Course: OE
Discrete Mathematics

Semester: I	Credits: 2	Subject Code: OE2-12308	Lectures: 30

Course Outcomes:

At the end of this course, the learner will be able to:
- CO1-Define and understand the basics of logic. Write an argument using logical notation and determine validity of the argument.
- CO2-Determine properties of relations, identify equivalence and partial order relations and represent them diagrammatically.
- CO3-Apply among various counting principles and apply them appropriately.
- CO4-Understand the basic concepts of Graph Theory and its types.

Unit 1: Logic and Boolean Algebra	15

- Revision - Propositional Logic, Propositional Equivalences
- Predicates and Quantifiers - Predicate, n-Place Predicate or n-ary Predicate, Universal Quantifier and Existential Quantifier
- Rules of Inference - Argument in propositional Logic, Rules of Inference for Propositional Logic, Constructing Arguments, Validity of Argument using Direct and Indirect method
- Relations – Definition, Types of relations, Equivalence relations, Digraphs of relations, matrix representation of relation. Partial Order Relations – Definition, Poset, Hasse diagram
- Lattices - Definition and terminologies, Properties of Lattices (without proof) Types of Lattices: Complemented Lattice, Bounded Lattice and Distributive Lattice – Definition and examples, Theorem on existence and uniqueness of complement of an element in a distributive lattice. (with proof)
- Boolean Algebra - Introduction to Boolean Variable and Boolean Function, Boolean Identities, Definition of Boolean Algebra, Representation of Boolean Functions: Minterm, Maxterm, Disjunctive Normal Form and Conjunctive Normal Form
- Test/Assigenment

Unit 2: Counting Principles and Graphs	15

- Cardinality of Set - Cardinality of a finite set, Basics of Counting - The Product Rule, The Sum Rule
- The Inclusion- Exclusion Principle (with proof – for 2 sets and 3 sets) (without proof for n sets)
- The Pigeonhole Principle – Statement, The Generalized Pigeonhole Principle and its Applications
- Problems based on all above-mentioned Principles
- Results and Problems based on Permutations & Combinations, Permutations with repetition & without repetition, Combinations with repetition & without repetition.
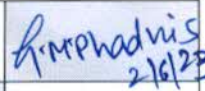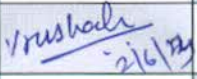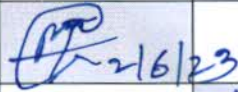- Introduction to Graphs – Undirected Graphs, Elementary Terminologies and Results,
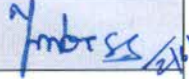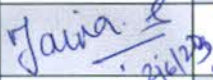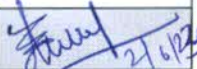
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Handshaking lemma, Corollary of Handshaking lemma
- Types of graphs, Isomorphism- Definition and Problems
- Adjacency & Incidence Matrix
- To check degree sequence (Sequence is graphical or not) -Havel - Hakimi Theorem (Only Statement)
- Subgraphs- Definition, Examples, Types of subgraphs -Vertex deleted subgraphs, Edge deleted subgraphs, Induced subgraphs, Spanning Subgraphs
- Complement of Graph and Self Complementary graphs
- Union, Intersection and Product of Graphs, Fusion of vertices
- Directed Graphs: Definition, Examples, Elementary terminologies and Properties, Types of digraphs.
- Assignment

Recommended: Text books

- Gupta S. C. and Kapoor V. K. 1987, *Fundamentals of Applied Statistics* (3rd Edition) S. Chand and Sons, New Delhi.
- Sarma K.V.S. 2001 *Statistics Made Simple. Do it Yourself on P.C.* Prentice Hall

Reference Books:

- C. L. Liu, *Elements of Discrete Mathematics*, Tata McGrawHill
- Harary, *Graph Theory*, Narosa Publishing House Pvt. Ltd., New Delhi, 2013.
- Kolman, Busby, Rehman, *Discrete Mathematical Structures*, Prentice Hall
- Narsingh Deo, *Graph Theory with applications to computer science and Engineering,* Prentice Hall..

Websites:

- https://www.tutorialspoint.com/discrete_mathematics/index.htm
- https://nptel.ac.in
- https://swayam.gov.in

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