Discrete Structures

Course Code: **MCA-101** **L T C**
Course Name: **Discrete Structures** **3 1 4**

INSTRUCTIONS TO PAPER SETTERS:

1. Question No. 1 should be compulsory and cover the entire syllabus. There should be 10 questions of short answer type of 2.5 marks each, having at least 2 questions from each unit.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions to evaluate analytical/technical skills of candidate. However, student may be asked to attempt only 1 question from each unit. Each question should be of 12.5 marks, including its subparts, if any.
3. Examiners are requested to go through the Course Outcomes (CO) of this course and prepare the question paper accordingly, using Bloom's Taxonomy (BT), in such a way that every question be mapped to some or other CO and all the questions, put together, must be able to achieve the mapping to all the CO(s), in balanced way.

LEARNING OBJECTIVES:

In this course, the learners will be able to develop expertise related to the following:-

1. Familiarization of basic mathematical structures and combinatorics
2. Understanding and ability to apply mathematical logic and Boolean Algebra
3. Understanding and application of number theory and elementary Group Theory
4. Application and construction of graphs in providing solutions of Computer Science problems

PRE-REQUISITES:

Basic knowledge of Mathematics.

COURSE OUTCOMES (COs):

After completion of this course, the learners will be able to:-

CO #	Detailed Statement of the CO	BT Level	Mapping to PO #
CO1	Choose appropriate discrete structures and combinatorics for basic problems.	BTL1	PO1, PO2, PO3
CO2	Interpret and illustrate the basics of Group Theory.	BTL2	PO1, PO2, PO3,PO4
CO3	Examine and infer mathematical logic and Boolean Algebra.	BTL4	PO1, PO2,PO3, PO4, PO7
CO4	Evaluate applications of number theory.	BTL5	PO1, PO2, PO3, PO4
CO5	Implement and create models for computer science problems by understanding the concepts of Graph Theory.	BTL6	PO1, PO2, PO3, PO4, PO7, PO11

UNIT – I

No. of Hours: 11 **Chapter / Book Reference: TB1 [Chapters 2, 4, 5, 6, 7]; TB2 [Chapters 2, 3]; TB3 [Chapter 4, 7, 8, 10, 11]**

Sets Theory Concepts: Sets, Subsets, Power Set, Multi-sets, Operations on Sets, Algebra of sets, Principle of Inclusion and Exclusion; Cartesian Product, Relations, Types of Relations, Equivalence Relation, Partial Order Relation, Closure of Relation; Function, Properties of Functions, One-one Function, Many-one Function, Onto function, Composition of a Function, Invertible Function.

Combinatorics: Permutation, Combination, Combination with Unlimited Repetition, Pigeonhole Principle.

Recurrence Relations: Definition, Solution of Linear First-order Recurrence Relations with Constant Coefficients (Homogeneous and Non-homogeneous).

UNIT – II

No. of Hours: 12 **Chapter / Book Reference: TB1 [Chapters 1, 4, 5, 10]; TB2 [Chapters 1, 4]; TB3 [Chapters 2, 3, 9]**

Formal logic: Statement, Symbolic Representation, Tautologies, Fallacy, Operations on Logic, Logically Equivalence, Algebra of Propositions, Arguments and Validity, Rules of Inference for Propositional Logic, Normal Forms.

Methods of Proofs: Direct Proof, Indirect Proof, Proof by Contradiction, Proof by Exhaustive Cases, Principle of Mathematical Induction, Principle of Complete Induction.

Lattices: Poset, Lattice, Sublattices, Types of Lattices - Bounded Lattice, Distributive Lattice, Complemented Lattice; Isomorphic Lattices.

Boolean Algebra: Definition, Subalgebra, Boolean Function, Boolean Expressions, Minimization of Boolean Function, K-Map.

UNIT – III

No. of Hours: 11 **Chapter / Book Reference: TB1 [Chapters 3, 11]; TB2 [Chapters 3, 6]; TB3 [Chapters 6, 12, 20]**

Number Theory: Primes, Division Algorithm, Greatest Common Divisor (GCD), LCM, Euclidean Algorithm, Fundamental Theorem of Arithmetic, Congruences, Linear Congruence equations, Chinese-Remainder Theorem, Euler Phi function, Fermat's Little Theorem, Applications of Congruences – ISBN, UPC, Introduction to Cryptography.

Group Theory: Definition, Groups as Symmetries, Subgroups, Cosets, Cyclic Group, Normal Subgroups, Quotient Group, Lagrange's Theorem, Homomorphism, Permutation Group.

UNIT – IV

No. of Hours: 10 **Chapter / Book Reference: TB1 [Chapter 8]; TB2 [Chapter 5]; TB3 [Chapters 14, 15]**

Graph Theory: Graphs, Types of Graphs, Degree of a Vertex, Subgraphs and Isomorphic Graphs, Representation of Graphs, Operations of Graphs, Walks and Paths, Connectivity, Weighted Graphs, Euler Graph, Fluery's Algorithm, Hamiltonian Graph, Cut-Vertices and Cut-Edges, Planar Graphs, Euler's formula, Graph Colouring - Vertex Colouring, Edge Colouring, Chromatic Number and Chromatic Polynomial, Welch-Powell Algorithm, Four Colour Conjecture, Five Colour Theorem (with proof).

TEXT BOOKS:

TB1. Kenneth H. Rosen, "Discrete Mathematics & its Applications: With Combinatorics and Graph Theory", McGraw Hill, 7th Edition, 2017.

TB2. J. P. Tremblay and R. Manohar, "Discrete Mathematical Structures with Applications to Computer Science", McGraw Hill, 1st Edition, 2001.

TB3. Swapan Kumar Sarkar, "A Textbook of Discrete Mathematics", S. Chand Publishing, 9th Edition, 2019.

REFERENCE BOOKS:

RB1. Kolman, Busby and Ross, "Discrete Mathematical Structures", Pearson, 10th Edition, 2015.

RB2. D. S. Malik and M. K. Sen, "Discrete Mathematics: Theory and Applications", Cengage, 1st Edition, 2012.

RB3. C. L. Liu, D. P. Mohapatra, "Elements of Discrete Mathematics", McGraw Hill, 4th Edition, 2012.

RB4. S. Santha, "Discrete Mathematics with Combinatorics and Graph Theory", Cengage, 1st Edition, 2009.

RB5. Narsingh Deo, "Graph Theory with Applications to Engineering and Computer Science", PHI, 1st Edition (1979), 24th Indian Print, 2003.