GUJARAT TECHNOLOGICAL UNIVERSITY

Master in Computer Application (MCA)

Year II – (Semester-III) (W.E.F. June 2016)

Subject Name: Basic Mathematics
Subject Code: 3630001

Objective

The objective of this course is to present the foundations of many basic mathematical topics used in Computer Science including RDBMS, Data Structures, Analysis of Algorithms, Theory of Computation, Cryptography, Artificial Intelligence and others. This course will enhance the student's ability to think logically and mathematically.

Prerequisites: Binary number system

Unit No.	Chapter Details	Weightage	No. of Lecture
1	**Set Theory, Propositional & Predicate Logic** **Set Theory**: Basic Concepts of Set Theory: Definition, Notion, Inclusion, and Equality of Sets; the Power Set, Some Operations on Sets, Venn Diagrams; Some Basic Set Identities **Propositional Logic**: Definition, Statements & Notation, Truth Values, Connectives, Statement Formulas & Truth Tables, Well-formed Formulas, Tautologies, Equivalence of Formulas, Duality Law, Tautological Implications, Examples **Predicate Logic**: Definition of Predicates; Statement Functions, Variables, Quantifiers, Predicate Formulas, Free & Bound Variables; The Universe of Discourse, Examples, Valid Formulas & Equivalences, Examples	20%	08
2	**Natural Numbers, Matrices, Recursion** **Natural Numbers**: Peano's Axioms; Mathematical Induction, Principles of Mathematical Induction; Examples; Cardinality, Cardinal Numbers, Denumerable and Non-denumerable Set; Countable Set; Enumeration **Matrices**: Representation, Matrix Operations: Addition, Subtraction, Multiplication, Transpose; Special matrices: Null, Unit, Triangular Matrices; Inverse of a Matrix	25%	09

	Recursion: Recursive Functions, Sets & Predicates; Examples; Primitive Recursive Functions; Examples; Algorithms of Prime Numbers, & Perfect Numbers; Recursion in Programming languages		
3	**Relations and Functions** **Relations**: Definition, Binary Relation, Representation, Domain, Range, Universal Relation, Void Relation, Union, Intersection, and Complement Operations on Relations, Properties of Binary Relations in a Set: Reflexive, Symmetric, Transitive, Anti-symmetric Relations, Relation Matrix and Graph of a Relation; Partition and Covering of a Set, Equivalence Relation, Equivalence Classes, Compatibility Relation, Maximum Compatibility Block, Composite Relation, Converse of a Relation, Transitive Closure of a Relation R in Set X ***Partial Ordering***: Definition, Examples, Simple or Linear Ordering, Totally Ordered Set (Chain), Frequently Used Partially Ordered Relations, Representation of Partially Ordered Sets, Hesse Diagrams, Least & Greatest Members, Minimal & Maximal Members, Least Upper Bound (Supremum), Greatest Lower Bound (infimum), Well-ordered Partially Ordered Sets (Posets). Lattice as Posets, Definition & examples. **Functions**: Introduction & definition, argument. Co-domain, range, image, value of a function; Examples, Peano's successor function; onto (surjective), Into, one-to-one (injective), many- to-one, bijective (one-to-one and onto); examples; Composition of functions, examples; Inverse function, Identity map, condition of a function to be invertible, examples; Inverse of composite functions, Properties of Composition of functions; Binary and n-ary operations as mappings (functions), Properties of Binary operations; Characteristic function of a set; properties, examples; Hashing functions: Division method, and Mid-square method, examples;	**25%**	**10**
4	**Graph Theory & Trees** Graphs: Introduction, definition, examples; Nodes, edges, adjacent nodes, directed and undirected edge, Directed graph, undirected graph, examples; Initiating and terminating nodes, Loop (sling), Distinct edges, Parallel edges, Multi-graph, simple graph, weighted graphs, examples, Isolated nodes, Null graph; Isomorphic graphs, examples; Degree, In- degree, out-degree, total degree of a node, examples; Subgraphs: definition, examples; Converse (reversal or directional dual) of a digraph, examples;	**30%**	**12**

	Path: Definition, Paths of a given graph, length of path, examples; Simple path (edge simple), elementary path (node simple), examples; Cycle (circuit), elementary cycle, examples; Reachability: Definition, geodesic, distance, examples; Properties of reachability, the triangle inequality; Reachable set of a given node, examples, Node base, examples Connectedness: Definition, weakly connected, strongly connected, unilaterally connected, examples; Strong, weak, and unilateral components of a graph, examples, Applications to represent Resource allocation status of an operating system, and detection and correction of deadlocks; Matrix representation of graph: Definition, Adjacency matrix, boolean (or bit) matrix, examples; Determine number of paths of length n through Adjacency matrix, examples; Path (Reachability) matrix of a graph, examples; Warshall's algorithm to produce Path matrix, Flowchart. Trees: Definition, branch nodes, leaf (terminal) nodes, root, examples; Different representations of a tree, examples; Binary tree, m-ary tree, Full (or complete) binary tree, examples; Converting any m-ary tree to a binary tree, examples; Representation of a binary tree: Linked-list; Tree traversal: Pre-order, in-order, post-order traversal, examples, algorithms; Applications of List structures and graphs		

Text Books:

1. J. P. Tremblay and R.Manohar, “Discrete Mathematical Structures with Applications to Computer Science”, Tata McGraw-Hill (2010)
2. D. S. Malik & M. K. Sen, "Discrete Mathematics", Cengage Learning, (2004)

Reference Books:

1. K. H. Rosen, “Discrete Mathematics and its applications”, Tata McGraw-Hill, 6 th edition,
2. Bernard Kolmann & others, “Discrete Mathematical Structure”, Pearson Education, Sixth Edition
3. Edgar G. Goodaire, Michael M. Parmenter. “Discrete Mathematics with Graph Theory”, PHI,
4. J. P. Tremblay and W. K. Grassman. “Logic and Discrete Mathematics”, Pearson Education,

Chapter wise coverage from the Text Books:

Unit	Chapter wise coverage
1	Book-1: Set Theory: 2-1 Propositional Logic: Book-2: 1.2, 1.3 Predicate Logic: Book-2: 1.4
2	Natural Numbers: Book-1: 2-5 Matrices: Book-2: 4.1 Recursion: Book-1: 2-6

3	Relations: Book-1: 2-3 Functions: Book-1: 2-4
4	Graph Theory: Book-1: 5-1 (5-1.1 to 5-1.3), Trees: Book-1: 5-1.4, 5-2

Accomplishment of the student after completing the course:
The student will be able to understand various algorithms and implement them in C language. More specifically, she will be able to understand and apply the concepts of sets, cross product of sets and relation, recursion, functions, hash functions, matrices, and basic algorithms related with binary tree and graphs.