Gyanmanjari

Syllabus
Gyanmanjari College Of Computer Application
Semester-1 (MCA)

Subject: Mathematics(MCA2XX11302)

Type of course: Major (Core)

Prerequisite: Basic algebra, elementary logic, set notation, number operations, and problem-solving skills.

Rationale: This course introduces the mathematical foundations required for computer science, information technology, artificial intelligence, and modern engineering applications. It develops structured thinking through sets, functions, Combinatorics, graph theory, trees, number theory, and Boolean algebra. These topics are essential for algorithm design, data structures, digital logic, programming, network modeling, and logical reasoning. The course emphasizes conceptual clarity, analytical thinking, and practical mathematical methods used in computing and engineering systems.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks		Total Marks
CI	T	P	C	SEE	CCE	
4	0	0	4	100	50	150

Course Content:

Sr. No	Course Content	Hrs.	% Weightage
1	**Module 1:Set** Set operations: union, intersection, difference, complements; power set; superset; relations between sets; Venn diagram; cross product; symmetric difference; value of the total number in a given set using formula; De Morgan's Law and examples. **Description of ALA: The Venn Mapping Studio (10 Marks)** Students model a real-life problem using sets and Venn diagrams. **The activity includes:** • Defining relevant sets from a given situation • Drawing a correct Venn diagram • Computing required set operations	12	20%

Sr No.	Evaluation Methods	SEE	CCE
1	The Set Logic Audit	20	
2	ALA: The Venn Mapping Studio		10
	Total:	**20**	**10**

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Explaining complement and symmetric difference
Writing a brief interpretation of the result

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Module 2: Function and Combinatorics
Definitions and properties of functions: domain, range, co-domain, Injectivity, Surjectivity, Bijectivity, composition of functions, inverse functions, and elementary functions; basic counting principles for multiplication, addition; permutations and combinations; generating functions and recurrence relations with applications.
<table>
<tr><th>Sr No.</th><th>Evaluation Methods</th><th>SEE</th><th>CCE</th></tr>
<tr><td>1</td><td>The Open Book Exam</td><td>20</td><td></td></tr>
<tr><td>2</td><td>ALA:
The Counting Strategy Lab</td><td></td><td>10</td></tr>
<tr><td></td><td>Total:</td><td>20</td><td>10</td></tr>
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Description of ALA: The Counting Strategy Lab (10 Marks)
Students solve real-world problems involving arrangements, selections, scheduling, or coding patterns.
The activity includes:

Identifying the correct counting principle
Solving using permutation or combination methods
Justifying the selected approach
Presenting one recurrence-based example
Preparing a short summary of the logic used

</td><td>12</td><td>20%</td></tr>
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Module 3:Graph Theory
Definitions of graphs, vertices, and edges; types of graphs: directed and undirected, simple and Multigraph, weighted and unweighted graphs; degree of vertices; paths, cycles, and connectedness; graph algorithms: graph traversal algorithms, shortest path algorithm, minimum spanning tree algorithms.
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<tr><th>Sr No.</th><th>Evaluation Methods</th><th>SEE</th><th>CCE</th></tr>
<tr><td>1</td><td>Connections Everywhere: The Power of Graph Theory</td><td>20</td><td></td></tr>
<tr><td>2</td><td>Viva voce</td><td></td><td>10</td></tr>
<tr><td></td><td>Total:</td><td>20</td><td>10</td></tr>
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Description of Connections Everywhere: The Power of Graph Theory
In this task, students will prepare and deliver a presentation on "Graph Theory in the Real World", highlighting how graph theory are applied in practical situations such as communication, transportation, and social systems, engineering, navigation, graphics, robotics, and daily life examples. The topic will be aligned with the syllabus and assigned/approved by the faculty. This task is designed to assess students' conceptual understanding,
</td><td>12</td><td>20%</td></tr>
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<tr><td></td><td>application skills, and presentation ability.
The presentation should include:
• Introduction to TOPIC
• Real-life applications with diagrams/examples
• Mathematical representation
• Conclusion and key takeaways
• Use of visual aids (PPT, charts, or simulations)
• References</td><td></td><td></td></tr>
<tr><td>4</td><td>Module 4:Tree
Definition of trees, roots, branches, and leaves; properties of trees: height, depth, size, and degree; tree traversal algorithms: preorder, in order, and post order traversal; binary trees and their applications in sorting and searching algorithms.
<table><tr><th>Sr No.</th><th>Evaluation Methods</th><th>SEE</th><th>CCE</th></tr><tr><td>1</td><td>Mathematical Problem</td><td>20</td><td></td></tr><tr><td>2</td><td>ALA:
The Binary Tree TraversalFlowchart</td><td></td><td>10</td></tr><tr><td></td><td>Total:</td><td>20</td><td>10</td></tr></table>Description of ALA: The Binary Tree Traversal Flowchart
Students create and analyze a tree structure from a given practical problem such as menu hierarchy, file structure, or decision tree.
• Dependency Mapping: Create a Flowchart tracing independent variables through intermediate ones.
• Path Logic: Label branches with partial derivatives and solve "Problem solving" cases by summing product paths.
• Oral Report: Provide a "Verbal Illustration" of the process (e.g., how input changes affect final system output)</td><td>12</td><td>20%</td></tr>
<tr><td>5</td><td>Module 5:Number Theory
Properties of integers: divisibility, prime numbers, Greatest Common Divisor (GCD) and Least Common Multiple (LCM); decimal, binary, hexadecimal integer numbers in computer logic design; logical operators; laws of commutative, associative, and distributive; De Morgan's theorem; truth table.
<table><tr><th>Sr No.</th><th>Evaluation Methods</th><th>SEE</th><th>CCE</th></tr><tr><td>1</td><td>The Logic Circuit Test</td><td>20</td><td></td></tr><tr><td>2</td><td>ALA: The Boolean Simplification Sprint</td><td></td><td>10</td></tr><tr><td></td><td>Total:</td><td>20</td><td>10</td></tr></table>Description of ALA: The Boolean Simplification Sprint
Students participate in a timed activity to simplify Boolean expressions and validate them through truth tables.
The activity includes:</td><td>12</td><td>20%</td></tr>
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	• Step-by-step Boolean simplification • Naming the algebraic laws used • Building truth tables for original and simplified expressions • Showing logical equivalence • Explaining relevance in digital logic design		

Suggested Specification table with Marks:

Distribution of Marks (Revised Bloom's Taxonomy)						
Level	Remembrance (R)	Understanding (U)	Application (A)	Analyze (N)	Evaluate (E)	Create (C)
Weightage%	10%	20%	30%	20%	10%	10%

Course Outcomes:

After learning the course, the students should be able to:	
CO1	Apply set operations, Venn diagrams, relations. and De Morgan's laws to solve classification and counting problems.
CO2	Analyze functions and solve combinatorial problems using counting principles, permutations, combinations, generating functions, and recurrence relations.
CO3	Model and analyze graph-based problems using graph properties, traversal methods, shortest path techniques, and spanning trees.
CO4	Analyze tree structures and perform preorder, inorder, and postorder traversal for hierarchical data representation and binary tree applications.
CO5	Apply number theory concepts, number system conversions, truth tables, and Boolean algebra simplification in computing and digital logic problems.

Instructional Method:

The course will be delivered using classroom teaching supported by active learning, structured problem-solving, and computing-oriented mathematical applications. In addition to blackboard teaching, the instructor may use:

- Diagram-based teaching for sets, Venn diagrams, graphs, and trees
- Guided practice sessions for functions, counting principles, and recurrence relations
- Algorithm-based demonstrations for graph traversal, shortest path, and minimum spanning tree methods
- Tree-structure demonstrations for preorder, inorder, and postorder traversal
- Boolean reasoning exercises using truth tables and algebraic simplification
- Number conversion drills for decimal, binary, and hexadecimal systems
- Open-book and worksheet-based activities for combinatorics and graph analysis

- Peer-teaching and short presentations for graph models, tree structures, and logic simplification
- Internal evaluation through ALA, class tests, audits, visual mapping exercises, and oral explanation of solutions

Reference Books:

[1]Discrete Mathematics and Its Applications by Kenneth H. Rosen
[2] Discrete Mathematical Structures by Kolman, Busby, and Ross
[3] Elements of Discrete Mathematics by C.L. Liu and D.P. Mohapatra
[4] Graph Theory with Applications by J.A. Bondy and U.S.R. Murty
[5] Boolean Algebra and Its Applications by J. Eldon Whitesitt
[6] Discrete Mathematics for Computer Scientists by J.L. Hein

Suggestive Rubrics:

Suggestive Assessment Guidelines:
Module 1: ALA: The Venn Mapping Studio (10 Marks) **10 Marks:** Excellent representation of sets, operations, and formulas with correct interpretation **08 Marks:** Good work with minor diagram or notation mistakes **05 Marks:** Basic understanding shown but overlap counting or notation errors present **02 Marks:** Limited attempt with weak conceptual clarity **00 Marks:** Not submitted
Module 2: **ALA: The Counting Strategy Lab (10 Marks)** **10 Marks:** Correct method selection with accurate solution and strong reasoning **08 Marks:** Good solution with minor procedural errors **05 Marks:** Basic logic identified but execution incomplete **02 Marks:** Weak distinction between methods and limited explanation **00 Marks:** Not submitted
Module 3: **Connections Everywhere: The Power of Graph Theory** **10 Marks:** Excellent content, real-world relevance, correct concepts, clear visuals, confident explanation **08 Marks:** Content correct, good examples, minor presentation gaps **05 Marks:** Basic concepts covered, weak real-life linkage or visuals **02 Marks:** Very limited understanding, poorly structured **00 Marks:** Incomplete / off-topic
Module 4: **ALA: The Binary Tree Traversal Flowchart** **10 Marks:** Flawless Flowchart construction; perfect path logic; confident Oral Report. **08 Marks:** Correct flowchart with minor notation gaps; successful partial derivative derivation. **05 Marks:** Flowchart provided but lacks clear branching; struggles to explain the logical flow.

02 Marks: Poorly structured diagram; cannot link variables correctly. **00 Marks:** Incomplete or off-topic.
Module 5: **ALA: The Boolean Simplification Sprint (10 Marks)** **10 Marks:** Excellent simplification with correct truth table verification **08 Marks:** Mostly correct simplification and validation **05 Marks:** Basic logic understood but simplification incomplete **02 Marks:** Minimal success in equivalence verification **00 Marks:** Not submitted