LOK JAGRUTI UNIVERSITY (LJU)

INSTITUTE OF ENGINEERING AND TECHNOLOGY

Department of Information Technology (702)

Bachelor of Engineering (B.E.) – Semester – IV

Course Code:	**017023491**
Course Name:	**Discrete Mathematics**
Category of Course:	Professional Core Course (PCC)
Prerequisite Course:	Mathematics - II (017021291), Data Structures (017023292)

Teaching Scheme				
Lecture (L)	**Tutorial (T)**	**Practical (P)**	**Credit**	**Total Hours**
3	**1**	**0**	**4**	**40**

Syllabus

Unit No.	Topic	Prerequisite Topic	Successive Topic	Teaching Hours
01	**Set Theory**			**5 (8%)**
	1.1 Basic Concepts of Set Theory: Sets, Methods of Describing a Set: Roster Method and Set Selector/ Set Builder Method, Some Special Sets, Subsets, Proper Subsets, Equality of Sets, Null Set, Universal Set, Ordered Pair, Cartesian Product, Power Set, Examples.	---	Basics of Automata (017023492-Unit -1)	
	1.2 Venn Diagrams, Operations on Sets: Union of sets, Intersection of sets, Disjoint Sets, Difference of sets, Symmetric difference of sets, Complement of a set, Examples.	Basic Concepts of Set Theory (017023491-Unit-01)	---	
	1.3 Some Basic Set Identities: Idempotent Laws, Commutative Laws, Associative Laws, Distributive Laws, De Morgan's Laws, Absorption Laws, Double Complement, Examples.	---	---	
	1.4 Partitions of a Set, Cardinality of a finite set, Principle of Inclusion and Exclusion, Examples.	---	---	
02	**Functions & Counting**			**4 (9%)**
	2.1 Functions/ Mappings, Representation by diagram, Examples.	Set Theory (017023491-Unit-01)	---	
	2.2 Domain & Co-domain, Image of a function, Range of a function, Function as a set of ordered pairs, Identity Function, Constant Function, Examples.		---	
	2.3 Types of Functions: One to one Function (Injective Mapping), Many to One Function, Into Function, Onto Function (Surjective Mapping), One One Onto Function (Bijective Mapping), Inverse Function, Examples.		---	
	2.4 Composition (Product) of Functions, Examples.		---	
	2.5 Pigeonhole Principle, Extended Pigeonhole Principle, Examples.	---	---	
	2.6 Permutation and Combination, Binomial Co-efficient, Examples.	---	---	
03	**Propositional Logic**			**3 (10%)**
	3.1 Logic, Statements (Propositions), Open Statement, Truth Values, Examples.	---	---	
	3.2 Logical Connectives: Conjunction, Disjunction, Negation, Conditional Connectives, Biconditional, Contrapositive Implication, Exclusive Disjunction, Inverse, Examples.	---	---	
	3.3 Construction of Truth tables, Examples.	---	---	
	3.4 Tautology, Contradiction, Contingency, Examples.	---	---	
	3.5 Logical Equivalence, Examples, Logical Identities: De Morgan's Laws, Associative Laws, Commutative Laws, Idempotent Laws, Double Negation, Distributive Laws, Absorption Laws, Examples.	---	---	
04	**Propositional and Predicate Logic**			**4 (8%)**
	4.1 Normal Forms, Disjunctive Normal Forms (DNF), Conjunctive Normal Forms (CNF), Examples with and without using truth table.	Propositional Logic (017023491-Unit-03)	---	
	4.2 Arguments, Valid argument, Fallacy arguments, Examples.		---	
	4.3 Predicates, Universe of discourse.		---	
	4.4 Quantifiers: Universal Quantifier and Existential Quantifier, Examples.		---	
05	**Recurrence Relations**			**3 (7%)**
	5.1 Recursion, Recurrence Relation Introduction.	Higher Order Ordinary Differential Equations (017021291-Unit-09)	---	
	5.2 Linear Recurrence Relation with constant co-efficients, Characteristic equation, Homogeneous Solution (distinct and equal roots), Examples.		---	
	5.3 Non-Homogeneous Linear Recurrence Relation, Particular Solution for given right hand sides, Total Solution, Examples.		---	

06	**Relations**			**4 (11%)**
	6.1 Binary Relation, Domain, Range, Relation Matrix, Examples.	Set Theory (017023491-Unit-01)	---	
	6.2 Graphical representation of a relation (Digraph), Examples.	---	---	
	6.3 Inverse relation, Complement of a relation, Composition of relations, Relation in a set, Identity relation, Universal relation in a set, Void relation, Examples.	---	---	
	6.4 Types of relation: Reflexive relation, Symmetric relation, Compatible relation, Antisymmetric relation, Transitive relation, Examples.	---	---	
	6.5 Equivalence Relation, Examples.	---	---	
	6.6 Transitive Closure of a Relation, Transitive closure by conventional method, Warshall's Algorithm, Examples.	---	---	
07	**Partial Ordering**			**5 (13%)**
	7.1 Partial Order relation, Examples.	Relations (017023491-Unit-06)	---	
	7.2 Partial Ordered Set (POSET), Examples.		---	
	7.3 Representation of POSET, Construction of Hasse Diagram, Examples.		---	
	7.4 Chains, Anti- Chains, Maximal and Minimal Elements, Examples.		---	
	7.5 Upper Bound, Lower Bound, Least Upper Bound (LUB), Greatest Lower Bound (GLB), Examples.		---	
	7.6 Lattice, Lattice Operators, Sub Lattice, Properties of Lattices, Examples.		---	
	7.7 Types of Lattices: Bounded Lattice, Distributive Lattice, Complemented Lattice, Examples.		---	
	7.8 Boolean Algebra, Examples.		---	
08	**Graph Theory**			**4 (12%)**
	8.1 Graphs, Multigraphs, Pseudographs, Simple graphs, Degree of a vertex, Weighted graphs, Finite graphs, Infinite graphs, Directed graphs, In degree and out degree of a vertex, Underlying graph of a graph, Examples.	---	Fundamental Graph Algorithm (017023591-Unit- 5.1)	
	8.2 Complete graph, Regular graph, Null graph, Directed complete graph, Bipartite graph, Complete bipartite graph, Star graph, Wheel graph, Subgraphs, Spanning subgraphs, Complement of a subgraph, Null subgraph, Complement of a graph, Path, Simple path, Elementary path, Simple circuit, Elementary circuit, Planar graph, Examples.	---	---	
	8.3 Operations on graphs: Union of graphs, Intersection of graphs, Ring sum of graphs, Removal of an edge, Removal of a vertex, Examples.	---	Fundamental Graph Algorithm (017023591-Unit- 5.2, 5.3)	
	8.4 Hand Shaking Lemma, Examples, Isomorphic Graphs, Examples.	---	---	
	8.5 Eulerian path, Eulerian circuit, Eulerian graph, Hamiltonian path, Hamiltonian circuit, Hamiltonian graph, Examples.	---	---	
	8.6 Dijkstra's Algorithm, Floyd Warshall's Algorithm, Travelling Salesman Problem, Nearest Neighbour Method, Examples.	---	---	
09	**Connectedness and Trees**			**4 (11%)**
	9.1 Reachability, Reachable set, Geodesics, Distance, Connected graphs, Disconnected graphs, Strongly Connected graphs, Weakly connected graphs, Unilaterally Connected graphs, Adjacency Matrix, Path Matrix, Examples.	---	---	
	9.2 Tree Introduction, Forest, Leaf, branch node, Properties of trees.	---	---	
	9.3 Eccentricity of a vertex, level and height of a tree, radius and diameter of a tree, Center of a tree, Examples.	---	---	
	9.4 m-ary tree, regular m-ary tree, Binary tree, regular binary tree, Examples.	Tree (017023292-Unit-08)	---	
	9.5 Prefix Code, Optimal tree, Huffman Coding, Examples.	---	Greedy Algorithm (017023591-Unit- 6.1, 6.2, 6.3)	
	9.6 Spanning tree, Minimum spanning tree, Prim's Algorithm, Kruskal's Algorithm, Examples.	---	---	
10	**Algebraic Structures**			**4 (11%)**
	10.1 Binary operation on a set, Composition table, Algebraic Structures, Examples.	---	---	
	10.2 Properties of Binary Operations: Closure, Associative, Commutative, Existence of Identity, Existence of Inverse, Examples.	---	---	
	10.3 Groupoid, Semi Group, Monoid, Group, Abelian group, Examples.	---	---	
	10.4 Addition and Multiplication modulos, Group Permutations, Examples.	---	---	
	10.5 Subgroup, Examples.	---	---	

Proposed Theory + Practical Evaluation Scheme by Academicians (% Weightage Category Wise and it's Marks Distribution)					
L:	**3**	**T:**	**1**	**P:**	**0**
Note: In Theory Group, Total 4 Test (T1+T2+T3+T4) will be conducted for each subject. Each Test will be of 25 Marks. Each Test Syllabus Weightage: Range should be 20% - 30%					
Group (Theory or Practical)	**Group (Theory or Practical) Credit**	**Total Subject Credit**	**Category**	**% Weightage**	**Marks Weightage**
Theory	**4**	**4**	MCQ	20%	20
Theory			Theory Descriptive	0%	0
Theory			Formulas and Derivation	0%	0
Theory			Numerical	80%	80
Expected Theory %	**100%**		**Calculated Theory %**	**100%**	**100**
Practical	**0**		Individual Project	0%	0
Practical			Group Project	0%	0
Practical			Internal Practical Evaluation (IPE)	0%	0
Practical			Viva	0%	0
Practical			Seminar	0%	0
Expected Practical %	**0%**		**Calculated Practical %**	**0%**	**0**
Overall %	**100%**			**100%**	**100**

Course Outcome	
	Upon completion of the course students will be able to
1	Understand the basic principles of sets, operations in sets and Principle of Inclusion and Exclusion. Types of functions, domain and range of a function, perform the composition of functions and apply counting Write an argument using logical notation and determine if the argument is or is not valid. To simplify and evaluate basic logic statements including compound statements, implications, inverses, converses, and contra positives using truth tables and the properties of logic.
2	Introduction to Normal Forms. To express a logic sentence in terms of predicates, quantifiers, and logical connectives. Be familiar with recurrence relations. Apply relations and to determine their properties.
3	Introduction to Partial Order Relation. Introduction to Graph theory, Types of Graphs, Operations on graphs, understand the shortest path algorithms.
4	Introduction to Reachability, Properties of Tree and algorithms on spanning Tree. Use the properties of algebraic structures.
Suggested Reference Books	
1	J. P. Tremblay and R. Manohar, Discrete Mathematical Structures with Applications to Computer Science, Tata McGraw-Hill,1997.
2	S. Lipschutz and M. L. Lipson, Schaum's Outline of Theory and Problems of Discrete Mathematics, 2nd Ed., Tata McGraw-Hill,1999.
3	K. H. Rosen, Discrete Mathematics and its applications, Tata McGraw-Hill, 6th Ed., 2007.
4	David Liben-Nowell, Discrete Mathematics for Computer Science, Wiley publication, July 2017.
5	Eric Gossett, Discrete Mathematics with Proof, 2nd Edition,Wiley publication, July 2009.

List of Open Source Software/Learning website	
1	https://nptel.ac.in