DISCRETE STRUCTURES

(Common to the branches CSE, IT, CSE (AI & ML) and CSE(DS))

Course Code: 22CM1102

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Course Outcomes: At the end of the Course, the student shall be able to

CO1: Verify the validity of a logical flow of arguments**(L5)**
CO2: Apply various counting techniques **(L3)**
CO3: Identify various types of relations and algebraic structures and their properties**(L4)**
CO4: Solve recurrence relations of various types**(L3)**
CO5: Understand various concepts of graphs and spanning trees**(L2)**

UNIT-I — 10 Lectures

Mathematical logic:

Statements and notations, connectives, well formed formulas, tautologies, equivalence of formulas, duality law, tautological implications, other connectives, normal forms, rules of inference, consistency of premises and indirect method of proof, Predicates variables and quantifiers, predicate formulas, free and bound variables, universe of discourse (Sections 1-1, 1-2.1 to 1-2.4, 1-2.6 to 1-2.11, 1-2.14, 1-3.1 to 1- 3.4, 1-4.1 to 1-4.3, 1-5.1 to 1-5.5 of textbook 1)

Learning Outcomes:

At the end of this unit, the student will be able to

1. determine the equivalence of formulas and implement the logic for mathematical proofs (L3)
2. infer the consistency of an argument (L4)
3. test the validity of the conclusion based on the hypothesis (L5)

UNIT-II — 10 Lectures

Elementary Combinatorics:

Basics of counting, Combinations and permutations, Enumeration of Combinations and permutations, Enumerating Combinations and permutations with repetitions, Enumerating permutations with constrained repetitions, The binomial and Multinomial theorems, The principle of inclusion-exclusion (2.1-2.5, 2.7, 2.8 of text Book 2)

Learning Outcomes:

At the end of this unit, the student will be able to

1. identify the terms for a given polynomial using binomial theorem (L4).
2. apply combinatorial tools and solve related problems(L3).
3. solve counting problems using the principle of inclusion and exclusion(L3).

UNIT-III — 10 Lectures

Relations and Algebraic structures:

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, composition of binary relations,Partial order relation, partially ordered set, Hasse diagram,

Algebraic structure, group, abelian group, subgroup, ring, field- definitions and examples,

(Sections 2-3.1 to 2-3.9, 3-5.1 to 3-5.4, 3-6.2 of the textbook 1)

Learning Outcomes:

At the end of this unit, the student will be able to

1. identify the different types of relations (L4)
2. classify the data into classes using equivalence relations (L4)
3. explain different algebraic structures (L2)

UNIT-IV **10 Lectures**

Recurrence relations:

Generating function of a sequence, calculating coefficients of a generating function, recurrence relations, solving linear recurrence relations by substitution method, generating function method and method of characteristic roots, solving inhomogeneous recurrence relations

(Sections 3.1- 3.6 of the text book 2)

Learning Outcomes:

At the end of this unit, the student will be able to

1. calculate coefficients of a generating function (L3)
2. solve linear recurrence relations (L3)
3. explain the method of solving inhomogeneous recurrence relations (L2)

UNIT-V **10 Lectures**

Graph theory:

Basic concepts of a graph, isomorphism and subgraph, tree and its properties, DFS, BFS algorithms for finding a spanning tree, Kruskal's and Prim's algorithms for finding a minimal spanning tree. (Sections 5.1-5.4 of textbook 2)

Learning Outcomes:

At the end of this unit, the student will be able to

1. classify different graphs (L4)
2. discuss graph isomorphism (L2)
3. determine a spanning tree from a graph (L3)

Textbooks:

1. J.P. Tremblay and R. Manohar, "*Discrete Mathematical Structures with Applications to Computer Science*", Tata McGraw Hill, 1997
2. Joe L. Mott, Abraham Kandel and T. P. Baker, "*Discrete Mathematics for computer scientists & Mathematicians*" , 2nd edition, Prentice Hall of India Ltd, 2012

Reference Books:

1. Keneth. H. Rosen, "Discrete Mathematics and its Applications", 6th edition, Tata McGrawHill, 2009.
2. Richard Johnsonburg, "Discrete mathematics", 7th edition, Pearson Education, 2008.
3. NarsinghDeo, "Graph Theory with Applications to Engineering and Computer Science", Prentice Hall of India, 2006.