CSE 219: Discrete Mathematical Structures (DMS)

Programme: B.Tech. (CSE) Year:1st Semester : I
Course : Core Credits : 4 Hours : 40

Course Context and Overview:

Discrete mathematics is the study of mathematical structures that are fundamentally discrete rather than continuous. In contrary to real numbers that have the property of varying smoothly, the objects studied in discrete mathematics (such as integers, graphs, and statements in logic) do not vary smoothly, but have distinct, separated values. Research in discrete mathematics substantially increased in the late twentieth century partly due to the development of digital computers which operate in discrete steps and store data in discrete bits. The objective of this course is to introduce the students to the fundamentals of discrete mathematics as used in the field of computer science. It will be attempted to teach the subject in such a way that is interesting and fruitful for both the students having a natural affinity for the beauty of abstract reasoning as well as for the students who are primarily interested in its practical applications.

Prerequisites Courses: Mathematics of Higher Secondary level

Course outcomes (COs):

On completion of this course, the students will have the ability to:
CO1: Clear thinking and creative problem solving.
CO2: Communicate mathematical ideas in both written and oral form for a variety of audiences.
CO3: Students will have a thorough understanding of the mathematical induction principle and will be able to apply this approach to prove mathematical statements.
CO4: Students should be able to apply fundamental counting algorithms to solve applied problems, particularly those found in the area of computer science.
CO5: Students should be able to identify the basic properties of graphs and trees and use these concepts to model simple applications.

Course Topics:

Topics	Lecture Hours
UNIT – I **SET THEORY, FUNCTIONS AND RELATIONS**	**8**
Set Theory: Definition of Sets, Venn Diagrams, Cartesian products, Power sets, Counting principle, Cardinality and Count ability (Countable and Uncountable sets),. **Function:** Domain, Range, One-to-One, Onto Inverses and Composition One-to-One Correspondence **Relation:** Definition, types of relation, composition of relations, domain and range of a relation, pictorial representation of relation, properties of relation, partial ordering relation.	
UNIT – II **COMBINATORICS**	**12**
Introduction to Numbers: Division algorithm, Introduction to logic and proof techniques, Divisibility Properties, Well Formed principle, Introduction to congruences. **Combinatorics:** Mathematical induction, Basic rules of Counting, Pigeon hall principle, Permutations and combinations, Binomial coefficients and Pascal triangle, **Advanced Counting Techniques:** Recurrence relations, solving recurrence relations, **Basic modular arithmetic** **Matrix Algebra:** Introduction to Matrix	
UNIT – III **MATHEMATICAL LOGIC AND DESCRETE STRUCTURES**	**10**
Propositional logic: Proposition logic, logical connectives, truth tables, tautologies, contradiction, normal forms (conjunctive and disjunctive), modus ponens and modus tollens, validity. **Predicate logic:** Universal and existential quantification. **Notion of proof**: Proof by implication, converse, inverse, contrapositive, negation, and contradiction, direct proof, proof by using truth table, proof by counter example. Induction over natural numbers, structural induction, weak and strong induction (First and second principle of Induction), Recursive mathematical definitions. **Discrete Structures:** Partially ordered sets, lattices, finite Boolean algebras, circuit design.	
UNIT – IV **GRAPHS AND TREES**	**06**

Graph Theory: Graph and subgraphs, paths, cycles, Euler and Hamiltonian graphs, bipartite graphs, graph isomorphism, trees and its properties, planar graphs on graphs, undirected graph, directed graphs, spanning tree/forests, graph isomorphism.	
UNIT – V **Discrete Probability**	
Finite probability space, events, Axiom of probability and probability measures, conditional probability, Bayes's Theorem, Independence, Integer random variables(Bernouilli, binomial), Expectation, Linearity of expectation.	**4**

Textbook:

- Kenneth H. Rosen: *Discrete mathematics and its applications*. Tata McGraw Hill Education Private Limited, 2012, Seventh editions.
  For Unit-V (Discrete Probability)- Fifth editions

Reference books:

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- Discrete Mathematics with Applications, Thomas Koshy. Elsevier.
- Bernard Kolman, Robert C. Busby, and Sharon Cutler Ross: Discrete mathematical structures. Prentice Hall PTR, 2005.
- Joshi K. D.: Foundations of Discrete Mathematics. New Age International (P) limited.
- David M. Burton: Number Theory. 6th Edition, Tata McGraw Hill Education Private Limited, 2007.
- G.H. Hardy, and Edward M. Wright: An Introduction to the Theory of Numbers. Oxford University Press. ISBN: 9780198533108.
- Deo Narsingh: *Graph Theory with Applications to Engineering and Computer Science*. Prentice Hall of India Private Limited, 2001.

Additional Resources:

Follow NPTEL lecture series on Discrete Mathematics

Evaluation Methods (tentative):

Item	Weightage
Class participation	06%
Revealed quizzes and surprise tests (~3):	24%

Mid-term examinations	30%
End-term examination	40%

Policy on cheating:

Anyone found using unfair means in the course will receive an F grade

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