GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Bachelor of Computer Applications

Level: Under Graduate

Course / Subject Code : BC02001051

Course / Subject Name : Mathematics-2

w. e. f. Academic Year:	2024-25
Semester:	2
Category of the Course:	Multidisciplinary Course

Prerequisite:	Basic mathematical skills
Rationale:	This course provides a foundational understanding of mathematical logic, relations, and graph theory, which are essential areas of study in computer science, mathematics, and related disciplines. **Mathematical Logic** forms the basis for reasoning and decision-making in computational systems, algorithm design, and programming languages. The study of **statements, connectives, and truth tables** equips students with the tools to analyze and verify logical expressions, which is crucial for building efficient algorithms, error-checking mechanisms, and developing formal proofs. The topics of **tautology, contradiction, equivalence, and normal forms** foster the ability to simplify and manipulate logical statements, making them more computationally feasible and interpretable. The section on **Relations & Ordering** explores the mathematical structures that underlie the relationships between different objects in a set, forming the foundation for database theory, object-oriented programming, and the design of relational systems. Understanding properties like **binary relations, equivalence relations, and partial ordering** prepares students for analyzing data relationships and optimizing search and retrieval operations. These concepts also support the study of **graph theory** by offering methods to categorize and compare sets of data and relationships systematically. **Graph Theory**, an essential tool for modeling networks, structures, and systems, is introduced to students in this course through its various components, such as **nodes, edges, paths, and connectivity**. Topics like **directed and undirected graphs, isomorphic graphs, and reachability** provide students with the skills to represent and solve real-world problems, such as transportation networks, social networks, and communication systems. Additionally, concepts of **graph connectivity** and **path finding** are crucial in algorithmic design, particularly in areas like network routing, graph traversal, and optimization. This course builds logical thinking, analytical skills, and problem-solving abilities that are central to computer science, ensuring students are well-prepared for more advanced topics in algorithms, data structures, artificial intelligence, and software

	engineering. By mastering these foundational concepts, students will be equipped to address complex computational challenges and contribute to innovations in various technical fields.

Course Outcome:

After completion of the course, students will be able to:

No	Course Outcomes	RBT Level*
1	**Apply** principles of mathematical logic to design and optimize algorithms by constructing and simplifying logical expressions, using truth tables, normal forms, and logical connectives to verify correctness and prove equivalence.	AP
2	**Apply** concepts of relations and ordering to model and analyze real-world systems by using relation matrices, graphs, and partitioning techniques to represent binary relations, equivalence relations, and partial orderings in problem-solving and data organization tasks.	AP
3	**Apply** combinatorial techniques, including counting principles, permutations, combinations, the pigeonhole principle, and binomial coefficients, to solve complex problems in probability, optimization, and algorithm design.	AP
4	**Apply** graph theory concepts, such as directed and undirected graphs, paths, cycles, and connectivity, to model and solve problems in network analysis, resource optimization, and route planning, utilizing graph representations to analyze relationships and determine efficient solutions in real-world systems.	AP

Teaching and Examination Scheme:

Teaching Scheme (in Hours)			Total Credits L+T+ (PR/2)	Assessment Pattern and Marks				Total Marks
				Theory		Tutorial / Practical		
L	T	PR	C	ESE (E)	PA / CA (M)	PA/CA (I)	ESE (V)	
4	0	0	4	70	30	-	-	100

Course Content:

Unit No.	Content	No. of Hours	Weightage (%)
1	**Mathematical Logic** ➢ Statements and Notation ➢ Connectives (Negation, Conjunction, Disjunction) ➢ Statement Formulas and Truth Table ➢ Conditional and Biconditional statement; Tautology and contradiction	11	25%

	➢ Equivalence Formulas ➢ Duality ➢ Normal Forms		
2	**Relation & Ordering** ➢ Relations ➢ Properties of Binary Relations in a set ➢ Relation Matrix and Graph of a Relation ➢ Partition and Covering of a Set ➢ Equivalence Relations ➢ Compatibility Relations ➢ Partial ordering ➢ Partially ordered set: Representation and Associated Terminologies	11	25%
3	**Combinatorics** ➢ The Basic Counting Principles ➢ Permutations and Combinations ➢ Pigeonhole Principle ➢ Binomial Coefficient ➢ Discrete Probability	11	25%
4	**Graph Theory:** ➢ Basic Concepts of Graph Theory; Initial Terminal nodes; Adjacent nodes; Directed edge; Undirected Edge; Directed Graph (Digraph), Undirected Graph; Mixed Graph; Loop; Distinct Edges; Parallel Edges; Multi Graph; Simple Graph; Weighted Graph; Isolated Nodes; Pendent Nodes; Null Graph; Isomorphic Graphs; In-degree, Out-degree, Total-degree; Sub graph. ➢ Paths, Length of a Path of a graph; Simple Path; Elementary Path; Cycle(circuit); Simple Cycle; Elementary cycle; Path of Minimum Length (Geodesic); Distance between two nodes; Reachability; Reachable set of a Node; Connected Graph; Strongly, Unilaterally, Weakly Connected Graph & Components	12	25%
	Total Hours:	**45**	**100%**

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**

20%	**30%**	**50%**	**-**	**-**	**-**

Where R: Remember; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create (as per Revised Bloom's Taxonomy)

References/Suggested Learning Resources:
(a) Textbook:

Sr No.	Book Title	Edition	Publisher	Author(s)
1.	Discrete Mathematical Structures with Applications to Computer Science	Latest	Tata McGraw Hill	J.P. Trembly; R. Manohar
2.	Discrete Mathematics	Latest	Cengage Learning	D. S. Malik; M.K. Sen

Reference Books:

Sr No.	Book Title	Edition	Publisher	Author(s)
1.	A textbook of Discrete Mathematics	Latest	S. Chand Publication	Swapan Kumar Sarkar
2.	Discrete Mathematics	Latest	Oxford University Press	Swapan Kumar Chakraborty; Bikas Kanti Sarkar

CO- PO Mapping:

Semester 2	**Subject Name: Mathematics-2**										
	POs										
Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	1	-	-	1	-	-	-	-	-	-
CO2	3	1	-	-	1	-	-	-	-	-	-
CO3	3	1	-	-	1	-	-	-	-	-	-
CO4	3	1	-	-	1	-	-	-	-	-	-

*Legend: '**3**' for high, '**2**' for medium, '**1**' for low and '**-**' for no correlation of each CO with PO.*

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