis, Rich Contexts	1
4.8	Low Intention and Sensor-Based Interaction	1
Module 5 [11 Hours]		
5.1	Non-WIMP Interfaces	1
5.2	Natural/Multimodal Interfaces	1
5.3	Mobile and Handheld Interaction	1

5.4	High-End Cloud Service and Multimodal Client Interaction	1
5.5	Natural/Immersive/Experiential Interaction	1
5.6	Ubiquitous Computing Applications	1
5.7	Virtual and Augmented Reality	1
5.8	Information and Data Visualisation	1
5.9	Understanding Hypertext and Finding Things	1
5.10	Web Technology and Issues	1
5.11	Static & Dynamic Web Content	1
Total Hours		**45**

CO Assessment Questions

Course Outcome 1 (CO1)

1. Describe the concept of user-centered design in HCI. (L2)
2. Explain the importance of usability testing in the HCI design process. (L2)
3. Describe a simple example of HCI design for a mobile application. (L2)

Course Outcome 2 (CO2)

1. Describe a common framework used in HCI to understand user interaction (L2)
2. Describe the importance of screen design and layout in HCI. (L2)
3. Design an interactive prototype for a travel booking website. Detail the navigation and screen layout, and explain how you would test its usability with potential users. (L3)

Course Outcome 3 (CO3)

1. Explain the concept of iterative design in HCI. (L2)
2. Given a new software project, outline how you would integrate HCI principles throughout the software life cycle. Provide specific activities for each stage. (L3)
3. Apply the cognitive walkthrough method to a new feature in a desktop software application. Describe the process and the insights gained. (L3)

Course Outcome 4 (CO4)

1. Describe the difference between diagrammatic and textual dialog notations.(L2)
2. Provide a brief overview of a method used for dialog analysis and design. (L2)
3. Explain how context-aware systems can utilize sensor-based interactions to improve usability. (L2)

Course Outcome 5 (CO5)

1. Explain the concept of multimodal interfaces. (L2)
2. How does dynamic web content improve user interaction on a website? (L2)
3. Develop a multimedia-rich web page for an online art gallery. Explain how you incorporate various media types (images, video, audio) to create an engaging user experience. (L3)

Model Question Paper

QP Code:……. Pages:……..

Reg No.: ……. Name: …….

MAR ATHANASIUS COLLEGE OF ENGINEERING (AUTONOMOUS), KOTHAMANGALAM

SECOND SEMESTER MCA DEGREE EXAMINATION, <Month, Year>

Course Code: M24CA1E204I

Course Name: HUMAN COMPUTER INTERACTION

Max. Marks: 60 Duration: 3 Hours

PART A

Answer all questions. Each question carries 2 marks.

1. Define Human-Computer Interaction.
2. List three ergonomic factors that should be considered in HCI design.
3. What are the main components of the interaction model in HCI?
4. What are the benefits of using WIMP interfaces over command-line interfaces?
5. Define usability engineering and its importance in software development.
6. What is heuristic evaluation and who conducts it?
7. What are dialog design notations, and why are they used?
8. What is status-event analysis in the context of rich interaction modeling?
9. What are Non-WIMP interfaces, and how do they differ from traditional WIMP interfaces?
10. Define ubiquitous computing and provide an example of its application.

PART B

Answer any five questions. Each question carries 8 marks.

11. Illustrate the HCI design process and explain the importance of usability testing in the HCI design process.
12. Apply the process of interaction design to develop a new mobile application for fitness tracking. Describe each stage of the design process.
13. What are the main stages of the software life cycle where HCI is particularly important?
14. Explain the concept of usability testing as a user participation evaluation method.
15. Describe sensor-based interaction and its applications in HCI.
16. Design a dialog flow for an ATM machine using diagrammatic notations. Ensure that the flow covers various user scenarios such as cash withdrawal and balance inquiry.
17. Describe a use case of AR in the retail industry.