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**

KNOWLEDGE IS POWER

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**

KNOWLEDGE IS POWER

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**

KNOWLEDGE IS POWER

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?

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MAR ATHANASIUS COLLEGE OF ENGINEERING
(Government Aided and Autonomous)
Kothamangalam 686 666

Affiliated to APJ Abdul Kalam Technological University
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)

$$\left(\begin{array}{cccc} 1 & -2k & 1 & : \; -2k \\ 0 & 2(k+1)(k-1) & -(k-1) & : \; 2k+1 \\ 0 & 0 & (k-1)(k+2) & : \; (k+2) \end{array}\right)$$

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

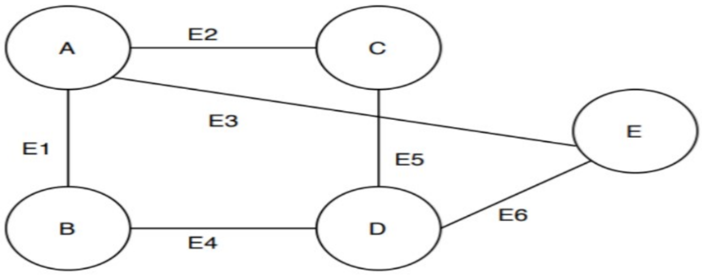
Max. Marks: 60 Duration: 3 Hours

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. $M\mathscr{R} = \begin{pmatrix} 1 & 0 & 0 \\ 1 & 1 & 1 \\ 0 & 0 & 1 \end{pmatrix}$
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, $x \equiv 2 \bmod(3)$ $x \equiv 3 \bmod(5)$ $x \equiv 2 \bmod(7)$

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,

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

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) = $\Sigma m(2,3,4,6,7)$ 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

	Computer Applications		
Bloom's Category	**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.

<u>SYLLABUS</u>

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)

KNOWLEDGE IS POWER

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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Kothamangalam 686 666

Affiliated to APJ Abdul Kalam Technological University
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)

KNOWLEDGE IS POWER

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.

KNOWLEDGE IS POWER

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

	Computer Applications		
Bloom's Category	**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

KNOWLEDGE IS POWER

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

	Data, Text and Web Mining		
Bloom's Category	**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 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 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.

<u>SYLLABUS</u>

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

	Computer Applications		
Bloom's Category	**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 PVT 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 $Z=3x+4y$Z=3x+4y subject to the constraints $2x+y\le$82x+y≤8, $x+2y\le$6x+2y≤6, and $x,\ge$0x,y≥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 Semester Examination (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 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]

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.

KNOWLEDGE IS POWER

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.

MAR ATHANASIUS COLLEGE OF ENGINEERING

(Government Aided and Autonomous)

Kothamangalam 686 666

Affiliated to APJ Abdul Kalam Technological University
Thiruvananthapuram

SEMESTER –III & IV

SYLLABUS

Master of Computer Applications (MCA)

2024

SEMESTER III

Slot	Course Code	Courses	Marks		L-T-P-J-S	Hours	Credit
			CIE	ESE			
A	M24CA1C301	Data Science and Machine Learning	40	60	3-1-0-0-3	4	4
B	M24CA1C302	Design and Analysis of Algorithms	40	60	3-1-0-0-3	4	4
C	M24CA1E303A	Elective II	40	60	3-1-0-0-3	4	4
D	M24CA1E304A	Elective III	40	60	3-1-0-0-3	4	4
G	M24CA1B305	Mobile Applications Development Lab	60	40	1-0-2-2-4	5	3
H	M24CA1L306	Data Science Lab	60	40	1-0-3-0-4	4	3
I	M24CA1M307	Mini Project	100	0	0-0-0-4-2	4	2
J	M24CA1N308	Professional Ethics & Human Values	50	0	1-0-0-0-1	1	Nil
K	M24CA1I309	Internship	50	0			1
		Total	**480**	**320**		**30**	**25**

Professional Electives: Elective II

Slot	Course Code	Courses	Marks		L-T-P-J-S	Hours	Credit
			CIE	**ESE**			
C	M24CA1E303A	Artificial Intelligence	40	60	3-1-0-0-3	4	4
C	M24CA1E303B	Generative AI	40	60	3-1-0-0-3	4	4
C	M24CA1E303C	Cognitive Computing	40	60	3-1-0-0-3	4	4
C	M24CA1E303D	Big Data Management and Analytics	40	60	3-1-0-0-3	4	4
C	M24CA1E303E	CI/CD and DevOps	40	60	3-1-0-0-3	4	4
C	M24CA1E303F	Cloud Security and Migration	40	60	3-1-0-0-3	4	4
C	M24CA1E303G	Business Management	40	60	3-1-0-0-3	4	4
C	M24CA1E303H	Organizational Behavior	40	60	3-1-0-0-3	4	4
C	M24CA1E303I	IPR and Cyber Laws	40	60	3-1-0-0-3	4	4

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Professional Electives: Elective III

Slot	Course Code	Courses	Marks		L-T-P-J-S	Hours	Credit
			CIE	ESE			
D	M24CA1E304A	Deep Learning	40	60	3-1-0-0-3	4	4
D	M24CA1E304B	Natural Language Processing	40	60	3-1-0-0-3	4	4
D	M24CA1E304C	Computer Vision	40	60	3-1-0-0-3	4	4
D	M24CA1E304D	Cloud Computing with AWS/ Azure/ Google Cloud Platform	40	60	3-1-0-0-3	4	4
D	M24CA1E304E	IOT and edge computing in the cloud	40	60	3-1-0-0-3	4	4
D	M24CA1E304F	Serverless Computing	40	60	3-1-0-0-3	4	4
D	M24CA1E304G	Social Network Analysis	40	60	3-1-0-0-3	4	4
D	M24CA1E304H	Cyber Security	40	60	3-1-0-0-3	4	4
D	M24CA1E304I	Blockchain Technology	40	60	3-1-0-0-3	4	4

SEMESTER IV

Slot	Course Code	Courses	Marks		L-T-P-J-S	Hours	Credit
			CIE	ESE			
M	M24CA1P401	Main Project	100	100	0-0-14-14-21	28	12
S	M24CA1S402	Seminar	50	0	0-0-2-0-2	2	2
	M24CA1O403	MOOC Course	To be completed successfully			0	2
		Total	**150**	**100**		**30**	**16**
	Total credits in all four semesters						**91**

*One MOOC Course of minimum 8 weeks has to be successfully completed before the end of fourth semester (starting from semester 1).

M24CA1C301	Data Science and Machine Learning	L	T	P	J	S	Credit	Year of Introduction
		3	1	0	0	3	4	2024

Preamble: This course offers a structured exploration of data science and machine learning, guiding students through data preprocessing, exploratory analysis, and model validation. The students will gain hands-on experience in regression, classification, ensemble methods, dimensionality reduction, and clustering, mastering techniques to optimize and evaluate machine learning models. By the end, students will be proficient in implementing intelligent data-driven solutions for real-world challenges.

Prerequisite: Foundational understanding of linear algebra, probability, and statistics, and along with proficiency in Python programming.

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

CO. No	Course Outcomes	Cognitive Knowledge Level
CO 1	Explain the fundamental concepts and techniques of machine learning and describe the processes involved in preparing data for machine learning applications.	Understand
CO 2	Apply regression and classification models, implement optimization techniques, and evaluate and improve model performance.	Apply
CO 3	Apply supervised learning methods such as Support Vector Machines and Decision Trees, implement optimization techniques, and analyse model performance and complexity.	Apply
CO 4	Describe ensemble learning and dimensionality reduction techniques and explain their role in improving model performance.	Understand
CO 5	Apply unsupervised learning techniques for clustering and evaluate their performance using appropriate metrics.	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 : 10 Marks
- Continuous Assessment Test 2 : 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.

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 to Data Science and Machine Learning:

Introduction to Data Science: The Data Science Process - Data Collection, Cleaning, Preprocessing.

Introduction to Machine Learning: Types of ML Systems, Challenges, Testing & Validation.

Feature Engineering & Data Preprocessing: Handling Missing Data, Encoding Categorical Variables, Feature Scaling, Feature Selection Techniques, Exploratory Data Analysis (EDA) - Visualization & Insights.

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Self-Study: Learn different steps in an end-to-end machine learning project. Implement a Data Cleaning Pipeline on a Real Dataset.

Module 2 [10 Hours]

Supervised Learning - Regression & Classification:

Regression Models: Linear Regression, Polynomial Regression, Ridge & Lasso Regression, Gradient Descent and Optimization Techniques.

Classification Models: Logistic Regression, k-Nearest Neighbours (k-NN), Naïve Bayes.

Performance Measures: Accuracy, Precision, Recall, F1-score, ROC Curve, Overfitting, Underfitting, and Regularization Techniques.

Self-Study: Multiclass Classification, Multilabel Classification, Multioutput Classification. Practice questions on Logistic Regression, k-NN and Naïve Bayes.

Module 3 [8 Hours]

Supervised Learning – SVM & Decision Trees:

Support Vector Machines (SVM): Linear & Nonlinear SVMs, Soft Margin SVM, Kernel Trick.

Decision Trees: Training, Pruning, Gini Index vs. Entropy, Computational Complexity.

Self-Study: Difference between Gini Index and Information Gain.

Module 4 [9 Hours]

Ensemble Methods & Dimensionality Reduction:

Ensemble Learning & Random Forests: Bagging, Boosting - AdaBoost, Gradient Boosting & XGBoost, Stacking.

Dimensionality Reduction: Curse of Dimensionality, Principal Component Analysis (PCA), t-SNE.

Self-Study: Comparison of AdaBoost, Gradient Boosting & XGBoost. Practice questions on PCA.

Module 5 [10 Hours]

Unsupervised Learning & Evaluation Metrics:

Clustering Techniques: K-Means, K-Medoids, DBSCAN, Hierarchical Clustering - Divisive and Agglomerative Methods

Evaluation Metrics for Clustering: Silhouette Score, Davies-Bouldin Index.

Self-Study: Implementing Clustering on a Real-World Dataset.

Reference Books:

1. Aurelien Geron, "Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow", 2nd Edition, O'Reilly, 2022.
2. Joel Grus "Data Science from Scratch", 2nd Edition, O'Reilly, 2019.
3. Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani, Jonathan Taylor, "An Introduction to Statistical Learning: With Applications in Python", 3rd Edition, Springer, 2023.
4. Andreas C. Muller, Sarah Guido, "Introduction to Machine Learning with Python", 1st Edition, O'Reilly, 2016.
5. Peter Flach, "Machine Learning -The Art and Science of Algorithms that Make Sense of Data", 1st Edition, Cambridge University Press, 2012.

KNOWLEDGE IS POWER

6. Trevor Hastie, Robert Tibshirani, Jerome Friedman, “The Elements of Statistical Learning - Data Mining, Inference, and Prediction” 2nd Edition, Springer, 2017.
7. Sebastian Raschka, Vahid Mirjalili, “Python Machine Learning”, 2nd Edition, Packt Publishing, 2017.
8. Rachel Schutt, Cathy O’Neil, “Doing Data Science”, 1st Edition, O’Reilly, 2013.

Online Resources:

1. https://onlinecourses.nptel.ac.in/noc21_cs69/preview
2. https://onlinecourses.nptel.ac.in/noc22_cs32/preview
3. https://onlinecourses.nptel.ac.in/noc19_cs52/preview
4. https://onlinecourses.swayam2.ac.in/ini25_cs02/preview

Course Contents and Lecture Schedule

NO	Topic	No. of Lecture / Tutorial Hours
Module 1 [8 Hours]		
1.1	Introduction to Data Science, The Data Science Process	1
1.2	Data Collection, Cleaning, Preprocessing.	1
1.3	Types of ML Systems, Challenges	1
1.4	Testing & Validation.	1
1.5	Handling Missing Data, Encoding Categorical Variables	1
1.6	Feature Scaling	1
1.7	Feature Selection Techniques	1
1.8	Exploratory Data Analysis (EDA) - Visualization & Insights	1
Module 2 [10 Hours]		
2.1	Linear Regression, Polynomial Regression	1
2.2	Ridge & Lasso Regression	1
2.3	Gradient Descent and Optimization Techniques	1
2.4	Logistic Regression	1
2.5	k-Nearest Neighbors (k-NN) Algorithm	1
2.6	Naïve Bayes Classifier	2
2.7	Performance Measures - Accuracy, Precision, Recall, F1-score, ROC Curve	2
2.8	Overfitting, Underfitting, and Regularization Techniques.	1
Module 3 [8 Hours]		
3.1	Linear & Nonlinear SVMs	2
3.2	Soft Margin SVM, Kernel Trick	1
3.3	Decision Trees -Training	2
3.4	Pruning	1
3.5	Gini Index vs. Entropy	1
3.6	DT Computational Complexity	1
Module 4 [9 Hours]		
4.1	Ensemble Learning, Random Forests, Bagging	1

4.2	Boosting – AdaBoost	1
4.3	Gradient Boosting	1
4.4	XGBoost	1
4.5	Stacking.	1
4.6	Dimensionality Reduction, Curse of Dimensionality	1
4.7	Principal Component Analysis (PCA)	2
4.8	t-SNE	1
Module 5 [10 Hours]		
5.1	Clustering Techniques - K-Means	2
5.2	K-Medoids	2
5.3	DBSCAN	2
5.4	Hierarchical Clustering - Divisive and Agglomerative Methods	2
5.5	Evaluation Metrics for Clustering - Silhouette Score, Davies-Bouldin Index	2
	Total Hours	**45**

CO Assessment Questions

Course Outcome 1 (CO1)

1. Explain the key steps involved in the data science process and discuss how data collection, cleaning, and preprocessing impact the quality of a machine learning model. (L2)
2. Differentiate between supervised, unsupervised, and reinforcement learning with suitable examples, and describe the challenges associated with each type of machine learning system. (L2)
3. How do feature scaling techniques such as Min-Max Scaling and Standardization affect machine learning models, and why are they necessary for certain algorithms? (L2)

Course Outcome 2 (CO2)

1. Explain the differences between Linear Regression, Polynomial Regression, Ridge Regression, and Lasso Regression, and describe scenarios where each would be most appropriate. (L2)
2. Given a dataset with multiple features, how would you apply Ridge and Lasso Regression to prevent overfitting? Implement both techniques in Python and compare their performance using appropriate evaluation metrics. (L3)
3. You are given an imbalanced dataset for binary classification. Explain how you would apply Logistic Regression and the k-Nearest Neighbours (k-NN) algorithm while addressing data imbalance issues. Justify your choice of performance metrics and model evaluation techniques. (L3)

Course Outcome 3 (CO3)

1. Given a non-linearly separable dataset, apply the kernel trick in Support Vector Machines (SVM) and compare the performance of different kernel functions (linear, polynomial, and RBF). How would you choose the optimal kernel for a given dataset? (L3)
2. What is the kernel trick in SVM, and why is it useful? (L2)
3. Train a Decision Tree model on a real-world dataset and demonstrate the impact of

pruning techniques (pre-pruning and post-pruning) on model performance. How does pruning help in reducing overfitting? (L3)

Course Outcome 4 (CO4)

1. Explain the differences between Bagging, Boosting (AdaBoost, Gradient Boosting, XGBoost), and Stacking. How do these ensemble techniques improve model performance, and in what scenarios would each be most effective? (L2)
2. Describe the impact of the Curse of Dimensionality on machine learning models. How do Principal Component Analysis (PCA) and t-SNE help mitigate this issue, and what are their key differences in terms of functionality and application? (L2)
3. In XGBoost, how do boosting techniques such as shrinkage, column subsampling, and regularization contribute to improving model accuracy and preventing overfitting? Provide an in-depth explanation of each mechanism .(L2)

Course Outcome 5 (CO5)

1. Given a large, high-dimensional dataset, apply K-Means, K-Medoids, DBSCAN, and Hierarchical Clustering. Compare their performance using Silhouette Score and Davies-Bouldin Index, and justify which clustering method is most suitable for the dataset. (L3)
2. Given a dataset where clusters have varying densities, explain why K-Means may fail and how DBSCAN can address this issue. Use a small numerical example to demonstrate the working of DBSCAN and discuss how it handles noise points. (L2)
3. Perform Hierarchical Clustering (both Divisive and Agglomerative) on a dataset and analyze the impact of different linkage methods (single, complete, average, and Ward's linkage) on the resulting dendrogram. How does the choice of linkage affect the final cluster structure? (L3)

Model Question Paper

QP Code:………… Pages:……………..

Reg No.: ……………. Name: ……………

MAR ATHANASIUS COLLEGE OF ENGINEERING (AUTONOMOUS), KOTHAMANGALAM

THIRD SEMESTER MCA DEGREE EXAMINATION, December 2024

Course Code: M24CA1C301

Course Name: DATA SCIENCE AND MACHINE LEARNING

Max. Marks: 60 Duration: 3 Hours

PART A

Answer all questions. Each question carries 2 marks.

1. Define the Data Science process and list its key steps.
2. Explain the role of feature scaling in data preprocessing. Why is it necessary for certain machine learning models?
3. Differentiate between Ridge Regression and Lasso Regression. How does each help in preventing overfitting?
4. Given a dataset with a high variance model, how would you modify the regression

approach to improve generalization? Justify your answer.

5. What is the kernel trick in SVM, and why is it useful?

6. Train a decision tree model on a dataset. What strategies would you use to prevent overfitting and optimize performance?

7. What is the key difference between bagging and boosting in ensemble learning? Provide an example of each.

8. Explain the impact of the Curse of Dimensionality and how PCA and t-SNE help in dimensionality reduction.

9. What is the primary difference between K-Means and DBSCAN clustering algorithms?

10. Given a dataset with clusters of varying densities, which clustering algorithm would you choose and why? Justify your answer with evaluation metrics.

PART B

Answer any five questions. Each question carries 8 marks.

11. Explain the key steps in the data science process, highlighting the importance of data collection, cleaning, and preprocessing. Use an example to illustrate how improper preprocessing can affect model performance.

12. The following dataset represents a simple regression problem:

X (Feature)	Y (Target)
1	2.1
2	2.9
3	3.7
4	5.1
5	5.9

Perform Linear Regression on this dataset and calculate the equation of the best-fit line using the least squares method. Interpret the results.

13. The following dataset represents a classification problem:

Feature 1	Feature 2	Class
2	3	A
4	1	B
5	4	A
7	2	B
8	5	A

Use the k-Nearest Neighbors (k-NN) algorithm with k=3 to classify a new data point (Feature 1 = 6, Feature 2 = 3). Show the step-by-step process and justify your classification.

14. A dataset has two classes (Positive and Negative) and is not linearly separable. Explain how a Soft Margin SVM and the Kernel Trick can be used to classify such data. Implement an example where you use a Polynomial Kernel to transform a non-linearly separable dataset into a linearly separable one.

15. Compare and contrast Bagging and Boosting techniques in ensemble learning. Explain with examples how Random Forest (Bagging) and AdaBoost (Boosting) improve model performance.

16. The following dataset represents points in a two-dimensional space:

X	Y
1	2
1	4
2	3
7	8
8	9
8	7

Perform K-Means clustering with k=2. Show the initial centroids, assign each point to a cluster, update the centroids, and iterate until convergence. Explain how the final clusters are formed.

17. Given a dataset where clusters have varying densities, explain why K-Means may fail and how DBSCAN can address this issue. Use a small numerical example to demonstrate the working of DBSCAN and discuss how it handles noise points.

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M24CA1C302	Design and Analysis of Algorithms	L	T	P	J	S	Credit	Year of Introduction
		3	1	0	0	3	4	2024

Preamble:

This course introduces key algorithm design techniques, including Divide and Conquer, Greedy, Dynamic Programming, and Backtracking, with a focus on algorithm complexity, NP-Completeness, and Network Flows. It prepares students to solve complex problems efficiently.

Prerequisite:

Basic knowledge of programming, data structures, discrete mathematics, and algorithm analysis.

Course Outcomes:

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

CO. No	Course Outcomes	Cognitive Knowledge Level
CO 1	Apply asymptotic notations to analyze algorithm efficiency, determine time complexity for various cases, and implement efficient algorithms using techniques like divide and conquer.	Apply
CO 2	Apply greedy strategy principles to solve optimization problems, including knapsack, minimum spanning trees, job scheduling, and Huffman coding.	Apply
CO 3	Understand dynamic programming concepts and explain their application in solving graph and optimization problems.	Understand
CO 4	Understand the concepts of backtracking and branch and bound, and describe their application in solving problems like N-Queens, graph coloring, Hamiltonian cycle, 8-puzzle, TSP, and knapsack.	Understand
CO 5	Understand concepts of computational complexity and network flows, and describe the characteristics of problems in classes P, NP, NP-Hard, and NP-Complete, as well as algorithms like Ford-Fulkerson and Max-Flow Min-Cut	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	2		2				2
CO 2	3	3	2					2
CO 3	3	3	3					2
CO 4	3	3	3		2			2
CO 5	3	2		3				2

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination (Marks %)
	Test 1 (Marks %)	Test 2 (Marks %)	
Remember	28	52	30
Understand	40	48	40
Apply	32	XX	30
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 : 10 Marks
- Continuous Assessment Test 2 : 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.

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 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 Algorithms: Characteristics of Algorithm, Analysis of Algorithms, Priory and Posterior analysis of Algorithms, Asymptotic Notations.

Complexity functions: Common Complexity functions, Different cases of time complexity-Best-Case, Worst-Case, and Average-Case Complexity, Analysis of Basic Algorithms (e.g., Sorting, Searching), Algorithm design techniques.

Divide and Conquer Method: Control Abstraction for Divide and Conquer, Binary Search, Merge Sort, Quick Sort, Matrix Multiplication.

Self-Study: Divide and Conquer- Finding Maximum and Minimum.

Module 2: [8 Hours]

Greedy Strategy: Control Abstraction, Knapsack Problem, Minimal Spanning Tree Algorithms-Prim's and Kruskal's Algorithm, Job Scheduling with Deadlines, Optimal Storage on Tapes, Optimal Merge Pattern, Huffman Coding.

Self-Study: Tree Vertex Splitting.

Module 3: [8 Hours]

Dynamic Programming: Control Abstraction, Principle of Optimal Substructure, All Pairs Shortest Path Problem, Multistage Graphs, Travelling Salesman Problem, Bellman-Ford Algorithm.

Self-Study: Optimal Binary Search Tree.

Module 4: [8 Hours]

Backtracking: Control Abstraction, N-Queens Problem, Introduction to Graph Coloring, Sum of Subsets Problem, Introduction to Hamiltonian cycle.

Branch and Bound: Control Abstraction, 8- Puzzle Problem, Travelling Salesman Problem, Knapsack Problem.

Self-Study: Branch and Bound- Job Scheduling with Deadlines.

Module 5: [9 Hours]

Complexity Theory: Class P and NP, Polynomial time reductions, Class NP Hard and NP Complete, Example Problems- Vertex Cover problem, Clique Problem.

Network Flows: Flow Networks and Network Flow, Max- Flow Min Cut Theorem, Ford Fulkerson method, Bipartite Matching.

Self-Study: Randomized Algorithms.

Reference Books:

1. Ellis Horowitz, Sartaj Sahni, Sanguthevar Rajasekaran, "Fundamentals of Computer Algorithms", Orient Longman, Universities Press, 2nd Edition (2008)
2. A. Levitin, "Introduction to the Design & Analysis of Algorithms", Pearson Education, 3rd Edition (2017).
3. Harsh Bhasin, "Algorithms Design and Analysis", Oxford University Press, 1st Edition (2015).
4. Rajesh K.Shukla, "Analysis and Design of Algorithms, A Beginner's Approach", Wiley (2015)
5. Richard Neapolitan , Kumarss Naimipour, "Foundations Of Algorithms ",Jones and Bartlett Publishers, Inc, 4th Edition (2011).
6. Sara Baase , Allen Van Gelder , "Computer Algorithms: Introduction to Design and Analysis", Pearson India, 3rd Edition (2002).
7. Thomas H. Cormen, et al., "Introduction to Algorithms", Prentice Hall, 3rd Edition (2010)

Online Resources:

1. https://www.geeksforgeeks.org/introduction-to-divide-and-conquer-algorithm/
2. https://www.programiz.com/dsa/greedy-algorithm
3. https://www.javatpoint.com/dynamic-programming
4. https://www.simplilearn.com/tutorials/data-structure-tutorial/backtracking-algorithm
5. https://www.naukri.com/code360/library/branch-and-bound-algorithm

Course Contents and Lecture Schedule

NO	Topic	No. of Lecture/Tutorial Hours
Module 1 [12 Hours]		**1**
1.1	Introduction to Algorithms, Characteristics of Algorithm.	1
1.2	Analysis of Algorithms, Priory and Posterior analysis of Algorithms.	1

1.3	Asymptotic Notations.	1
1.4	Common Complexity functions.	2
1.5	Different cases of time complexity-Best-Case, Worst-Case, and Average-Case Complexity.	1
1.6	Analysis of Basic Algorithms (e.g., Sorting, Searching), Algorithm design techniques.	1
1.7	Introduction of Divide and Conquer Method, Control Abstraction for Divide and Conquer.	1
1.8	Binary Search.	1
1.9	Merge Sort.	1
1.10	Quick Sort.	1
1.11	Matrix Multiplication.	1
Module 2 [8 Hours]		
2.1	Greedy Strategy- Control Abstraction.	1
2.2	Knapsack Problem.	1
2.3	Minimal Spanning Tree Algorithm- Prim's Algorithm.	1
2.4	Minimal Spanning Tree Algorithms- Kruskal's Algorithm.	1
2.5	Job Scheduling with Deadlines.	1
2.6	Optimal Storage on Tapes.	1
2.7	Optimal Merge Pattern.	1
2.8	Huffman Coding.	1
Module 3 [8 Hours]		
3.1	Dynamic Programming- Control Abstraction, Principle of Optimal Substructure.	1
3.2	All Pairs Shortest Path Problem.	1
3.3	Multistage Graphs.	2
3.4	Travelling Salesman Problem.	2
3.5	Bellman-Ford Algorithm.	2
Module 4 [8 Hours]		
4.1	Backtracking-Control Abstraction.	1
4.2	N-Queens Problem	1
4.3	Sum of Subsets Problem	1
4.4	Graph Colouring, Hamiltonian cycle.	1
4.5	Branch and Bound- Control Abstraction	1
4.6	8- Puzzle Problem	1
4.7	Travelling Salesman Problem.	1
4.8	Knapsack Problem.	1
Module 5 [9 Hours]		
5.1	Complexity Theory- Class P and NP.	1
5.2	Polynomial time reductions.	1
5.3	Class NP Hard and NP Complete.	1
5.4	Example Problems- Vertex Cover problem	1
5.5	Example Problems- Clique Problem.	1
5.6	Network Flows- Flow Networks and Network Flow.	1
5.7	Max- Flow Min Cut Theorem.	1
5.8	Ford Fulkerson method.	1
5.9	Bipartite Matching.	1
	Total	**45 Hours**

KNOWLEDGE IS POWER

CO Assessment Questions

Course Outcome 1 (CO1):

1. Describe the differences between priori and posteriori analysis of algorithms. (L2)
2. What is control abstraction in Divide and Conquer? (L2)
3. Calculate the time complexity of a simple loop structure. (L3)

Course Outcome 2 (CO2):

1. Explain the concept of control abstraction in the greedy strategy. (L2)
2. What is a minimal spanning tree, and why is it important? (L2)
3. Apply the Job Scheduling with Deadlines algorithm to schedule jobs and maximize profit. Show how the algorithm works with an example. (L3)

Course Outcome 3 (CO3):

1. Define the principle of optimal substructure in dynamic programming. (L2)
2. What is the main objective of the Bellman-Ford algorithm? (L2)
3. Explain a forward approach to solve a multistage graph problem. (L2)

Course Outcome 4 (CO4):

1. How does backtracking solve the N-Queens problem? (L2)
2. What is the goal of the graph coloring problem? (L2)
3. Explain the sum of subsets algorithm to solve a given problem with an example. (L2)

Course Outcome 5 (CO5):

1. What is a polynomial time reduction? (L2)
2. What is the vertex cover problem? (L2)
3. Write an algorithm to find maximum flow using the Ford-Fulkerson method. (L2)

KNOWLEDGE IS POWER

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. Describe the differences between priori and posteriori analysis of algorithms.
2. What is control abstraction in Divide and Conquer?
3. Explain the concept of control abstraction in the greedy strategy.
4. What is a minimal spanning tree, and why is it important?
5. Define the principle of optimal substructure in dynamic programming.
6. What is the main objective of the Bellman-Ford algorithm?
7. How does backtracking solve the N-Queens problem?
8. What is the goal of the graph coloring problem?
9. What is a polynomial time reduction?
10. What is the vertex cover problem?

PART B

Answer any five questions. Each question carries 8 marks.

11. Describe asymptotic notations (Big-O, Theta, Omega) and their significance in analysing algorithms.
12. Explain the role of divide and conquer in matrix multiplication algorithms.
13. Explain Kruskal’s algorithm for finding an MST and discuss how it avoids forming cycles.
14. Apply the Job Scheduling with Deadlines algorithm to schedule jobs and maximize profit. Show how the algorithm works with an example.
15. Implement a forward approach to solve a multistage graph problem.

16. Apply the sum of subsets algorithm to solve a given problem with an example.

17. Write an algorithm to find maximum flow using the Ford-Fulkerson method.

KNOWLEDGE IS POWER

M24CA1B305	Mobile Applicati Development Lab	L	T	P	J	S	Credit	Year of Introduction
		1	0	2	2	4	3	2024

Preamble: This course provides hands-on experience in building mobile applications for the Android and Flutter platforms. Students will gain practical skills in developing user interfaces, managing data, and implementing core application functionalities through a series of guided exercises and projects.

Prerequisite: Basics of programming and database concepts.

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

CO No.	Course Outcome	Cognitive Knowledge Level
CO 1	Develop basic Android applications by utilizing core components, managing application structure and effectively using the Android Virtual Device for development and debugging.	Apply
CO 2	Design and implement user interfaces with fundamental UI elements, manage data persistence, create accessible menus and begin utilizing Jetpack Compose for UI development in Android applications.	Apply
CO 3	Develop advanced Android UI components, effectively manage application styling and theming and implement robust data handling and perform database interactions.	Apply
CO 4	Build basic Flutter applications with interactive UIs, navigate between screens and understand the core structure provided by MaterialApp and Scaffold.	Apply
CO5	Develop Flutter applications with dynamic lists, manage application state using Provider, perform asynchronous data fetching from APIs and style Flutter UIs with custom themes and reusable widgets.	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	1	2				3
CO 2	3	2	2	3				3
CO 3	3	3	2	3	1		1	3
CO 4	3	2	1	2	1			3
CO 5	3	3	2	3	1	1	1	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** : **15 Marks**
- **Test 2** : **15 Marks**
- **Continuous Evaluation** : **20 Marks**

End Semester Examination (Out of 40 Marks)

- **Problem solving** : **15 Marks**
- **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 [8 Hours]

Core Android Components: Activities, Services, WorkManager, UI Components – Views and notifications, Communication Components–Intents and Intent Filters.

Application Structure and Resources: AndroidManifest.xml, User permissions, Resources and R.java, Assets, Layouts, Drawable Resources, Activities and Activity lifecycle.

Android Virtual Device: Launching emulator, Editing emulator settings, Logcat usage.

Self-Study: Debugging and Profiling Android Applications.

Module 2 [16 Hours]

User Interface Fundamentals: Form widgets, Text Fields, Validation of UI controls – Input validation, Error Handling, Layouts including ConstraintLayout for building responsive layouts, Density-Independent Units, Explicit Intents, Introduction to Jetpack Compose.

Data Persistence: Shared Preferences, DataStore**.**

Menus: Option menu, Context menu, Accessibility considerations.

Self-Study: Handling Implicit Intents

Module 3 [16 Hours]

Advanced UI design: Time and Date Pickers, Images and media, RecyclerView and Adapters, Alert Dialogs and Toast, Fragments, Navigation drawer.

Styles and Themes: styles.xml, Drawable resources, Applying styles and themes via code and manifest file.

Data Handling using MongoDB: Defining entities and databases, performing CRUD operations, Reading and updating Contacts.

Self-Study: Exploring advanced data handling techniques.

Module 4 [6 Hours]

Introduction to Flutter: Dart fundamentals, Flutter project setup and basics, Building basic UI with Flutter Widgets – Text, Container, Row, Column, Stack, Buttons and Assets. Material App and Scaffold understanding.

Navigation and Routing: Navigation using Navigator, Named routes, Passing data between screens.

Self-Study: Exploring Different Flutter Layout Widgets.

Module 5 [8 Hours]

Advanced Flutter Concepts and Data Handling: Lists and dynamic data display, Forms, GridView, Exception Handling. State management – Introduction to Provider, Asynchronous programming, making HTTP requests, Local data persistence with shared_preferences.

Flutter UI styling and themes: Applying styles to widgets, Creating custom themes and reusable custom widgets.

Self-Study: Building a simple Flutter application with a REST API.

Lab Schedule

Sl. No.	Topics	No. of Hours
1	Create an activity using basic UI controls and FlowLayout.	4
2	Understanding AndroidManifest.xml and Communication Components, working with resource folder and launching activity in emulator.	2
3	Activity life cycle and debugging using Logcat.	2
4	Validation of various UI controls, Error handling	4
5	Design activities using Layouts – RelativeLayout, GridLayout, CardLayout	4
6	ConstraintLayout and building responsive layouts	2
7	Explicit Intents for navigation, Introduction to Jetpack Compose	4
8	Implementation of Shared Preferences and DataStore.	2
9	Write programs that implement Option menu and Context menu.	2
10	Write programs that create advanced UI designs.	4
11	Implementing adapters and alert dialogs.	2
12	Working with fragments and navigation drawer.	2
13	Applying styles and themes	2
14	Working with database and implementing CRUD operations.	4
15	Dart fundamentals, Flutter project setup and basics	2
16	Design basic UI applications using Flutter Widgets.	4
17	Navigation and routing	2
18	Programs using Lists and implement state management	2
19	Asynchronous programming and HTTP requests	2
20	Creating custom themes and reusable custom widgets.	2
	Total Hours	**54**

Micro Project Topics:

1. **Simple To-Do List:**
   This project allows users to create, view, and mark tasks as complete. Tasks are stored locally, and the app features a user-friendly interface with a list view for task display.

Users can add tasks with titles and descriptions, and the application persists data between sessions.

2. **Simple Location Tracker:**

This app tracks the user's current location and displays the latitude and longitude coordinates on the screen. It also allows users to save a history of their tracked locations, which are stored locally. The app requests and handles location permissions, and uses a map widget to visually represent the user's location.

3. **Image Gallery Viewer:**

This app displays a grid or list of images fetched from the device's storage or a remote URL. Users can tap on an image to view it in full screen. The app handles image loading and caching to ensure smooth performance.

4. **Simple Note-Taking App:**

Users can create, edit, and delete text-based notes. Notes are stored locally, and the app provides a list view to display all notes. Users can add titles and content to their notes, and the app persists data between sessions.

5. **Basic Unit Converter:**

This app allows users to convert between different units, such as temperature (Celsius to Fahrenheit), distance (meters to feet), or currency (using a fixed conversion rate). Users input a value and select the input and output units from dropdown menus, with the result displayed in a text field.

6. **Basic Music Player:**

This app allows users to play music files stored on their device. It features a list view displaying available music tracks, playback controls (play, pause, stop), and a progress bar to indicate the current playback position. The app requests and handles permissions for accessing media storage.

7. **Simple Stopwatch/Timer:**

This project implements a stopwatch or timer application. Users can start, pause, and reset the timer, with the elapsed time displayed on the screen. The app handles time formatting and display.

8. **Basic Contact Information Display:**

This app displays a list of contacts from the device's contact list. Users can tap on a contact to view their name and phone number. The app requests and handles the necessary permissions to access contact data.

9. **Simple Weather Display:**

This app fetches weather data from a public API (e.g., OpenWeatherMap) based on a user-entered city name. The app displays the current temperature, weather condition, and an icon representing the weather.

10. **Simple Quiz App:**

This app presents users with a series of multiple-choice questions. The app tracks the user's score and displays the final result at the end of the quiz. The questions and answers are stored locally within the application.

Reference books:

1. Dawn Griffiths and David Griffiths, “Head First Android Development: A Brain-Friendly Guide”, O’Reilly, Third Edition (2021).
2. Rap Payne, “Beginning App Development with Flutter: Create Cross-platform Mobile

Apps”, Apress (2019).
3. Bill Phillips, Chris Stewart, Kristin Marsicano and Brian Gardner, “Android Programming”, Big Nerd Ranch Guides, Fourth Edition (2019).
4. Ian F Darwin, “Android Cookbook: Problems and Solutions for Android Developers”, O’Reilly, Second Edition (2017).
5. Shane Conder and Lauren Darcey, “Android Wireless Application Development – Developer’s Library”, Addison Wesley, Second Edition (2010).

Online Resources:

1. Android Developers official site
   https://developer.android.com/courses
2. Developing Android Apps with App Inventor - Coursera
   https://www.coursera.org/learn/app-inventor-android
3. Androidhive Blog https://www.androidhive.info/

CO Assessment Questions

Course Outcome 1 (CO 1)

1. Design a user interface with fields for username and password input, and a login **Button**, arranging them using **Linear Layout**. Validate the entered credentials against predefined values and display a **Toast** message indicating either "Login Successful" or "Login Failed" based on the validation outcome, ensuring the password field uses the appropriate input type.
2. Develop a registration form with fields for name, email, and phone number, and a registration **Button**, positioning them using **Relative Layout**. Implement an **on Click Listener** for the registration **Button** to retrieve and display the entered registration details in a Text View when the **Button** is clicked.
3. Create an Android **Activity** and override the activity lifecycle methods, using **Log.d()** within each to print a message indicating the current phase. Run the application and observe the Logcat output as various lifecycle events are initiated, adding comments to explain each method's purpose.

Course Outcome 2 (CO 2)

1. Develop an Android layout containing **Edit Text**, **Checkbox**, and **Toggle Button** elements, and implement validation logic to ensure that the **Edit Text** fields contain valid input, the **Checkbox** is checked when required, and the **Toggle Button** state is appropriately handled, displaying user-friendly error messages or feedback using Toast.
2. Construct an Android layout using **Frame Layout** that includes two or more **Image View** components, and implement functionality to toggle the visibility of these images, such that only one image is visible at a time, creating an effect of image switching or cycling.
3. Create an Android layout for a basic calculator application using **Grid Layout** to arrange number buttons and operation buttons, ensuring that the buttons are evenly distributed and the layout adapts to different screen sizes. Implement the logic for basic arithmetic operations when the corresponding operation buttons are pressed, displaying the result of the calculation in a **Text View** within the calculator's layout.
4. Create an Android layout that displays a title **Text View** with a custom font applied. Implement a custom **Toast** message that displays a personalized message with a unique background or text color, triggered by a button click within the layout.
5. Write Android code that (a) launches the Google Maps application to display a specified location, (b) sends an email to a selected email application with a predefined subject and

body, and (c) attaches an image from the device's storage to an email, all using implicit Intents to delegate these actions to other applications.

Course Outcome 3 (CO 3)

1. Develop an Android application that utilizes **Array Adapter** to populate a **List View** with a list of strings, demonstrating the creation and usage of an **Array Adapter** to efficiently display data in a list view.
2. Create an Android application where a **List View** is populated with a list of image thumbnails using a custom adapter, and upon selecting a thumbnail from the **List View**, display the corresponding full-sized image in a separate **Image View**.
3. Implement an Android layout with a **Spinner** component and attach an **on Item Selected Listener** to it, such that when an item is selected from the **Spinner**, a **Toast** message or a **Text View** is updated to display the selected item's value.
4. Develop an Android application that includes an Options Menu in the Action Bar, where selecting an item from the menu triggers the navigation to a different **Activity** within the application.
5. Design an Android application that creates a database with a table, and implements CRUD operations.

Course Outcome 4 (CO 4)

1. Create a Flutter project that utilizes core Dart concepts to build a user interface composed of **Text**, **Image**, and **Button** widgets arranged within **Column** and **Row** layout widgets.
2. Design a Flutter application with two distinct screens, where the first screen contains a button that, when pressed, navigates to the second screen with a defined named route, and the second screen includes a button to navigate back to the first screen, also passing data between the screens during navigation.
3. Develop a Flutter application that uses **Material App** as the root widget to define the application's theme and structure, and employs **Scaffold** to create the layout for a screen, including an **AppBar** with a title, a **Body** containing UI elements like **Text** and **Elevated Button**, and a **Floating Action Button** that performs a simple action when pressed.

Course Outcome 5 (CO 5)

1. Create a Flutter app that uses **List View. builder** to display a list of items fetched from a public REST API, such as a list of posts or users. Implement asynchronous programming using **Future** and **async/await** to handle the API call and JSON parsing. Utilize the **Provider** package to manage the application's state, updating the UI when the data is loaded and handling loading states and potential errors.
2. Design a Flutter app that allows users to input and save data, such as a list of user-created items, using **shared-preferences** to persist the data locally. Style the application's widgets using **Text Style** and **Theme Data** to create a custom theme. Implement reusable custom widgets to encapsulate UI elements and improve code organization and maintainability.
3. Develop a Flutter application that displays a collection of items in a **GridView**, utilizing a custom adapter to manage the display of these items. Incorporate state management to handle user interactions such as selecting an item, which then triggers a change in the UI. Upon selection of an item, display an **Alert Dialog** box that provides additional options or information related to the selected item.

M24CA1L306	Data Science Lab	L	T	P	J	S	Credit	Year of Introduction
		1	0	3	0	4	3	2024

Preamble: This lab course provides hands-on experience in Data Science and Machine Learning using Python. Students will explore data preprocessing, visualization, and feature engineering, followed by supervised and unsupervised learning techniques. The course covers advanced topics such as deep learning, time series forecasting, and model deployment. By the end of the course, students will be equipped with practical skills to implement, evaluate, and deploy machine learning models for real-world applications.

Prerequisite: Basic programming knowledge in Python

Course Outcomes:

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

CO. No	Course Outcomes	Cognitive Knowledge Level
CO 1	Efficiently handle, preprocess, analyze, and visualize data using Python, apply feature engineering techniques, and automate data collection through web scraping.	Analysis
CO 2	Implement and evaluate regression and classification models, understand feature importance, apply regularization techniques, and compare different supervised learning algorithms for predictive analysis.	Evaluate
CO 3	Apply Support Vector Machines (SVM), evaluate model performance, optimize hyperparameters, and implement clustering techniques to uncover patterns and groupings in data.	Evaluate
CO 4	Apply dimensionality reduction techniques, implement ensemble learning methods for improved model performance, and develop time series forecasting models for real-world applications.	Evaluate
CO 5	Build and train neural networks using TensorFlow/Keras, apply deep learning techniques for image and sequence data, and deploy trained models using Flask for real-world applications.	Create

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	2	2	3
CO 2	3	3	3	3	2	2	2	3
CO 3	3	3	3	3	2	2	2	3
CO 4	3	3	3	3	2	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)

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

End Semester Examination (Out of 40 Marks)

o	Problem solving	:	30Marks
o	Viva	:	5 Marks
o	Git Repository	:	5Marks

Syllabus

Module 1 [10 Hours]

Introduction to Python for Data Science: NumPy Basics, Pandas DataFrames, Data Import & Export.

Data Handling & Preprocessing: Handling Missing Values, Feature Scaling, Data Transformation.

Exploratory Data Analysis (EDA) with Pandas & Seaborn: Summary Statistics & Correlation Analysis, Data Visualization, Outlier Detection.

Feature Engineering: Creating New Features, Categorical Feature Encoding, Feature Selection.

Web Scraping & Data Collection: Extract Data from a Static Web Page, Automate Data Collection using Scrapy, Handling JavaScript-rendered Pages.

Module 2 [10 Hours]

Machine Learning & Regression Models: Implement Simple Linear Regression, Multiple Linear Regression, Feature Importance Analysis.

Polynomial Regression: Apply Polynomial Regression on a Non-Linear Dataset, Overfitting in Polynomial Regression, Regularization in Polynomial Regression (Ridge & Lasso).

Classification Algorithms: Logistic Regression for Binary Classification, k-NN Classification, Comparison of Logistic Regression vs k-NN, Decision Tree Classification, Random Forest vs Decision Tree, Naïve Bayes for Text Classification.

Module 3 [8 Hours]

Support Vector Machines (SVM) & Model Evaluation: SVM for Binary Classification, Model Evaluation - Confusion Matrix & ROC Curve, Tuning SVM with Hyperparameter Optimization.

Hyperparameter Tuning & Cross-Validation: Grid Search vs Random Search for Hyperparameter Tuning, k-Fold Cross-Validation in Model Selection, Hyperparameter Tuning in SVM.

k-Means Clustering: k-Means on Synthetic Data, Customer Segmentation, Impact of k on Clustering Results.

Hierarchical Clustering: Dendrogram Visualization, Comparing k-Means & Hierarchical Clustering, Clustering Countries based on Socioeconomic Data.

Module 4 [7 Hours]

Dimensionality Reduction & Feature Extraction:

PCA on High-Dimensional Data, t-SNE for Data Visualization, Feature Extraction for Improved Classification.

Ensemble Learning: Bagging with Random Forest, Boosting with AdaBoost, XGBoost for High-Performance Classification.

Time Series Forecasting & Real-World Case Study: Understanding Time Series Data, Moving Averages & ARIMA, Real-World Case Study - Stock Price Prediction.

Module 5 [10 Hours]

Introduction to Neural Networks & TensorFlow/Keras: Understanding Perceptrons & Activation Functions, Building a Simple ANN Model for Binary Classification, ANN for Multiclass Classification.

Convolutional Neural Networks (CNNs) for Image Classification: Image Preprocessing for CNNs, Building a CNN Model, Fine-tuning Pretrained CNN Models.

Recurrent Neural Networks (RNNs) & LSTMs for Sequence Data: Understanding RNNs & LSTMs, LSTM for Time-Series Forecasting, Sentiment Analysis with LSTMs.

Model Deployment & Flask API: Saving & Loading Models, Building a Flask API for Model Deployment, Deploying a Deep Learning Model.

Lab Schedule

Lab Session No.	Exercises	No. of hours
1	**Introduction to Python for Data Science** **Packages:** numpy, pandas	2
	1.1 NumPy Basics: Create a NumPy array of shape (5,5) filled with random numbers between 1 and 100. Perform element-wise addition, multiplication, and compute the mean, median, and standard deviation of the array.	
	1.2 Pandas DataFrames: Create a Pandas DataFrame from a dictionary with columns: ['Name', 'Age', 'Salary'] and display summary statistics. Add a new column that calculates the yearly salary (assuming given salary is monthly).	
	1.3 Data Import & Export: Read a CSV file into a Pandas DataFrame and display the first 5 rows. Write the modified DataFrame to a new CSV file.	
2	**Data Handling & Preprocessing** **Packages:** pandas, numpy, sklearn.preprocessing **Suggested Dataset:** titanic.csv from Seaborn (sns.load_dataset('titanic'))	2
	2.1 Handling Missing Values: Load a dataset with missing values (eg. titanic.csv from Seaborn). Fill missing values in the Age column using the median.	
	2.2 Feature Scaling: Apply **MinMaxScaler** and **StandardScaler** to a numeric column (Fare) in the Titanic dataset.	

	2.3 Data Transformation: Encode categorical variables (Sex, Embarked) using **OneHotEncoder** and **LabelEncoder**.	
3	**Exploratory Data Analysis (EDA) with Pandas & Seaborn** **Packages: pandas, matplotlib, seaborn** **Suggested Dataset:** iris.csv (sns.load_dataset('iris')) **3.1 Summary Statistics & Correlation Analysis:** Load the iris dataset and display descriptive statistics (mean, median, standard deviation). Compute the correlation matrix and visualize it using a heatmap. **3.2 Data Visualization:** Create a **box plot** for the SepalWidthCm column to detect outliers. Create a **pair plot** to analyze relationships among numerical features. **3.3 Outlier Detection:** Use the **IQR method** to identify and remove outliers in the SepalWidthCm column.	**2**
4	**Feature Engineering** **Packages:** pandas, sklearn.preprocessing **Suggested Dataset:** Create a simple house_prices.csv with columns like ['Size', 'Rooms', 'Price', 'Neighborhood']. **4.1 Creating New Features:** Load the house_prices.csv dataset (create manually with columns ['Size', 'Rooms', 'Price']). Create a new feature: **Price per Room** = Price / Rooms. **4.2 Categorical Feature Encoding:** Convert categorical columns (Neighborhood) into numerical values using **One-Hot Encoding**. **4.3 Feature Selection:** Use **Variance Threshold** to remove low-variance features in a dataset.	**2**
5	**Web Scraping & Data Collection** **Packages:** beautifulsoup4, scrapy, selenium **Suggested Websites:** • Static: Example News Site (Can use any real news site with simple HTML) • Dynamic: Amazon, Flipkart (Requires Selenium for JavaScript rendering) **5.1 Extract Data from a Static Web Page:** Scrape the titles and links of articles from a news website (e.g., https://example.com/news). Use **BeautifulSoup** to parse HTML and extract data.	**2**

	5.2 Automate Data Collection using Scrapy: Build a Scrapy spider to crawl multiple pages and collect product names and prices from an e-commerce site.	
	5.3 Handling JavaScript-rendered Pages: Use **Selenium** to extract the latest news headlines from a website with dynamic content.	
6	**Introduction to Machine Learning & Regression Models** **Packages:** pandas, numpy, sklearn.linear_model, sklearn.metrics, matplotlib **Suggested Datasets:** • advertising.csv (Manually created or found online) • Boston Housing Dataset (sklearn.datasets.load_boston())	**2**
	6.1 Implement Simple Linear Regression: Load the **advertising dataset** (advertising.csv) containing TV Ad Spend and Sales. Train a Linear Regression model to predict Sales based on TV Ad Spend. Plot the regression line and compute the Mean Squared Error (MSE).	
	6.2 Multiple Linear Regression: Use **Boston Housing Dataset** (load_boston() from sklearn.datasets). Train a model to predict MEDV (Median House Price) based on all available features. Evaluate the model using **R^2 Score** and **RMSE**.	
	6.3 Feature Importance Analysis: Identify the top 3 most important features affecting house prices using **coefficient values** from the trained model.	
7	**Polynomial Regression** **Packages:** numpy, pandas, sklearn. preprocessing, sklearn. linear_ model, matplotlib **Suggested Datasets:** • Position_Salaries.csv (Can be manually created or found online) • Synthetic data using NumPy	**2**
	7.1 Apply Polynomial Regression on a Non-Linear Dataset: Load **Position vs Salary Dataset** (Position_Salaries.csv). Fit **Linear Regression** and **Polynomial Regression (degree=2,3,4)** models. Compare their performance using **MSE and R^2 Score**.	
	7.2 Overfitting in Polynomial Regression: Generate synthetic data with a quadratic relationship ($y = 4x^2 + 3x$ + noise). Fit models with polynomial degrees ranging from 1 to 6. Plot the curves and analyze the impact of overfitting.	
	7.3 Regularization in Polynomial Regression (Ridge & Lasso): Apply **Ridge Regression** and **Lasso Regression** to prevent overfitting. Compare their coefficients and performance.	

8	**Classification Algorithms - Logistic Regression & k-NN** **Packages:** sklearn.linear_model, sklearn.neighbors, sklearn.metrics, seaborn **Suggested Datasets:** • sklearn.datasets.load_breast_cancer() • sns.load_dataset('iris') • sns.load_dataset('titanic')		2
	8.1 Logistic Regression for Binary Classification: Load the **Breast Cancer Dataset** (load_breast_cancer() from sklearn.datasets). Train a Logistic Regression model to classify benign/malignant tumors. Compute accuracy and visualize the decision boundary.		
	8.2 k-NN Classification: Use the **Iris dataset** (sns.load_dataset('iris')). Train a k-NN model to classify flower species. Experiment with different values of k and plot accuracy scores.		
	8.3 Comparison of Logistic Regression vs k-NN Use **Titanic dataset** (sns.load_dataset('titanic')). Train **Logistic Regression** and **k-NN** models. Compare their confusion matrices and classification reports.		
9	**Classification Algorithms - Decision Trees, Random Forests & Naïve Bayes** **Packages:** sklearn.tree, sklearn.ensemble, sklearn.naive_bayes, graphviz, seaborn **Suggested Datasets:** • sns.load_dataset('iris') • heart.csv (Available on Kaggle) • spam.csv (Manually created or found online)		2
	9.1 Decision Tree Classification: Use **Iris dataset** (sns.load_dataset('iris')). Train a **Decision Tree Classifier** and visualize the tree. Tune max_depth to analyze its effect on overfitting.		
	9.2 Random Forest vs Decision Tree: Load **Heart Disease dataset** (heart.csv). Train both **Decision Tree** and **Random Forest** classifiers. Compare their accuracy using **cross-validation**.		
	9.3 Naïve Bayes for Text Classification: Load a sample **spam email dataset** (spam.csv). Train a **Multinomial Naïve Bayes** classifier to detect spam. Evaluate model performance using **Precision-Recall**.		
10	**Support Vector Machines (SVM) & Model Evaluation** **Packages:** sklearn.svm, sklearn.metrics, matplotlib **Suggested Datasets:**		2

	• sklearn.datasets.load_breast_cancer() • heart.csv (Available on Kaggle)	
	10.1 SVM for Binary Classification: Use **Breast Cancer dataset** (load_breast_cancer()). Train an **SVM classifier** with different kernel types (linear, rbf). Visualize the decision boundary for linear kernel.	
	10.2 Model Evaluation - Confusion Matrix & ROC Curve: Use **Heart Disease dataset** (heart.csv). Train an SVM classifier. Compute **Confusion Matrix, Precision, Recall, F1-score, and AUC-ROC curve**.	
	10.3 Tuning SVM with Hyperparameter Optimization: Use **GridSearchCV** to tune C and gamma parameters. Compare performance before and after tuning.	
11	**Hyperparameter Tuning & Cross-Validation** **Packages:** sklearn.model_selection, sklearn.ensemble, matplotlib **Suggested Datasets:** • sns.load_dataset('titanic') • sklearn.datasets.load_breast_cancer()	**2**
	11.1 Grid Search vs Random Search for Hyperparameter Tuning: Use **Random Forest Classifier** on the Titanic dataset. Apply **GridSearchCV** and **RandomizedSearchCV** to find the best hyperparameters.	
	11.2 k-Fold Cross-Validation in Model Selection: Train a **Logistic Regression model** using **5-fold cross-validation**. Compare cross-validation accuracy scores.	
	11.3 Hyperparameter Tuning in SVM: Use **SVM classifier** on the Breast Cancer dataset. Optimize kernel, C, and gamma using **GridSearchCV**	
12	**k-Means Clustering** **Packages:** sklearn.cluster, matplotlib, seaborn **Suggested Datasets:** • sklearn.datasets.make_blobs() (Synthetic Data) • Mall_Customers.csv (Available on Kaggle) • sns.load_dataset('iris')	**2**
	12.1 k-Means on Synthetic Data: Generate synthetic 2D data with three clusters (make_blobs() from sklearn.datasets). Apply **k-Means clustering** and visualize cluster assignments. Evaluate with the **Elbow Method** and **Silhouette Score**.	
	12.2 Customer Segmentation: Use **Mall Customer Segmentation dataset** (Mall_Customers.csv). Perform k-Means clustering on Annual Income and Spending	

	Score. Visualize clusters and interpret results.	
	12.3 Impact of k on Clustering Results: Run k-Means with different values of k on **Iris dataset** (sns.load_dataset('iris')). Compare cluster purity using **confusion matrix** against actual species labels.	
13	**Hierarchical Clustering** **Packages:** scipy.cluster.hierarchy, sklearn.cluster, matplotlib, seaborn **Suggested Datasets:** • sns.load_dataset('iris') • Mall_Customers.csv (Available on Kaggle) • happiness.csv (World Happiness Report dataset)	2
	13.1 Dendrogram Visualization: Use **Iris dataset** (sns.load_dataset('iris')). Apply **Hierarchical Agglomerative Clustering** and plot a **dendrogram**.	
	13.2 Comparing k-Means & Hierarchical Clustering: Use **Mall Customers dataset** (Mall_Customers.csv). Perform both **k-Means** and **Agglomerative Clustering**. Compare cluster purity and silhouette scores.	
	13.3 Clustering Countries based on Socioeconomic Data: Load **World Happiness Report dataset** (happiness.csv). Apply **Hierarchical Clustering** to group similar countries. Interpret results based on GDP, Social Support, and Happiness Score.	
14	**Dimensionality Reduction & Feature Extraction (PCA & t-SNE)** **Packages:** sklearn.decomposition, sklearn.manifold, matplotlib **Suggested Datasets:** • sklearn.datasets.load_wine() • fetch_openml('mnist_784') (MNIST dataset) • heart.csv (Available on Kaggle)	2
	14.1 PCA on High-Dimensional Data: Use **Wine Dataset** (load_wine() from sklearn.datasets). Apply **PCA** and reduce dimensions to 2. Visualize data in 2D and analyze variance explained.	
	14.2 t-SNE for Data Visualization: Apply **t-SNE** on the **MNIST handwritten digits dataset** (fetch_openml('mnist_784')). Visualize clusters of digits in a 2D space.	
	14.3 Feature Extraction for Improved Classification: Use **Heart Disease dataset** (heart.csv). Apply **PCA** and train a **Logistic Regression model** on reduced features. Compare accuracy before and after PCA.	
15	**Ensemble Learning (Bagging & Boosting)**	2

	Packages: sklearn.ensemble, xgboost, seaborn **Suggested Datasets:** • heart.csv (Available on Kaggle) • sklearn.datasets.load_breast_cancer() • sns.load_dataset('titanic')	
	15.1 Bagging with Random Forest: Use **Heart Disease dataset** (heart.csv). Train a **Random Forest classifier** and compare performance with Decision Tree.	
	15.2 Boosting with AdaBoost: Use **Breast Cancer dataset** (load_breast_cancer()). Train an **AdaBoost classifier** and analyze improvement over Decision Tree.	
	15.3 XGBoost for High-Performance Classification: Use **Titanic dataset** (sns.load_dataset('titanic')). Train an **XGBoost model** and compare accuracy with Random Forest.	
16	**Time Series Forecasting & Real-World Case Study** **Packages:** statsmodels.tsa, pandas, matplotlib, seaborn **Suggested Datasets:** • AirPassengers.csv (Available in statsmodels.tsa.datasets) • TSLA.csv (Download from Yahoo Finance)	**2**
	16.1 Understanding Time Series Data: Load **Air Passenger dataset** (AirPassengers.csv). Plot time series trends and check for seasonality.	
	16.2 Moving Averages & ARIMA: Apply **Moving Average smoothing** to detect trends. Train an **ARIMA model** to forecast the next 12 months.	
	16.3 Real-World Case Study: Stock Price Prediction: Load **Tesla Stock Prices** (TSLA.csv). Perform **EDA → Preprocessing → Train ARIMA/XGBoost model**. Evaluate predictions using **Mean Absolute Error (MAE)**.	
17	**Introduction to Neural Networks & TensorFlow/Keras** **Packages:** tensorflow, keras, numpy, matplotlib, sklearn **Suggested Datasets:** • sklearn.datasets.load_breast_cancer() • sns.load_dataset('iris')	**2**
	17.1 Understanding Perceptrons & Activation Functions: Implement a **single-layer perceptron** for classifying **AND, OR, XOR** logic gates. Experiment with different activation functions (sigmoid, ReLU, tanh).	
	17.2 Building a Simple ANN Model for Binary Classification: Use **Breast Cancer dataset** (load_breast_cancer() from sklearn.datasets). Train a **feedforward neural network** with Keras Sequential API. Evaluate performance using **accuracy and loss**	

	plots. **17.3 ANN for Multiclass Classification:** Train a neural network on the **Iris dataset** (sns.load_dataset('iris')). Compare performance with **Logistic Regression and Decision Trees**.	
18	**Convolutional Neural Networks (CNNs) for Image Classification** **Packages:** tensorflow, keras, matplotlib, cv2, sklearn **Suggested Datasets:** • keras.datasets.mnist.load_data() • keras.datasets.cifar10.load_data() • Cats vs. Dogs dataset (Available on Kaggle) **18.1 Image Preprocessing for CNNs:** Load images from **CIFAR-10 dataset** (keras.datasets.cifar10.load_data()). Normalize pixel values and apply **data augmentation** (ImageDataGenerator). **18.2 Building a CNN Model:** Train a **CNN classifier** on **MNIST handwritten digits dataset** (keras.datasets.mnist). Use **Conv2D, MaxPooling, Flatten, Dense layers** in Keras. Plot training loss and accuracy. **18.3 Fine-tuning Pretrained CNN Models:** Load **pretrained VGG16** (keras.applications.VGG16). Train on **custom image dataset** (e.g., **Cats vs. Dogs from Kaggle**). Compare accuracy before and after fine-tuning.	**2**
19	**Recurrent Neural Networks (RNNs) & LSTMs for Sequence Data** **Packages:** tensorflow, keras, numpy, pandas, matplotlib, seaborn **Suggested Datasets:** • AirPassengers.csv (Available in statsmodels.tsa.datasets) • keras.datasets.imdb.load_data() **19.1 Understanding RNNs & LSTMs:** Train a **basic RNN** on a **synthetic time series dataset** (numpy.sin()). Compare RNN vs. LSTM performance. **19.2 LSTM for Time-Series Forecasting:** Use **Air Passenger dataset** (AirPassengers.csv). Train an **LSTM model** for future passenger prediction. Evaluate using **Mean Absolute Error (MAE)**. **19.3 Sentiment Analysis with LSTMs:** Load **IMDB movie reviews dataset** (keras.datasets.imdb). Train an **LSTM model** for positive/negative sentiment classification.	**2**
20	**Model Deployment & Flask API** **Packages:** flask, tensorflow, pickle, requests, json **Suggested Datasets:**	**2**

	• sns.load_dataset('iris') • keras.datasets.mnist.load_data()	
	20.1 Saving & Loading Models: Train a **Logistic Regression model** on **Iris dataset**. Save the model using pickle and reload it for predictions.	
	20.2 Building a Flask API for Model Deployment: Develop a **Flask API** to serve an ML model. Send JSON requests and return predictions.	
	20.3 Deploying a Deep Learning Model: Train a CNN on **MNIST dataset**. Serve predictions through a Flask API and test using requests.post().	
	Total Hours	**40**

Reference Books:

1. Aurelien Geron, "Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow", 2nd Edition, O'Reilly, 2022.
2. Rachel Schutt, Cathy O'Neil, "Doing Data Science", 1st Edition, O'Reilly, 2013.
3. Joel Grus "Data Science from Scratch", 2nd Edition, O'Reilly, 2019.
4. Andreas C. Muller, Sarah Guido, "Introduction to Machine Learning with Python", 1st Edition, O'Reilly, 2016.
5. Peter Flach, "Machine Learning -The Art and Science of Algorithms that Make Sense of Data", 1st Edition, Cambridge University Press, 2012.
6. Trevor Hastie, Robert Tibshirani, Jerome Friedman, "The Elements of Statistical Learning - Data Mining, Inference, and Prediction" 2nd Edition, Springer, 2017.
7. Christopher M. Bishop, "Pattern Recognition and Machine Learning", 1st Edition, Springer, 2006.
8. Sebastian Raschka, Vahid Mirjalili, "Python Machine Learning", 2nd Edition, Packt Publishing, 2017.

Online Resources:

1. https://onlinecourses.nptel.ac.in/noc21_cs69/preview
2. https://onlinecourses.nptel.ac.in/noc22_cs32/preview
3. https://onlinecourses.nptel.ac.in/noc19_cs52/preview
4. https://onlinecourses.swayam2.ac.in/ini25_cs02/preview

KNOWLEDGE IS POWER

M24CA1M307	Mini Project	L	T	P	J	S	Credit	Year of Introduction
		0	0	0	4	2	2	2024

Preamble:

This Mini Project course is designed to provide students with hands-on experience in software development, following industry best practices. It emphasizes Agile methodologies, project planning, development, testing, and documentation to ensure a structured approach. By the end of the course, students will have built a mid-sized application, aligning with modern industry trends like Database Systems, AI, cloud computing, cybersecurity, and web & mobile applications.

Prerequisite:

Knowledge in software engineering principles and programming skills.

Course Outcomes:

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

CO No.	Course Outcome (CO)	Bloom's Category Level
CO 1	Identify and formulate a software project idea by analyzing requirements and feasibility.	Analyse
CO 2	Design scalable system architecture or algorithms that support Database, AI, cloud computing, web applications, or mobile applications using appropriate industry-standard frameworks and technologies.	Apply
CO 3	Develop and implement the project using programming languages, frameworks, and best coding practices.	Create
CO 4	Conduct testing and debugging to ensure software quality and reliability.	Evaluate
CO 5	Demonstrate project execution and document the complete development process following software engineering 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	3	3	3	2	3	3	3
CO 2	3	3	3	3	2	3	3	3
CO 3	3	3	3	3	2	3	3	3
CO 4	3	3	3	3	2	3	3	3
CO 5	3	3	3	3	2	3	3	3

Assessment Pattern

Attendance	10%
Continuous Evaluation	20%
Documentation & GitHub Repository Management	20%
First Presentation - Requirement Analysis & Design	10%
Interim Presentation - Development & Testing	10%
Final Presentation & Demonstration	30%

Mark Distribution

Total Marks	CIE	ESE
100	100	-

Marks Division

Attendance by Project Supervisor	10 Marks
Continuous Evaluation by Project Guide	20 Marks
Documentation & GitHub Repository Management by Project Guide	10 Marks
Documentation & GitHub Repository Management by Project Supervisor	10 Marks
First Evaluation by the Project Assessment Board	10 Marks
Interim Evaluation by the Project Assessment Board	10 Marks
Final Evaluation by the Project Assessment Board	30 Marks
Total	**100 Marks**

Guidelines

- Students shall identify Real-Life Projects which are relevant and useful to the society or industry.
- The project shall be an individual project and must be done in-house. The student has to spend time in the lab during the assigned hours for the project work.
- Attendance as per MCA regulation is applicable for submitting the project for final evaluation.
- Students shall submit project synopsis and get prior approval from the Project Supervisor before the project work begins. The Faculty Advisor shall serve as the Project Supervisor unless instructed otherwise by the Head of the Department.
- If there is a customer for the project then he/she will be the Product Owner (External Guide) and a faculty from the department will be the Internal Guide. If there is no such customer then the Internal Guide himself/herself shall act as the Product Owner.
- A faculty / technical staff shall act as the Scrum Master to continuously monitor the project development. Scrum meetings, of less than 15 minutes, at the convenience of the Scrum Master are to be highly encouraged. Ensure such meetings occur once in three days.
- Set a sprint as two weeks, ensure biweekly reviews. A review shall not exceed 30 minutes. A demo to the Product Owner (Project Guide) is mandatory in every review.
- The student shall maintain a Scrum Book (Rough Record) which has to be divided into 4 parts – (i) Product Backlog (ii) Database & UI Design (iii) Testing & Validation and (iv) Details of Versions. Make dated entries in the corresponding part at regular intervals. The corrections and comments from Product Owner and Scrum Master should be clearly indicated with the Date.

- Test Driven Development methodology may be practiced for the project development. BugZilla, BackLog or any such tool may be used for Bug Tracking.
- Git shall be used for Version Control and Git commit history may be verified as part of project evaluation.
- LaTeX or an equivalent tool shall be used for preparing Presentations and Project Report.
- Two evaluations of project's progress (First & Interim) shall be conducted as part of Internal Assessment. Project Assessment Board may consist of Project Supervisor, Product Owner, Scrum Master and one other Faculty Member from the department. Scrum reviews shall not be sacrificed for such presentations.
- At the end of the semester entire project development activities shall be evaluated internally by the Project Assessment Board.

Week	Schedule
1	Familiarisation with build tools (editor/IDE, compiler such as gcc with commonly used options/switches, debugger like dgb). Familiarisation with an IDE (Eclipse, NetBeans…), that supports build tools and common version control operations using Git . Familiarisation with Docker Selection of Topic, Formation of Development Team, Feasibility analysis.
2	Topic Approval, Meeting of Development Team including Scrum Master with Product Owner. Informal, preliminary discussions of requirements. Creating user stories in the rough record. Commencement of the Project.
3	Project Presentation - First Identifying Modules, Initial Design of Database & UI. Creating a Docker container for the environment Creating an empty git repository by Scrum Master / one member of the Development team and setting permission to other members. Pushing the first version of the Project along with a Readme file containing contact details of team members. Creating pull requests for sample update of Readme by each member and merging the pull requests of one by another.
4-5	Setting up systems for development, testing and production. Design of the basic model of a simple deployment pipeline Creating a suitable folder structure (Maven's folder structure is desirable). Creating Unit tests using an XUnit framework, Writing the build and code analysis script, Writing acceptance test scripts and test cases, Setting up a Continuous Integration System like Jenkins. Automating acceptance tests with Selenium, Karate or an equivalent tool, writing a simple deployment script that uses scp/rsync or Ansible for copying the Dockerfile and running Docker with ssh. First Scrum Review. (Here onwards, the Scrum reviews are conducted on every other week)

7	Project Presentation - Interim Evaluation to be based on Git History
14	Submission of Project Report, with Scrum Book Project Presentation – Final Evaluation to be based on Git History, Scrum Book, Project Report and Presentation

References:

1. Continuous Delivery: Reliable Software Releases through Build, Test, and Deployment Automation (Addison-Wesley Signature Series (Fowler)) 1st Edition
2. Alistair Cockburn, Agile Software Development: The Cooperative Game, Addison Wesley, 2nd Edition (2006).
3. Andrew Hunt, David Thomas, The Pragmatic Programmer: From Journeyman to Master, Pearson India, 1st Edition (2008).
4. Ken Schwaber, Mike Beedle, Agile Software Development with Scrum, Pearson (2008).
5. Lisa Crispin, Janet Gregory, Agile Testing: A Practical Guide for Testers and Agile Teams, Addison Wesley Professional, 1st Edition (2008).
6. Mike Cohn, User Stories Applied: For Agile Software Development, Addison Wesley, 1st Edition, (2004).
7. Pressman, R.S., Software Engineering: A Practitioner's Approach, McGraw Hill SE, 7th Edition, (2010).
8. Robert C. Martin, Agile Software Development, Principles, Patterns and Practices, Prentice Hall Imprint, Pearson Education, 2nd Edition (2002).\
9. Rod Stephens, Beginning Software Engineering, Wrox Series, Wiley India Pvt Ltd (2015).
10. RyPress Ry's Git Tutorial (Free e-book)

Online Resources:

1. https://onlinecourses.nptel.ac.in/noc19_cs70/preview, “Software Project Management”, Prof. Rajib Mall, Prof. Durga Prasad Mohapatra, IIT Kharagpur.
2. https://onlinecourses.nptel.ac.in/noc20_cs68/preview, “Software Engineering”, Prof. Rajib Mall, IIT Kharagpur.
3. https://onlinecourses.nptel.ac.in/noc22_cs61/preview, “Software Testing”, Prof. Meenakshi D'souza, IIIT Bangalore.

M24CA1N308	Professional Ethics & Human Values	L	T	P	J	S	Credit	Year of Introduction
		1	0	0	0	1	0	2024

Preamble: This course is designed to provide postgraduate students with a comprehensive understanding of ethical principles, values and practices in professional settings, cultivate ethical decision-making skills and a strong sense of social responsibility among students pursuing careers in various fields.

Prerequisite: Nil

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

	Course Outcome	Cognitive Knowledge Level
CO 1	Analyze ethical theories by incorporating human values and apply them to real-life scenarios.	Apply
CO 2	Analyze professional codes of conduct and evaluate ethical dilemmas in various industries.	Apply
CO 3	Demonstrate ethical leadership qualities and apply ethical decision-making models in complex situations.	Apply
CO 4	Analyze ethical challenges posed by emerging trends and technologies and propose ethical solutions.	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
CO 2		2	2		1		3	2
CO 3		2	1		2		3	2
CO 4		1	1		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
- Activity Report : 10 marks
- Attendance : 10 marks

Syllabus

Module 1 [3 Hours]

Foundation of Ethics: Definition of ethics and its importance in professional settings, Comparative analysis of ethical theories and their relevance to decision making, Significance and classification of human values, Exploration of fundamental moral values and principles that guide ethical behavior, Ethical reasoning and moral judgment in practical situations.

Self-Study: Examination of ethical dilemmas and conflicts in the context of moral values.

Module 2 [3 hours]

Professional Ethics in Practice: Impact of technology on ethical decision making and social responsibility, Role of organizations in addressing social and environmental issues, Ethical guidelines for professionals and organizations, Importance of whistleblowing in organizational ethics.

Self-Study: Ethical implications of Artificial Intelligence, Ethical challenges in the healthcare industry.

Module 3 [3 Hours]

Ethical Leadership and Decision Making: Ethical leadership styles and practices, Ethical decision making models, International business ethics and cross-cultural communication, Role of corporate governance in promoting ethical practices, Boardroom ethics and stakeholder management.

Self-Study: Case studies of companies with exemplary CSR practices, Cross-cultural ethical considerations.

Module 4 [3 Hours]

Emerging Trends in Ethics and Values: Ethical considerations in emerging technologies, Ethical challenges in the adoption of new technologies, Sustainable business practices and corporate sustainability, Ethical marketing strategies and consumer protection, Ethics in scientific research, Intellectual property rights.

Self-Study: Ethical considerations in data privacy and security.

Teaching Plan

Sl. No.	Topic	No. of Lecture/ Tutorial Hours
Module 1 [3 Hours]		
1.1	Definition of ethics and its importance in professional settings, Comparative analysis of ethical theories and their relevance to decision making	1
1.2	Significance and classification of human values, Exploration of fundamental moral values and principles that guide ethical behavior	1
1.3	Ethical reasoning and moral judgment in practical situations.	1
Module 2 [3 Hours]		
2.1	Impact of technology on ethical decision making and social responsibility, Role of organizations in addressing social and environmental issues	1
2.2	Ethical guidelines for professionals and organizations, Importance of whistleblowing in organizational ethics	2
Module 3 [3 Hours]		
3.1	Ethical leadership styles and practices, Ethical decision making models	1

3.2	International business ethics and cross-cultural communication, Role of corporate governance in promoting ethical practices, Boardroom ethics and stakeholder management.	2
Module 4 [3 Hours]		
4.1	Ethical considerations in emerging technologies, Ethical challenges in the adoption of new technologies,	1
4.2	Sustainable business practices and corporate sustainability, Ethical marketing strategies and consumer protection, Ethics in scientific research, Intellectual property rights.	2
	Total Hours	12

Reference books:

1. Ronald A. Howard, Clinton D, Korver and Bill Birchard, "Ethics for the real world: Creating a personal code to guide decisions in work and life", Harvard Business Review Press (2008).

2. Michael J. Quinn, "Ethics for the Information Age", Pearson, Sixth Edition (2016).

3. Simon Sinek, "Leaders Eat Last: Why some teams pull together and other don't", Brilliance Audio (2017).

4. A. N. Tripathi, "Human Values", New Age Publishers, Third Edition (2019).

Online Resources:

1. Ethics in Action (Edx)
   https://www.edx.org/learn/ethics/sdg-academy-ethics-in-action
2. Leadership and Business Ethics: Insights and Strategies (Udemy)
   https://www.udemy.com/course/insights-into-integrity-ethics-and-morality-for-leaders/?couponCode=ST22MT240325G3
3. Exploring human values: Visions of happiness and perfect society (NPTEL)
   https://nptel.ac.in/courses/109104068

KNOWLEDGE IS POWER

M24CA1I309	Internship	L	T	P	J	S	Credit	Year of Introduction
		0	0	0	0	0	1	2024

Objectives:

The objective of the academic internship program is to provide students with industry exposure, enabling them to apply theoretical knowledge in real-world scenarios while enhancing their technical, communication, and problem-solving skills. The program aims to develop professionalism, workplace ethics, teamwork, and adaptability while providing hands-on experience and networking opportunities to prepare students for future careers, ensuring they gain industry-relevant skills, effective communication, teamwork, critical thinking, and ethical decision-making. Additionally, they will gain confidence in transitioning to full-time employment and build a professional portfolio showcasing their learning and contributions.

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	Students will apply theoretical knowledge from their academic program to practical tasks and real-world scenarios during their internship	Apply
CO 2	Develop hands-on experience with industry-specific tools, technologies, and methodologies.	Apply
CO 3	Build connections with industry professionals and understand the importance of teamwork and collaboration.	Apply
CO 4	Identify, analyze, and propose solutions to real-world business or technical challenges.	Apply
CO 5	Develop adaptability, leadership qualities, and time management skills to enhance employability	Apply

Mapping of Course outcome with Programme Outcome

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

End Semester Examination

Presentation	-	10 Marks
Student’s diary	-	20 Marks
Internship Report	-	10 Marks
Comprehensive Viva Voce	-	10 Marks

Presentation & Viva Voce will be done by a committee comprising Head of the Department/Senior Faculty nominated by HOD, Faculty Advisor and Guide.

Guidelines

a. The internship opportunities include industry roles preferably with a stipend, positions in government or PSUs, IT companies, opportunities with leading education or research institutes, and experiences within incubation centers or start-ups.

b. All the students need to do internship for minimum duration of 6 weeks

c. Students are required to produce a letter from the organization before starting the Internship and a committee constituted by the head of the department shall make the decision on permission

d. All students should compulsorily follow the rules and regulations as laid by industry.

e. Students shall report the progress of their work to his/her guide on every week.

f. Each student has to maintain a diary to record their daily activities.

g. After completion of internship, students are required to submit

  a) Attendance Certificate from the company
  b) Student's diary
  c) Report of work done
  d) Internship certificate

Internship Report: After completion of the internship, the student should prepare a comprehensive report to indicate what he has observed and learnt in the training period and should be submitted to the Faculty Guide. The student may contact Industrial Supervisor for assigning special topics and problems and should prepare the final report on the assigned topics. Student's Diary will also help to a great extent in writing the industrial report since much of the information has already been incorporated by the student into the diary. The report should be signed by the Head of the Department and Guide.

Student's Diary: The main purpose of writing daily diary is to cultivate the habit of documenting and to encourage the students to search for details. It develops the students' thought process and reasoning abilities. The students should record in the daily training diary the day to day account of the observations, impressions, information gathered and suggestions given, if any. The daily training diary should be signed after every day by the supervisor/ in charge of the section where the student has been working. The diary should also be shown to the Faculty Mentor visiting the industry from time to time and got ratified on the day of his visit.

The format of student's diary

Name of the Organization/Section:

Name and Address of the Section Head:

Name and Address of the Supervisor:

Name and address of the student:

Internship Duration: From .... To ....

Brief description about the nature of internship:

Day	Brief write up about the Activities carried out: Such as design, sketches, result observed, issues identified, data recorded, etc.
1	
2	
3	

Signature of Industry Supervisor Signature of Section Head/HR ManagerOffice Seal

Attendance Sheet

Name of the Organization/Section:

Name and Address of the Section Head:

Name and Address of the Supervisor:

Name and address of the student:

Internship Duration: From .... To ....

Month & Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	...
Month & Year																					
Month & Year																					

Signature of Industry Supervisor Signature of Section Head/HR ManagerOffice Seal

M24CA1E303A	Artificial Intelligence	L	T	P	J	S	Credit	Year of Introduction
		3	1	0	0	3	4	2024

Preamble: This course intends to provide a comprehensive introduction to the fundamental concepts of Artificial Intelligence, including knowledge representation, search algorithms, planning, machine learning, robotics and multi-agent systems. The course will equip students with the knowledge and skills to understand intelligent systems that can perceive, reason, act and learn in complex environments.

Prerequisite: Strong foundation in Mathematics, proficiency in programming and ideally some prior exposure to machine learning concepts.

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

CO No.	Course Outcome	Cognitive Knowledge Level
CO 1	Understand the fundamental concepts of Artificial Intelligence, including AI problem formulation, intelligent agents, search algorithms and apply these concepts to solve basic AI problems	Apply
CO 2	Understand and apply advanced search algorithms including local search, adversarial search, game-playing strategies and utilize knowledge representation techniques like semantic nets to solve complex AI problems.	Apply
CO 3	Understand and represent knowledge using various techniques like propositional and first-order logic, semantic networks, frames, ontologies, rule-based system and apply these representations to build intelligent agents and reason under uncertainty.	Apply
CO 4	Understand various planning techniques and explore various machine learning approaches, to improve the performance of AI systems.	Understand
CO 5	Understand the key concepts in Robotics and AI, and explore the challenges and solutions in multiagent systems.	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	2			1	2
CO 2	2	2	2	2	1		1	2
CO 3	2	2	2	2	1		1	2
CO 4	2	2	2	1	1		2	3
CO 5	2	2	2	1	1		2	3

Assessment Pattern

	Artificial Intelligence		
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
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 (Modules 1 & 2) : 10 Marks
- Continuous Assessment Test 2 (Modules 3 & 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 [10 Hours]**

Artificial Intelligence: Foundations of AI, AI problem Formulation, Example Problems – 8-puzzle problem and Block World problem.

Intelligent Agents: Structure of agents, Agent System, Hierarchical control.

Problem Solving by searching: Control Strategies - state space search, search tree. Uninformed (Blind) Search Methods – Depth-First Search, Breadth-First Search, Depth-Limited Search and Iterative Deepening Depth-First Search. Informed (Heuristic) Search Strategies – Greedy best-first search, A* search.

Self-Study: Applications of AI in everyday Life, Types of agents and Environment properties.

Module 2 [12 Hours]

Search Strategies: Local search algorithms – Hill-climbing search, simulated annealing, local beam search, genetic algorithms. Optimization- Systematic methods for Optimization. Adversarial search – Games, Optimal decisions in games, Alpha-Beta pruning, Constraint Satisfaction Problems.

Semantic nets and description matching: Semantic nets, the Describe-and-Match method and recognition of abstractions.

Self-Study: Games with chance – Monte Carlo tree search.

Module 3 [9 Hours]

Knowledge representation: Knowledge representation – defining a solution, physical symbol system hypothesis, reasoning and acting. Knowledge-based agents, propositional logic - syntax and semantics, Agents based on propositional logic, First-order Logic, Knowledge Engineering in first order logic, propositional vs. first order inference, Knowledge representation in AI – Semantic Networks, Frames, Ontologies, Rule based systems – Production rules, Forward Chaining, Backward Chaining, Resolution.

Reasoning Under Uncertainty: Nonmonotonic Reasoning, Bayesian Networks, Dempster-Shafer theory.

Self-Study: Syntactic-semantic spectrum of representation, Logic and Slot-and-filler structures, other representational techniques.

Module **4 [7 Hours]**

Planning: Planning as State-Space Search, Planning Graphs, Hierarchical Planning, STRIPS representation, forward planning, Regression Planning, planning as a CSP, Partial-Order planning.

Learning: Learning in problem-solving, learning from examples, Explanation-based learning, Inductive Logic Programming, Learning Belief Networks, Reinforcement Learning.

Self-Study: Planning under uncertainty – One-Off decisions, sequential decisions, decision processes.

Module 5 [7 Hours]

Robotics and AI: Robotic perception, Robot motion planning, planning uncertain movements, Robotic software architectures.

Multi-Agent Systems: Multiagent framework, representation of games, computing strategies, reasoning.

Self-Study: Swarm Intelligence and its applications in Robotics and multi-agent system.

Reference Books:

1. Stuart J Russell and Peter Norvig, "Artificial Intelligence: A Modern Approach", Pearson Education, Fourth Edition (2022). (Modules – 1,2,3,4,5)
2. Vinod Chandra S S and Anand Hareendran S, "Artificial Intelligence: Principles and Applications", PHI Learning, Second Edition. (Modules – 1,2,3,4,5)
3. David L. Poole and Alan K. Mackworth, "Artificial Intelligence: Foundations of Computational Agents", Cambridge University Press, Third Edition (2023). (Modules – 1,4,5)
4. Elaine Rich, Kevin Knight and Shivashankar B Nair, "Artificial Intelligence", MedTech Science Press, Fourth Revised Edition (2024). (Modules – 3,4)

5. Dan W Patterson, "Introduction to Artificial Intelligence and Expert Systems", Pearson Education India, First Edition (2015).
6. Deepak Khemani, "A first course in Artificial Intelligence", McGraw Hill Education (2013).
7. Nils J. Nilsson, "Principles of Artificial Intelligence", Illustrated Reprint Edition, Springer Heidelberg (2014)
8. Patrick Henry Winston, "Artificial Intelligence", Pearson Education, Third Edition (2002).
9. Stephen Lucci and Danny Kopec, "Artificial Intelligence in the 21st Century", Mercury Learning and Information, Second Edition (2015).
10. Toshinori Munakata, "Fundamentals of the new Artificial Intelligence", Springer London, Second Edition (2008).

Online Resources:

1. Prof. Mausam, IIT Delhi, "An Introduction to Artificial Intelligence".
   https://nptel.ac.in/courses/106102220
2. Prof. Deepak Khemani, IIT Madras, "Artificial Intelligence: Search methods for Problem Solving"

https://nptel.ac.in/courses/106106226

3. AI Foundations for Everyone (Coursera)
   https://www.coursera.org/specializations/ai-foundations-for-everyone

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
Module 1 [10 Hours]		
1.1	Foundations of AI, AI problem formulation, Example problems	2
1.2	Agent Architecture & hierarchical control	2
1.3	Problem solving by searching- State space search, Uninformed search methods – Breadth-First and Depth-First search	2
1.4	Depth-Limited Search and Iterative Deepening Depth-First Search	1
1.5	Informed search strategies – Heuristic functions, Greedy Best-First Search	2
1.6	A* Search	1
Module 2 [12 Hours]		
2.1	Local Search Algorithms – Hill-climbing search, simulated annealing, local beam search	2
2.2	Genetic Algorithms	2
2.3	Systematic methods for optimization	2
2.4	Adversarial search - Games, Optimal decisions in games, Alpha-Beta pruning	2
2.5	Constraint Satisfaction Problems	2
2.6	Semantic nets, the Describe-and-Match method and recognition of abstractions.	2
Module 3 [9 Hours]		
3.1	Knowledge representation and knowledge-based agents	1
3.2	Propositional Logic - syntax and semantics, Agents based on	1

	propositional logic	
3.3	First-Order logic, Knowledge Engineering in FOL, Propositional vs. First-Order inference	2
3.4	Rule-based system - Production rules, Forward Chaining, Backward Chaining, Resolution	1
3.5	Semantic Networks	1
3.6	Frames and Ontologies	2
3.7	Nonmonotonic Reasoning, Bayesian Networks, Dempster-Shafer theory	1
Module 4 [7 Hours]		
4.1	Planning as State-Space search	1
4.2	Planning graphs, STRIPS Representation	1
4.3	Hierarchical planning, Forward Planning	1
4.4	Regression Planning, Planning as a CSP	1
4.5	Learning in problem-solving, Learning from examples	1
4.6	Explanation-based learning, Inductive Logic Programming	1
4.7	Learning Belief Networks, Reinforcement Learning	1
Module 5 [7 Hours]		
5.1	Robotic perception	1
5.2	Robot motion planning, planning uncertain movements	2
5.3	Robotic software architectures	1
5.4	Multiagent framework	1
5.5	Representation of games, Computing Strategies	1
5.6	Reasoning in Multi-Agent Systems	1
	Total Hours	**45**

CO Assessment Questions

Course Outcome 1 (CO1)

1. Imagine you are designing an AI system for a self-driving car. Explain how the concept of the Physical Symbol System Hypothesis could be applied in this scenario. Discuss how the car would represent knowledge about its environment (roads, traffic signals, pedestrians) using symbols, and how it would use these symbols to reason and make decisions (e.g., navigate intersections, avoid collisions). (L2)
2. Provide a concrete example of an agent system, such as a home automation system, and illustrate how hierarchical control could be applied within this system. (L2)
3. Design a heuristic function for the 8-Puzzle problem that could be used in a Greedy Best-First Search. Discuss the potential advantages and disadvantages of using this heuristic function compared to A* search in terms of solution quality and computational cost. (L3)

Course Outcome 2 (CO2)

1. Explain the difference between hill-climbing search and simulated annealing. How does simulated annealing overcome a major limitation of hill-climbing? (L2)
2. Describe how the minimax algorithm with alpha-beta pruning can be used to determine the optimal move for a player in a two-player game like Tic-Tac-Toe. Explain how alpha-beta pruning helps to improve the efficiency of the minimax search. (L3)
3. Consider the Traveling Salesperson Problem (TSP), where the goal is to find the shortest possible route that visits a set of cities exactly once. How could you adapt a genetic algorithm to solve the TSP? Describe the representation of a solution, the fitness function, and the genetic operators that would be used. (L3)

Course Outcome 3 (CO3):

1. Explain the difference between propositional logic and first-order logic in terms of their expressive power. Provide a simple example to illustrate this difference. (L2)
2. What are the situations in which forward chaining might be preferred over backward chaining in rule-based systems? (L2)
3. "If it is raining, then the ground is wet. The ground is wet." Represent this knowledge using propositional logic. Use the resolution principle to determine if the proposition "It is aining" can be inferred from the given knowledge. (L3)

Course Outcome 4 (CO4):

1. Explain the difference between a goal state and a leaf node in the context of a search tree used for planning. (L1)
2. Imagine you are building a system to classify emails as spam or not spam. How would you use the technique of "learning from examples" to train this system? Describe the process and the type of data you would need. (L2)
3. Describe a scenario where reinforcement learning could be effectively applied. Explain the key components of the reinforcement learning problem in this scenario: the agent, the environment, the actions, the rewards, and the learning goal. (L2)

Course Outcome 5 (CO5):

1. Explain the difference between a map and a metric map in the context of robotic perception. How does a metric map provide more information for robot navigation? (L2)
2. Consider a mobile robot navigating in a dynamic environment with moving obstacles. What are the challenges involved in planning the robot's motion in such an environment. How can techniques like probabilistic motion planning and dynamic window approaches help address these challenges? (L3)
3. Describe the concept of emergent behavior in multi-agent systems. How can the concept of emergent behavior be utilized in the design of artificial multi-agent systems? (L2)

Model Question Paper
QP CODE: Pages: 02

Reg No.: …………… Name: ……………………

MAR ATHANASIUS COLLEGE OF ENGINEERING (AUTONOMOUS), KOTHAMANGALAM
THIRD SEMESTER M.C.A. DEGREE EXAMINATION, DECEMBER 2024
Course Code: M24CA1E303A
Course Name: ARTIFICIAL INTELLIGENCE

Max. Marks: 60 Duration: 3 Hours

PART A

Answer all questions. Each question carries 2 marks.

1. Explain model-based agents. How does the inclusion of an internal state model enhance an agent's capabilities?
2. Describe the key difference between Breadth-First Search (BFS) and Depth-First Search (DFS) in terms of their exploration strategy. In what scenarios might BFS be preferred over DFS, and vice versa?
3. Explain how inheritance in semantic networks can be used to facilitate efficient

knowledge representation and reasoning.

4. Explain the concept of a convex function in the context of optimization problems. Why is convexity an important property for optimization algorithms?
5. Differentiate a taxonomy and an ontology.
6. What is the advantage of representing probabilistic relationships using a Bayesian Network compared to simply listing a joint probability distribution over all variables?
7. What are the main types of levels in a planning graph, and what information is represented at each level?
8. Explain how the STRIPS representation handles the frame problem.
9. Why is it crucial for robots to plan for uncertain movements, and what are some of the sources of this uncertainty?
10. What is the significance of belief-desire-intention (BDI) architectures in reasoning with multiagent systems?

PART B

Answer any five questions. Each question carries 8 marks.

11. Evaluate the Physical Symbol System Hypothesis (PSSH). With relevant examples, discuss whether it holds relevance in contemporary AI research.
12. Describe the Constraint Satisfaction Problem (CSP) framework, including its key components. Explain how backtracking search can be used to solve a CSP. Discuss the concept of constraint propagation and how it can improve the efficiency of backtracking search.
13. Explain the minimax algorithm for two-player, zero-sum games. Discuss how it determines optimal decisions by exploring the game tree. Describe how alpha-beta pruning improves the efficiency of the minimax algorithm. How the alpha and beta values are used to prune branches of the game tree.
14. Explain the core concepts of Dempster-Shafer Theory (DST). What does a mass function represent and how are mass functions assigned to propositions? Explain the relationship of belief and plausibility to the mass function. Additionally explain how DST handle uncertainty and ignorance more effectively?
15. Explain the concept of unification in the context of first-order logic resolution. Describe the resolution inference rule and how it utilizes unification to derive new clauses from existing ones. Discuss the role of unification in proving theorems and solving problems using first-order logic.
16. Explain the process of learning the structure of a Bayesian Network from data. How the parameters of a Bayesian Network is determined given its structure.
17. Discuss the important characteristics and components of a typical layered robotic software architecture. What are the advantages and disadvantages of using a layered approach for designing robotic software systems?

M24CA1E303B	Generative AI	L	T	P	J	S	Credit	Year of Introduction
		3	1	0	0	3	4	2024

Preamble:

This course provides a comprehensive understanding of Generative AI, covering key neural network architectures, training techniques, and applications in image, text, and video generation using advanced models like, GANs, Vision Transformers, Transformer-based language models and Autoencoders.

Prerequisite:

Foundational understanding of machine learning concepts and Familiarity with basic neural networks.

Course Outcomes:

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

CO. No	Course Outcomes	Cognitive Knowledge Level
CO 1	Understand deep, convolutional, and recurrent neural networks, covering key aspects like training, parameters, hyperparameters, and backpropagation for practical applications.	Understand
CO 2	Apply generative AI techniques to preprocess data, visualize patterns, and develop AI-generated text, images, and videos using emerging models	Apply
CO 3	Understand the principles of generative models, GANs, and vision transformers, including their architectures, training processes, and applications in image generation.	Understand
CO 4	Understand transformer-based language models, large language models, and prompt engineering, including their architecture, training, fine-tuning, and applications in text generation.	Understand
CO 5	Understand the principles, architectures, types, and applications of Autoencoders, along with techniques for training and utilizing them in image and text generation.	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	1	1		2
CO 2	3	2	2	3	1	1	2	2
CO 3	3	2	2	3	1	1	2	2
CO 4	2	2	2	3	1	1	2	2
CO 5	2	2	2	3	1	1	2	2

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination (Marks%)
	Test 1 (Marks %)	Test 2 (Marks %)	
Remember	20	40	20
Understand	60	60	60
Apply	20	XX	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(Module1&Module2) : 10 Marks
- Continuous Assessment Test 2(Module3&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 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]

Neural Networks: Deep neural networks- Steps in training neural networks, Parameters and hyper parameters, Back propagation. Convolutional neural network-Convolutional, Pooling, Fully connected layers. Recurrent Neural Networks- Back propagation through time.

Self-Study: CNN Implementation in Python using Frameworks (TensorFlow, Keras), Handling imbalanced data, Real world applications of CNN.

Module 2 [9 Hours] :

Generative AI: overview, Types of Generative Models, Applications of Generative AI- Generative text, Generative images, Generative videos. Pre-processing and cleaning data for

Generative AI, Visualizing data distributions and patterns in Generative AI datasets, Emerging Trends and Technologies in Generative AI Models- ChatGPT, Co-Pilot, Midjourney, DALL.E

Self-Study: Use Matplotlib or Seaborn to visualize data distributions and patterns in Generative AI datasets.

Module 3 [9 Hours]

Image Generation: Overview of Generative models, Generative Adversarial Networks (**GAN)-** Discriminative and generative model, GAN Training, Loss function**.** Training and Fine-Tuning GANs **Generative Vision transformers**: Self-Attention & Multi-Head Attention, Vision Transformer Architecture**.**

Self-Study: Train the GAN model on a dataset such as MNIST, Application of image generation from text.

Module 4 [9 Hours]

Text Generation: Transformer based Language models- GPT architecture and variants, Application of GPT models in text generation, Fine tuning pretrained GPT models. Large Language Models **(LLM)-** over view, Training, Fine tuning, Evaluation and feedback through reinforcements, Real world applications. Introduction to Prompt engineering.

Self-Study: Implement GPT architecture for text generation and dialogue systems.

Module 5 [9 Hours]

Image and text generation with Autoencoders: Fundamentals of Autoencoders- Encoder-Decoder Architecture, Types of Autoencoders. Variational Autoencoders- Latent Space Representation, Difference Between Standard AE & VAE, Training VAEs for Image Generation**.** Convolutional Autoencoders- Encoder & Decoder Using CNN Layers, Applications. LSTM Autoencoders- Handling Sequential Data, Text reconstruction.

Self-Study: Usecase scenarios- Noise reduction in images, Medical image compression, Chatbot response generation.

Reference Books:

1. Generative AI with Python and TensorFlow 2: Create images, text, and music with VAEs, GANs, LSTMs,Transformer models" , Joseph Babcock and Raghav Bali , 2024
2. Foster, David. Generative Deep Learning: Teaching Machines to Paint, Write, Compose, and Play. O'Reilly Media, 2019.
3. Rehmani, Altaf. Generative AI for Everyone: Understanding the Essentials and Applications of This Breakthrough Technology. 1st ed., Independently published, 2023.
4. Goodfellow, Ian, Yoshua Bengio, and Aaron Courville. Deep Learning. MIT Press, 2016.
5. Adam Gibson, Josh Patterson, Deep Learning: A Practitioner's Approach, 1st edition, O'Reilly Media, 2017
6. Nikhil Buduma, Fundamentals of Deep Learning: Designing Next-Generation Machine Intelligence Algorithms, 1st edition, O'Reilly Media, 2017

Online Resources:

1. Aggarwal, Charu. Autoencoders, Generative Models, and Beyond. Springer, 2021.
2. https://www.ltimindtree.com/wp-content/uploads/2023/01/DeepPoV-Generative-AI.pdf
3. https://www.coursera.org/courses?query=generative%20ai
4. https://cloud.google.com/learn/training/machinelearning-ai

Course Contents and Lecture Schedule

NO	Topic	No. of Lecture/Tutorial Hours
Module 1 [9 Hours]		
1.1	Deep neural networks	1
1.2	Steps in training neural networks	1
1.3	Parameters and hyper parameters	1
1.4	Back propagation	1
1.5	Convolutional neural network	1
1.6	Convolutional layers, Pooling layers	1
1.7	Fully connected layers	1
1.8	Recurrent Neural Networks	1
1.9	Back propagation through time	1
Module 2 [9 Hours]		
2.1	Types of Generative Models	1
2.2	Applications of Generative AI	1
2.3	Generative text	1
2.4	Generative images	1
2.5	Generative videos	1
2.6	Pre-processing and cleaning data for Generative AI	1
2.7	Visualizing data distributions and patterns in Generative AI datasets	1
2.8	ChatGPT, Co-Pilot,	1
2.9	Midjourney.	1
Module 3 [9 Hours]		
3.1	Overview of Generative models	1
3.2	Generative Adversarial Networks	1
3.3	Discriminative and generative model	1
3.4	GAN Training, Loss function	1
3.5	Training and Fine-Tuning GANs	1
3.6	Vision transformers	1
3.7	Self-Attention	1
3.8	Multi-Head Attention	1
3.9	Vision Transformer Architecture	1
Module 4[9 hours]		
4.1	Transformer based Language models	1
4.2	GPT architecture and variants	1
4.3	Application of GPT models in text generation	1
4.4	Fine tuning pretrained GPT models	1
4.5	Large Language Models	1
4.6	Training, Fine tuning	1

4.7	Evaluation and feedback through reinforcements	1
4.8	Real world applications.	1
4.9	Introduction to Prompt engineering.	1
Module 5[9 hours]		
5.1	Fundamentals of Autoencoders- Encoder-Decoder Architecture.	1
5.2	Types of Autoencoders	1
5.3	Variational Autoencoders- Latent Space Representation	1
5.4	Difference Between Standard AE & VAE	1
5.5	Training VAEs for Image Generation	1
5.6	Convolutional Autoencoders	1
5.7	Encoder & Decoder Using CNN Layers, Applications	1
5.8	LSTM Autoencoders- Handling Sequential Data	1
5.9	Text reconstruction	1
	Total hours	**45**

Co Assessment Questions

Course Outcome 1 (CO1)

1. How does the number of filters affect the performance of a CNN? (L2)
2. What is the significance of recurrent connections in RNNs (L2)
3. Explain the vanishing gradient problem in RNNs and how it affects learning. (L2)

Course Outcome 2 (CO2)

1. Explain the key components and working principles of Generative AI. (L2)
2. How do generative text models like ChatGPT generate human-like responses? (L2)
3. Given a dataset of music compositions, how would you decide whether to use an autoregressive model or a transformer-based model for music generation (L3)

Course Outcome 3 (CO3)

1. How do generative models learn to create realistic images from data?. (L2)
2. What is the fundamental difference between discriminative and generative models? (L2)
3. What are the main components of the Vision Transformer (ViT) architecture. (L2)

Course Outcome 4 (CO4:

1. Explain the architecture of GPT models and how they process text. (L2)
2. What is the role of the attention mechanism in the GPT architecture. (L2)
3. How do LLMs leverage large-scale datasets for training? (L2)

Course Outcome 5 (CO5)

1. How does dimensionality reduction play a role in autoencoders? (L2)
2. How does sampling from the latent space enable VAEs to generate new data? (L2)
3. How do LSTM autoencoders perform text reconstruction. (L2)

Model Question Paper

QP CODE: Pages: 2

Reg No.:____________________________Name:___________________________

MAR ATHANASIUS COLLEGE OF ENGINEERING (AUTONOMOUS), KOTHAMANGALAM

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

Course Code: M24CA1E303B

Course Name: Generative AI

Max. Marks: 60 Duration: 3 Hours

PART A

Answer all questions. Each question carries 2 marks.

1. Differentiate between parameters and hyperparameters in neural networks.
2. How does an RNN handle sequential data differently than a feedforward neural network?
3. What are the challenges in generating realistic images using AI??
4. What are some of the latest advancements in Generative AI?
5. What are the key differences between traditional image generation techniques and generative models?
6. Explain how GANs are different from other deep learning-based generative models.
7. How does the training objective of LLMs differ from smaller transformer-based models?
8. How does fine-tuning help adapt GPT models to domain-specific tasks?
9. What is the significance of sparse autoencoders in feature extraction?
10. What are some real-world applications of LSTM autoencoders in NLP?

PART B

Answer any five questions. Each question carries 8 marks.

11. How does backpropagation through time (BPTT) differ from standard backpropagation?
12. A publishing company wants to use Generative AI to summarize long articles. How would you ensure that the summaries retain the key ideas and avoid misinformation?
13. What is self-attention, and why is it important in Vision Transformers?
14. Compare the attention mechanism in Vision Transformers with convolutional operations in CNNs.
15. What are some examples of LLM applications in medical and legal fields.
16. How does the latent space representation of text differ from that of images in autoencoders?
17. What role do convolutional autoencoders play in super-resolution image generation?

M24CA1E303C	Cognitive Computing	L	T	P	J	S	Credit	Year of Introduction
		3	1	0	0	3	4	2024

Preamble: Cognitive Computing leverages AI, Machine Learning, NLP, and Data Analytics to create intelligent systems that learn, reason, and interact naturally. This course covers cognitive system fundamentals, NLP and Big Data integration, analytics and cloud computing, cognitive application development, and emerging innovations shaping the future of intelligent computing.

Prerequisite: Basic programming knowledge and a fundamental understanding of AI and ML concepts.

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 fundamentals and design principles of cognitive computing, including its core components, AI foundation, machine learning, hypothesis generation, and visualization methods.	Understand
CO 2	Explore the significance of Natural Language Processing, Big Data, and Knowledge Representation in cognitive systems, along with their applications, integration methods, and foundational models.	Understand
CO 3	Describe the role of analytics, cloud, and distributed computing in cognitive systems, evaluating their capabilities, business value, and data integration strategies.	Understand
CO 4	Explain the process of building a cognitive application, including objective definition, domain selection, user analysis, question formulation, corpus development, and model training and testing.	Understand
CO 5	Explore emerging areas and future applications of cognitive computing, including industry-specific opportunities, technical advancements, and innovative architectures.	Understand

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	2	1	1	1	3
CO 2	3	3	3	2	1	1	1	3
CO 3	3	3	3	2	1	1	1	3
CO 4	3	3	3	2	1	1	1	3
CO 5	3	3	3	2	1	1	1	3

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination (Marks%)
	Test 1 (Marks %)	Test 2 (Marks %)	
Remember	40	40	40
Understand	60	60	60
Apply	XX	XX	XX
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 : 10 Marks
- Continuous Assessment Test 2 : 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.

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 to Cognitive Computing: Cognitive Systems, Artificial Intelligence as the Foundation, Elements of a Cognitive System.

Design Principles for Cognitive Systems: Components of a Cognitive System, Bringing Data into the Cognitive System, Machine Learning, Hypotheses Generation and Scoring, Presentation and Visualization Services.

Self-Study: Cognitive Decision-Making through an Intelligent Database Agent for Predictive Analysis (Ref:2).

Module 2 [12 Hours]

Natural Language Processing and Cognitive Systems: The Role of NLP in a Cognitive System, Semantic Web, Applying Natural Language Technologies to Business Problems.

Big Data and Cognitive Computing: Introduction to Big Data, Architectural Foundation for Big Data, Analytical Data Warehouses, Integration of Big Data with Traditional Data.

Representation of Knowledge in Cognitive System: Knowledge Representation, Defining Taxonomies and Ontologies, How to Represent Knowledge, Models for Knowledge Representation.

Self-Study: A Convergence of Mining and Machine Learning: The New Angle for Educational Data Mining (Ref:2)

Module 3 [9 Hours]

Analytics and Cognitive Computing: Types of Analytics, Capabilities of Analytics, Building Business Value using Analytics.

Cloud and Distributed Computing in Cognitive Computing: Introduction to Distributed Computing, Characteristics of Cloud Computing, Cloud Computing Models, Delivery Models of the Cloud, Data Integration and Management in the Cloud.

Self-Study: IoT-Based Smart Agriculture in India (Ref:2)

Module 4 [8 Hours]

Process of Building a Cognitive Application: Defining the Objective, Defining the Domain, Understanding the Intended Users and Defining their Attributes, Defining Questions and Exploring Insights, Creating and Refining the Corpora, Training and Testing.

Self-Study: The Process Building a Cognitive Healthcare Application, Case Study - IBM's Watson as a Cognitive System. (Ref:1)

Module 5 [10 Hours]

Emerging Cognitive Computing Areas: Characteristics of Ideal Markets for Cognitive Computing, Vertical Markets and Industries, Retail, Travel, Transportation and Logistics, Telecommunications, Security and Threat Detection, Cognitive Computing Opportunities.

Future Applications for Cognitive Computing: Requirements for the Next Generation, Technical Advancements, Emerging Innovations - Deep QA and Hypothesis Generation, NLP, Cognitive Training Tools, Data Integration and Representation, Neurosynaptic Architectures, Quantum Architectures.

Self-Study: Case Study – How Smart Cities are enabled using Cognitive Computing. (Ref:1)

Reference Books:

1. Judith Hurwitz, Marcia Kaufman, Adrian Bowles, "Cognitive Computing and Big Data Analytics", John Wiley & Sons, 2015.
2. Vishal Jain, Akash Tayal, Jaspreet Singh, Arun Solanki, "Cognitive Computing Systems: Applications and Technological Advancements", Apple Academic Press Inc., 1st Edition, 2021.
3. Makarand R Velankar, Parikshit N. Mahalle, Gitanjali R Shinde, "Cognitive Computing for Machine Thinking", Springer, 2024.

Online Resources:

1. https://onlinecourses.nptel.ac.in/noc22_ee122/preview
2. https://onlinecourses.nptel.ac.in/noc22_cs56/preview
3. https://www.udemy.com/course/ibm-watson-for-artificial-intelligence-cognitive-computing

Course Contents and Lecture Schedule

NO	Topic	No. of Lecture / Tutorial Hours
Module 1 [6 Hours]		
1.1	Introduction to Cognitive Computing, Artificial Intelligence as the Foundation	1
1.2	Components of a Cognitive System	1
1.3	Bringing Data into the Cognitive System	1
1.4	Machine Learning	1
1.5	Hypotheses Generation and Scoring	1
1.6	Presentation and Visualization Services	1
Module 2 [12 Hours]		
2.1	Introduction to NLP, The Role of NLP in a Cognitive System	1
2.2	Semantic Web	1
2.3	Applying NL Technologies to Business Problems	1
2.4	Introduction to Big Data	1
2.5	Architectural Foundation for Big Data	1
2.6	Analytical Data Warehouses	1
2.7	Integration of Big Data with Traditional Data.	1
2.8	Knowledge Representation	2
2.9	Defining Taxonomies and Ontologies	1
2.10	How to Represent Knowledge	1
2.11	Models for Knowledge Representation.	1
Module 3 [9 Hours]		
3.1	Types of Analytics	1
3.2	Capabilities of Analytics	1
3.3	Building Business Value using Analytics.	1
3.4	Introduction to Distributed Computing	1
3.5	Characteristics of Cloud Computing	1
3.6	Cloud Computing Models	2
3.7	Delivery Models of the Cloud	1
3.8	Data Integration and Management in the Cloud.	1
Module 4 [8 Hours]		
4.1	Defining the Objective of Cognitive Application	1
4.2	Defining the Domain of Cognitive Application	1
4.3	Understanding the Intended Users and Defining their Attributes	1
4.4	Defining Questions and Exploring Insights	2
4.5	Creating and Refining the Corpora	2
4.6	Training and Testing	1
Module 5 [10 Hours]		
5.1	Characteristics of Ideal Markets for Cognitive Computing	1
5.2	Vertical Markets and Industries - Retail, Travel	1
5.3	Transportation and Logistics, Telecommunications, Security and Threat Detection	1
5.4	Cognitive Computing Opportunities	1
5.5	Requirements for the Next Generation, Technical Advancements	1

5.6	Emerging Innovations - Deep QA and Hypothesis Generation	1
5.7	NLP, Cognitive Training Tools	1
5.8	Data Integration and Representation	1
5.9	Neurosynaptic Architectures	1
5.10	Quantum Architectures	1
	Total Hours	**45**

CO Assessment Questions

Course Outcome 1 (CO1)

1. Explain how Artificial Intelligence serves as the foundation of Cognitive Computing. How does it enable cognitive systems to mimic human-like reasoning and learning? (L2)
2. Describe the key components of a cognitive system and explain how they interact to process and analyze data effectively. (L2)
3. What is the role of Hypotheses Generation and Scoring in a cognitive system? Provide an example to illustrate how this process aids in decision-making. (L2)

Course Outcome 2 (CO2)

1. Explain the role of Natural Language Processing (NLP) in a cognitive system. How does NLP enhance human-computer interaction and decision-making? (L2)
2. How does Big Data integrate with traditional data systems? Discuss the challenges and benefits of combining these two approaches in cognitive computing. (L2)
3. What is the significance of taxonomies and ontologies in knowledge representation? Provide an example of how they help structure and organize information in a cognitive system. (L2)

Course Outcome 3 (CO3)

1. Explain the different types of analytics and describe how they contribute to decision-making in cognitive computing. (L2)
2. What are the key characteristics of cloud computing, and how do they enhance the capabilities of cognitive systems? (L2)
3. How does data integration and management in the cloud support cognitive computing applications? Provide an example to illustrate its impact. (L2)

Course Outcome 4 (CO4)

1. Why is it important to clearly define the objective and domain of a cognitive application? How do these factors influence the system's design and functionality? (L2)
2. How does understanding the intended users and their attributes help in designing an effective cognitive application? Provide an example to illustrate its significance. (L2)
3. Explain the role of training and testing in developing a cognitive application. How does refining the corpora contribute to improving system accuracy? (L2)

Course Outcome 5 (CO5)

1. What characteristics make a market ideal for cognitive computing applications? Provide examples of industries that benefit the most from cognitive technologies. (L2)
2. How do emerging innovations like Deep QA, Hypothesis Generation, and NLP

contribute to the advancement of cognitive computing? Explain with relevant use cases. (L2)

3. What is the significance of neurosynaptic and quantum architectures in the future of cognitive computing? How do they enhance computational capabilities? (L2)

Model Question Paper

QP Code:………… Pages:……………..

Reg No.: ……………. Name: …………….

MAR ATHANASIUS COLLEGE OF ENGINEERING (AUTONOMOUS), KOTHAMANGALAM

THIRD SEMESTER MCA DEGREE EXAMINATION, December 2024

Course Code: M24CA1E303C

Course Name: COGNITIVE COMPUTING

Max. Marks: 60 Duration: 3 Hours

PART A

Answer all questions. Each question carries 2 marks.

1. What are the key elements of a cognitive system?
2. How does machine learning contribute to cognitive computing?
3. Define Natural Language Processing (NLP) and its role in cognitive computing.
4. Explain the importance of taxonomies and ontologies in knowledge representation.
5. What are the main types of analytics used in cognitive computing?
6. How does data integration in cloud computing enhance cognitive applications?
7. What is the significance of defining the objective before building a cognitive application?
8. Explain the role of training and testing in refining a cognitive system's performance.
9. How does Deep QA differ from traditional question-answering systems in cognitive computing?
10. Why are neurosynaptic architectures considered a breakthrough for next-generation cognitive computing?

PART B

Answer any five questions. Each question carries 8 marks.

11. Explain the key components of a cognitive system and how they interact to process and analyze data effectively.
12. Define Natural Language Processing (NLP) and describe its role in cognitive computing with real-world examples.
13. How does knowledge representation influence the effectiveness of cognitive systems? Discuss different models used for knowledge representation.
14. What are the different types of analytics in cognitive computing, and how do they contribute to decision-making?
15. Describe the process of building a cognitive application, emphasizing the importance of defining objectives, domain selection, and user attributes.

16. How do cognitive computing technologies create business opportunities across industries like healthcare, retail, and finance? Provide examples.
17. Explain the significance of neurosynaptic and quantum architectures in the future of cognitive computing. How do they enhance computational capabilities?

KNOWLEDGE IS POWER

M24CA1E303D	Big Data Management and Analytics	L	T	P	J	S	Credit	Year of Introduction
		3	1	0	0	3	4	2024

Preamble:

This course provides a comprehensive understanding of Big Data concepts, processing frameworks, cloud integration, real-time analytics, and visualization techniques, equipping learners with the knowledge and skills to efficiently manage, analyze, and interpret large-scale data

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	Understand the fundamental concepts, characteristics, storage models, and distributed computing technologies essential for handling and analyzing Big Data efficiently.	Understand
CO 2	Gain knowledge of Big Data processing frameworks along with their ecosystems, architectures, and optimization techniques for efficient large-scale data processing.	Understand
CO 3	Understand cloud computing concepts, deployment and delivery models, resource management, and their integration with Big Data for scalable storage, processing, and analytics solutions	Understand
CO 4	Develop an understanding of real-time Big Data analytics, including data stream processing, mining techniques, evaluation methods, and tools like Apache Kafka and Apache Storm for real-time insights	Understand
CO 5	Apply Big Data visualization techniques using various tools like R and Tableau to analyze, represent, and interpret complex datasets effectively for insightful decision-making.	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	2	2	2	3	1	1		2
CO 2	2	3	3	3	1	1		2
CO 3	2	3	3	3	1	1	2	2
CO 4	3	2	3	3	1	1		2
CO 5	3	2	3	3	1	1		2

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination (Marks%)
	Test 1 (Marks %)	Test 2 (Marks %)	
Remember	40	20	20
Understand	60	60	60
Apply	XX	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(Module1&Module2) : 10 Marks
- Continuous Assessment Test 2(Module3&Module4) : 10 Marks
- Assignment/Tutorials/Seminar s : 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]

Big Data & Distributed Systems: Overview of Big Data, Elements of Big Data, Big data characteristics. Technologies for handling Big Data- HDFS, MapReduce, In-Memory Computing Technology for Big Data. Big Data Storage Concepts-File systems and Distributed File Systems, NoSQL data models, Sharding, Replication, CAP theorem, ACID and BASE properties. Role of Distributed Computing in Big Data analytics.

Self-Study: Big Data Use Cases, Characteristics of Big Data Applications.

Module 2 [10 Hours]

Big Data Processing Frameworks: Hadoop and its Ecosystems **-** HDFS architecture, HDFS commands, Parallel data processing, Distributed data processing, Processing in Batch mode, Processing in Real time mode. Introducing HBase- Architecture, Storing data with HBase, HBase in operation. Hive, ZooKeeper.

Apache Spark: Map and Reduce Concepts, Limitations of traditional MapReduce, Spark **Vs** Hadoop MapReduce, Spark Architecture and Cluster design Components-Driver, Executers, DAG Spark RDD, DataFrames, Spark SQL Batch and real time processing with Spark.

Self-Study: Introduction of Big data Machine learning with MapReduce.

Module 3 [9 Hours]

Cloud Computing for Big Data: Cloud deployment models, Cloud delivery models, Cloud services for Big Data, Building Cloud Computing Environments, Computing Platforms and Technologies, Relationship between Cloud Computing and Big Data-Overview, Benefits and challenges, Factorization facilitates in cloud, Cloud System for data management, Resource Scheduling, centralized to decentralized social network, Business challenges.

Self-Study: Cloud providers in Big Data market, Case Study-Streaming data analysis, Tweet analysis in Social Network.

Module 4 [8 Hours]

Realtime Big Data Analytics: Data Streams, Characteristics, Challenges in mining data streams, Requirements and principles for real time processing, Constructing histograms from data streams. Learning from data streams - Clustering from data streams, Clustering variables, Frequent pattern mining, Frequent Itemset mining, Sequence pattern mining. Evaluating streaming algorithms - Evaluation Issues, Evaluation Metrics.

Tools for real time analytics: Apache Kafka,Architecture, Kafka stream processing Examples, Apache Storm, Real-time stream processing use cases.

Self-Study: Best Practices for Big data Analytics, Clustering examples, Kafka Installation-Implementing Single Node-Single Broker Cluster.

Module 5 [9 Hours]

Big Data Visualization: Data Visualization Process, Conventional data visualization concepts, Big data visualization – Challenges, Big data categorization, Techniques used for visual data representation. Basic Charts and Plots, Visualizing Complex Data and Relation.

Big Data visualization Tools: Performing graphical analysis in R- Using plots for Single variable, Two variables, Multiple Variables. Saving graphs to external files, Data visualization with Tableau.

Self-study: Basic plotting functions in R, creating basic charts, Implementing interactive visualizations

Reference Books:

1. DT Editorial Services. Big Data Black Book Revised, Dreamtech Press, 2016.
2. Mittal, M., Balas, V. E., Goyal, L. M., & Kumar,Big Data Prossing using Spark in clod R. (Eds.). (2025).
3. Kane, Frank. *Taming Big Data with Apache Spark and Python*. O’Reilly Media, 2017.
4. Damji, J. S., Wenig, B., Das, T., & Lee, D. (2020). *Learning Spark: Lightning-Fast Data Analytics* (M. Zaharia, Foreword). O’Reilly Media
5. Seema Acharya, Subhashini Chellappan, Big Data and Analytics –Willey India ISBN 13 9788126554782
6. Michael Miller, “Cloud Computing”, Dorling Kindersley India,2009.
7. Charu C. Aggarwal, “Data Streams: Models and Algorithms”, Kluwer Academic Publishers, Springer 2007 Edition
8. Joao Gama, “Knowledge Discovery from Data Streams”, CRC Press, 2010.
9. Byron Ellis, “Real Time Analytics: Techniques to Analyze and Visualize Streaming Data”, John Wiley and Sons, 2014.

10. Miller, James D. Big data visualization. Packt Publishing Ltd, 2017.
11. Kirk, Andy. Data Visualization A Handbook for Data Driven Design, Sage Publications, 2016.

Online Resources:

1. https://www.coursera.org/learn/big-data-machine-learning
2. https://github.com/AlessandroCorradini/University-of-California-San-Diego-Big-Data-Specialization
3. https://www.datacamp.com/
4. https://www.analyticsvidhya.com/

Course Contents and Lecture Schedule

NO	Topic	No. of Lecture/Tutorial Hours
Module 1 [9 Hours]		
1.1	Overview of Big Data, Elements of Big Data, Big data characteristics.	1
1.2	Technologies for handling Big Data- HDFS	1
1.3	MapReduce	1
1.4	In-Memory Computing Technology for Big Data	1
1.5	Big Data Storage Concepts-File systems and Distributed File Systems	1
1.6	NoSQL data models, Sharding, Replication	1
1.7	CAP theorem	1
1.8	ACID and BASE properties	1
1.9	. Role of Distributed Computing in Big Data analytics.	1
Module 2 [10 Hours]		
2.1	Hadoop and its Ecosystems - HDFS architecture	1
2.2	HDFS commands, Parallel data processing, Distributed data processing,	1
2.3	Processing in Batch mode, Processing in Real time mode.	1
2.4	Introducing HBase- Architecture, Storing data with HBase	1
2.5	Hive, ZooKeeper	1
2.6	Map and Reduce functions	1
2.7	Driver, Executers, DAG Spark RDD	1
2.8	DataFrames, Spark SQL Batch and real time processing with Spark	1
2.9	Apache Spark- Hadoop Vs Spark, Cluster design	1
2.10	Architecture and Components, Data processing with Spark RDD	1
Module 3 [9 Hours]		
3.1	Cloud deployment models, Cloud delivery models	1
3.2	Cloud services for Big Data, Building Cloud Computing Environments	1

3.3	Computing Platforms and Technologies	**1**
3.4	Relationship between Cloud Computing and Big Data-Overview	**1**
3.5	Factorization facilitates in cloud	**1**
3.6	Cloud System for data management. Resource Scheduling	**1**
3.7	Resource Scheduling,	**1**
3.8	centralized to decentralized social network	**1**
3.9	Business challenges, Applications.	**1**
3.10	Benefits and challenges	**1**
Module 4[8 hours]		
4.1	Data Streams, Characteristics, Challenges in mining data streams	**1**
4.2	Requirements and principles for real time processing	**1**
4.3	Constructing histograms from data streams	**1**
4.4	Learning from data streams - Clustering from data streams	**1**
4.5	Clustering variables, Frequent pattern mining	**1**
4.6	Sequence pattern mining, Evaluation Issues, Evaluation Metrics	**1**
4.7	Evaluating streaming algorithms	**1**
4.8	Apache Kafka,Architecture, Kafka stream processing Examples, Apache Storm, Real-time stream processing use cases.	**1**
Module 5[9 hours]		
5.1	Data Visualization Process, Conventional data visualization concepts	**1**
5.2	Big data visualization – Challenges	**1**
5.3	Big data categorization	**1**
5.4	Techniques used for visual data representation	**1**
5.5	Basic Charts and Plots, Visualizing Complex Data and Relation	**1**
5.6	Performing graphical analysis in R	**1**
5.7	Using plots for Single variable	**1**
5.8	Two variables, Multiple Variables	**1**
5.9	Saving graphs to external files, Data visualization with Tableau	**1**
	Total hours	**45**

Co Assessment Questions

Course Outcome 1 (CO1)

1. What are the key elements of Big Data? Provide examples. (L2)
2. What is HDFS? Describe its architecture and working principles. (L2)
3. What are NoSQL databases? Explain different NoSQL data models. (L2)

Course Outcome 2 (CO2)

1. How does parallel data processing work in Hadoop? (L2)

2. What techniques can be used to optimize MapReduce jobs for better performance? (L2)
3. What are the advantages of using Apache Spark for real-time data processing? (L3)

Course Outcome 3 (CO3)

1. What are the advantages of using Platform as a Service (PaaS) for Big Data analytics? (L2)
2. How does cloud computing enable real-time Big Data analytics? (L2)
3. Compare on-premise Big Data solutions with cloud-based Big Data solutions. (L2)

Course Outcome 4 (CO4:

1. What are the key characteristics of data streams in real-time analytics? (L2)
2. What is Apache Kafka, and how does it facilitate real-time data processing? (L2)
3. What is Apache Storm, and how does it support real-time stream processing? (L2)

Course Outcome 5 (CO5)

1. What are the key steps involved in the data visualization process? (L2)
2. When should you use a scatter plot versus a line graph? (L2)
3. Using R, how would you create a visualization for a dataset containing sales revenue for different products across various regions? (L3)

Model Question Paper

QP CODE: Pages: 2

Reg No.:____________

Name:______________

MAR ATHANASIUS COLLEGE OF ENGINEERING (AUTONOMOUS), KOTHAMANGALAM

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

Course Code: M24CA1E303D

Course Name: Big Data Management and Analytics

Max. Marks: 60 Duration: 3 Hours

PART A

Answer all questions. Each question carries 2 marks.

1. Explain the characteristics of Big Data using the 5Vs model.
2. Explain the MapReduce programming model and its role in processing Big Data.
3. Compare batch processing and real-time processing in Big Data. Provide examples.
4. What is HBase? Explain its architecture and how it stores data.
5. Explain how Software as a Service (SaaS) is utilized in Big Data solutions.
6. What cloud services are commonly used for Big Data storage and processing?
7. What challenges arise when mining data streams, and how can they be addressed?
8. How can histograms be efficiently constructed from data streams?
9. How does big data categorization impact visualization techniques?
10. How is graphical analysis performed in R?

PART B

Answer any five questions. Each question carries 8 marks.

11. Explain how Apache Spark differs from MapReduce in distributed data processing.
12. Explain the CAP theorem with real-world examples.
13. How does hardware and network topology affect the efficiency of MapReduce processing?
14. Discuss the cluster design in Apache Spark. How does it differ from Hadoop clusters?

15. What is the role of computing platforms like AWS, Azure, and Google Cloud in Big Data analytics?
16. What methods can be used to update histograms dynamically in streaming environments?
17. You have a dataset containing customer transactions. How would you categorize the data to optimize visualization techniques?

KNOWLEDGE IS POWER

M24CA1E303E	CI/CD and DevOps	L	T	P	J	S	Credit	Year of Introduction
		3	1	0	0	3	4	2024

Preamble:

This course explores DevOps principles, automation, CI/CD pipelines, containerization, and cloud-native architectures. It equips learners with practical skills in tools like Docker, Kubernetes, Terraform, and cloud DevOps services to enhance software delivery and system reliability.

Prerequisite:

Learners should have a basic understanding of software engineering principles, cloud computing concepts, Linux fundamentals, networking basics, and familiarity with scripting languages like Python.

Course Outcomes:

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

CO. No.	Course Outcomes	Cognitive Knowledge Level
CO 1	Understand DevOps fundamentals, apply its principles, and integrate Agile and Lean practices to enhance software development.	Understand
CO 2	Understand the principles and best practices of CI/CD, including build automation, code quality analysis, version control, deployment strategies and configuration management.	Understand
CO 3	Apply containerization techniques, deploy applications using Kubernetes, and utilize advanced orchestration strategies to manage cloud-native environments efficiently.	Apply
CO 4	Understand cloud computing models, cloud-native architectures, multi-cloud deployments, and DevOps practices on cloud platforms for efficient software delivery and cost optimization.	Understand
CO 5	Understand monitoring, observability, and DevSecOps practices, including metrics, logging, distributed tracing, security automation, and infrastructure security in CI/CD pipelines.	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	2		1			2
CO 2		3	2	3			1	2
CO 3	1	3	2	3			1	2
CO 4		3	2	3		1		2
CO 5		3	2	3			3	2

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination (Marks%)
	Test 1 (Marks %)	Test 2 (Marks %)	
Remember	40	20	30
Understand	60	60	50
Apply	XX	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(Module1&Module2) : 10 Marks
- Continuous Assessment Test 2(Module3&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 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 to DevOps: Definition, Evolution, and need for DevOps, The CALMS Model - Culture, Automation, Lean, Measurement, Sharing. DevOps Principles - Collaboration, Automation, Continuous Improvement. DevOps vs. Traditional SDLC and ITIL, Organizational Structures for DevOps.

Agile and Lean Practices in DevOps: Agile Principles and Methodologies - Scrum, Kanban. CI-friendly agile practices – Trunk-based development, Feature Toggles. Lean Principles in DevOps - Reducing waste, Value Stream Mapping.

Self-Study: Relationship between Agile and DevOps.

Module 2 [11 Hours]

Continuous Integration (CI): Principles and Best Practices, **Build Automation Tools** -Maven, Gradle**. Code Quality & Static Analysis** - SonarQube, Checkstyle. **Version Control (Git)** – Branching Strategies, Merge Conflict Resolution.

Continuous Delivery (CD) & Deployment Strategies: Principles and Practices of CD, Release Management & Orchestration Deployment Strategies - Blue/Green, Canary, Rolling. Configuration Management - Ansible, Chef, Puppet. Infrastructure as Code (IaC) - Terraform, CloudFormation.

CI/CD Pipelines & GitOps: Pipeline Design and Implementation, GitLab CI/CD, GitHub Actions, Azure DevOps. GitOps and ArgoCD for Kubernetes Deployments.

Self-Study: Pipeline Orchestration Tools - Jenkins

Module 3 [9 Hours]

Containerization Fundamentals: Docker - Images, Containers, Networking, Storage. Dockerfile & Docker Compose, Container Security Best Practices.

Kubernetes Orchestration: Kubernetes Architecture & Components - Pods, Deployments, Services. Deploying Applications on Kubernetes, Service Discovery & Networking, Helm for Kubernetes Application Packaging.

Advanced Orchestration: Kubernetes Operators, Multi-Cluster Management.

Self-Study: CI/CD Integration with Kubernetes, Monitoring and Logging in Kubernetes.

Module 4 [9 Hours]

Integration of Cloud & DevOps: Cloud Service Models - IaaS, PaaS, SaaS. Multi-Cloud & Hybrid Cloud Deployments.

Cloud-Native Architectures: Microservices, Serverless Computing. API Gateway & Service Mesh - Istio, Linkerd. CI/CD on Cloud Platforms. AWS DevOps Services - CodePipeline, CodeDeploy, CodeBuild. Azure DevOps Services, Google Cloud DevOps Solutions, FinOps & Cloud Cost Optimization.

Self-Study: Disaster Recovery in Cloud DevOps. Edge Computing with Cloud-Native DevOps.

Module 5 [8 Hours]

Monitoring and Observability: Metrics & Logs, Monitoring Tools - Prometheus, Grafana, ELK Stack. Distributed Tracing - Jaeger, Zipkin.

DevSecOps & Security in CI/CD: Security Automation in CI/CD Pipelines, Static & Dynamic Application Security Testing, Infrastructure Security & Zero Trust Model, Policy-as-Code - OPA, Kyverno.

Self-Study: AI-Driven Monitoring and Anomaly Detection. Compliance Automation in DevSecOps Pipelines.

Reference Books:

1. Gene Kim, Kevin Behr, George Spafford, The Phoenix Project: A Novel About IT, DevOps, and Helping Your Business Win, IT Revolution Press, 5th Anniversary Edition, 2018.
2. Gene Kim, Jez Humble, Patrick Debois, John Willis, The DevOps Handbook: How to Create World-Class Agility, Reliability, & Security in Technology Organizations, IT Revolution Press, 1st Edition, 2016.
3. Ken Schwaber, Mike Beedle, Agile Software Development with Scrum, Pearson, 1st Edition, 2001.

4. Jez Humble, David Farley, Continuous Delivery: Reliable Software Releases through Build, Test, and Deployment Automation, Addison-Wesley Professional, 1st Edition, 2010.
5. Kief Morris, Infrastructure as Code: Managing Servers in the Cloud, O'Reilly Media, 1st Edition, 2016.
6. Jeff Nickoloff, Stephen Kuenzli, Docker in Action, Manning Publications, 2nd Edition, 2019.
7. Marko Lukša, Kubernetes in Action, Manning Publications, 1st Edition, 2018.
8. Cornelia Davis, Cloud Native Patterns: Designing Change-tolerant Software, Manning Publications, 1st Edition, 2019.
9. Sam Newman, Building Microservices: Designing Fine-Grained Systems, O'Reilly Media, 1st Edition, 2015.
10. Kyle Kingsbury, Monitoring Distributed Systems, O'Reilly Media, 1st Edition, 2015.
11. Brett Slatkin, Effective Python: 59 Specific Ways to Write Better Python, Addison-Wesley Professional, 1st Edition, 2015.
12. Henry van Merode, Continuous Integration (CI) and Continuous Delivery (CD): A Practical Guide to Designing and Developing Pipelines, Apress, 1st Edition, 2023.
13. Amit Bhanushali, Alekhya Achanta, Beena Bhanushali, Continuous Integration and Delivery with Test-driven Development: Cultivating Quality, Speed, and Collaboration through Automated Pipelines, BPB Publications, 1st Edition, 2024.

Online Resources:

1. https://elearn.nptel.ac.in/shop/iit-workshops/completed/azure-devops-and-micro-services-azure-kubernetes-deployment-models
2. https://elearn.nptel.ac.in/shop/iit-workshops/completed/cicd-devops-automation-and-devsecops-automation
3. https://elearn.nptel.ac.in/shop/iit-workshops/completed/azure-devops-and-micro-services-azure-kubernetes-deployment-models

Course Contents and Lecture Schedule

NO	Topic	No. of Lecture/Tutorial Hours
Module 1 [8 Hours]		
1.1	Introduction, Definition, Evolution, and Need for DevOps	1
1.2	The CALMS Model -Culture, Automation, Lean, Measurement, Sharing	1
1.3	DevOps Principles - Collaboration, Automation, Continuous Improvement.	1
1.4	DevOps vs. Traditional SDLC and ITIL, Organizational Structures for DevOps.	1
1.5	Agile Principles and Methodologies - Scrum, Kanban -	1
1.6	CI-friendly Agile Practices	2
1.7	Trunk-Based Development, Feature Toggles.	1
1.8	Lean Principles in DevOps - Reducing Waste, Value Stream Mapping. Relationship between Agile and DevOps.	1

Module 2 [11 Hours]		
2.1	Continuous Integration (CI): Principles and Best Practices,	1
2.2	Build Automation Tools -Maven, Gradle.	1
2.3	Code Quality & Static Analysis - SonarQube, Checkstyle.	1
2.4	Version Control (Git) – Branching Strategies, Merge Conflict Resolution.	1
2.5	Principles and Practices of CD,	1
2.6	Release Management & Orchestration Deployment Strategies - Blue/Green, Canary, Rolling.	1
2.7	Configuration Management - Ansible, Chef, Puppet.	1
2.8	Infrastructure as Code (IaC) - Terraform, CloudFormation.	1
2.9	CI/CD Pipelines & GitOps: Pipeline Design and Implementation.	1
2.10	Pipeline Orchestration Tools - Jenkins, GitLab CI/CD, GitHub Actions, Azure DevOps.	1
2.11	GitOps and ArgoCD for Kubernetes Deployments	1
Module 3 [9 Hours]		
3.1	Docker - Images, Containers, Networking, Storage.	1
3.2	Dockerfile & Docker Compose.	1
3.3	Container Security Best Practices.	1
3.4	Kubernetes Architecture & Components - Pods, Deployments, Services.	1
3.5	Deploying Applications on Kubernetes	3
3.6	Service Discovery & Networking,	1
3.7	Helm for Kubernetes Application Packaging.	1
3.8	Kubernetes Operators	1
3.9	Multi-Cluster Management	1
Module 4[9 hours]		
4.1	Cloud Service Models - IaaS, PaaS, SaaS.	1
4.2	Multi-Cloud & Hybrid Cloud Deployments.	1
4.3	Microservices	1
4.4	Serverless Computing.	1
4.5	API Gateway	1
4.6	Service Mesh - Istio, Linkerd. CI/CD on Cloud Platforms	1
4.7	AWS DevOps Services - CodePipeline, CodeDeploy, CodeBuild	1
4.8	Azure DevOps Services	1
4.8	Google Cloud DevOps Solutions	1
4.9	FinOps & Cloud Cost Optimization.	
Module 5[8 hours]		
5.1	Monitoring and Observability: Metrics & Logs.	1
5.2	Monitoring Tools – Prometheus.	1

5.3	Grafana, ELK Stack.	1
5.4	Distributed Tracing - Jaeger, Zipkin.	1
5.5	DevSecOps & Security in CI/CD: Security Automation in CI/CD Pipelines.	1
5.6	Static & Dynamic Application Security Testing.	1
5.7	Infrastructure Security & Zero Trust Model.	1
5.8	Policy-as-Code - OPA, Kyverno.	1
	Total hours	**45**

Co Assessment Questions

Course Outcome 1 (CO1)

1. Write any two goals of DevOps. (L2)
2. What is Value Stream Mapping in Lean DevOps practices? (L1)
3. Explain the CALMS model in DevOps and how each component contributes to the success of DevOps practices. (L2)

Course Outcome 2 (CO2)

1. Name two build automation tools used in CI/CD pipelines. (L1)
2. What is a branching strategy in Git? (L2)
2. Write a short note on the role of build automation tools in CI/CD pipelines. (L2)

Course Outcome 3 (CO3)

1. What is a Docker image, and how is it different from a Docker container? (L1)
2. Write any two differences between Docker containers and VMs. (L2)
3. You are tasked with deploying and managing a complex stateful application on Kubernetes. How would you use Kubernetes Operators to automate its lifecycle management? Provide a real-world example to illustrate your approach. (L3)

Course Outcome 4 (CO4:

1. What are the three main cloud service models? (L1)
2. How does serverless computing differ from traditional cloud computing models? (L2)
3. Explain the benefits and challenges of multi-cloud and hybrid cloud deployments in the context of DevOps practices. (L2)

Course Outcome 5 (CO5)

1. Explain the role of metrics and logs in achieving observability in DevOps. (L1)
2. Name two components of the ELK Stack. (L1)
3. Explain the importance of monitoring and observability in DevOps (L2)

Model Question Paper

QP CODE: Pages: 2

Reg No.:__________________________Name:____________________

MAR ATHANASIUS COLLEGE OF ENGINEERING (AUTONOMOUS), KOTHAMANGALAM

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

Course Code: M24CA1E303G

Course Name: Business Management

Max. Marks: 60 Duration: 3 Hours

PART A

Answer all questions. Each question carries 2 marks.

1. What are the five components of the CALMS model in DevOps? (2)
2. Name two Agile methodologies commonly used in DevOps practices. (2)
3. What is the purpose of static code analysis tools like SonarQube? (2)
4. What is the difference between Blue/Green and Canary deployment strategies? (2)
5. How does Docker Compose simplify multi-container application management? (2)
6. Write a basic Dockerfile command to create an image for a Python application. (2)
7. What is the difference between multi-cloud and hybrid cloud deployments? (2)
8. Write any two benefits of using a multi-cloud strategy for DevOps practices. (2)
9. What is distributed tracing? Name any one tool used for it. (2)
10. Write a short note on zero trust model. (2)

PART B

Answer any five questions. Each question carries 8 marks.

11. Explain the CALMS model in DevOps and how each component contributes to the success of DevOps practices. (8)
12. What is Infrastructure as Code (IaC)? With an example explain how tools support CI/CD pipelines? (8)
13. You are tasked with deploying and managing a complex stateful application on Kubernetes. How would you use Kubernetes Operators to automate its lifecycle management? Provide a real-world example to illustrate your approach. (8)
14. Explain cloud-native architectures. (8)
15. Write a short note on policy-as-code. (8)
16. Compare and contrast DevOps with Traditional SDLC and ITIL. (8)
17. With a diagram, explain Kubernetes architecture with its components. (8)

M24CA1E303F	Cloud Security and Migration	L	T	P	J	S	Credit	Year of Introduction
		3	1	0	0	3	4	2024

Preamble:

Delve into the various aspects of cloud security, covering data protection best practices, threat mitigation strategies, compliance adherence and the secure, seamless migration of workloads to cloud environments.

Prerequisite:

Understanding of basic networking concepts.

Course Outcomes:

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

CO No	Course Outcomes	Cognitive Knowledge Level
CO 1	Understand cloud computing and security, assess cloud risks and use encryption to protect data.	Understand
CO 2	Understanding of cloud storage types and key security principles developing expertise in data classification, risk assessment frameworks, and advanced access control mechanisms.	Understand
CO 3	Understanding of cloud migration strategies, including cloud networking and connectivity and best practices for migration execution and testing.	Understand
CO 4	Implement risk management strategies, analyzing log data, utilizing real-time alerting and anomaly detection, monitoring network traffic and securing containerized environments.	Apply
CO 5	Understanding threat intelligence within cybersecurity while mastering incident response for efficient monitoring and effective recovery.	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	3	3	1	2	2	3
CO 2	2	2	3	3	1	2	2	3
CO 3	2	2	3	3	1	2	2	3
CO 4	2	2	3	3	1	2	2	3
CO 5	2	2	3	3	1	2	2	3

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination (Marks%)
	Test 1 (Marks%)	Test 2 (Marks%)	
Remember	20	10	10
Understand	80	80	80
Apply	XX	10	10
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)

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

Syllabus

Module 1 [8 Hours]

Cloud Security Fundamentals: Introduction to Cloud Computing and Security, Data Breaches, Insider Threats, Misconfiguration and Mismanagement, Risk Assessment for Cloud Environments, Data Encryption Techniques, Encryption at Rest, In Transit and during Processing.

Self-Study: Data Loss Prevention, Multi-Factor Authentication, Role-Based Access Control, Cloud Security Posture Management.

Module 2 [10 Hours]

Data Protection in the Cloud: Data Lifecycle in the Cloud, Cloud Storage Types, Ensuring Data Availability, Integrity and Confidentiality, Data classification and sensitivity levels, Risk assessment frameworks, Role-based access control (RBAC) and Attribute-based access control (ABAC), Multi-factor authentication (MFA) and Single sign-on (SSO).

Self-Study: Cloud-based encryption solutions, Zero Trust Architecture (ZTA) in the cloud.

Module 3 [9 Hours]

Cloud Migration Strategies: Cloud Migration Planning, Framework- Rehost, Replatform, Repurchase, Refactor, Retain, Retire. Data Migration Strategies, Cloud Networking and Connectivity, Migration Execution and Testing, Cloud Migration Tools.

Self-Study: Case Studies for real-world cloud migration scenarios.

Module 4 [8 Hours]

Cloud Security Monitoring: Identifying and assessing vulnerabilities, Risk management strategies, Log management and analysis- Audit Logs, Access Logs, Network Logs. Real-time alerting and anomaly detection, Network traffic monitoring, Monitoring containerized environments.

Self-Study: Behavioral analytics for anomaly detection, Cloud security and monitoring tools.

Module 5 [10 Hours]

Threat Intelligence and Incident Response: Threat intelligence in cybersecurity, Types of threat intelligence - Strategic, Tactical, Operational, Technical. Threat Intelligence Lifecycle- Collection and aggregation, Analysis and interpretation, Dissemination and communication, Feedback and refinement of intelligence processes. Incident response lifecycle - Preparation, Identification, Containment, Eradication, Recovery. Monitoring, Incident Recovery.

Self-Study: Advanced Persistent Threats, Digital Evidence Collection and Chain of Custody, Forensic Analysis Tools.

Reference Books:

1. Jamuna S. Murthy, Siddesh G. M., and Srinivasa K. G., Cloud Security: Concepts, Applications and Practices, August 28, 2024.
2. Hanim Eken, Fundamentals of Cloud and Cloud Security Kindle Edition, 2023.
3. Rebekah Brown, Scott J. Roberts, Intelligence-Driven Incident Response, 2023.
4. Paul Ticher, Data Protection and the Cloud: Are the risks too great?, 2015.
5. Jos Antonio Hernndez, Ammar Hasayen, Javier Aguado, Cloud Migration Handbook Vol. 1: A Practical Guide to Successful Cloud Adoption and Migration Hardcover, October 2019.
6. Tim Mather, Subra Kumaraswamy, Shahed Latif, Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance, 2009.

Online Resources:

1. https://www.youtube.com/watch?v=jI8IKpjiCSM
2. https://www.youtube.com/watch?v=CAu-dX_JydI
3. https://www.youtube.com/watch?v=9ziB82V7qVM
4. https://www.youtube.com/watch?v=cxQJ9BioO0U
5. https://www.youtube.com/watch?v=-FPVZ8nth8g

Course Contents and Lecture Schedule

No	Topics	No. of Lecture/ Tutorial Hours
Module 1[8 Hours]		
1.1	Introduction to Cloud Computing and Security	2
1.2	Data Breaches, Insider Threats	1
1.3	Misconfiguration and Mismanagement	1
1.4	Risk Assessment for Cloud Environments	1
1.5	Data Encryption Techniques	1
1.6	Encryption at Rest	1
1.7	In Transit and During Processing	1
Module 2[10 Hours]		
2.1	Data Lifecycle in the Cloud	1
2.2	Cloud Storage Types	1
2.3	Ensuring Data Availability	1
2.4	Integrity and Confidentiality	1
2.5	Data classification and sensitivity levels	1
2.6	Risk assessment frameworks	1
2.7	Role-based access control (RBAC)	1
2.8	Attribute-based access control (ABAC)	1
2.9	Multi-factor authentication (MFA)	1
2.10	Single sign-on (SSO)	1
Module 3 [9 Hours]		
3.1	Cloud Migration Planning	1
3.2	Framework- Rehost, Replatform	1
3.3	Repurchase, Refactor	1
3.4	Retain, Retire	1
3.5	Data Migration Strategies	1
3.6	Cloud Networking and Connectivity	2
3. 7	Migration Execution and Testing.	2
Module 4 [8 Hours]		
4.1	Identifying and assessing vulnerabilities	1
4.2	Risk management strategies	1
4.3	Log management and analysis- Audit Logs, Access Logs	1
4.4	Network Logs	1
4.5	Real-time alerting and	1
4.6	Anomaly detection	1
4.7	Network traffic monitoring	1
4.8	Monitoring containerized environments.	1
Module 5 [10 Hours]		
5.1	Threat intelligence in cybersecurity	1
5.2	Types of threat intelligence - Strategic, Tactical	1
5.3	Operational, Technical	1
5.4	Threat Intelligence Lifecycle- Collection and aggregation	1
5.5	Analysis and interpretation, Dissemination and communication	1

5.6	Feedback and refinement of intelligence processes	1
5.7	Incident response lifecycle Preparation, Identification, Containment	1
5.8	Eradication, Recovery	1
5.9	Monitoring	1
5.10	Incident Recovery	1
	Total Hours	**45**

CO Assessment Questions

Course Outcome 1 (CO1)

1. What are the three major cloud service models? (L2)
2. What do you mean by cloud misconfiguration? (L2)
3. Explain insider threats in cloud security with real-world examples. How can they be prevented? (L2)

Course Outcome 2 (CO2)

1. What is data classification in cloud security? (L2)
2. What is Attribute-Based Access Control (ABAC)? (L2)
3. What is Single Sign-On (SSO) in cloud authentication? (L2)

Course Outcome 3 (CO3)

1. What is the difference between 'Replatform' and 'Refactor' in cloud migration? (L2)
2. How does a hybrid cloud network impact cloud migration? (L2)
3. How can an organization minimize downtime and ensure business continuity during migration? (L2)

Course Outcome 4 (CO4)

1. What is the purpose of audit logs in cybersecurity? (L2)
2. How does network logging help in identifying security threats? (L2)
3. Discuss the role of machine learning in anomaly detection and threat prediction in cloud environments. (L3)

Course Outcome 5 (CO5)

1. What is the role of tactical threat intelligence in cybersecurity? (L2)
2. What challenges do organizations face in threat intelligence collection, analysis, and dissemination? (L2)
3. How does real-time monitoring help in incident response? Discuss its role in detecting threats early. (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:* M24CA1E303F**

***Course Name:* Cloud Security and Migration**

Max. Marks: 60 Duration: 3 Hours

PART A

Answer all questions. Each question carries 2 marks.

1. What do you mean by cloud misconfiguration?
2. What is a shared responsibility model in cloud security?
3. What is the purpose of a risk assessment framework?
4. How does encryption help in maintaining data confidentiality?
5. What is the purpose of a migration execution plan?
6. Why is bandwidth consideration important in cloud data migration?
7. How does network logging help in identifying security threats?
8. What is real-time alerting in security monitoring?
9. What happens in the collection and aggregation phase of the Threat Intelligence Lifecycle?
10. How does monitoring help in cybersecurity incident detection?

PART B

Answer any five questions. Each question carries 8 marks.

11. Explain the major cloud security challenges and how organizations can mitigate them.
12. Explain the working of MFA and how it enhances cloud security.
13. Discuss different data migration strategies and their impact on performance and security.
14. How does network traffic monitoring enhance cloud security? Discuss different tools and techniques used.
15. Explain the importance of incident recovery and the steps involved in restoring normal operations after a cyber-attack.
16. Explain the concept of Multi- Factor Authentication and its importance in cloud security.
17. Explain a real-world case study where proper log management and monitoring helped prevent a major security breach.

M24CA1E303G	Business Management	L	T	P	J	S	Credit	Year of Introduction
		3	1	0	0	3	4	2024

Preamble:

This course explores key business and management principles for the digital age, preparing future technology leaders to navigate the intersection of technology and business. It covers foundational concepts, decision-making, financial analysis, marketing, and innovation, combining traditional and modern approaches to develop strategic leadership and resource management skills in tech-driven organizations.

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	Understand management concepts, functions, and theories, differentiate business types, and evaluate organizational structures and their impact on operations.	Understand
CO 2	Understand decision-making, leadership, motivation, and team dynamics, applying relevant theories and techniques in organizational contexts.	Understand
CO 3	Apply financial management principles in accountancy, analyse financial statements for accurate reporting, apply budgeting techniques for financial planning, and evaluate investment risks to ensure sound financial decision-making.	Apply
CO 4	Understand marketing strategies, digital tools, consumer behaviour, branding, CRM, and e-commerce to effectively support business growth in the digital era.	Understand
CO 5	Understand innovation, entrepreneurship, and change management principles to enhance business growth, sustainability, and corporate social responsibility.	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			1		1
CO 2		1	2			1		2
CO 3		1	1	1		1		1
CO 4		2		3		2		1
CO 5				1				1

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination (Marks%)
	Test 1 (Marks %)	Test 2 (Marks %)	
Remember	40	20	30
Understand	60	60	50
Apply	XX	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(Module1&Module2) : 10 Marks
- Continuous Assessment Test 2(Module3&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 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]

Business Management: Management vs. Administration, Functions of Management- Planning, Organizing, Leading, Controlling. Evolution of Management Theories**,** Classical Theories (Fayol, Taylor), Human Relations Theory (Mayo), Contemporary Theories. Types of Business- Manufacturing, Service, Retail, and E-business.

Organizational Structure: Types of Organizational Structures- Functional, Divisional, Matrix, Flat vs. Tall Organizations, Impact of Structure on Business Operations.
Self-Study: Case study on a multinational company's management structure.

Module 2 [8 Hours]

Managerial Decision Making and Leadership: Decision-Making, Types of Decisions- Programmed vs. Non-programmed Decisions. Decision-Making Tools and Techniques- Decision Trees, Cost-Benefit Analysis, Break Even Analysis.

Leadership and Motivation: Leadership Styles and Theories- Trait Theory, Behavioral Theory, Contingency Theory, Transformational Leadership. Motivation Theories- Maslow's Hierarchy of Needs, Herzberg's Two-Factor Theory, McGregor's Theory X and Theory Y. Leadership in the Digital Era - Team Dynamics and Conflict Management, Building Effective Teams, Conflict Resolution Strategies in Organizations.

Self-Study: Prepare a report on motivation and leadership in modern workplace based on insights from any of the TED Talks.

Module 3 [9 Hours]

Financial Management and Business Analysis: Objectives of Financial Management, Financial Planning and Analysis, Time Value of Money, Financial Statements, Balance Sheet, Income Statement, and Cash Flow Statement, Understanding Profitability, Liquidity, and Solvency Ratios.

Budgeting and Capital Budgeting: Types of Budgets- Operating, Cash, Capital. Capital Budgeting Techniques- NPV, IRR, Payback Period, Risk Analysis in Investment Decisions.

Self-Study: Familiarize any Accounting package like Tally.

Module 4 [9 Hours]

Marketing Strategies and Digital Transformation: Definition and Importance of Marketing, Marketing Concepts and Strategies, Role of Digital Marketing in the Modern Business Landscape. Marketing Mix- Product, Price, Place, Promotion. Consumer Behavior and Market Segmentation, Importance of Market Research and Analysis.

Branding and Customer Relationship Management (CRM): Brand Management Strategies, Customer Loyalty and Retention, CRM Systems and Technologies.

Digital Marketing: Digital Marketing Tools- SEO, SEM, Social Media, Content Marketing, Email Marketing. Marketing Analytics and Data-Driven Decision Making, E-Commerce and Digital Sales Channels.

Self-Study: Subscription-based business models in digital commerce, social commerce.

Module 5 [7 Hours]

Innovation, Entrepreneurship, and Change Management: Innovation in Business, Types of Innovation - Product, Process, Business Model Innovation. Innovation Management- Generating Ideas, Evaluating Ideas, Implementing Innovation.

Entrepreneurship: Entrepreneurial Characteristics and Traits, starting a New Business, Business Plan Development, Funding, Legal Structures, Managing Risk and Uncertainty in Startups.

Change Management: Theories of Change Management - Kotter's 8-Step Model, Lewin's Change Model, Resistance to Change and Overcoming Barriers, Change Management in Digital Transformation

Self-Study: Business Sustainability, Sustainable Business Practices, Corporate Social Responsibility (CSR)

Reference Books:

1. Tripathi, P.C., and P.N. Reddy. Principles of Management. 6th edition, McGraw-Hill, 2017.
2. Prasad, L.M. Principles & Practice of Management. Sultan Chand & Sons, 2021.

3. Koontz, Harold, and Cyril O'Donnell. Essentials of Management. 6th edition, McGraw-Hill, 2021.
4. Pandey, I.M. Financial Management. 12th edition, Pearson India, 2021
5. Chandra, Prasanna. Financial Management: Theory and Practice. 11th edition, McGraw Hill, 2022.
6. Kotler, Philip. Principles of Marketing. Indian Edition, 19th edition, Pearson Education, 2023.
7. Gupta, Seema. Digital Marketing: A Practical Approach. 3rd edition, McGraw-Hill, 2022.
8. Drucker, Peter F. Innovation and Entrepreneurship. Indian Edition, HarperCollins India, 2006.
9. Khanka, S.S. Entrepreneurial Development. S. Chand Publishing, 2020.
10. Subbarao, Srinivas, and Puneet Kumar. Organizational Leadership and Change Management. Paramount Publishing House, 2014.

Online Resources:

1. https://onlinecourses.nptel.ac.in/noc22_mg42
2. https://onlinecourses.nptel.ac.in/noc20_mg11
3. https://archive.nptel.ac.in/courses/110/101/110101131
4. https://archive.nptel.ac.in/courses/110/106/110106164

Course Contents and Lecture Schedule

NO	Topic	No. of Lecture/Tutorial Hours
Module 1 [12 Hours]		
1.1	Introduction	1
1.2	Management vs. Administration	1
1.3	Functions of Management: Planning, Organizing, Leading, Controlling	1
1.4	Organizing	1
1.5	Leading, Controlling	1
1.6	Evolution of Management Theories, Classical Theories (Fayol, Taylor)	2
1.7	Human Relations Theory (Mayo), Contemporary Theories	1
1.8	Definition of Business, Types of Business: Manufacturing, Service	1
1.9	Retail, and E-business	1
1.10	Organizational Structure, Types of Organizational Structures: Functional, Divisional, Matrix	1
1.11	Flat vs. Tall Organizations, Impact of Structure on Business Operations	1
Module 2 [8 Hours]		
2.1	Decision-Making, Types of Decisions- Programmed vs. Non-programmed Decisions.	1
2.2	Decision-Making Tools and Techniques- Decision Trees, Cost-Benefit Analysis	1

2.3	Break Even Analysis	1
2.4	Leadership Styles and Theories- Trait Theory, Behavioral Theory	1
2.5	Contingency Theory, Transformational Leadership	1
2.6	Motivation Theories- Maslow's Hierarchy of Needs, Herzberg's Two-Factor Theory, McGregor's Theory X and Theory Y	1
2.7	Leadership in the Digital Era - Team Dynamics and Conflict Management	1
2.8	Building Effective Teams, Conflict Resolution Strategies in Organizations	1
Module 3 [9 Hours]		
3.1	Objectives of Financial Management, Financial Planning and Analysis	1
3.2	Time Value of Money, Financial Statements, Balance Sheet	1
3.3	Income Statement, and Cash Flow Statement	1
3.4	Understanding Profitability, Liquidity, and Solvency Ratios	1
3.5	Problem Solving	3
3.6	Budgeting - Types of Budgets- Operating, Cash, Capital	1
3.7	Capital Budgeting Techniques- NPV, IRR, Payback Period, Risk Analysis in Investment Decisions	1
Module 4[9 hours]		
4.1	Definition and Importance of Marketing, Marketing Concepts and Strategies	1
4.2	Role of Digital Marketing in the Modern Business Landscape. Marketing Mix- Product, Price, Place, Promotion	1
4.3	Consumer Behavior and Market Segmentation, Importance of Market Research and Analysis	1
4.4	Brand Management Strategies, Customer Loyalty and Retention	1
4.5	CRM Systems and Technologies	1
4.6	Digital Marketing Tools- SEO, SEM	1
4.7	Social media, Content Marketing, Email Marketing	1
4.8	Marketing Analytics and Data-Driven Decision Making	1
4.8	E-Commerce and Digital Sales Channels	1
Module 5[7 hours]		
5.1	Innovation in Business, Types of Innovation - Product, Process, Business Model Innovation	1
5.2	Innovation Management- Generating Ideas, Evaluating Ideas, Implementing Innovation	1
5.3	Entrepreneurial Characteristics and Traits, starting a New	1

	Business	
5.4	Business Plan Development, Funding	1
5.5	Legal Structures, Managing Risk and Uncertainty in Startups	1
5.6	Theories of Change Management - Kotter's 8-Step Model, Lewin's Change Model	1
5.7	Resistance to Change and Overcoming Barriers, Change Management in Digital Transformation	1
	Total hours	**45**

Co Assessment Questions

Course Outcome 1 (CO1)

1. What is Management? (L1)
2. Write a short note on matrix organization. (L2)
3. Explain Fayol's classical theory of management. (L2)
4. What is e-business? Explain. (L2)

Course Outcome 2 (CO2)

1. What are the key steps in the decision-making process? (L1)
2. What are the key characteristics of an effective leader? (L2)
3. Explain McGregor's Theory X and Theory Y. How do they impact managerial behavior? (L2)
4. Compare and contrast autocratic and democratic leadership styles. (L2)

Course Outcome 3 (CO3)

1. What are the key objectives of financial management? (L1)
2. What are the main types of risks involved in investment decisions? (L2)
3. Explain how variance analysis helps in budgetary control. (L2)
4. Enter the following Transactions in the Journal of KD LTD for the year 2017. (L3)

   Jan.01- Commenced business with cash Rs. 1,75,000

   Jan.01- Purchased Building for cash Rs.1,00,000

   Jan.02- Goods purchased for cash Rs. 75,000

   Jan.03- Sold goods to Ramesh Rs. 30,000

   Jan.04- Paid wages Rs. 500

   Jan.06- Sold goods for cash Rs. 10,000

   Jan.10- Paid for trade expenses Rs. 700

   Jan 11- Purchased stationery Rs. 2500

Course Outcome 4 (CO4:

1. What is marketing, and why is it important for businesses? (L1)
2. What are the key factors that influence consumer behavior? (L2)
3. What are the four components of the marketing mix? Explain. (L2)
4. Explain how businesses use customer personas in marketing. (L2)

Course Outcome 5 (CO5)

1. What are the three main types of innovation? (L1)
2. What is the role of risk management in entrepreneurship? (L1)
3. Explain the different types of innovation in business with suitable examples. (L2)
4. Write short notes on the various funding options available for startups and their advantages and disadvantages. (L2)

Model Question Paper

QP CODE: Pages: 2

Reg No.:______________Name:_______________________________

MAR ATHANASIUS COLLEGE OF ENGINEERING (AUTONOMOUS), KOTHAMANGALAM

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

Course Code: M24CA1E303G

Course Name: Business Management

Max. Marks: 60 Duration: 3 Hours

PART A

Answer all questions. Each question carries 2 marks.

1. How managerial skills are related to levels of management. Explain. (2)
2. Differentiate flat and tall organizations. (2)
3. Write any two differences between programmed and non-programmed decisions. (2)
4. Write a short note on contingency theory of leadership. (2)
5. What is time value of money? (2)
6. Explain payback period in capital budgeting. (2)
7. Write any two roles of digital marketing in modern marketing scenario. (2)
8. What is e-mail marketing? (2)
9. Differentiate between product innovation and process innovation. (2)
10. Name any two sources of funding for startups. (2)

PART B

Answer any five questions. Each question carries 8 marks.

11. Explain the universal principles of management identified by Fayol. (8)
12. Explain McGregor's X theory and Y theory. (8)
13. Journalise the following transactions in the books of Archana Enterprises. (8)

    1-12-2017- Business started with cash Rs 75,000

    07-12-2017- Purchased goods for cash Rs 10,000

    09-12-2017- Sold goods to Swati Rs 5,000

    11-12-2017- Purchased goods from Kevin Rs 2000

    12-12-2017- Purchased furniture Rs 3,000

    18-12-2017- Cash received from Swati Rs 5,000

    25-12-2017- Paid rent Rs 1,000

    30-12-2017- Paid salary Rs 1,500

14. Explain marketing mix. (8)
15. Explain the process of starting a new business and the factors to consider. (8)
16. Explain Lewin's Change Model and how it is applied in organizational change. (8)
17. As a leader, how can you build effective teams? Explain. (8)

M24CA1E303H	Organizational Behavior	L	T	P	J	S	Credit	Year of Introduction
		3	1	0	0	3	4	2024

Preamble:

This course intends to provide a comprehensive knowledge of core organizational behavior concepts and their practical applications in addressing contemporary workplace challenges.

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	Gaining insights into core organizational behavior concepts and apply them to address contemporary workplace challenges.	Apply
CO 2	Understand psychological factors influencing individual behavior, identify factors that influence intelligence and effective stress management techniques.	Understand
CO 3	Understand group dynamics and teamwork principles to effectively manage teams in real-world scenarios.	Understand
CO 4	Understand and apply various motivational theories and strategies to enhance workplace performance.	Understand
CO 5	Understand and apply effective strategies to manage and implement organizational change.	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	3	1	3	3	3	3
CO 2	1	1	3	1	3	3	3	3
CO 3	1	1	3	1	3	3	3	3
CO 4	1	1	3	1	3	3	3	3
CO 5	1	1	3	1	3	3	3	3

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination (Marks%)
	Test 1 (Marks%)	Test 2 (Marks%)	
Remember	08	40	16
Understand	60	60	70
Apply	32	XX	14
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)

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

Syllabus

Module 1 [10 Hours]

Foundation of Organizational Behavior: Introduction to organizational behavior, Management roles, Management skills, Organizational behavior models - Autocratic model, Custodial model, Supportive model, Collegial model, System model. Opportunities in organizational behavior - Innovation and change, Networked organizations, Work-life balance, Ethics in organizational behavior. Challenges in organizational behavior - Workforce diversity, Technological advancements, Leadership development, Conflict resolution, Remote work and virtual teams.

Self-Study: Disciplines contributing to organizational behavior - Psychology, Social psychology, Sociology, Anthropology.

Module 2 [9 Hours]

Psychological Dynamics in the Workplace: Individual behavior in organizations, Workplace attitudes and values- Job satisfaction, Organizational commitment, Employee engagement, Alignment of personal and organizational values, Developing positive attitudes and values. Intelligence – Types of intelligence, Factors influencing intelligence. Stress at work – Stressors, Potential sources of stress, Consequences of stress, Managing stress.

Self-Study: Communication strategies, Theories and models of Stress management.

Module 3 [10 Hours]

Group Dynamics and Teamwork: Understanding groups – Types of groups, Stages of group development, Group roles and norms, Decision making in groups, Communication in groups. Teamwork – Types of teams, Stages of team development, Effective communication in teams, Goal setting and team objectives, Virtual and hybrid teams.

Self-Study: Conflict and conflict resolution, Teamwork simulation and Case studies.

Module 4 [8 Hours]

Motivation: Early theories of motivation**,** Contemporary theories of motivation, Types of motivation, Motivational strategies in organizations, Workplace motivation and performance, Cultural and individual differences in motivation, Leadership and motivation, Challenges in motivating employees.

Self-Study: Successful motivational practices in organizations, Group activities and role-play exercises.

Module 5 [8 Hours]

Organizational Change and Development: Understanding organizational change, Force field theory of change, Change management process, Resistance to change, Creating culture for change, Communication in change management, Training and development for change, Sustaining change.

Self-Study: Evaluating change initiatives, Organizational culture and sustainability.

Reference Books:

1. Stephen P. Robbins, Timothy A. Judge, Neharika Vohra, Organizational Behavior, 2022.
2. K. Aswathappa, Organisational Behaviour, 12th Edition, 2023.
3. Ricky W. Griffin, Jean M. Phillips, Stanley M. Gully, Organizational Behavior: Managing People and Organizations, 13 th Edition, 2020.
4. Fred Luthans, Organizational Behavior An Evidence-based Approach, 2011.
5. John R. Schermerhorn Jr., Hunt, Richard N. Osborn, Mary Uhl-Bien Organizational Behavior, 12 th Edition, 2010.

Online Resources:

1. https://www.youtube.com/watch?v=pHg3ZfGk5j0
2. https://www.youtube.com/watch?v=6sxycGzJc34
3. https://www.youtube.com/watch?v=xLMCJO4Op7w
4. https://www.youtube.com/watch?v=t_AfTFYM4FU
5. https://www.youtube.com/watch?v=OUJJgktZqTw
6. https://www.youtube.com/watch?v=FVoxjstO5A4
7. https://www.youtube.com/watch?v=YS5dITh1TsQ
8. https://www.youtube.com/watch?v=DJausrOVOWE
9. https://www.youtube.com/watch?v=SmlD6jpM73I
10. https://www.youtube.com/watch?v=13giOIhtsUw

Course Contents and Lecture Schedule

No	Topics	No. of Lecture/ Tutorial Hours
Module 1[10 Hours]		
1.1	Introduction to organizational behavior	1
1.2	Management roles	1
1.3	Management skills	1
1.4	Organizational behavior models - Autocratic model, Custodial model	1
1.5	Supportive model, Collegial model, System model	1
1.6	Opportunities in organizational behavior- Innovation and change, Networked organizations	1
1.7	Work-life balance, Ethics in organizational behavior	1
1.8	Challenges in organizational behavior -Workforce diversity, Technological advancements	1
1.9	Leadership development, Conflict resolution	1
1.10	Remote work and Virtual teams	1
Module 2 [9 Hours]		
2.1	Individual behavior in organizations	1
2.2	Workplace attitudes and values- Job satisfaction	1
2.3	Organizational commitment, Employee engagement	1
2.4	Alignment of personal and organizational values	1
2.5	Developing positive attitudes and values	1
2.6	Intelligence – Types of intelligence	1
2.7	Factors influencing intelligence	1
2.8	Stress at work – Stressors, Potential sources of stress	1
2.9	Consequences of stress, Managing stress	1
Module 3 [10 Hours]		
3.1	Understanding groups – Types of groups	1
3.2	Stages of group development, Group roles and norms	1
3.3	Decision making in groups	1
3.4	Communication in groups	1
3.5	Teamwork – Types of teams	1
3.6	Stages of team development	1
3. 7	Effective communication in teams	1
3.8	Goal setting and team objectives	1
3.9	Virtual and hybrid teams.	2
Module 4 [8 Hours]		
4.1	Early theories of motivation	1
4.2	Contemporary theories of motivation	1
4.3	Types of motivation	1
4.4	Motivational strategies in organizations	1
4.5	Workplace motivation and performance	1
4.6	Cultural and individual differences in motivation	1
4.7	Leadership and motivation	1

4.8	Challenges in motivating employees	1
Module 5 [8 Hours]		
5.1	Understanding organizational change	1
5.2	Force field theory of change	1
5.3	Change management process	1
5.4	Resistance to change	1
5.5	Creating culture for change	1
5.6	Communication in change management	1
5.7	Training and development for change	1
5.8	Sustaining change	1
	Total Hours	**45**

CO Assessment Questions

Course Outcome 1 (CO1)

1. What do you mean by human skills? (L2)
2. What is work-life balance in an organization? (L2)
3. How can a manager address unethical practices in a remote team while maintaining ethical standards and promoting a positive work culture? (L3)

Course Outcome 2 (CO2)

1. What are workplace attitudes? (L2)
2. Explain the consequences of stress in the workplace and how it affects individual and organizational performance. (L2)
3. Discuss the role of intelligence and stress management in improving workplace productivity. (L2)

Course Outcome 3 (CO3)

1. What are the stages of group development? (L2)
2. Explain the process of decision-making in groups. (L2)
3. Explain how goal setting and team objectives ensure team success. (L2)

Course Outcome 4 (CO4)

1. What is the difference between motivation and performance? (L2)
2. What is Herzberg's two-factor theory? (L2)
3. Describe the difficulties of keeping employees motivated and propose solutions. (L2)

Course Outcome 5 (CO5)

1. What is the role of communication in change management? (L2)
2. What is the importance of creating a culture for change? (L2)
3. Explain the steps involved in sustaining change in an organization. (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: **M24CA1E303H**

Course Name: **Organizational Behavior**

Max. Marks: 60 Duration: 3 Hours

PART A

Answer all questions. Each question carries 2 marks.

1. What are informational roles in management?
2. What is change in the context of Organizational Behavior
3. What is role ambiguity in the context of workplace stress?
4. What is job involvement?
5. What is the difference between formal and informal groups?
6. What is the role of communication in group dynamics?
7. What is the role of leadership in employee motivation?
8. What is the significance of workplace motivation?
9. What is the role of leadership in managing organizational change?
10. Mention any two challenges in implementing change in an organization.

PART B

Answer any five questions. Each question carries 8 marks.

11. How do you resolve team issues caused by a manager's poor communication during a software implementation?
12. Explain different types of intelligence and their relevance in the workplace.
13. Explain how communication breakdowns can be avoided with example.
14. Explain the relationship between leadership and motivation. How can leaders enhance motivation?
15. Discuss the importance of creating a culture for change. How can leaders promote a change-oriented culture?
16. Explain the impact of groupthink on decision-making in groups.
17. What are the strategies to ensure long-term success after implementing organizational change?

M24CA1E303I	IPR and Cyber Laws	L	T	P	J	S	Credit	Year of Introduction
		3	1	0	0	3	4	2024

Preamble:

This course covers Intellectual Property Rights (IPR) and Cyber Laws**,** including patents, trademarks, copyrights, industrial designs, and online security. It also explores the IT Act, 2000**,** cybercrimes, and digital rights. Students will gain essential legal knowledge for protecting intellectual property and navigating cyberspace.

Prerequisite:

An interest in intellectual property, cybersecurity, and digital rights will aid in grasping key topics effectively.

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 basics of Intellectual Property Rights (IPR), its importance, international agreements, and the patent process.	Understand
CO 2	Understand the fundamentals of trademarks and copyrights, including their registration, protection, infringement issues, and the specific aspects of software copyright.	Understand
CO 3	Understand the principles of Industrial Designs, Geographic Indications, and Trade Secrets, including their definitions, legal protections, registration requirements, and application procedures under relevant laws.	Understand
CO 4	Understand the fundamentals of Cyber Law, including its need, historical development, cyberspace issues, and the role of ISPs in India.	Understand
CO 5	Apply the IT Act 2000 and its amendments to analyse and address privacy violations, cybercrimes, intermediary offences, and related punishments.	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	2	2					2	1
CO 2	2	2					3	1
CO 3	2	2					2	1
CO 4	2	3		1			3	2
CO 5	2	3	2	2	1		3	2

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination (Marks %)
	Test 1 (Marks %)	Test 2 (Marks %)	
Remember	40	20	20
Understand	60	60	60
Apply	XX	20	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 Pattern (Out of 40 marks):

- Continuous Assessment Test 1 : 10 Marks
- Continuous Assessment Test 2 : 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.

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 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]

Fundamentals of IPR: Introduction, Intellectual property, Need for protection of intellectual property, WIPO, Intellectual property rights and development, Rationale of protection, TRIPS Agreement.

Patents: Introduction, Patentable and Non-patentable Invention, Types of patent applications, Guidelines for registration of patent, Patent filing, Grant of patent, Types of patent documents.

Self-Study: Visit the WIPO website (www.wipo.int) and summarize recent developments in intellectual property rights.

Module 2 [8 Hours]

Trademarks: Introduction, Guidelines for registration, Requirements for filing trademarks, Trademark Infringement, Protection of trademarks.

Copyright: Introduction, Rights conferred by copyright, Registration, Ownerships, Terms, Transfer of copyrights, Copyright infringement, Databases and copyright.

Software Copyright: Introduction, Need of software copyright, Classification of software according to copyright, Software auditing, Copyright notice, Transfer of copyright.

Self-Study: Identify a real-world example of copyright infringement (e.g., plagiarism, unauthorized use of software) and summarize legal consequences.

Module 3 [8 Hours]

Industrial Designs: Introduction, Need for protection of design, Requirements for registration of designs, Design Act 2000, Duration of registration of design, Application procedure. Geographic Indications**-** Introduction, Filing. Granting**-** Protection of geographic indications. Trade Secret**-** Definition, Discovering and protecting of trade secret.

Self-Study: Research a famous trade secret (e.g., Coca-Cola recipe) and discuss how it is protected legally.

Module 4 [8 Hours]

Cyber law: Need for cyber laws, Historical perspective, Cyberspace, Deception by squatting in cyberspace, Protection of copyright on cyberspace, Infringement of copyright on cyberspace-linking, hyperlinking and framing, ISP in cyberspace – cyber space and protection of patents in India.

Self-Study: Research a well-known cybercrime case in India and explain its legal consequences.

Module 5 [9 Hours]

Information Technology Act and Punishments: Introduction to IT Act 2000, Amendments on IT Act, Violation of the right of privacy in cyberspace/internet punishment for violation of privacy, Breach of confidentiality and privacy under IT act, Terrorism on cyberspace Overview of cybercrimes, Offences by intermediaries offences related to protected system, Offences of misrepresentation, Punishment for Abetment and Attempt to commit offences under the IT act.

Self-Study: IT Act Case Study**-** Research a case where the IT Act 2000 was used to convict cybercriminals.

Reference Books:

1. Dr. R. Radhakrishnan and Dr. S. Balasubramanian, “Intellectual Property Rights: Text and Cases”, Excel Books
2. Gagandeep Chander, Harish Kaur “Cyber Law and IT Protection”, PHI Learning Pvt.Ltd. 1 January 2022
3. K G A Yuvaraja Ariaputhiry, M Saranaga Priya Muthalu, “Intellectual Property Law IPR”, YUVARAJA 29 November 2024
4. D. Bainbridge, “Introduction to Computer Law”, Pearson Education
5. Rohas Nagpal, “Cyber Crime & Corporate Liability”, CCH, 2008

Online Resources:

1. https://www.udemy.com/course/cyber-security-law/
2. https://www.coursera.org/specializations/introduction-intellectual-property
3. https://blog.ipleaders.in/registration-of-trademarks/
4. https://www.simplilearn.com/what-is-cyber-law-article
5. https://blog.ipleaders.in/information-technology-act-2000/

Course Contents and Lecture Schedule

NO	Topic	No. of Lecture/Tutorial Hours
Module 1 [10 Hours]		1
1.1	Introduction – Intellectual property	1
1.2	Need for protection of intellectual property	1
1.3	WIPO – Intellectual property rights and development	1
1.4	Rationale of protection – TRIPS Agreement	1
1.5	Patents – Introduction – Patentable and Non-patentable Invention	1
1.6	Types of patent applications	1
1.7	Guidelines for registration of patent – patent filing	2
1.8	Grant of patent – types of patent documents	2
Module 2 [10 Hours]		
2.1	Trademarks– Introduction – Guidelines for registration	2
2.2	Requirements for filing trademarks	1
2.3	Trademark Infringement – Protection of trademarks	1
2.4	Copyright – Introduction – Rights conferred by copyright	1
2.5	Registration– ownerships – terms- transfer of copyrights	1
2.6	Copyright infringement – databases and copyright	1
2.7	Software Copyright– Introduction – Need of software copyright – classification of software according to copyright	2
2.8	Software auditing – copyright notice – transfer of copyright	1
Module 3 [10 Hours]		
3.1	Industrial Designs– Introduction – Need for protection of design	2
3.2	Requirements for registration of designs – Design Act,2000 – Duration of registration of design – application procedure	2
3.3	Geographic Indications – Introduction – Filing -Examples	2
3.4	Granting – Protection of geographic indications.	2
3.5	Trade Secret – definition – discovering and protecting of trade secret-Examples	2
Module 4 [7 Hours]		
4.1	Cyber law - Need for cyber laws - Historical perspective	1
4.2	Cyberspace - deception by squatting in cyberspace	1
4.3	Protection of copyright on cyberspace	1
4.4	Infringement of copyright on cyberspace - linking, hyper linking and framing	2
4.5	ISP in cyberspace - cyberspace and protection of patents in India.	2
Module 5 [8 Hours]		
5.1	Information Technology Act and Punishments- Introduction to IT Act2000- Amendments on IT Act	2
5.2	Violation of the right of privacy in cyberspace/internet	2
5.3	Punishment for violation of privacy, breach of confidentiality and privacy under IT act-Terrorism on cyberspace overview of cybercrimes	2
5.4	Offences by intermediaries- offences related to protected	1

	system offences of misrepresentation	
5.5	Punishment for Abetment and Attempt to commit offences under the IT act.	1
	Total	45

CO Assessment Questions

Course Outcome 1 (CO1):

1. Describe the need for protection of intellectual property. (L2)
2. Explain TRIPS Agreement. (L2)
3. Illustrate types of patent applications. (L2)

Course Outcome 2 (CO2):

1. Explain Trademark Infringement and Protection of trademarks. (L2)
2. Describe software copyright. (L2)
3. Explain Trademark Infringement and Protection of trademarks. (L2)

Course Outcome 3 (CO3):

1. Describe the need for protection of design and explain Design Act, 2000. (L2)
2. Describe the procedure of discovering and protecting of trade secret. (L2)
3. Implement a forward approach to solve a multistage graph problem. (L2)

Course Outcome 4 (CO4):

1. Write the importance of cyber laws. (L2)
2. Describe the protection of copyright on cyberspace (L2)
3. Explain ISP in cyberspace (L2)

Course Outcome 5 (CO5):

1. What are the different amendments on IT Act 2000. (L2)
2. Describe Terrorism on cyberspace. (L2)
3. Apply the concept of offences of misrepresentation to a real-world legal case and discuss its implications (L3)

Model Question Paper

QP CODE: Pages: 2

Reg No : Name:

MAR ATHANASIUS COLLEGE OF ENGINEERING (AUTONOMOUS)

KOTHAMANGALAM

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

Course Code: M24CA1E303I

Course Name: IPR and Cyber Laws

Max. Marks: 60 *Duration: 3 hours*

PART A

Answer all questions. Each question carries 2 marks.

1. Describe the need for protection of intellectual property.

2. Illustrate types of patent applications.
3. Describe software copyright.
4. Anu creates a painting and she wants to protect it from copying. Which type of IP she can use? Justify.
5. Describe the need for protection of design and explain Design Act, 2000.
6. Describe the procedure of discovering and protecting of trade secret.
7. Write the importance of cyber laws.
8. Describe the protection of copyright on cyberspace
9. What are the different amendments on IT Act 2000.
10. Describe Terrorism on cyberspace.

PART B

Answer any five questions. Each question carries 8 marks.

11. Explain TRIPS Agreement.
12. Explain Trademark Infringement and Protection of trademarks.
13. Explain basic concepts of Geographic Indications such as filing, granting and Protection of geographic indications.
14. Explain ISP in cyberspace.
15. Apply the concept of offences of misrepresentation to a real-world legal case and discuss its implications .
16. Explain the significance of IPR in fostering innovation, economic growth, and competition.
17. Explain the importance of industrial design protection in fostering innovation and market competitiveness.

M24CA1E304A	Deep Learning	L	T	P	J	S	Credit	Year of Introduction
		3	1	0	0	3	4	2024

Preamble:

This course equips students with a comprehensive understanding of deep learning fundamentals, architectures, and advanced techniques, while enabling them to apply neural network models, including convolutional, recurrent, and generative networks, to solve real-world problems effectively.

Prerequisite:

Familiarity with Linear and Probability, Basic understanding of Python Programming, Knowledge of Machine Learning concepts.

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 fundamentals of deep learning and neural networks, including their biological inspiration, architecture, learning mechanisms, supervised models, activation functions, and optimization techniques.	Understand
CO 2	Understand neural network training techniques, optimize model performance using regularization methods, diagnose model behavior, and implement neural networks effectively using TensorFlow.	Understand
CO 3	Apply convolutional neural network architectures, including pretrained models and transfer learning, to solve tasks such as image classification, object detection, and segmentation.	Apply
CO 4	Understand the architecture, functioning, and training challenges of recurrent neural networks (RNNs), including advanced variants like LSTMs and GRUs, and their applications in handling sequence data effectively.	Understand
CO 5	Understand the concepts, architectures, and applications of deep generative models, including autoencoders, variational autoencoders, and generative adversarial networks (GANs), along with their training techniques, loss functions, and challenges.	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	2	1	1		2
CO 2	3	3	3	3	1	2		2
CO 3	3	3	3	3	1	2		2
CO 4	2	2	3	3	1	2		2
CO 5	2	2	3	2	1	2	2	2

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination (Marks%)
	Test 1 (Marks %)	Test 2 (Marks %)	
Remember	40	20	20
Understand	60	60	60
Apply	XX	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(Module1&Module2) : 10 Marks
- Continuous Assessment Test 2(Module3&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 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]

Artificial Neural Networks: History of Deep Learning, Deep Learning Basics, Review of Neural networks, Model of a biological neuron, McCulloch Pitts Neuron, Supervised Learning. How to build deep learning models- Perceptron, Perceptron Learning Algorithm and Convergence Multilayer Perceptron, Learning OR function, Learning AND function, Learning XOR. Activation functions- Linear and nonlinear activation function. Deep Neural Networks- Feed forward neural networks, function of feed forward neural networks, Loss Functions, Gradient Descent, Back propagation.

Self-Study: Test various activation functions and observe their impact on model performance, Evolution of neural network architectures.

Module 2 [10 Hours]

Implementing Neural Networks: Parameters and hyper parameters of neural networks, Learning rate. Neural network training – Underfitting and overfitting, Bias, Variance, How to improve underfitting and overfitting, Regularization, Dropout, Data augmentation, Early stopping, Batch normalization, Neural network initialization – Zero initialization, Random initialization, Train-test split, Cross validation, Training and validation curves, Diagnosing model behaviour.

Introduction to TensorFlow : TensorFlow features, Tensor data structure- rank, shape, type. TensorFlow graph, Implementing neural networks in TensorFlow, Introduction to Keras, Data Visualization- Feature and weight visualization, tSNE.

Self-Study: Implement basic neural networks using Python libraries like TensorFlow or PyTorch, Designing a Neural Network for Handwritten Digit Recognition.

Module 3 [8 Hours]

Convolutional Neural Networks: Convolutional layers in neural network - Convolution operation, Filters, Feature maps, Stride, Padding. Pooling layer- Max pooling, Min pooling, Average pooling. Fully connected layers, SoftMax and output layers**.** Architecture of CNN- Pretrained models, Transfer learning, Architecture of Lenet, Alexnet and VGG 16. Applications of CNN- Image classification, Object detection, Semantic segmentation, Instance segmentation.

Self-Study: CNN Implementation in Python using Frameworks (TensorFlow, Keras), Handling imbalanced data, Real world applications of CNN.

Module 4 [8 Hours]

Recurrent Neural Networks: Overview of sequence data**,** Architecture and working of RNNs, Different types of RNN, Application of RNNs. Training RNNs- Backpropagation Through Time (BPTT), Challenges in training, Two issues of standard RNN- Vanishing and Exploding Gradients problem. Advanced RNN Architectures **-** Long Short-Term Memory (LSTM) cells, Forget, Input, and Output gates, Role of cell state and hidden state, LSTM equations and intuition, Applications of LSTMs, Reducing vanishing gradients. Gated Recurrent Units (GRUs) – Update gate, Reset gate, Cell state, Comparison with LSTM, GRU equations and intuition. Applications of GRU.

Self-Study: Applications in speech recognition and natural language processing (NLP), Develop a model using LSTMs or GRUs to predict stock prices based on historical data.

Module 5 [9 Hours]

Deep Generative Models: Generative and discriminative models, Applications of generative models Autoencoders- Architecture, Encoder, Latent Space, Decoder. Loss functions-Mean Squared Error (MSE), Cross-Entropy, Hyperparameters of Autoencoders. Variational autoencoders -Architecture, Encoder as a probabilistic model, Decoder as a generative model, Loss function, Applications. Generative Adversarial Networks (GAN) - Discriminative and generative models, GAN generator, GAN discriminator. GAN Training - Upsampling and latent space sampling, Back propagation, Loss function -Cross entropy, Minimax loss, Wasserstein loss, Gan challenges, GAN applications.

Self-study: Applications of generative models in real-world scenarios, Dimensionality reduction, Hyperparameters of Autoencoders.

Reference Books:

1. Bengio, Yoshua, Ian J. Goodfellow, and Aaron Courville. "Deep learning." An MIT Press book in preparation. (2016). (Module 1,2,3,4,5)
2. Michael Nielsen, Neural Networks and Deep Learning, 1st edition, Determination Press, 2015. (Module 1,2)
3. Adam Gibson, Josh Patterson, Deep Learning: A Practitioner's Approach, 1st edition,

O'Reilly Media, 2017.

4. Nikhil Buduma, Fundamentals of Deep Learning: Designing Next-Generation Machine Intelligence Algorithms, 1st edition, O'Reilly Media, 2017

Online Resources:

1. Hands on Machine Learning with Scikit Learn and TensorFlow, Aurélien Géron
2. https://www.cse.iitm.ac.in/~miteshk/CS6910/Slides/Lecture2.pdf
3. http://colah.github.io/posts/2015-08-Understanding-LSTMs/
4. https://developers.google.com/machine-learning/gan

Course Contents and Lecture Schedule

NO	Topic	No. of Lecture/Tutorial Hours
Module 1 [10 Hours]		
1.1	History of Deep Learning, Deep Learning Basics, Review of Neural networks	1
1.2	Model of a biological neuron, McCulloch Pitts Neuron, Supervised Learning	1
1.3	Perceptron, Perceptron Learning Algorithm and Convergence	1
1.4	Multilayer Perceptron, Learning OR function, Learning AND function	1
1.5	Learning OR function, Learning AND function, Learning XOR.	1
1.6	Linear and nonlinear activation function	1
1.7	Feed forward neural networks, function of feed forward neural networks	1
1.8	Loss Functions	1
1.9	Gradient Descent	1
1.10	Back propagation	1
Module 2 [10 Hours]		
2.1	Parameters and hyper parameters of neural networks, Learning rate	1
2.2	Underfitting and overfitting, Bias, Variance, How to improve underfitting and overfitting	1
2.3	Regularization, Dropout	1
2.4	Data augmentation, Early stopping	1
2.5	Early stopping, Batch normalization	1
2.6	Zero initialization, Random initialization, Train-test split	1
2.7	Cross validation, Training and validation curves, Diagnosing model behaviour	1
2.8	TensorFlow features, Tensor data structure- rank, shape, type. TensorFlow graph	1
2.9	Implementing neural networks in TensorFlow, Introduction to Keras	1

2.10	Data Visualization- Feature and weight visualization, tSNE	1
Module 3 [8 Hours]		
3.1	Convolutional layers in neural network, Convolution operation	1
3.2	Filters, Feature maps, Stride, Padding	1
3.3	Max pooling, Min pooling, Average pooling	1
3.4	Fully connected layers, SoftMax and output layers	1
3.5	Architecture of CNN	1
3.6	Pretrained models, Transfer learning	1
3.7	Architecture of Lenet	1
3.8	Alexnet	1
3.9	VGG 16	1
3.10	Applications of CNN, Image classification, Object detection, Semantic segmentation, Instance segmentation	1
Module 4[8 hours]		
4.1	Overview of sequence data, Architecture and working of RNNs	1
4.2	Different types of RNN, Application of RNNs	1
4.3	Backpropagation Through Time (BPTT)	1
4.4	Challenges in training, Two issues of standard RNN- Vanishing and Exploding Gradients problem	1
4.5	Long Short-Term Memory (LSTM) cells, Forget, Input, and Output gates	1
4.6	LSTM equations and intuition, Applications of LSTMs, Reducing vanishing gradients	1
4.7	Gated Recurrent Units (GRUs) – Update gate, Reset gate, Cell state	1
4.8	GRU equations and intuition. Applications of GRU	1
Module 5[9 hours]		
5.1	Generative and discriminative models, Applications of generative models	1
5.2	Autoencoders- Architecture, Encoder, Latent Space, Decoder	1
5.3	Loss functions-Mean Squared Error (MSE), Cross-Entropy	1
5.4	Hyperparameters of Autoencoders	1
5.5	Variational autoencoders -Architecture, Encoder as a probabilistic model, Decoder as a generative model	1
5.6	Loss function, Applications	1
5.7	Generative Adversarial Networks (GAN) - Discriminative and generative models, GAN generator, GAN discriminator	1
5.8	GAN Training - Upsampling and latent space sampling, Back propagation	1
5.9	Loss function -Cross entropy, Minimax loss, Wasserstein loss, Gan challenges, GAN applications.	1
	Total hours	**45**

Co Assessment Questions

Course Outcome 1 (CO1)

1. What are the main components of a neural network? (L2)
2. How does the structure of a biological neuron inspire artificial neural networks? (L2)
3. Explain the Perceptron Learning Algorithm and its convergence properties. (L2)

Course Outcome 2 (CO2)

1. What are the key parameters and hyperparameters in a neural network? (L2)
2. Define bias and variance in the context of model training. (L2)
3. Diagnose a model exhibiting underfitting and suggest changes to improve its performance. (L2)

Course Outcome 3 (CO3)

1. Explain the purpose of filters (kernels) in a convolutional layer. (L2)
2. Differentiate between max pooling and average pooling. (L2)
3. Explain how average pooling can be applied to reduce the size of a 6x6 feature map to 3x3. (L3)

Course Outcome 4 (CO4:

1. How do RNNs process sequential data differently from feedforward neural networks? (L2)
2. What is Backpropagation Through Time (BPTT) in RNNs. (L2)
3. How does a GRU differ from an LSTM in terms of architecture? (L2)

Course Outcome 5 (CO5)

1. Mention two applications of generative models in real-world scenarios (L2)
2. How does Mean Squared Error (MSE) work as a loss function in autoencoders? (L2)
3. What is the purpose of the decoder in a VAE?. (L2)

Model Question Paper

QP CODE: Pages: 2

Reg No.:__________________________Name:__________________________

MAR ATHANASIUS COLLEGE OF ENGINEERING (AUTONOMOUS), KOTHAMANGALAM

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

Course Code: M24CA1E304A

Course Name: Deep Learning

Max. Marks: 60 Duration: 3 Hours

PART A

Answer all questions. Each question carries 2 marks.

1. What distinguishes deep learning from traditional machine learning techniques?
2. Explain the difference between a single-layer and a multi-layer neural network.
3. How does the learning rate affect the training process?
4. What is the difference between underfitting and overfitting in a neural network?
5. How does pooling help in reducing computational complexity in CNNs?

6. If a 4x4 feature map is passed through a 2x2 max pooling layer with a stride of 2, what will be the size of the output?
7. What is the role of the forget gate in an LSTM cell?
8. Name two types of RNNs and their key characteristics.
9. Differentiate between generative and discriminative models with examples.
10. What is the role of the encoder and decoder in an autoencoder?

3.

PART B

Answer any five questions. Each question carries 8 marks.

11. How does backpropagation update the weights in a neural network?
12. Give examples of common loss functions used in regression and classification tasks.
13. Apply dropout to a given neural network architecture and evaluate its effect on performance.
14. Why is random initialization preferred over zero initialization?
15. Explain the architecture of VGG-16, highlighting its key features and contributions to deep learning.
16. Derive the key equations of a GRU cell and explain the intuition behind its gates and states.
17. Describe the architecture of a GAN, explaining the roles of the generator and discriminator.

M24CA1E304B	Natural Language Processing	L	T	P	J	S	Credit	Year of Introduction
		3	1	0	0	3	4	2024

Preamble: This course offers a comprehensive introduction to the NLP field, covering fundamental concepts and practical techniques for understanding human language. Students will explore diverse NLP tasks, from basic text processing to advanced topics like recurrent neural networks and large language models, gaining both theoretical grounding and hands-on experience to build real-world NLP systems.

Prerequisite: Proficiency in programming and ideally some prior exposure to machine learning concepts.

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

CO No.	Course Outcome	Cognitive Knowledge Level
CO 1	Learn the fundamental natural language processing concepts and text processing techniques.	Understand
CO 2	Comprehend and apply language modeling techniques, including N-grams, smoothing methods and various text representation methods.	Understand
CO 3	Familiarize the techniques for part-of-speech tagging, syntactic analysis and lexical semantic analysis.	Understand
CO 4	Understand and apply Recurrent Neural Network variants to text analysis tasks such as text classification and sequence labeling.	Apply
CO 5	Learn the architecture and training of large language models and their application to various NLP tasks, considering the ethical implications of using LLM.	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	1					2
CO 2	2	1	1	1				2
CO 3	2	1	1	1				2
CO 4	3	2	2	3			1	3
CO 5	3	2	2	1			1	3

Assessment Pattern

Bloom's Category	Artificial Intelligence		
	Continuous Assessment Tests		End Semester Examination (% Marks)
	Test 1 (% Marks)	Test 2 (% Marks)	
Remember	40	20	20
Understand	60	50	60
Apply	XX	30	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 (Modules 1 & 2) : 10 Marks
- Continuous Assessment Test 2(Modules 3 & 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 [9 Hours]**

Introduction to NLP: Natural Language Understanding, Language analysis – Syntax, Semantics, Pragmatics, Key NLP tasks. Regular Expressions **-** Advanced regex syntax, using regex for text search and manipulation.

Text Processing: Text normalization, Word and sentence segmentation, Lemmatization, Stemming, Morphology, Probabilistic similarity measures. **Lexicons and Word Senses -** Introduction to Lexicons, Word Senses.

Self-Study: Develop a text preprocessing pipeline for a domain. (Eg. Social media, News Articles.)

Module 2 [9 Hours]

Language Modeling: Markov assumption and N-grams, Calculating N-gram probabilities, evaluating N-gram models with perplexity, Smoothing Techniques.

Text Representation: Bag of N-grams, TF-IDF, Word Embeddings, Various embedding models like GloVe, Word2Vec, Doc2Vec and FastText, **Evaluation of Word Vectors -** Intrinsic and Extrinsic tasks.

Self-Study: Build a language model for the selected domain and evaluate the model's perplexity.

Module 3 [10 Hours]

Part-of-Speech Tagging: The concept of POS tags and tagsets, Stochastic Tagging, Hidden Markov Models for POS tagging, Conditional Random Fields for POS tagging.

Syntactic Analysis: Context-Free Grammars and Parsing – Top-down and bottom-up parsing algorithms – CYK algorithm, parse trees and syntactic structure, Probabilistic Context-Free Grammar, Dependency Parsing – Dependency structure, grammar-free parsing, graph-based dependency parsing.

Lexical Semantics: WordNet, Thematic Roles, Semantic Role Labeling with CRFs.

Self-Study: Perform syntactic analysis of the selected domain using a parser.

Module 4 [7 Hours]

Recurrent Neural Networks for Text Analysis: Sequential data and recurrent connections, vanishing gradient problem, backpropagation. Modeling sequences - parameter sharing in recurrent neural networks, neural language models, word prediction. Variants of RNN – Long Short-Term Memory networks and Gated Recurrent Unit networks.

Self-Study: Apply LSTM/ GRU for text classification or sequence labeling.

Module 5 [10 Hours]

Large Language Models: Introduction to transformers – Attention mechanism, Encoder-decoder architecture, positional encoding. Transformer-based language models – BERT, GPT, Pre-training and fine-tuning, Application of LLMs in various NLP tasks.

Advanced NLP Applications: Text Classification, Sentiment Analysis, Information Extraction, Named Entity Recognition (NER), Question Answering and Summarization, Dialogue and Conversational Agent, Machine Translation, Multilingual and cross-lingual NLP.

Self-Study: Explore a pre-trained LLM and fine-tune it for the selected task.

Reference Books:

1. Daniel Jurafsky and James H. Martin, "Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition with Language Models", 3rd edition (2025). https://web.stanford.edu/~jurafsky/slp3. (All Modules)
2. Christopher Manning and Hinrich Schütze, "Foundations of Statistical Natural Language Processing", MITPress Cambridge, 2nd edition (2003). (Modules 1, 2, 3)
3. Sowmya Vajjala, Bodhisattwa Majumder, Anuj Gupta and Harshit Surana, "Practical Natural Language Processing: A Comprehensive Guide to Building Real-World NLP Systems", O'Reilly Media (2020) (Modules 2, 4, 5)
4. Yoav Goldberg and Graeme Hirst, Neural Network Models for Natural Language Processing, Morgan and Claypool Life Sciences, 2017 (Modules 2, 3, 4)
5. Jacob Eisenstein, "Natural Language Processing: A Concise Introduction", MIT Press (2019). (Module 2, 4)
6. Hobson Lane, Cole Howard and Hannes Hapke, "Natural Language Processing in Action", MANNING publications (2019). (Module 4)

7. Steven Bird, Ewan Klein and Edward Loper (2009). Natural Language Processing with Python: Analyzing Text with the Natural Language Toolkit, Oreilly Media Inc.
8. Yoav Goldberg Neural Network Methods for Natural Language Processing, Morgan and Claypool (2017)
9. Benjamin Bengfort, Rebecca Bilbro, and Tony Ojeda, "Applied Text Analysis with Python Enabling Language-Aware Data Products with Machine Learning", O'Reilly
10. Rajesh Arumugam, Rajalingappa Shanmugamani "Hands-on natural language processing with python: A practical guide to applying deep learning architectures to your NLP application". PACKT publisher, 2018.

Online Resources:

1. Natural Language Processing in Deep Learning by Stanford (Coursera)
2. Natural Language Processing with Classification and Vector Spaces (Coursera)
3. Natural Language Processing (NPTEL)

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
Module 1 [9 Hours]		
1.1	Natural Language Understanding, Key NLP tasks	1
1.2	Language analysis – Syntax, Semantics, Pragmatics	2
1.3	Regular Expressions **-** Advanced regex syntax, using regex for text search and manipulation.	1
1.4	Text normalization, Word and sentence segmentation, Lemmatization, Stemming	2
1.5	Morphology	1
1.6	Probabilistic similarity measures	1
1.7	**Lexicons and Word Senses -** Introduction to Lexicons, Word Senses.	1
Module 2 [9 Hours]		
2.1	Language Modeling, Markov assumption and N-grams	2
2.2	Calculating N-gram probabilities and evaluating N-gram models with perplexity	1
2.3	Smoothing Techniques	2
2.4	Text Representation, Bag of N-grams, TF-IDF	1
2.5	Word Embeddings, Word2Vec	1
2.6	GloVe, Doc2Vec and FastText	1
2.7	**Evaluation of Word Vectors -** Intrinsic and Extrinsic tasks.	1
Module 3 [10 Hours]		
3.1	Introduction to POS tags and tagsets	1
3.2	Stochastic Tagging	1
3.3	Hidden Markov Models for POS tagging	1
3.4	Conditional Random Fields for POS tagging	1

3.5	Context-Free Grammars and Parsing – Top-down and bottom-up parsing	2
3.6	CYK algorithm, parse trees	1
3.7	Dependency structure, grammar-free parsing, graph-based dependency parsing.	1
3.8	WordNet, Thematic Roles, Semantic Role Labeling with CRFs	2
Module 4 [7 Hours]		
4.1	Sequential data and Neural Networks	1
4.2	Recurrent Neural Networks and vanishing gradient problem	2
4.3	Modeling sequences - parameter sharing in recurrent neural networks	1
4.4	Neural language models, word prediction	1
4.5	Long Short-Term Memory networks	1
4.6	Gated Recurrent Unit networks	1
Module 5 [10 Hours]		
5.1	Introduction to transformers – Attention mechanism	2
5.2	Encoder-decoder architecture	1
5.3	BERT	1
5.4	GPT, Pre-training and fine-tuning	2
5.5	Text Classification, Sentiment Analysis	1
5.6	Information Extraction, Named Entity Recognition (NER)	1
5.7	Question Answering and Summarization	1
5.8	Dialogue and Conversational Agent, Machine Translation, Multilingual and cross-lingual NLP	1
	Total Hours	**45**

CO Assessment Questions

Course Outcome 1 (CO1):

1. “I saw the man with the telescope.". How pragmatic context could be used to resolve the semantic ambiguity of the given sentence and arrive at the intended meaning. (L2)
2. Explain the purpose of each step in text processing and how it contributes to improving the quality of text data for NLP tasks. (L2)
3. Use regular expression to extract all the product names that follow a specific pattern ("Product Name - Model Number") from a large corpus of text data containing information about products, including their names, descriptions, and prices. (L2)

Course Outcome 2 (CO2):

1. Explain the Markov assumption in the context of language modeling. Illustrate how the probability of the sentence, “I like cats”, is calculated using the N-gram model. (L2)
2. Why IDF is an important factor in weighting terms, and how does TF-IDF help in tasks like information retrieval or text summarization? (L2)
3. Briefly describe the two main architectures of Word2Vec. What are the advantages of using word embeddings compared to "one-hot" vector representations of words? (L2)

Course Outcome 3 (CO3):

1. Explain the concept of Part-of-Speech (POS) tagging and its importance in NLP. Describe the difference between a tagset and a POS tag. (L2)
2. Explain the difference between context-free grammars and dependency grammars. Describe the top-down and bottom-up parsing approaches for CFGs. (L2)
3. How does Semantic Role Labeling contribute to information extraction and other downstream NLP tasks? Describe how Conditional Random Fields can be used for SRL. (L2)

Course Outcome 4 (CO4):

1. A Recurrent Neural Network is trained to predict the next word in a sentence. The network learns very well on short sentences, but struggles with longer ones. Explain why this might be happening and what specific problem related to gradient flow is likely at play. (L3)
2. Describe the general steps involved in backpropagation through time (BPTT) to update the weights of the network. (L3)
3. Explain how parameter sharing in RNNs helps to reduce the number of parameters and improve generalization. For the sentence, "The cat sat on the mat", explain how the same weight matrix is used across different time steps. (L3)

Course Outcome 5 (CO5):

1. Why is the attention mechanism considered a key innovation in Transformers, and what advantages does it offer compared to previous approaches? (L2)
2. Explain why pre-training is considered crucial for the success of LLMs. Explain how to fine-tune a pre-trained LLM for question answering task. (L2)
3. How LLMs might be applied to Text Summarization for generating abstracts of research papers? (L2)

Model Question Paper

QP CODE: Pages: 02

Reg No.: ……………. Name: …………………….

MAR ATHANASIUS COLLEGE OF ENGINEERING (AUTONOMOUS), KOTHAMANGALAM

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

Course Code: M24CA1E304B

Course Name: NATURAL LANGUAGE PROCESSING

Max. Marks: 60 Duration: 3 Hours

PART A

Answer all questions. Each question carries 2 marks.

1. Explain why combining regular expressions with lexical resources can lead to more accurate and robust information extraction.
2. Briefly explain the difference between syntax and semantics in the context of natural language understanding.
3. What is the purpose of smoothing in N-gram language models? Briefly describe one smoothing technique.

4. Explain the difference between TF (Term Frequency) and IDF (Inverse Document Frequency) in the context of text representation.
5. What is the role of WordNet in lexical semantics?
6. Explain the core idea behind Hidden Markov Models (HMMs) for POS tagging.
7. What specific mechanisms within LSTMs and GRUs address the challenges of long sequences?
8. Briefly explain the concept of parameter sharing in RNNs and why it is beneficial.
9. You have a large dataset of text data. Describe two ways you could pre-train a large language model using this data.
10. What is fine-tuning in the context of large language models, and why is it important for applying LLMs to specific tasks?

PART B

Answer any five questions. Each question carries 8 marks.

11. Describe a text processing pipeline that you would use to prepare the review text for sentiment analysis of customer reviews for a new product. Explain how each step in the text processing pipeline contributes to improving the accuracy of the sentiment analysis.
12. How is GloVe trained, and how might its training process influence its performance on different evaluation tasks? Why extrinsic evaluation is considered important, even if intrinsic evaluation shows promising results?
13. How would Named Entity Recognition (NER) complement POS tagging and dependency parsing to improve the accuracy of actor identification in a news headline? What types of named entities would be most relevant in this context?
14. Explain how to build a system to predict the next word a user will type in a text message, using a Recurrent Neural Network. How to handle the vanishing gradient problem if it arose during training? Evaluate the performance of word prediction model?
15. Discuss how a Recurrent Neural Network can be used to perform sentiment analysis. What are the potential challenges of using RNNs for sentiment analysis, and how to address them?
16. How to evaluate the performance of a sentiment analysis system? Explain the selection of metrics used in evaluating the performance of the system?
17. What kind of data is needed to fine-tune the LLM for question answering? How to structure this data, including the context, question, and correct answer span?

M24CA1E304C	Computer Vision	L	T	P	J	S	Credit	Year of Introduction
		3	1	0	0	3	4	2024

Preamble:

This course provides a comprehensive understanding of computer vision techniques, covering CNN architecture, image formation, processing methods, feature extraction, motion analysis, and 3D reconstruction for visual recognition and analysis tasks.

Prerequisite:

Familiarity with machine learning concepts and basic image processing techniques.

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 principles of CNN architecture, key operations, and their applications in visual recognition tasks.	Apply
CO 2	Understand fundamental concepts of image formation, vision systems, transformations, distortions, and digital imaging techniques.	Understand
CO 3	Understand fundamental image processing techniques, including transformations, filtering methods, and frequency domain analysis for image enhancement and manipulation.	Understand
CO 4	Understand feature extraction techniques, edge and line detection methods, and image segmentation approaches for visual analysis.	Understand
CO 5	Understand structure from motion, factorization methods, and dense motion estimation techniques for 3D reconstruction and motion analysis.	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	2	2	3	1	1		2
CO 2	3	2	2	3	1	1		2
CO 3	3	2	2	3	1	1		2
CO 4	3	2	2	3	1	1		2
CO 5	3	2	2	3	1	1	2	2

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination (Marks%)
	Test 1 (Marks %)	Test 2 (Marks %)	
Remember	20	40	20
Understand	60	60	60
Apply	20	XX	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(Module1&Module2) : 10 Marks
- Continuous Assessment Test 2(Module3&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 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]

Convolutional Neural Networks: Convolutional layers in deep neural network - Convolution operation, Filters, Feature maps, Stride, Padding. Pooling layer- Max pooling, Min pooling, Average pooling. Fully connected layers, SoftMax and output layers**.** Architecture of CNN- Pretrained models, Transfer learning. Applications of CNN- Image classification, Object detection, Semantic segmentation, Instance segmentation.

Self-Study: CNN Implementation in Python using Frameworks (TensorFlow, Keras), Handling imbalanced data, Real world applications of CNN.

Module 2 [10 Hours]

Image formation: Introduction, Components of a vision system, Geometric primitives and transformations- 2D transformations, 3D transformation, 3D rotation ,3D to 2D projections, Lens distortions. Photometric image formation – Lighting, Reflectance and shading, Optics. Digital camera – Sampling and aliasing, Colour, Compression.

Self-Study: Difference between digital and analog images, Role of lenses in vision systems, How colour is represented in digital images.

Module 3 [8 Hours]

Image Processing: Point operators – Pixel transformations, Colour transformations, Compositing and matting, Histogram equalization. Linear filtering- Separable filtering, Band-pass and steerable filters. Non-linear filtering- Morphology, Distance transforms, Fourier transforms, Pyramids and wavelets.

Self-Study: Colour models- RGB, HSV, HSL, YUV, CMYK. Concept of high-pass, low-pass filters, Basic morphological operations: erosion, dilation, opening, and closing.

Module 4 [9 Hours]

Feature Extraction and Image segmentation: Points and patches - Feature detectors, Feature descriptors, Feature matching, Feature tacking. Edges- Edge detection, Edge linking. Lines- Successive approximation, Hough transforms, vanishing points. Segmentation - Active contours, Split and merge, Mean shift and mode finding.

Self-Study: Difference between local and global features, Canny Edge Detector- Multi-stage processing.

Module 5 [8 Hours]

Structure from motion: Two frame structure from motion, Projective reconstruction, Self-calibration. Factorization- Perspective and projective factorization, Sparse 3D model extraction, Application. Dense motion estimation- Translational alignment, Parametric motion, Spline based motion, Optical flow, Application.

Self-Study: Handling missing data in factorization methods, Applications in object tracking and motion segmentation.

Reference Books:

1. Richard Szeliski, “Computer Vision: Algorithms and Applications”, Springer, 1st Ed.,
2. David A. Forsyth, Jean Ponce, “Computer Vision: A Modern Approach”, 2nd Ed.,
3. Computer Vision - Dana.H.Ballard & Christopher.M.Brown
4. R. C. Gonzalez, R. E. Woods. Digital Image Processing. Addison Wesley Longman, Inc., 1992.
5. Bengio, Yoshua, Ian J. Goodfellow, and Aaron Courville. "Deep learning." An MIT Press book in preparation. (2016). (Module 1,2,3,4,5)
6. Adam Gibson, Josh Patterson, Deep Learning: A Practitioner's Approach, 1st edition, O'Reilly Media, 2017
7. Nikhil Buduma, Fundamentals of Deep Learning: Designing Next-Generation Machine Intelligence Algorithms, 1st edition, O'Reilly Media, 2017

Online Resources:

1. https://cs231n.stanford.edu/
2. https://ocw.mit.edu/courses/6-801-machine-vision-fall-2020/resources/mit6_801f20_lec12/
3. https://www2.eecs.berkeley.edu/Courses/CSC280/

Course Contents and Lecture Schedule

NO	Topic	No. of Lecture/Tutorial Hours
Module 1 [10 Hours]		
1.1	Convolutional layers in deep neural network	1
1.2	Convolution operation, Filters, Feature maps	1
1.3	Stride, Padding	1
1.4	Pooling layer- Max pooling, Min pooling, Average pooling	1
1.5	Fully connected layers	1
1.6	SoftMax and output layers	1
1.7	Architecture of CNN	1
1.8	Pretrained models, Transfer learning	1
1.9	Applications of CNN- Image classification, Object detection	1
1.10	Semantic segmentation, Instance segmentation	1
Module 2 [10 Hours]		
2.1	Introduction, Components of a vision system	1
2.2	Geometric primitives and transformations-Introduction	1
2.3	2D transformations	1
2.4	3D transformation	1
2.5	3D to 2D projections	1
2.6	Lens distortions	1
2.7	Photometric image formation-Introduction	1
2.8	Lighting, Reflectance and shading, Optics	1
2.9	Digital camera – Sampling	1
2.10	Aliasing, Colour, Compression	1
Module 3 [8 Hours]		
3.1	Point operators – Pixel transformations	1
3.2	Colour transformations, Compositing and matting	1
3.3	Histogram equalization	1
3.4	Linear filtering- Separable filtering, Band-pass and steerable filters	1
3.5	Non-linear filtering- Morphology	1
3.6	Distance transforms	1
3.7	Fourier transforms	1
3.8	Pyramids and wavelets	1
Module 4[8 hours]		
4.1	Points and patches - Feature detectors, Feature descriptors	1
4.2	Feature matching, Feature tacking	1

4.3	Edge detection, Edge linking	1
4.4	Lines-Successive approximation	1
4.5	Hough transforms	1
4.6	vanishing points	1
4.7	Active contours, Split and merge	1
4.8	Mean shift and mode finding	1
Module 5[9 hours]		
5.1	Two frame structure from motion	1
5.2	Projective reconstruction	1
5.3	Self-calibration	1
5.4	Perspective and projective factorization	1
5.5	Sparse 3D model extraction, Application	1
5.6	Translational alignment	1
5.7	Parametric motion	1
5.8	Spline based motion	1
5.9	Optical flow, Application	1
	Total hours	**45**

Co Assessment Questions

Course Outcome 1 (CO1)

1. How do filters (kernels) work in a convolutional neural network? (L2)
2. How does the SoftMax activation function work in classification tasks? (L2)
3. Given an input image of size 32×32×3, a CNN applies a convolutional layer with 5×5 filters (stride=1, no padding) and generates 16 feature maps. Calculate the output size of the feature maps. (L3)

Course Outcome 2 (CO2)

1. Define geometric primitives in the context of image formation. (L2)
2. What is the difference between 2D and 3D transformations? (L2)
3. Diagnose a model exhibiting underfitting and suggest changes to improve its performance. (L3)

Course Outcome 3 (CO3)

1. Define pixel transformation with an example. (L2)
2. What is the purpose of colour transformation in image processing? (L2)
3. How does histogram equalization enhance an image? (L3)

Course Outcome 4 (CO4:

1. What is feature extraction in image processing? (L2)
2. What is the difference between feature detectors and feature descriptors? (L2)
3. What is feature tracking? Explain different methods used for tracking features across frames. (L2)

Course Outcome 5 (CO5)

1. How does two-frame structure from motion work? (L2)
2. What is the purpose of sparse 3D model extraction? (L2)
3. Describe projective reconstruction in SfM. How is it different from metric reconstruction? (L2)

Model Question Paper

QP CODE: Pages: 2

Reg No.: ……………………… Name: ……………………………………………

MAR ATHANASIUS COLLEGE OF ENGINEERING (AUTONOMOUS), KOTHAMANGALAM

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

Course Code: M24CA1E304C

Course Name: Computer Vision

Max. Marks: 60 Duration: 3 Hours

PART A

Answer all questions. Each question carries 2 marks.

1. What are feature maps in a CNN, and how are they generated?
2. How does max pooling differ from average pooling and min pooling?
3. What is lens distortion, and how does it affect image formation?
4. What are the common types of image compression techniques used in digital cameras?
5. What is a steerable filter? How is it used in image analysis?
6. What are wavelets, and how are they useful in image analysis?
7. What is feature matching, and why is it important in computer vision?
8. Define edge detection and its significance in image segmentation.
9. What is the Hough transform, and how is it used in detecting lines?
10. Explain translational alignment in motion estimation.

PART B

Answer any five questions. Each question carries 8 marks.

11. Discuss the architecture of a Convolutional Neural Network (CNN). Explain the significance of pretrained models and transfer learning in deep learning applications.
12. Describe different types of 2D and 3D transformations used in image processing.
13. What are the key optical properties of a camera system, and how do they affect image quality?
14. Explain the concept of morphological filtering. How is it used for image enhancement and feature extraction?
15. Discuss the significance of distance transforms in image processing. How are they applied in shape analysis?
16. What are vanishing points in image processing? Explain their significance in perspective analysis.

17. Describe parametric motion and spline-based motion estimation. How are they used in video processing?

M24CA1E304D	Cloud Computing with AWS/ Azure/ Google Cloud Platform	L	T	P	J	S	Credit	Year of Introduction
		3	1	0	0	3	4	2024

Preamble:

This course explores the principles of cloud computing, focusing on the architecture, services, and deployment strategies of AWS, Azure, and Google Cloud Platform to equip learners with practical skills for building and managing cloud-based solutions.

Prerequisite:

Learners should have a basic understanding of cloud computing.

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 concepts, architectures, service and deployment models, as well as modern technologies like microservices, serverless computing, containerization, and orchestration.	Understand
CO 2	Understand key AWS services, deployment and management tools, security features, and optimization strategies for effective cloud computing.	Apply
CO 3	Apply Microsoft Azure services, deployment and management tools, security features, and optimization strategies to design, implement, and manage efficient cloud-based solutions.	Understand
CO 4	Understand GCP and its cloud services, deployment and management tools, security features, and optimization strategies for building scalable and secure cloud solutions.	Understand
CO 5	Understand cloud security principles, cloud-native technologies, and cost management strategies to ensure secure, scalable, and cost-effective cloud deployments.	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	2	2	3	1	2		2
CO 2	2	2	3	3	2	3		2
CO 3	2	2	3	3	2	3	2	
CO 4	2	3	3	3	2	3		3
CO 5	2	2	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	40	30
Understand	60	60	50
Apply	20	XX	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(Module1&Module2) : 10 Marks
- Continuous Assessment Test 2(Module3&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 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 to cloud computing: Definition and Characteristics, Evolution of Cloud Computing, Cloud Service models with real-world examples - IaaS, PaaS and SaaS. Cloud Deployment Models and their use cases - Public, Private, Hybrid, Multi-cloud. Cloud Architectures - Cloud Computing Reference Architecture and key components, Microservices Architecture and Benefits, Serverless Computing and its role in Modern Applications. Containerization - docker and its advantages. Orchestration - Kubernetes, ECS for managing containers.

Self-Study: Green Cloud Computing

Module 2 [10 Hours]

AWS: Core Services include Compute - EC2, Lambda and ECS. Storage - S3, EBS and Glacier. Networking - VPC, Route 5 and Direct Connect. AWS Management and Deployment involve AWS Management Console, AWS CLI & SDKs. Infrastructure as Code - Cloud Formation and Terraform. Security & Compliance features - AWS IAM, Security Groups and NACLs, AWS

Shield and WAF. Monitoring & Optimization covers AWS CloudWatch, AWS Cost Explorer, Auto Scaling, and Load Balancers.

Self-Study: Quantum Computing and Cloud Integration

Module 3 [10 Hours]

Microsoft Azure: Compute - Virtual Machines, Windows/Linux, Azure Functions. AKS - Managed Kubernetes. Storage - Azure Blob Storage, Azure Files and Azure Queue Storage. Networking - Azure Virtual Network, Azure DNS and ExpressRoute. Azure Management and Deployment - Azure Portal, Azure CLI and PowerShell, Azure Resource Manager Templates. Security and Compliance features - Azure Active Directory, Azure Security Center, Azure Key Vault. Monitoring and Optimization covers Azure Monitor, Azure Cost Management, Autoscaling, Traffic Manager.

Self-Study: Cloud-Based DevOps and CI/CD Pipelines

Module 4 [10 Hours]

Google Cloud Platform: Compute Engine - VMs and Cloud Functions, Serverless, GKE - Kubernetes Engine. Cloud Storage - Scalable Object Storage. Cloud SQL - Managed Databases. Cloud Spanner - Global Scale Database. VPC - Private Cloud. Cloud DNS - Domain Management. Cloud Interconnect - Direct Connectivity. GCP Management and Deployment - Google Cloud Console for UI-Based Management, Google Cloud CLI for Automation, Deployment Manager for Infrastructure as Code. Security and Compliance - Cloud IAM for Access Control, Security Command Center for Risk Assessment, Cloud KMS for Encryption Key Management. Monitoring and Optimization - Cloud Monitoring and Logging, Cloud Billing and Cost Management, Load Balancing and Autoscaling.

Self-Study: Confidential Computing in Cloud Security

Module 5 [7 Hours]

Cloud Security - Identity and Access Management (IAM) across AWS, Azure, and GCP, Data Encryption at Rest and in Transit, Network Security Best Practices, Threat Detection and Compliance.

Cloud-Native Technologies - Microservices Architecture for Scalable Applications, Serverless Computing to Reduce Infrastructure Overhead, Containerization (Docker) for Lightweight Deployments, Orchestration - Kubernetes, ECS, AKS, GKE.

Cloud Cost Management - Cost Optimization Strategies, Billing and Monitoring Tools, Rightsizing and Reserved Instances, Auto-Scaling and Cost-Efficient Storage.

Self-Study: Chaos Engineering in Cloud Environments

Reference Books:

1. Kamaljit Singh & Ricardo Puttini, "Cloud Computing: Concepts, Technology, and Architecture", Pearson, 1st Edition, 2013.
2. Cornelia Davis, "Cloud Native Patterns: Designing Changeable Systems", Manning Publications, 1st Edition, 2019.
3. Ben Piper & David Clinton, "AWS Certified Solutions Architect Study Guide", Sybex, 3rd Edition, 2020.
4. James Beswick, "Programming AWS Lambda", O'Reilly Media, 1st Edition, 2020.
5. Jim Cheshire, "Microsoft Azure Fundamentals", Microsoft Press, 2nd Edition, 2022.
6. Chris Hay & Rob Eisenberg, "Azure in Action", Manning Publications, 1st Edition, 2010.
7. Ricardo Castro & Ahsan Farid, "Google Cloud Platform for Developers", Packt Publishing, 1st Edition, 2018.
8. Drew Hodun & Jason Yee, "Learning Google Cloud", O'Reilly Media, 1st Edition, 2021.
9. Ronald L. Krutz & Russell Dean Vines, "Cloud Security: A Comprehensive Guide to Protecting Your Data and Infrastructure", Wiley, 1st Edition, 2010.

10. Marko Lukša, "Kubernetes in Action", Manning Publications, 2nd Edition, 2022.

Online Resources:

1. https://onlinecourses.nptel.ac.in/noc21_cs14
2. https://onlinecourses.nptel.ac.in/noc23_cs90
3. https://onlinecourses.nptel.ac.in/noc25_cs12

Course Contents and Lecture Schedule

NO	Topic	No. of Lecture/Tutorial Hours
Module 1 [8 Hours]		
1.1	Definition and Characteristics, Evolution of Cloud Computing	1
1.2	Cloud Service models with real-world examples - IaaS, PaaS and SaaS	
1.3	Cloud Deployment Models and their use cases - Public, Private, Hybrid, Multi-cloud	1
1.4	Cloud Architectures - Cloud Computing Reference Architecture and key components	1
1.5	Microservices Architecture and Benefits	1
1.6	Serverless Computing and its role in Modern Applications	1
1.7	Containerization - docker and its advantages	1
1.8	Orchestration - Kubernetes, ECS for managing containers	
Module 2 [10 Hours]		
2.1	AWS - Core Services include Compute - EC2, Lambda and ECS	1
2.2	Storage - S3, EBS and Glacier	1
2.3	Networking - VPC, Route 5 and Direct Connect	1
2.4	AWS Management and Deployment involve AWS Management Console	1
2.5	AWS CLI & SDKs, and Infrastructure as Code - Cloud Formation and Terraform.	1
2.6	Security & Compliance features - AWS IAM,	1
2.7	Security Groups and NACLs	1
2.8	AWS Shield and WAF. Monitoring & Optimization covers	1
2.9	AWS CloudWatch, AWS Cost Explorer	1
2.10	Auto Scaling, and Load Balancers	1
Module 3 [10 Hours]		
3.1	Microsoft Azure Compute - Virtual Machines - Windows/Linux	1
3.2	Azure Functions, AKS - Managed Kubernetes	1
3.3	Storage - Azure Blob Storage	1
3.4	Azure Files and Azure Queue Storage	1
3.5	Networking - Azure Virtual Network	1
3.6	Azure DNS and ExpressRoute	1
3.7	Azure Management and Deployment - Azure Portal	1
3.8	Azure CLI and PowerShell, Azure Resource Manager Templates	1
3.9	Security and Compliance features - Azure Active	1

	Directory, Azure Security Center, Azure Key Vault	
3.10	Monitoring and Optimization covers Azure Monitor, Azure Cost Management, Autoscaling, Traffic Manager	1
Module 4[10 hours]		
4.1	Google Cloud Platform: Compute Engine - VMs and Cloud	1
4.2	Functions - Serverless, GKE - Kubernetes Engine, Cloud Storage - Scalable Object Storage	1
4.3	Cloud SQL - Managed Databases, Cloud Spanner - Global Scale Database	1
4.4	VPC - Private Cloud, Cloud DNS - Domain Management, Cloud Interconnect - Direct Connectivity	1
4.5	GCP Management and Deployment - Google Cloud Console for UI-Based Management	1
4.6	Google Cloud CLI for Automation, Deployment Manager for Infrastructure as Code	1
4.7	Security and Compliance - Cloud IAM for Access Control, Security Command Center for Risk Assessment	1
4.8	Cloud KMS for Encryption Key Management	1
4.9	Monitoring and Optimization - Cloud Monitoring and Logging	1
4.10	Cloud Billing and Cost Management, Load Balancing and Autoscaling	1
Module 5[7 hours]		
5.1	Cloud Security - Identity and Access Management (IAM) across AWS, Azure, and GCP	**1**
5.2	Data Encryption at Rest and in Transit, Network Security Best Practices, Threat Detection and Compliance	**1**
5.3	Microservices Architecture for Scalable Applications, Serverless Computing to Reduce Infrastructure Overhead	**1**
5.4	Containerization (Docker) for Lightweight Deployments	**1**
5.5	Orchestration - Kubernetes, ECS, AKS, GKE	**1**
5.6	Cost Optimization Strategies, Billing and Monitoring Tools	**1**
5.7	Rightsizing and Reserved Instances, Auto-Scaling and Cost-Efficient Storage	**1**
	Total hours	**45**

Co Assessment Questions

Course Outcome 1 (CO1)

1. What is Infrastructure as a Service? (L1)
2. What is Docker? (L1)
3. Describe the four cloud deployment models and their ideal use cases. (L2)

Course Outcome 2 (CO2)

1. Compare AWS CloudFormation and Terraform for infrastructure deployment. (L2)
2. Define AWS WAF. (L1)
3. A web application needs protection from DDoS attacks. Which AWS security features would you implement? Explain your choices. (L3)

Course Outcome 3 (CO3)

1. What is the difference between Azure Blob Storage and Azure Files? (L1)
2. What is the purpose of Azure Virtual Network? (L1)
3. Compare Azure DNS and Azure ExpressRoute in terms of functionality. (L3)

Course Outcome 4 (CO4)

1. What is Google Compute Engine (GCE) used for? (L1)
2. What is Cloud Spanner, and how does it differ from Cloud SQL? (L2)
3. Compare Cloud Interconnect and VPN in terms of security and performance. (L2)

Course Outcome 5 (CO5)

1. What is a Reserved Instance, and how does it save costs? (L1)
2. What is the difference between AKS and GKE? (L2)
3. Explain the benefits of Microservices Architecture in cloud-native applications. (L2)

Model Question Paper

QP CODE: Pages: 2

Reg No.: …………………………. _Name:………………………………….

MAR ATHANASIUS COLLEGE OF ENGINEERING (AUTONOMOUS), KOTHAMANGALAM

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

Course Code: M24CA1E304D

Course Name: Cloud Computing with AWS/ Azure/ Google Cloud Platform

Max. Marks: 60 Duration: 3 Hours

PART A

Answer all questions. Each question carries 2 marks.

1. Define multi-cloud. (2)
2. What are containers in cloud computing? (2)
3. Define AWS Lambda. (2)
4. Explain the purpose of AWS Direct Connect. (2)
5. What type of data is Azure Queue Storage used for? (2)
6. What is Azure ExpressRoute, and how is it different from a VPN? (2)
7. How does Cloud Storage in GCP differ from traditional storage? (2)
8. How does Cloud DNS help in domain name management? (2)
9. What is the difference between data encryption at rest and in transit? (2)
10. What is the role of firewalls in cloud security? (2)

PART B

Answer any five questions. Each question carries 8 marks.

11. Explain the Cloud Computing Reference Architecture and its key components. (8)
12. Your company experiences unpredictable traffic spikes. Would you choose EC2 Auto Scaling or AWS Lambda? Justify your choice. (8)
13. Write short notes on Azure CLI and PowerShell. (8)
14. Explain the difference between Compute Engine, Cloud Functions, and GKE with real-world examples. (8)
15. How does Kubernetes simplify container orchestration? (8)
16. Compare Public Cloud and Private Cloud in terms of cost, security, and scalability.(8)
17. Compare AWS Route 53 and Direct Connect for networking. (8)

M24CA1E304E	IoT and edge computing in the cloud	L	T	P	J	S	Credit	Year of Introduction
		3	1	0	0	3	4	202 4

Preamble:

This course explores the integration of Internet of Things (IoT) devices with cloud and edge computing paradigms to enable efficient data processing, real-time analytics, and intelligent decision-making at scale.

Prerequisite:

Learners should have a basic understanding of microprocessors, hardware, cloud computing and low-level programming.

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 fundamentals of IoT, its architecture, key components, communication models, and applications across various domains.	Understand
CO 2	Understand the fundamentals of edge computing, its benefits, architectures, key technologies, and its distinction from cloud computing.	Understand
CO 3	Understand IoT cloud platforms, their services, and how they enable device management, data analytics, and application deployment in IoT ecosystems.	Apply
CO 4	Understand security challenges in IoT, implement best practices for securing IoT systems, and manage IoT devices effectively throughout their lifecycle.	Understand
CO 5	Develop IoT applications by acquiring and processing sensor data, implementing edge analytics, integrating cloud services, and ensuring scalable and reliable IoT deployments.	Understand

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO 1	3	2	1					1
CO 2	3	2	2	2		1		3
CO 3	3	2	2	3	1	1	1	3
CO 4	2	3	3	2	2	1	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	40	20	30
Understand	60	60	50
Apply	XX	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(Module1&Module2) : 10 Marks
- Continuous Assessment Test 2(Module3&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 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 to IoT: Definition, Characteristics, and Evolution of IoT, IoT vs. Traditional Distributed Systems, Applications and Use Cases of IoT - Smart Homes, Smart Cities, Industrial IoT.

IoT Architectures: Three-Layer Architecture - Perception, Network, Application. IoT System Components - Sensors, Actuators, Gateways, Cloud Platforms. IoT Communication Models - M2M, MQTT, CoAP.

Self-Study: Digital twin concept in IoT.

Module 2 [10 Hours]

Introduction to Edge Computing: Motivation and Benefits of Edge Computing, Edge vs. Cloud Computing, Edge Computing Architectures - Fog, Mist.

Edge Computing Technologies: Hardware Platforms for Edge Devices - Microcontrollers, Single-Board Computers. Edge Operating Systems - Linux-based, Real-time OS. Containerization at the Edge - Docker, Kubernetes.

CI/CD Pipelines & GitOps: Pipeline Design and Implementation, GitLab CI/CD, GitHub Actions, Azure DevOps. GitOps and ArgoCD for Kubernetes Deployments.

Self-Study: Federated Learning in Edge Computing.

Module 3 [10 Hours]

IoT Cloud Platforms: AWS IoT Core, Azure IoT Hub, Google Cloud IoT Core, IBM Watson IoT Platform.

Cloud-Based IoT Services: Device Management, Data Storage and Analytics, Application Development and Deployment.

Self-Study: Familiarize AWS IoT Core and Azure IoT Hub

Module 4 [8 Hours]

Security Challenges in IoT: Vulnerabilities and Threats in IoT Systems, Authentication and Authorization, Data Encryption and Privacy.

Security Best Practices for IoT: Secure Device Provisioning, Network Security, Data Security and Privacy.

IoT Device Management: Remote Monitoring and Control, Firmware Updates, Device Lifecycle Management.

Self-Study: Serverless Computing for IoT.

Module 5 [9 Hours]

IoT Application Development: Sensor Data Acquisition and Processing, Edge Analytics and Machine Learning, Cloud-Based Application Development.

IoT Deployment: Device Connectivity and Networking, Cloud Integration, Scalability and Reliability

Self-Study: Applications of Blockchain in IoT.

Reference Books:

1. Rajkumar Buyya, Amir Vahid Dastjerdi, "Internet of Things: Principles and Paradigms", Morgan Kaufmann, 1st Edition, 2016.
2. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry, "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", Cisco Press, 1st Edition, 2017.
3. Adrian McEwen, Hakim Cassimally, "Designing the Internet of Things", Wiley, 1st Edition, 2013.
4. Rajkumar Buyya, Satish Narayana Srirama, "Edge Computing: Fundamentals, Advances and Applications", Springer, 1st Edition, 2019.
5. Chuan-Kun Wu, Bo Liu, Wei Ren, "IoT Security: Advances in Authentication", Wiley, 1st Edition, 2020.
6. Ashok Iyengar, Joseph Pearson, "Edge Computing Patterns for Solution Architects: Learn methods and principles of resilient distributed application architectures from hybrid cloud to far edge", Packt Publishing, 1st Edition, 2022.
7. Alex Khang, Vugar Abdullayev, Vladimir Hahanov, Vrushank Shah, "Advanced IoT Technologies and Applications in the Industry 4.0 Digital Economy", CRC Press, 1st Edition, 2023.
8. Rajkumar Buyya, Lalit Garg, Giancarlo Fortino, Sanjay Misra, "New Frontiers in Cloud Computing and Internet of Things", Springer, 1st Edition, 2022.
9. Om Pal, P. K. Gupta, Rajeev Kumar, Rajesh Kumar Shukla, "Advanced Cyber Security Techniques for Data, Blockchain, IoT, and Network Protection", IGI Global, 1st Edition, 2023.
10. Benjamin Cabé, "Building Enterprise IoT Solutions with Eclipse IoT Technologies: An Open-Source Approach to Edge Computing", Apress, 1st Edition, 2021.

Online Resources:

1. https://onlinecourses.nptel.ac.in/noc21_cs17
2. https://onlinecourses.nptel.ac.in/noc23_cs65
3. https://archive.nptel.ac.in/courses/106/105/106105166

Course Contents and Lecture Schedule

NO	Topic	No. of Lecture/Tutorial Hours
Module 1 [8 Hours]		
1.1	Definition, Characteristics, and Evolution of IoT,	1
1.2	IoT vs. Traditional Distributed Systems, Applications and Use	1
1.3	Cases of IoT - Smart Homes, Smart Cities, Industrial IoT.	2
1.4	Three-Layer Architecture - Perception, Network, Application.	1
1.5	IoT System Components - Sensors, Actuators, Gateways, Cloud Platforms.	2
1.6	IoT Communication Models - M2M, MQTT, CoAP.	1
Module 2 [10 Hours]		
2.1	Motivation and Benefits of Edge Computing, Edge vs. Cloud Computing	1
2.2	Edge Computing Architectures - Fog, Mist.	1
2.3	Hardware Platforms for Edge Devices - Microcontrollers	1
2.4	Single-Board Computers.	1
2.5	Edge Operating Systems - Linux-based	1
2.6	Real-time OS	1
2.7	Containerization at the Edge - Docker, Kubernetes.	1
2.8	Pipeline Design and Implementation, GitLab CI/CD	1
2.9	GitHub Actions, Azure DevOps.	1
2.10	GitOps and ArgoCD for Kubernetes Deployments	1
Module 3 [10 Hours]		
3.1	AWS IoT Core	2
3.2	Azure IoT Hub	2
3.3	Google Cloud IoT Core	2
3.4	IBM Watson IoT Platform	1
3.5	Device Management	1
3.6	Data Storage and Analytics	1
3.7	Application Development and Deployment	1
Module 4[8 hours]		
4.1	Vulnerabilities and Threats in IoT Systems	1
4.2	Authentication and Authorization	1
4.3	Data Encryption and Privacy	1

4.4	Secure Device Provisioning	1
4.5	Network Security	1
4.6	Data Security and Privacy	1
4.7	Remote Monitoring and Control	1
4.8	Firmware Updates, Device Lifecycle Management.	1
Module 5[9 hours]		
5.1	Sensor Data Acquisition and Processing	2
5.2	Edge Analytics and Machine Learning	2
5.3	Cloud-Based Application Development	2
5.4	Device Connectivity and Networking,	1
5.5	Cloud Integration,	1
5.6	Scalability and Reliability	1
	Total hours	**45**

Co Assessment Questions

Course Outcome 1 (CO1)

1. Explain the three layers of the IoT architecture and their roles. (L2)
2. Write the role of MQTT in IoT. (L1)
3. Differentiate IoT with traditional with IoT. (L2)

Course Outcome 2 (CO2)

1. Why edge-computing is used? (L2)
2. What are the advantages of using containerization? (L1)
3. Explain the role of edge operating systems. (L2)

Course Outcome 3 (CO3)

1. What is an IoT Cloud Platform? (L1)
2. What are edge computing capabilities in cloud-based IoT platforms? (L2)
3. If a manufacturing company wants to use predictive maintenance for its machines, how would you implement a solution using AWS IoT Core. (L3)

Course Outcome 4 (CO4:

1. What are the common security vulnerabilities in IoT systems? (L1)
2. Name three major threats to IoT systems. (L2)
3. Explain authentication and authorization mechanisms used in IoT systems. (L2)

Course Outcome 5 (CO5)

1. Explain how edge analytics reduces latency in IoT systems. (L1)
2. Explain the difference between edge computing and cloud computing in IoT. (L2)
3. Explain how machine learning models are deployed in IoT edge devices. (L2)

Model Question Paper

QP CODE: Pages: 2

Reg No.:_________________________Name:__________________

MAR ATHANASIUS COLLEGE OF ENGINEERING (AUTONOMOUS), KOTHAMANGALAM

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

Course Code: M24CA1E304E

Course Name: IoT and Edge Computing in the Cloud

Max. Marks: 60 Duration: 3 Hours

PART A

Answer all questions. Each question carries 2 marks.

1. What is an IoT system? (2)
2. Differentiate MQTT and CoAP. (2)
3. How does edge computing differ from cloud computing in terms of latency and data processing? (2)
4. Differentiate between Fog computing and Mist computing in edge computing architectures. (2)
5. If you were to develop a real-time vehicle tracking system, which IoT cloud platform would you choose and why? (2)
6. Why is data analytics important in IoT applications? (2)
7. What is data encryption, and why is it important in IoT? (2)
8. Explain the difference between symmetric and asymmetric encryption in IoT security. (2)
9. What is sensor data acquisition in IoT? (2)
10. Compare wired and wireless IoT device connectivity options. (2)

PART B

Answer any five questions. Each question carries 8 marks.

11. Explain the key components of an IoT system. (8)
12. Explain the role of edge operating systems in managing edge computing workloads. (8)
13. Design a cloud-based IoT solution for a smart agriculture system using any IoT cloud platform of your choice. Describe how data is collected, processed, and used. (8)
14. How can blockchain technology enhance security in IoT ecosystems? (8)
15. Explain the importance of device connectivity and networking in IoT deployment. (8)
16. Differentiate IoT with traditional with IoT. (8)
17. How does containerization enhance the deployment and scalability of edge applications? (8)

M24CA1E304F	Serverless Computing	L	T	P	J	S	Credit	Year of Introduction
		3	1	0	0	3	4	2024

Preamble:

Enables the creation of scalable, secure and cost-effective serverless systems, ready to tackle real-world problems in the cloud.

Prerequisite:

Basic knowledge of cloud computing, programming (Python, Node.js, or Java), and web technologies.

Course Outcomes:

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

CO No	Course Outcomes	Cognitive Knowledge Level
CO 1	Gain a theoretical understanding of the evolution of serverless computing, explore the serverless ecosystem and evaluate the scalability and key features of serverless architectures.	Understand
CO 2	Understanding of key strategic considerations when selecting and utilizing major serverless platforms for the development of robust, scalable and efficient serverless solutions.	Understand
CO 3	Apply industry-standard testing frameworks and tools to enhance serverless application quality.	Apply
CO 4	Understanding of the concepts of concurrent executions, traffic spikes, traffic shaping, microservices optimization and distributed systems optimization within the context of serverless architectures.	Understand
CO 5	Understand unique security challenges in cloud environments, identify and mitigate security threats such as injection flaws, data breaches and DDoS attacks, implement function isolation and security boundaries, manage error handling and exception 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	1	2	1		1	2
CO 2	2	2	1	2	1		1	2
CO 3	2	2	1	2	1		1	2
CO 4	2	2	1	2	1		1	2
CO 5	2	2	1	2	1		1	2

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination (Marks%)
	Test 1 (Marks%)	Test 2 (Marks%)	
Remember	20	10	20
Understand	80	80	70
Apply	XX	10	10
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 subdivisions.

Syllabus

Module 1 [9 Hours]

Introduction to Serverless Computing: Evolution from traditional to serverless architectures, Serverless Ecosystem, Scalability, Event-driven Execution, Auto-scaling, Pay-per-use Billing, Server Management Abstraction, Concurrency Management.

Self-Study: Infrastructure as a Service, Platform as a Service, Software as a Service, S3 Events, Message Queues.

Module 2 [10 Hours]

Serverless Computing Platforms: AWS Lambda- Connecting with AWS services, Monitoring and Debugging. Azure Serverless- Workflow Automation, Connectors, Integration. Google Cloud Serverless- NoSQL Database, Real-time Synchronization, Serverless Applications. Ecosystem Comparison- Tools, SDKs, Community Support.

Self-Study: Fully Managed Service, High Availability, Low Latency, Global Tables, Built-in Security.

Module 3 [8 Hours]

Verification in Serverless Architecture: Introduction to Verification in Serverless, Functional Verification, Non-Functional Verification, Jest, Pytest, Integration Testing, End-to-End Testing, Performance and Load Testing, Security Testing, Mocking.

Self-Study: Local Development, Deploy Applications, Package Functions, Manage Resources.

Module **4 [8 Hours]**

Concurrency Management in Serverless Architectures: Introduction to Concurrency in Serverless, Handling Traffic Spikes, Traffic Shaping, Microservices and Distributed Systems for Traffic Management, Event Queues and Buffering, Locking and Synchronization, Concurrent Execution in Serverless Environments, Concurrency Control Techniques.

Self-Study: Invocation Metrics, Error Tracking and Failures, Cold Starts, Concurrency and Throttling.

Module 5 [10 Hours]

Serverless Application Security: Unique Security Challenges, Shared Responsibility Model, Security Threats- Injection Flaws, Data Breaches, DDoS Attacks. Function Isolation and Security Boundaries, Error Handling and Exception Management, AWS Security Hub, Azure Security Center, GCP Security Command Center.

Self-Study: Security Monitoring and Logging Tools, Intrusion Detection and Prevention Systems, Incident Response Planning and Procedures, Security Monitoring and Threat Intelligence.

Reference Books:

1. Boris Scholl, Trent Swanson, Peter Jausovec, Cloud Native: Using Containers, Functions, and Data to Build Next-Generation Applications, O'REILLY, October 2019.
2. Martin L. Abbott and Michael T. Fisher, Art of Scalability, The: Scalable Web Architecture, Processes, and Organizations for the Modern Enterprise 2nd Edition.
3. Scott Patterson, Mastering Serverless Computing: Unleashing the Power of AWS Lambda and Azure Functions, Independently Published,2022.
4. Abhishek Mishra, Building Scalable Applications with AWS Lambda, Google Cloud Functions, and Azure Functions, Independently Published, 2022.
5. Peter Sbarski, Yan Cui, Ajay Nair, Serverless Architectures on AWS, Second Edition, 2022.
6. Kuldeep Chowhan, Pankaj Kataria, and Praveen Kumar Sreeram Hands-On Serverless Computing, 2018.
7. Maddie Stigler, Beginning Serverless Computing: Developing with Amazon Web Services, Microsoft Azure, and Google Cloud, 2017.
8. Sasha Rosenbaum, Brian Peek, and Eduardo Laureano, Serverless Computing in Azure with .NET: Build, Test, and Automate Deployment of Azure Functions Using .NET Core, 1st Edition, Kindle Edition. 2017.
9. Ben Piper, David Clinton, AWS Certified Solutions Architect Study Guide, 4^{th} Edition.
10. Guy Podjarny, Liran Tal, Serverless Security, O'Reilly Media, 2019.

Online Resources:

1. https://www.youtube.com/watch?v=YoBfFwsoWIU
2. https://www.youtube.com/watch?v=RzsaM6kL1FU
3. https://www.youtube.com/watch?v=LHgCA3XVNkw
4. https://www.youtube.com/watch?v=dZbmE7iyZxg
5. https://www.youtube.com/watch?v=2TYsmCz0oUk

6. https://www.youtube.com/watch?v=oiZH5U_a0pg
7. https://www.youtube.com/watch?v=JiHpL-wcgNY
8. https://www.youtube.com/watch?v=T6dDeVG6cgo
9. https://www.youtube.com/watch?v=2s_x55xj010
10. https://www.youtube.com/watch?v=jYbfQ07Z7rM

Course Contents and Lecture Schedule

No	Topics	No. of Lecture/ Tutorial Hours
Module 1[9 Hours]		
1.1	Evolution from traditional to serverless architectures	2
1.2	Serverless Ecosystem	1
1.3	Scalability	1
1.4	Event-driven Execution	1
1.5	Auto-scaling	1
1.6	Pay-per-use Billing	1
1.7	Server Management Abstraction	1
1.8	Concurrency Management	1
Module 2[10 Hours]		
2.1	AWS Lambda- Connecting with AWS services	1
2.2	Monitoring and Debugging	1
2.3	Azure Serverless- Workflow Automation	2
2.4	Connectors, Integration	1
2.5	Google Cloud Serverless- NoSQL Database	1
2.6	Real-time Synchronization	1
2.7	Serverless Applications	1
2.8	Ecosystem Comparison- Tools, SDKs, Community Support.	2
Module 3 [8 Hours]		
3.1	Introduction to Verification in Serverless	1
3.2	Functional Verification	1
3.3	Non-Functional Verification	1
3.4	Jest, Pytest	1
3.5	Integration Testing, End-to-End Testing	1
3.6	Performance and Load Testing	1
3. 7	Security Testing	1
3.8	Mocking	1
Module 4 [8 Hours]		
4.1	Introduction to Concurrency in Serverless	1
4.2	Handling Traffic Spikes	1
4.3	Traffic Shaping	1
4.4	Microservices and Distributed Systems for Traffic Management	1
4.5	Event Queues and Buffering	2

4.6	Locking and Synchronization	1
4.7	Concurrent Execution in Serverless Environments	1
4.8	Concurrency Control Techniques	1
Module 5 [10 Hours]		
5.1	Unique Security Challenges	1
5.2	Shared Responsibility Model	1
5.3	Security Threats- Injection Flaws	1
5.4	Data Breaches	1
5.5	DDoS Attacks	1
5.6	Function Isolation and Security Boundaries	1
5.7	Error Handling and Exception Management	1
5.8	AWS Security Hub	1
5.9	Azure Security Center	1
5.10	GCP Security Command Center	1
	Total Hours	**45**

CO Assessment Questions

Course Outcome 1 (CO1)

1. How does serverless computing reduce operational overhead compared to traditional architectures? (L2)
2. How do serverless platforms integrate with other cloud services? Provide examples.(L2)
3. What factors influence the scalability limits of a serverless function? (L2)

Course Outcome 2 (CO2)

1. What tools and techniques can you use to monitor the execution time and error rates of your Lambda functions? (L1)
2. Imagine you are building a serverless web application where AWS Lambda needs to interact with DynamoDB. What specific configurations and SDK integrations are required for efficient interaction? (L2)
3. A real-time analytics system requires ingestion of streaming data. How would you design this system using GCP serverless tools? (L2)

Course Outcome 3 (CO3)

1. What challenges are unique to verifying serverless applications? (L1)
2. What role does mocking play in the functional verification of serverless applications? (L2)
3. Describe how you would set up an integration test for a serverless application interacting with multiple AWS services. (L3)

Course Outcome 4 (CO4)

1. What is concurrency in serverless architectures, and how does it differ from concurrency in traditional systems? (L2)
2. How would you design a distributed system with serverless microservices to ensure load balancing and fault tolerance? (L2)
3. Explain how Dead Letter Queues (DLQs) assist in handling failures in concurrent serverless systems. (L2)

Course Outcome 5 (CO5)

1. What security responsibilities are managed by cloud providers in serverless platforms? (L1)
2. Describe how to implement error handling in serverless functions to avoid exposing stack traces or sensitive data. (L2)
3. What types of security standards and frameworks does AWS Security Hub support for 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:* M24CA1E304F**

***Course Name:* Serverless Computing**

Max. Marks: 60 Duration: 3 Hours

PART A

Answer all questions. Each question carries 2 marks.

1. What are the key differences between traditional, container-based, and serverless architectures?
2. What are the limitations of serverless auto-scaling, and how can they be mitigated?
3. What are the primary differences between Google Cloud Functions and Google Cloud Run?
4. If a Lambda function starts exceeding its memory limit, how would you diagnose and resolve this issue?
5. How can you use Jest to test serverless functions deployed in AWS Lambda?
6. What does end-to-end testing involve in the context of serverless applications?
7. What is traffic shaping, and how is it used in serverless applications?
8. What is the difference between push-based and pull-based event queues in terms of concurrency control?
9. Why is managing third-party dependencies critical for securing serverless applications?
10. How can setting up separate execution environments for serverless functions improve security?

PART B

Answer any five questions. Each question carries 8 marks.

11. What strategies can be employed to handle concurrency issues, such as throttling or high-latency requests?
12. A real-time analytics system requires ingestion of streaming data. How would you design this system using GCP serverless tools?

13. Provide an example of how mocking can simplify the testing of a Lambda function that interacts with DynamoDB.
14. Explain how Dead Letter Queues (DLQs) assist in handling failures in concurrent serverless systems.
15. In what scenarios would limiting the concurrency of a serverless function improve system performance?
16. How would you use AWS Security Hub to perform a security assessment of an application built with multiple AWS services?
17. Describe how to implement error handling in serverless functions to avoid exposing stack traces or sensitive data.

KNOWLEDGE IS POWER

M24CA1E304G	Social Network Analysis	L	T	P	J	S	Credit	Year of Introduction
		3	1	0	0	3	4	2024

Preamble:

Studies the relationships and interactions within a network of individuals or entities to solve practical problems, from identifying misinformation spread on social media to optimizing corporate networks and understanding biological interactions.

Prerequisite:

Basic understanding of statistics, graph theory and programming.

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 Semantic Web Technologies, Linked Data and the LOD Cloud, along with skills to analyze network structures, centrality measures, density, connectivity, community detection, diffusion, influence and methods for collecting social network data.	Understand
CO 2	Apply semantic web technologies, including knowledge representation, ontology development, ontology reasoning, data interoperability and advanced querying with SPARQL.	Apply
CO 3	Understand to model, analyze and interpret social network data using data collection and preprocessing techniques, graph-based representations, network metrics, community detection, structural analysis and machine learning methods.	Understand
CO 4	Understanding of the graph structure of the web, including algorithms for searching and connected components, distribution metrics and various exponent calculations for web graph analysis.	Understand
CO 5	Understanding of link analysis, including web link structure, hyperlink networks, various link analysis techniques, algorithms like PageRank and HITS, as well as link prediction, influence and centrality in network analysis.	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	3	2		2	2
CO 2	1	1	2	3	2		2	2
CO 3	1	1	2	3	2		2	2
CO 4	1	1	2	3	2		2	2
CO 5	1	1	2	3	2		2	2

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination (Marks%)
	Test 1 (Marks%)	Test 2 (Marks%)	
Remember	20	40	20
Understand	60	60	60
Apply	20	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)

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

Syllabus

Module 1 [8 Hours]

Introduction to the Semantic Web and Social Networks: Foundations of Semantic Web Technologies, Linked Data Principles, Linked Open Data (LOD) Cloud, Network Structure, Measures of Centrality, Network Density and Connectivity, Community Detection, Diffusion and Influence in Networks, Social Network Data Collection**.**

Self-Study: Types of Networks, The macro-structure of social networks, Personal networks.

Module 2 [10 Hours]

Semantic Web Knowledge Representation: Knowledge Representation Basics, Introduction to Ontology, Ontology Components and Structure, Ontology Languages for the Semantic Web, Ontology Reasoning and Inference, Ontology and Data Interoperability, SPARQL and Resource Description Framework, Federated Queries and Query Optimization, SPARQL and Linked Data.

Self-Study: SPARQL Tools- SPARQL Endpoints, Query Engines, Ontology Editors, SPARQL Clients.

Module 3 [9 Hours]

Strategies for Modeling and Analysis: Data Collection and Preprocessing, Graph-Based Representation, Network Data Structures, Network Metrics and Analysis, Community Detection and Analysis, Structural Analysis of Social Networks, Machine Learning and Social Network Analysis, Aggregating Social Network Data.

Self-Study: Reasoning with Social Network Data, Anomaly Detection in Networks, Visualization of Network Data.

Module 4 [10 Hours]

Graph Structure of the Web: Breadth First Search (BFS) Algorithm, Strongly Connected Components (SCC) Algorithm, Weakly Connected Components (WCC) Algorithm, In-degree and out- degree distributions, Connected Components, Zipf's Law, Rank Exponent R, Out-Degree Exponent O, Hop Plot Exponent H, Eigen Exponent E.

Self-Study: Facebook Network Structure, Comparing Web and Facebook Networks.

Module 5 [8 Hours]

Link Analysis: Web Link Structure and Hyperlink Networks, Link Analysis Techniques, PageRank Algorithm, Hyperlink-Induced Topic Search (HITS) Algorithm, Stochastic Approach for Link-Structure Analysis (SALSA), Link Prediction in Networks, Influence and Centrality in Link Analysis.

Self-Study: Cascade Models, Probabilistic Cascades, Epidemic Models, Independent Cascade Models, Cascade Prediction.

Reference Books:

1. Matthew A. Russell, Mikhail Klassen, Mining The Social Web, 3rd Edition, 2019.
2. John Scott, Social Network Analysis,4th Edition, 2017.
3. Pascal Hitzler, Knowledge Representation for the Semantic Web, 2010.
4. Antonio Zilli, Ernesto Damiani, Paolo Ceravolo, Semantic Knowledge Management: An Ontology-based Framework 1st Edition, 2008.
5. Jure Leskovec, Anand Rajaraman and Jeffrey David Ullman, Mining of Massive Datasets, 3rd Edition, 2020.

Online Resources:

1. https://www.youtube.com/watch?v=s9bfuxZh0V8&t=56s
2. https://www.youtube.com/watch?v=15c0GKDMe4E
3. https://www.youtube.com/watch?v=cCI8PKHAfFQ
4. https://www.youtube.com/watch?v=wVV1UYBeYn4&list=PLv4HhF8dU0AH_zXmaoQ3AbHkKcA1wlfyB&index=2
5. https://www.youtube.com/watch?v=7tRxCpHhDcw&list=PLtxumkqNwyiSrml9t7OCDq2ouLkHcn50Z&index=7

Course Contents and Lecture Schedule

No	Topics	No. of Lecture/ Tutorial Hours
Module 1[8 Hours]		
1.1	Foundations of Semantic Web Technologies	1
1.2	Linked Data Principles, Linked Open Data (LOD) Cloud	1
1.3	Network Structure	1
1.4	Measures of Centrality	1
1.5	Network Density and Connectivity	1
1.6	Community Detection	1
1.7	Diffusion and Influence in Networks	1
1.8	Social Network Data Collection	1
Module 2[10 Hours]		
2.1	Knowledge Representation Basics	1
2.2	Introduction to Ontology	1
2.3	Ontology Components and Structure	1
2.4	Ontology Languages for the Semantic Web	1
2.5	Ontology Reasoning and Inference	1
2.6	Ontology and Data Interoperability	1
2.7	SPARQL and Resource Description Framework (RDF)	2
2.8	Federated Queries and Query Optimization	1
2.9	SPARQL and Linked Data	1
Module 3 [9 Hours]		
3.1	Data Collection and Preprocessing	1
3.2	Graph-Based Representation	1
3.3	Network Data Structures	1
3.4	Network Metrics and Analysis	1
3.5	Community Detection and Analysis	1
3.6	Structural Analysis of Social Networks	1
3. 7	Machine Learning and Social Network Analysis	2
3.8	Aggregating Social Network Data	1
Module 4 [10 Hours]		
4.1	Breadth First Search (BFS) Algorithm	1
4.2	Strongly Connected Components (SCC) Algorithm	1
4.3	Weakly Connected Components (WCC) Algorithm	1
4.4	In-degree and out- degree distributions	1
4.5	Connected Components	1
4.6	Zipf's Law	1
4.7	Rank Exponent R	1
4.8	Out-Degree Exponent O	1

4.9	Hop Plot Exponent H	1
4.10	Eigen Exponent E	1
Module 5 [8 Hours]		
5.1	Web Link Structure and Hyperlink Networks	1
5.2	Link Analysis Techniques	2
5.3	PageRank Algorithm	1
5.4	Hyperlink-Induced Topic Search (HITS) Algorithm	1
5.5	Stochastic Approach for Link-Structure Analysis (SALSA)	1
5.6	Link Prediction in Networks	1
5.7	Influence and Centrality in Link Analysis.	1
	Total Hours	**45**

CO Assessment Questions

Course Outcome 1 (CO1)

1. What is the Semantic Web, and how does it differ from the traditional web? (L1)
2. How do social networks relate to the Semantic Web? (L2)
3. How does the Semantic Web enhance information retrieval and data integration? (L2)

Course Outcome 2 (CO2)

1. How does ontology facilitate data interoperability in the Semantic Web? (L2)
2. What is Resource Description Framework and what is its purpose? (L2)
3. Define SPARQL and its role in querying Semantic Web data. (L2)

Course Outcome 3 (CO3)

1. What is the importance of data collection and preprocessing in network analysis? (L1)
2. Define degree centrality in network metrics. (L1)
3. What is social network data aggregation, and why is it important? (L2)

Course Outcome 4 (CO4)

1. What is the difference between strongly connected components (SCC) and weakly connected components (WCC) in a graph? (L1)
2. What does Zipf's Law describe in the structure of the web? (L2)
3. How does the Breadth-First Search (BFS) algorithm help in web graph traversal? (L2)

Course Outcome 5 (CO5)

1. Define web link structure and hyperlink networks. (L1)
2. What is link prediction in network analysis? (L2)
3. Describe the HITS algorithm and explain the concept of hubs and authorities. (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: **M24CA1E304G**

Course Name: **Social Network Analysis**

Max. Marks: 60 Duration: 3 Hours

PART A

Answer all questions. Each question carries 2 marks.

1. How do social networks relate to the Semantic Web?
2. How does the Semantic Web enhance information retrieval and data integration?
3. How does ontology facilitate data interoperability in the Semantic Web?.
4. What is a Federated Query in SPARQL?
5. What is the importance of data collection and preprocessing in network analysis?
6. What is modularity in community detection?
7. Define in-degree and out-degree distributions in the context of web graphs.
8. Define stochastic models in the context of network structures.
9. Define web link structure and hyperlink networks.
10. How do hyperlinks contribute to ranking pages on the web?

PART B

Answer any five questions. Each question carries 8 marks.

11. Explain the concept of the Semantic Web and how it enhances data interoperability and integration.
12. Given a dataset in RDF format, demonstrate how to write and execute a SPARQL query to retrieve specific information.
13. Explain the process of data collection and preprocessing in social network analysis. How does it impact analysis accuracy?
14. How do in-degree and out-degree distributions influence the connectivity and ranking of web pages? Provide examples.
15. Discuss the importance of Zipf's Law, Rank Exponent (R), Out-Degree Exponent (O), Hop Plot Exponent (H), and Eigen Exponent (E) in understanding web graph structures.
16. How does influence spread in hyperlink networks? Discuss real-world applications.
17. How does link analysis contribute to search engine optimization (SEO) and spam detection?

M24CA1E304H	Cyber Security	L	T	P	J	S	Credit	Year of Introduction
		3	1	0	0	3	4	2024

Preamble:

This course introduces **cryptography, cybersecurity, cyber laws, and cybercrime**, covering encryption, cyber threats, legal frameworks, and mobile security. It equips students with essential skills to safeguard digital information.

Prerequisite:

Basic knowledge of **computer networks, algorithms, and mathematics** is recommended for understanding cryptography and cybersecurity concepts.

Course Outcomes:

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

CO. No	Course Outcomes	Cognitive Knowledge Level
CO 1	Understand fundamental cryptographic concepts, classical encryption techniques, symmetric key encryption models, block cipher principles, and encryption standards.	Understand
CO 2	Understand the principles of public key cryptography, RSA algorithm, key management techniques, hash functions, and message authentication mechanisms.	Understand
CO 3	Understand fundamental cybersecurity concepts, security layers, cyber threats, attack types, internet governance challenges, and cybersecurity policies.	Understand
CO 4	**Understand** cybersecurity regulations, international and national cyber laws, the fundamentals of cyber forensics, digital evidence handling, and forensic investigation processes.	Understand
CO 5	**Apply** security measures to protect mobile and wireless devices, implement authentication mechanisms, and mitigate risks associated with cyber threats and frauds in mobile computing environments.	Apply

Mapping of course outcomes with program outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	2	2	2	1	-	-	2
CO2	3	2	2	2	1	-	-	2
CO3	2	3	2	3	2	-	3	3
CO4	2	3	2	3	2	-	3	3
CO5	2	3	3	3	3	2	3	3

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination (Marks %)
	Test 1 (Marks %)	Test 2 (Marks %)	
Remember	40	20	20
Understand	60	60	60
Apply	XX	20	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 Pattern (Out of 40 marks):

- o Continuous Assessment Test 1 : 10 Marks
- o Continuous Assessment Test 2 : 10 Marks
- o Assignment/Tutorials/Seminars : 12 Marks
- o 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.

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 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 [11 Hours]

Cryptography: Introduction and terminology, Classical encryption techniques - Symmetric cipher model, substitution techniques, transposition techniques. Conventional symmetric key encryption- Block ciphers and stream ciphers, Block cipher design principles, Modes of operation, Data Encryption Standard, Multiple encryption, Triple DES.

Self-Study: Advanced Encryption Standard (AES).

Module 2 [7 Hours]

Public key cryptography: Principles of public key cryptosystems, The RSA algorithm, Key management – Diffie Hellman Key exchange.

Message Authentication and Hash Functions: Authentication requirements, Authentication functions, Hash functions- Introduction, Basic uses of hash function. Message Authentication Code (MAC)- Introduction, Basic use of MAC.

Self-Study: Digital signatures – Ensuring data integrity, Confidentiality and authenticity.

Module 3 [7 Hours]

Introduction to Cyber Security: Basic cyber security concepts, Layers of security, Vulnerability, Threat, Harmful acts, Internet governance – Challenges and Constraints, Computer criminals, CIA Triad, Assets and threat, Motive of attackers, Active attacks, Passive attacks, Software attacks, Hardware attacks, Cyber threats-Cyber warfare, Cybercrime, Cyber terrorism, Cyber espionage, Comprehensive cyber security policy.

Self-Study: **Quantum cryptography and its impact on cybersecurity.**

Module 4 [10 Hours]

Cyberspace and the Law: Introduction, Cyber security regulations, Roles of International Law. The INDIAN Cyberspace, National Cyber security policy.

Cyber Forensics: Introduction of cyber forensics, Historical background of cyber forensics, Digital forensics science, The need for computer forensics, Cyber forensics and digital evidence, Forensics analysis of email, Digital forensics lifecycle, Forensics investigation, Challenges in computer forensics.

Self-Study: Ransomware attacks - Evolution, Techniques, and defense strategies.

Module 5 [10 Hours]

Cybercrime in Mobile and Wireless Devices: Introduction, Proliferation of mobile and wireless devices, Trends in mobility, Credit card frauds in mobile and wireless computing, Security challenges posed by mobile devices, Registry settings for mobile devices, Authentication service security, Attacks on mobile/laptops, Organizational security policies and measures in mobile computing.

Self-Study: Security implications of the Internet of Things (IoT).

Reference Books:

1. Nina Godbole and SunitBelpure, Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, Wiley. January 2011
2. B.B.Gupta, D.P.Agrawal, HaoxiangWang, Computer and Cybersecurity: Principles ,Algorithm, Applications, and Perspectives, CRC Press, ISBN 9780815371335, 2018.
3. William Stallings, “Cryptography and Network Security,” 6th Edition, Pearson Education, March (2013).

Online Resources:

1. https://www.techtarget.com/searchsecurity/definition/Data-Encryption-Standard
2. https://www.tutorialspoint.com/what-are-the-principles-of-public-key-cryptosystem-in-information-security
3. https://www.indeed.com/career-advice/career-development/cyber-security-concepts
4. https://www.upguard.com/blog/cybersecurity-regulations-india
5. https://www.studocu.com/in/document/babu-banarasi-das-university/cyber-security/cyber-security-unit-2-notes/73726515

Course Contents and Lecture Schedule

NO	Topic	No. of Lecture/Tutorial Hours
Module 1 [11 Hours]		1
1.1	Cryptography- Introduction and terminology	1
1.2	Classical Encryption techniques - Symmetric cipher model	1
1.3	Substitution techniques	1
1.4	transposition techniques.	1

1.5	Conventional symmetric key Encryption- Block ciphers and Stream Ciphers	1
1.6	Block cipher design principles	1
1.7	Modes of operation	2
1.8	Data Encryption Standard	2
1.9	Multiple Encryption, Triple DES.	1
Module 2 [7 Hours]		
2.1	Principles of public key cryptosystems	1
2.2	The RSA algorithm	1
2.3	Key management – Diffie Hellman Key exchange.	1
2.4	Authentication requirements	1
2.5	Authentication functions	1
2.6	Hash functions- Introduction, Basic uses of hash function.	1
2.7	Message Authentication Code (MAC)- Introduction, Basic use of MAC.	1
Module 3 [7 Hours]		
3.1	Basic cyber security concepts, layers of security	1
3.2	Vulnerability, threat, Harmful acts,	1
3.3	Internet governance – Challenges and constraints, Computer criminals	1
3.4	CIA Triad, Assets and threat, motive of attackers	1
3.5	active attacks, passive attacks	1
3.4	Software attacks, hardware attacks,	1
3.5	Cyber threats-Cyber warfare, Cyber crime	1
3.6	Cyber terrorism, Cyber espionage	1
3.7	Comprehensive cyber security policy.	1
Module 4 [10 Hours]		
4.1	Cyberspace and the law: Introduction, Cyber security regulations	1
4.2	Roles of International Law. The INDIAN Cyberspace	1
4.3	National Cyber Security Policy	1
4.4	Introduction, Historical background of cyber forensics, digital forensics science	1
4.5	The need for computer forensics	2
4.6	cyber forensics and digital evidence	1
4.7	Forensics analysis of email, Digital forensics lifecycle	1
4.8	Forensics investigation	1
4.9	Challenges in computer forensics	1
Module 5 [10 Hours]		
5.1	Mobile and wireless devices: Introduction, Proliferation of mobile and wireless devices	2
5.2	Trends in mobility, Credit card frauds in mobile and	2

	wireless computing.	
5.3	Security challenges posed by mobile devices.	1
5.4	Registry settings for mobile devices.	1
5.5	Authentication service security.	1
5.6	Attacks on mobile/laptop.	1
5.7	Organizational security policies and measures in mobile computing.	2
	Total Hours	**45**

CO Assessment Questions

Course Outcome 1 (CO1):

1. Define key in cryptography. (L2)
2. What are cryptographic attacks? (L2)
3. Explain the architecture and working of the Data Encryption Standard (DES). (L2)

Course Outcome 2 (CO2):

1. What is public key cryptography? (L2)
2. What is the role of the modulus (n) in RSA? (L2)
3. Describe the working of the RSA algorithm with an example. (L2)

Course Outcome 3 (CO3):

1. What is cyber security? (L2)
2. What is a vulnerability in cyber security? (L2)
3. Explain the impact of cyber laws on businesses and online transactions. (L2)

Course Outcome 4 (CO4):

1. What is cyberspace, and why is it important? (L2)
2. What are the penalties for cybercrimes under Indian law? (L2)
3. How does the Indian IT Act, 2000 address cybercrimes and data protection? (L2)

Course Outcome 5 (CO5):

1. What is cybercrime in the context of mobile and wireless devices? (L2)
2. How would you identify a phishing attack on a mobile device? (L2)
3. Develop a guideline for safely using public Wi-Fi on mobile devices. (L3)

KNOWLEDGE IS POWER

Model Question Paper

QP CODE: Pages: 2

Reg No : Name:

MAR ATHANASIUS COLLEGE OF ENGINEERING (AUTONOMOUS)

KOTHAMANGALAM

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

Course Code: M24CA1E304H

Course Name: Cyber Security

Max. Marks: 60 Duration: 3 hours

PART A

Answer all questions. Each question carries 2 marks.

1. Define key in cryptography.
2. What are cryptographic attacks?
3. What is public key cryptography?
4. What is the role of the modulus (n) in RSA?
5. What is cyber security?
6. What is a vulnerability in cyber security?
7. What is cyberspace, and why is it important?
8. What are the penalties for cybercrimes under Indian law?
9. What is cybercrime in the context of mobile and wireless devices?
10. How would you identify a phishing attack on a mobile device?

PART B

Answer any five questions. Each question carries 8 marks.

11. Explain the purpose of different modes of operation in block ciphers.
12. Describe the working of the RSA algorithm with an example.
13. Explain the impact of cyber laws on businesses and online transactions.
14. How does the Indian IT Act, 2000 address cybercrimes and data protection?
15. Develop a guideline for safely using public Wi-Fi on mobile devices.
16. Explain the architecture and working of the Data Encryption Standard (DES).
17. Explain how cyber terrorism is different from traditional terrorism.

KNOWLEDGE IS POWER

M24CA1E304I	Blockchain Technology	L	T	P	J	S	Credit	Year of Introduction
		3	1	0	0	3	4	2024

Preamble:

This course covers Blockchain Technology, from basics like architecture and consensus algorithms to advanced topics like smart contracts, Bitcoin, and Ethereum. It explores real-world applications in finance, supply chain, and government, alongside integration with AI and cloud computing. By the end, you'll gain practical knowledge to apply blockchain in various industries.

Prerequisite:

A basic understanding of computer science, programming (Python/JavaScript), and cryptography, along with an interest in distributed systems and emerging technologies, is recommended for this course.

Course Outcomes:

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

CO. No	Course Outcomes	Cognitive Knowledge Level
CO 1	Understand blockchain's evolution, architecture, types, consensus mechanisms, and the concept of decentralization, laying a strong foundation for advanced blockchain.	Understand
CO 2	Understand consensus algorithms, Bitcoin's structure, and wallet types, gaining foundational knowledge of blockchain operations and cryptocurrency mechanics.	Understand
CO 3	Understand smart contracts, oracles, decentralized applications, and blockchain use cases in government, healthcare, finance, and supply chain, as well as its integration with cloud computing and AI.	Understand
CO 4	Understand the Ethereum network, its ecosystem components, and the Solidity programming language, enabling them to develop and deploy smart contracts for real-world applications.	Understand
CO 5	Apply blockchain to design solutions for finance, supply chain, and government, ensuring privacy and security through cryptography.	Apply

Mapping of course outcomes with program outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO 1	3	2	1	2	1	1	2	2
CO 2	3	2	1	2	1	1	2	2
CO 3	3	3	2	3	2	2	3	3
CO 4	3	3	3	3	2	2	3	3
CO 5	3	3	3	3	3	3	3	3

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination (Marks %)
	Test 1 (Marks %)	Test 2 (Marks %)	
Remember	40	20	20
Understand	60	60	60
Apply	XX	20	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 Pattern (Out of 40 marks):

- Continuous Assessment Test 1 : 10 Marks
- Continuous Assessment Test 2 : 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.

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 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]

Introduction to Blockchain: Digital Money to Distributed Ledger, Architecture, Elements of blockchain, Benefits and limitations, Types of blockchain, Consensus – Definition, Types. Decentralization – Decentralization using blockchain, Methods of decentralization, Routes to decentralization, Blockchain and full ecosystem decentralization.

Self-Study**: Public and Private Blockchains**

Module 2 [10 Hours]

Distributed Consensus Mechanisms: Consensus Algorithms- Crash Fault-Tolerance (CFT) algorithms – Paxos, Raft. Byzantine fault-tolerance (BFT) algorithms – Practical Byzantine Fault Tolerance (PBFT), Proof of work (PoW), Proof of stake (PoS), Types of PoS.

Bitcoin and Blockchain Technology: Bitcoin – Definition, Cryptographic keys – Private keys, Public keys, Addresses. Transactions – Lifecycle, Coinbase transactions, Transaction validation. Blockchain – The genesis block. Mining – Tasks of miners, Mining algorithm, Hash rate. Wallets – Types of wallets.

Self-Study: **Cryptocurrency Wallets – Types, Security, and Best Practices** for safely storing and using cryptocurrencies.

Module 3 [9 Hours]

Smart Contracts: Definition, Smart contract templates, Oracles, Types of oracles, Deploying smart contracts, Decentralization terminology – Decentralized applications, Decentralized Autonomous Organizations.

Blockchain with AI, Cloud, and Industry Applications: Blockchain integration with allied technologies- Blockchain and Cloud Computing, Blockchain and Artificial Intelligence. Use cases of Blockchain technology – Government, Health care, Finance, Supply chain management.

Self-Study: Blockchain in Supply Chain Management – Applications and Benefits

Module 4 [7 Hours]

Ethereum Basics: Ethereum – The Ethereum network. Components of the Ethereum ecosystem – Keys and addresses, Accounts, Transactions and messages. The Ethereum Virtual Machine, Blocks and blockchain. The Solidity language – The layout of a Solidity source code, Structure of a smart contract, Variables, Data types, Control structures, Events, Inheritance, Libraries, Functions, Error handling. Smart contracts Case study: Voting, Auction.

Self-Study: Introduction to Decentralized Applications – Building Blocks and Use Cases

Module 5 [9 Hours]

Blockchain in Finance and Supply chain: Blockchain in Financial Software and Systems-Settlements, KYC, Capital Markets-Insurance. Blockchain in Supply chain - Provenance of goods, Visibility, Supply chain finance, Invoice management, Discounting.

Blockchain for Government: Digital identity, Land records and other kinds of record keeping between government entities, Public distribution system, Social welfare systems, Blockchain Cryptography- Privacy and Security on Blockchain.

Self-Study: Blockchain in Digital Identity – Applications and Benefits.

Reference Books:

1. Mark Gates, "Block chain: Ultimate guide to understanding block chain, bit coin, crypto currencies, smart contracts and the future of money", Wise Fox Publishing and Mark Gates 2017.
2. Salman Baset, Luc Desrosiers, Nitin Gaur, Petr Novotny, Anthony O'Dowd, Venkatraman Ramakrishna, "Hands-On Block chain with Hyper ledger: Building decentralized applications with Hyperledger Fabric and Composer", 2018.
3. Bahga, Vijay Madisetti, "Block chain Applications: A Hands-On Approach", Arshdeep Bahga, Vijay Madisetti publishers 2017.
4. Tapscott, Don, and Alex Tapscott. Blockchain Revolution: How the Technology Behind Bitcoin and Other Cryptocurrencies Is Changing the World. Portfolio, 2016.
5. Gilder, George. Life After Google: The Fall of Big Data and the Rise of the Blockchain Economy. Gateway Editions, 2018.

Online Resources:

1. https://ethereum.org/en/smart-contracts/
2. https://ethereum.org/en/developers/docs/smart-contracts/
3. https://subscription.packtpub.com/book/data/9781839213199/2/ch02lvl1sec15/platforms-for-decentralization
4. https://www.techtarget.com/searchcio/feature/What-are-the-4-differenttypes-of-blockchain technology
5. https://www.tutorialspoint.com/what-is-decentralization-in-blockchain
6. https://www.geeksforgeeks.org/blockchain-and-distributed-ledgertechnology-dlt/

Course Contents and Lecture Schedule

NO	Topic	No. of Lecture/ Tutorial Hours
Module 1 [10 Hours]		1
1.1	Introduction to Blockchain, History-Digital Money to Distributed Ledger	1
1.2	Architecture	1
1.3	Elements of blockchain	1
1.4	Benefits and limitations	1
1.5	Types of blockchain.	1
1.6	Consensus – Definition, Types.	1
1.7	Decentralization – Decentralization using blockchain	1
1.8	Methods of decentralization	1
1.9	Routes to decentralization	1
1.10	Blockchain and full ecosystem decentralization.	1
Module 2 [10 Hours]		
2.1	Consensus Algorithms	1
2.2	Crash fault-tolerance (CFT) algorithms- Paxos, Raft	1
2.3	Byzantine fault-tolerance (BFT) algorithms	1
2.4	Practical Byzantine Fault Tolerance (PBFT)	1
2.5	Proof of work (PoW), Proof of stake (PoS), Types of PoS.	1
2.6	Bitcoin – Definition, Cryptographic keys – Private keys, public keys, addresses.	1
2.7	Transactions – Lifecycle, Coinbase transactions	1
2.8	Transaction validation. Blockchain – The genesis block	1
2.9	Mining – Tasks of miners, Mining algorithm, Hash rate.	1
2.10	Wallets – Types of wallets.	1
Module 3 [9 Hours]		
3.1	Smart Contracts – Definition, Smart contract templates	1
3.2	Oracles, Types of oracles	1
3.3	Deploying smart contracts	1
3.4	Decentralization terminology – Decentralized applications	1
3.5	Decentralized Autonomous Organizations.	1
3.6	Use cases of Blockchain technology – Government, Health care	1
3.7	Use cases of Blockchain technology – Finance, Supply chain management.	1
3.8	Blockchain and allied technologies – Blockchain and Cloud Computing.	1
3.9	Blockchain and allied technologies – Blockchain and Artificial Intelligence.	1

Module 4 [7 Hours]		
4.1	Ethereum – The Ethereum network, Components of the Ethereum ecosystem – Keys and addresses.	1
4.2	Accounts, Transactions and messages.	1
4.3	The Ethereum Virtual Machine, Blocks and blockchain.	1
4.4	The Solidity language – The layout of a Solidity source code, Structure of a smart contract	1
4.5	Variables, Data types, Control structures	1
4.6	Events, Inheritance, Libraries, Functions, Error handling.	1
4.7	Smart contracts Case study: Voting, Auction.	1
Module 5 [9 Hours]		
5.1	Blockchain in Financial Software and Systems: Settlements, KYC	1
5.2	Capital Markets-Insurance	1
5.3	Blockchain in trade/supply chain- Provenance of goods, Visibility	1
5.4	Trade/Supply chain finance	1
5.5	Invoice management / Discounting.	1
5.6	Blockchain for Government: Digital identity	1
5.7	Land records and other kinds of record keeping between government entities	1
5.8	Public distribution system / Social welfare systems	1
5.9	Blockchain Cryptography- Privacy and Security on Blockchain.	1
	Total Hours	**45**

CO Assessment Questions

Course Outcome 1 (CO1)

1. What is the primary purpose of blockchain technology? (L2)
2. Describe the concept of a "genesis block" in blockchain. (L2)
3. Compare and contrast public, private, and consortium blockchains (L2)

Course Outcome 2 (CO2)

1. Describe the role of a leader in the Raft consensus algorithm. (L2)
2. What is the significance of the nonce in PoW? (L2)
3. Explain the purpose of transaction fees in Bitcoin and how they are determined. (L2)

Course Outcome 3 (CO3)

1. What is a smart contract, and how does it function? (L2)
2. Describe the use of blockchain in asset tokenization. (L2)
3. Explain the concept of a Decentralized Autonomous Organization (DAO) and its purpose. (L2)

Course Outcome 4 (CO4)

1. What is the Ethereum network, and how does it differ from Bitcoin? (L2)
2. What is the role of gas in Ethereum transactions? (L2)
3. Explain the difference between memory and storage in Solidity. (L2)

Course Outcome 5 (CO5)

1.	What is the role of blockchain in financial settlements?	(L2)
2.	How does blockchain prevent double-spending attacks?	(L2)
3.	Apply blockchain to create a secure and decentralized KYC verification process.	(L3)

Model Question Paper

QP CODE: **Pages: 2**

Reg No : **Name:**

MAR ATHANASIUS COLLEGE OF ENGINEERING (AUTONOMOUS) KOTHAMANGALAM

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

Course Code: M24CA1E304I

Course Name: Blockchain Technology

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

PART A

Answer all questions. Each question carries 2 marks.

1. What is the primary purpose of blockchain technology?
2. Describe the concept of a "genesis block" in blockchain.
3. Describe the role of a leader in the Raft consensus algorithm.
4. What is the significance of the nonce in PoW?
5. What is a smart contract, and how does it function?
6. Describe the use of blockchain in asset tokenization.
7. What is the Ethereum network, and how does it differ from Bitcoin?
8. What is the role of gas in Ethereum transactions?
9. What is the role of blockchain in financial settlements?
10. How does blockchain prevent double-spending attacks?

PART B

Answer any five questions. Each question carries 8 marks.

11. Describe the key components of blockchain architecture and their functions.
12. Explain the purpose of transaction fees in Bitcoin and how they are determined.
13. Explain the concept of a Decentralized Autonomous Organization (DAO) and its purpose.
14. Explain the difference between memory and storage in Solidity.
15. Apply blockchain to create a secure and decentralized KYC verification process.
16. Compare and contrast public, private, and consortium blockchains
17. Explain the role of wallet addresses in cryptocurrency transactions.

MAR ATHANASIUS COLLEGE OF ENGINEERING

(Government Aided and Autonomous)

Kothamangalam 686 666

Affiliated to APJ Abdul Kalam Technological University
Thiruvananthapuram

SEMESTER –IV

SYLLABUS

Master of Computer Applications (MCA)
2024

M24CA1P401	Main Project	L	T	P	J	S	Credit	Year of Introduction
		0	0	14	14	21	12	2024

Preamble:

This project is designed to help students apply software engineering principles to a real-world software project. It aims to familiarize them with the stages of a deployment pipeline and guide them in developing a software product using the latest software development methodologies.

Prerequisite:

Knowledge in software engineering principles and programming skills.

Course Outcomes:

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

CO. No	Course Outcomes	Cognitive Knowledge Level
CO 1	Propose a real-world project that addresses practical needs in society or industry by actively interacting with stakeholders to identify and gather project requirements.	Analyze
CO 2	Apply suitable development methodology for the development of the product / project.	Apply
CO 3	Analyze and design a software product / project	Create
CO 4	Test the Modules at various stages of project development	Evaluate
CO 5	Build, integrate, document, and deploy the software product or project.	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	2	3	2	3	1	3	2	2
CO 2	3	2	2	3	1	3	2	2
CO 3	3	3	2	3	1	1	2	2
CO 4	3	3	2	3	1	1	2	2
CO 5	2	3	2	3	1	1	2	2

Mark Distribution

Total Marks	CIE marks	ESE marks (By External Expert)
200	100	100

Continuous Internal Evaluation (Out of 100 Marks)

- Interim Evaluation by Project Assessment Board – 20 Marks
- Final Evaluation by Project Assessment Board – 30 Marks
- Continuous Internal Evaluation by Guide – 30 Marks
- Attendance by Project Supervisor – 10 Marks
- Report by Project Supervisor – 10 Marks

Guidelines:

- Students shall identify Real-Life Projects which are relevant and useful to the society or industry.
- The project shall be an individual project and must be done in-house. The student has to spend time in the lab for the project work. Attendance as per MCA regulations is applicable for submitting the project for final evaluation.
- However, in exceptional cases students shall be given permission to work on the project outside the campus and at the industry premises if the organization offering the project belongs to anyone of the following categories.
    - CMM Level 5 Certified Company
    - Publicly listed company in India
    - National Research Institute
    - Central / State Government Department
    - Project funded by the Central / State Government Agency
- In such cases, the student is required to produce a letter from the organisation before starting the project and a committee constituted by the head of the department shall make the decision on permission. Industries and training institutes that offer project work for a fee shall not be permitted.
- Students shall submit project synopsis and get prior approval from the Project Supervisor before the project work begins. The Faculty Advisor shall serve as the Project Supervisor unless instructed otherwise by the Head of the Department.
- If there is a customer for the project then he/she will be the Product Owner (External Guide) and a faculty from the department will be the Internal Guide. If there is no such customer then the Internal Guide himself/herself shall act as the Product Owner.
- A faculty / technical staff shall act as the Scrum Master to continuously monitor the project development. Periodic meetings, of less than 15 minutes, at the convenience of the Scrum Master are to be highly encouraged. Ensure such meetings occur once in three days.
- The student shall maintain a Scrum Book (Rough Record) which has to be divided into 4 parts – (i) Product Backlog (ii) Database & UI Design (iii) Testing & Validation and (iv) Details of Versions. Make dated entries in the corresponding part at regular intervals. The corrections and comments from Product Owner and Scrum Master should be clearly indicated with the Date.
- Test Driven Development methodology may be practiced for the project development. BugZilla, BackLog or any such tool may be used for Bug Tracking.
- Git shall be used for Version Control and Git commit history may be verified as part of project evaluation .
- LaTeX or an equivalent tool shall be used for preparing Presentations and Project Report.
- Students shall be encouraged to publish their work in journals and due credit shall be given to such students.

- For the externally done projects, periodic confidential progress report and attendance statement shall be collected from the External Guide and be reviewed by the Project Supervisor.
- Set a sprint as two weeks, ensure biweekly reviews. A review shall not exceed 30 minutes. A demo to the Product Owner (Project Guide) is mandatory in every review.
- Interim evaluations of the project's progress shall be conducted by a Project Assessment Board as part of internal assessment. Two such evaluations are desirable. Scrum reviews shall not be sacrificed for such presentations.
- The Project Assessment Board shall be constituted by the Head of the Department with the following five members.

  Chairman:

  1. Head of the Department

  Members:

  2. Project Guide of the student
  3. One faculty member from the Department
  4. One faculty member from a sister Department
  5. An external expert, either from an academic/research institute or Industry. (For the externally done projects, the external guide shall be invited as external expert.)
- At the end of the semester, two evaluations shall be there on the entire project development activities. First an internal evaluation by the Project Assessment Board and second an external evaluation by an External Examiner.
- An External Examiner either from an academic institute or industry shall be appointed by the COE for the External Evaluation.

Week	Schedule
(May be scheduled in line with the academic calendar)	
1	Selection of Topic, Submission of project synopsis and getting approval Meeting of Development Team including Scrum Master with Product Owner (Project Guide)
2	Commencement of the Project.
4	First Sprint release and Scrum Review by the Product Owner (Project Guide)
6	Second Sprint release and Scrum Review by the Project Guide First interim evaluation by the Project Assessment Board
8	Third Sprint release and Scrum Review by the Project Guide
10	Fourth Sprint release and Scrum Review by the Project Guide
11	Second interim evaluation by the Project Assessment Board
12	Fifth Sprint release and Scrum Review by the Project Guide
13	Submission of project report, with Scrum Book Final project presentation Evaluation by the Project Assessment Board
14	Final evaluation by the External Examiner.

References:

1. Continuous Delivery: Reliable Software Releases through Build, Test, and Deployment Automation (Addison-Wesley Signature Series (Fowler)) 1st Edition
2. Alistair Cockburn, Agile Software Development: The Cooperative Game, Addison Wesley, 2nd Edition (2006).
3. Andrew Hunt, David Thomas, The Pragmatic Programmer: From Journeyman to Master, Pearson India, 1st Edition (2008).
4. Ken Schwaber, Mike Beedle, Agile Software Development with Scrum, Pearson (2008).
5. Lisa Crispin, Janet Gregory, Agile Testing: A Practical Guide for Testers and Agile Teams, Addison Wesley Professional, 1st Edition (2008).
6. Mike Cohn, User Stories Applied: For Agile Software Development, Addison Wesley, 1st Edition, (2004).
7. Pressman, R.S., Software Engineering: A Practitioner's Approach, McGraw Hill SE, 7th Edition, (2010).
8. Robert C. Martin, Agile Software Development, Principles, Patterns and Practices, Prentice Hall Imprint, Pearson Education, 2nd Edition (2002).\
9. Rod Stephens, Beginning Software Engineering, Wrox Series, Wiley India Pvt Ltd (2015).
10. RyPress Ry's Git Tutorial (Free e-book)

Online Resources:

1. https://onlinecourses.nptel.ac.in/noc19_cs70/preview, "Software Project Management", Prof. Rajib Mall, Prof. Durga Prasad Mohapatra, IIT Kharagpur.
2. https://onlinecourses.nptel.ac.in/noc20_cs68/preview, "Software Engineering", Prof. Rajib Mall, IIT Kharagpur.
3. https://onlinecourses.nptel.ac.in/noc22_cs61/preview, "Software Testing", Prof. Meenakshi D'souza, IIIT Bangalore.

M24CA1S402	Seminar	L	T	P	J	S	Credit	Year of Introduction
		0	0	2	0	2	2	2024

Preamble:

This course intends to enable the students to gain knowledge in any of the technically relevant current topics on Computer Science or Information Technology, and to acquire confidence in presenting the topic and preparing a report.

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	Identify and explore technically relevant current topics in Computer Science or Information Technology through extensive research.	Understand
CO 2	Demonstrate the ability to analyze, synthesize, and critically evaluate information from various sources on the chosen topic.	Understand
CO 3	Develop and enhance technical presentation skills by effectively communicating ideas, concepts, and research findings to an audience.	Apply
CO 4	Improve technical report-writing skills by organizing and documenting research findings in a structured and professional manner.	Apply
CO 5	Gain confidence in public speaking, academic discussions, and professional interactions through seminar presentations.	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	2	2	2	1	1	1	3
CO 2	2	2	2	3	1	1	1	3
CO 3	2	2	2	3	1	1	1	3
CO 4	2	2	1	3	1	1	1	3
CO 5	2	2	3	2	1	1	1	3

Mark Distribution

Total Marks	CIE marks	ESE marks
50	50	-

Continuous Internal Evaluation (Out of 50 Marks)

Evaluation by the Supervisor/ Guide – 10 Marks

Evaluation by Seminar Assessment Board:

Scope, Relevance and Knowledge in the Topic	_	10 Marks
Presentation Skill and Quality of Slides	–	20 Marks
Report	–	10 Marks

Guidelines:

- Students shall conduct detailed study on a technically relevant current topic in Computer Science / Information Technology under the supervision of a Faculty Guide and present it as a seminar at the end of the study.
- The study may be conducted on
    - articles published in reputed journals/conference proceedings
    - recent development in Computer Science / Information Technology
    - recent research and development activity in a research lab
    - latest software tool or framework
- Students shall submit an abstract on identified topic and get prior approval from the Faculty Guide before the study begins.
- The student shall submit a seminar report, based on the study and their findings. The report shall not be a reproduction of original paper or manual.
- The study and its findings shall be presented in the class taking a duration of 15-20 minutes.
- LaTeX or an equivalent tool shall be used for preparing Presentations and Seminar Report.
- Students shall be encouraged to publish their study in journals and due credit shall be given to such students.
- A committee of three senior faculty members shall constituted by the head of the department and the seminar presentation shall be evaluated by that committee.

KNOWLEDGE IS POWER

M24CA1O403	MOOC Course	L	T	P	J	S	Credit	Year of Introduction
		0	0	0	0	0	2	2024

Preamble:

Students of the MCA Programme are required to successfully complete an approved MOOC course of at least 8 weeks duration, offered by NPTEL/SWAYAM platforms, as part of their curriculum before the end of the fourth semester.

Eligibility & Approval Process

1. The students shall enroll and successfully complete a minimum of one MOOC course before the completion of their fourth semester.
2. Two credits will be awarded to students who successfully complete the MOOC course, based on the evaluation pattern of the respective institute offering the course.
3. Only MOOC courses offered by AICTE, NPTEL, SWAYAM, or NITTTR shall be considered.
4. The MOOC course should have a minimum of 8 weeks duration.
5. The MOOC courses should have at least 70% of their content aligned with the area or stream of study.
6. The department shall publish a list of eligible MOOC Courses approved by the Board of Studies on relevant subjects every year.
7. Students are permitted to register only for courses listed in the approved list.
8. Students shall not register for MOOC courses that have 50% or more content similarity with any of the courses they have completed or will be undertaking in the MCA Programme.
9. Students shall submit to the Faculty Advisor (FA) the details of the MOOC they wish to register for.
10. The Faculty Advisor shall verify the details and recommend the course if it is applicable to the student.
11. The student must then obtain approval from the Head of the Department based on this recommendation.
12. Only after receiving this approval may the student register for the MOOC Course.
13. Students may register for the MOOC Course at any time during their course of study, in accordance with the schedule published by the offering institute; however, they must submit the course completion certificate before the end of their fourth semester.
14. Submission of the ‘Successful Course Completion Certificate’ to the college portal is mandatory for the publication of the final results of the MCA programme.