(ii) Forouzan, A. B., Gilberg, R. F. *Computer Science: A Structured Approach using C++,* 2nd edition, Cengage Learning, 2010

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.

DISCIPLINE SPECIFIC CORE COURSE – 5: Discrete Mathematical Structures

Credit distribution, Eligibility and Pre-requisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
DSC 05 Discrete Mathematical Structures	4	3	0	1	Class XII pass with Mathematics	Nil

Learning Objectives

This course is designed as a foundational course to make students learn about the mathematical constructs that are used in Computer Science such as Boolean algebra, sets, relations, functions, principles of counting, and recurrences. In this course, the knowledge of mathematical notation, ideas and concepts learnt at the pre-college levels is extended to orient the students towards mathematical thinking required in Computer Science.

Learning outcomes

On successful completion of the course, students will be able to:

- Relate mathematical concepts and terminology to examples in the domain of Computer Science.
- Model real world problems using various mathematical constructs.
- Use different proofing techniques; construct simple mathematical proofs using logical arguments.
- Formulate mathematical claims and construct counterexamples.

SYLLABUS OF DSC- 5
UNIT – I (06 Hours)
Sets, Functions, Sequences and Summations, Relations: Sets: Set Operations, Computer Representation of Sets, Countable and Uncountable Set, Principle of Inclusion and Exclusion, Multisets; Functions: One-to-one and Onto Functions, Inverse Functions and Compositions of

Functions, Graphs of Functions Sequences and Summations: Sequences, Special Integer Sequences, Summations; Relations: Properties of Binary Relations, Equivalence relations and Partitions, Partial Ordering Relations and Lattices.

UNIT – II (09 Hours)

Logic and Proofs: Propositional Logic, Propositional Equivalences, Use of first-order logic to express natural language predicates, Quantifiers, Nested Quantifiers, Rules of Inference, Introduction to Proofs, Proof Methods and Strategies, Mathematical Induction.

UNIT – III (09 Hours)

Number Theory: Division and Integers, Primes and Greatest Common Divisors, Representation of Integers, Algorithms for Integer Operations, Modular Exponentiation, Applications of Number Theory.

UNIT – IV (06 Hours)

Combinatorics/Counting: The Pigeonhole Principle, Permutations and Combinations, Binomial Coefficients, Generalized Permutations and Combinations, Generating Permutations and Combinations.

UNIT – V (09 Hours)

Graphs and Trees: Graphs: Basic Terminology, Multigraphs and Weighted Graphs, Paths and Circuits, Eulerian Paths and Circuits, Hamiltonian paths and Circuits, Shortest Paths, Spanning Trees, Graph Isomorphism, Planar Graphs; Trees: Trees, Rooted Trees, Path Lengths in Rooted Trees.

UNIT – VI (06 Hours)

Recurrence: Recurrence Relations, Generating Functions, Linear Recurrence Relations with Constant Coefficients and their solution.

Practical component (if any) – 30 Hours

1. Create a class SET. Create member functions to perform the following SET operations:
    1) is member: check whether an element belongs to the set or not and return value as true/false.
    2) powerset: list all the elements of the power set of a set .
    3) subset: Check whether one set is a subset of the other or not.
    4) union and Intersection of two Sets.
    5) complement: Assume Universal Set as per the input elements from the user.
    6) set Difference and Symmetric Difference between two sets.
    7) cartesian Product of Sets.

    Write a menu driven program to perform the above functions on an instance of the SET class.

2. Create a class RELATION, use Matrix notation to represent a relation. Include member functions to check if the relation is Reflexive, Symmetric, Anti-symmetric, Transitive. Using these functions check whether the given relation is: Equivalence or Partial Order relation or None

3. Write a Program that generates all the permutations of a given set of digits, with or without repetition.
4. For any number n, write a program to list all the solutions of the equation $x_1 + x_2 + x_3 + ...+ x_n = C$, where C is a constant ($C<=10$) and $x_1, x_2, x_3, ..., x_n$ are nonnegative integers, using brute force strategy.
5. Write a Program to evaluate a polynomial function. (For example store $f(x) = 4n^2 + 2n + 9$ in an array and for a given value of n, say $n = 5$, compute the value of f(n)).
6. Write a Program to check if a given graph is a complete graph. Represent the graph using the Adjacency Matrix representation.
7. Write a Program to check if a given graph is a complete graph. Represent the graph using the Adjacency List representation.
8. Write a Program to accept a directed graph G and compute the in-degree and out-degree of each vertex.

Essential/recommended readings

1. Liu, C. L., Mohapatra, D. P. *Elements of Discrete Mathematics: A Computer Oriented Approach*, 4th edition, Tata McGraw Hill, 2017.
2. Rosen, K. H.. *Discrete Mathematics and Its Applications*, 8th edition, McGraw Hill, 2018.

Suggestive readings

(i) Cormen, T. H., Leiserson, C. E., Rivest, R. L., Stein C. *Introduction to Algorithms*, 4th edition, Prentice Hall of India. 2022.
(ii) Trembley, J. P., Manohar, R. *Discrete Mathematical Structures with Application to Computer Science*, Tata McGraw Hill, 1997.
(iii) Albertson, M. O. and Hutchinson, J. P. *Discrete Mathematics with Algorithms*, John Wiley and Sons, 1988.

DISCIPLINE SPECIFIC CORE COURSE – 6: Probability for Computing

Credit distribution, Eligibility and Pre-requisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
DSC06 Probability for computing	**4**	**3**	**0**	**1**	Class XII pass with Mathematics	**Nil**