Course Code	Course name	L	T	P	C
CSEG2006	Discrete Mathematical Structures	3	0	0	3
Total Units to be Covered: 7		Total Contact Hours: 45			
Prerequisite(s):	Advanced Engineering Mathematics – 2	Syllabus version: 1.0			

Course Objectives

To develop mathematical reasoning skills that equip the students with ideas and techniques, required in Discrete Mathematics and its Applications, necessary for understanding and practicing the art and science of computing.

Course Outcomes

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

CO1. Develop a comprehensive understanding of discrete structures, viz., mathematical logic, propositions, connectives, arguments, sets, functions, relations, etc., that build the foundation of computer science.

CO2. Recognize the applicability of the basic notions of number theory and counting principles such as modular arithmetic, congruence equations, Pigeonhole principle, principle of inclusion and exclusion, etc., in solving complex problems in diverse domains related to cryptography and internet security.

CO3. Illustrate the basic terminologies in graph theory which are used in design of algorithms for a wide range of applications related to shortest path problems, graph coloring problems, etc.

CO4. Use the framework of network science in building models for various problems arising in communication, social and biological networks.

CO-PO Mapping

Program Outcomes / Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	3	1	1	-	-	-	-	-	-	-	1	-	-	-
CO 2	3	3	1	1	-	-	-	-	-	-	-	1	-	-	-
CO 3	3	2	1	1	-	-	-	-	-	-	-	1	-	-	-
CO 4	3	2	1	1	-	-	-	-	-	-	-	1	-	-	-

Average	3	2.5	1	1	-	-	-	-	-	-	-	1	-	-	-

1 – Weakly Mapped (Low) **2 – Moderately Mapped (Medium)**

3 – Strongly Mapped (High) **"_" means there is no correlation**

Syllabus

Unit I: Motivation **1 Lecture Hour**

Introduction to Discrete Mathematics and its significance in Computer Science. Why learn Discrete Mathematics?

Unit II: Mathematical Logic **6 Lecture Hours**

Mathematical Logic, Proposition, Connectives, Tautologies, and Contradictions, Logical Equivalences, Normal forms, and applications. Predicates and Quantifiers, Interpretation of an Argument, and its validity. Recapitulation of the Unit.

Unit III: Relations **6 Lecture Hours**

Review of Set Theory, Functions, one-one onto Functions, Relations and their properties, n-ary Relations, Illustrations through Applications, Representations, Closures, Partial Ordering, Decomposition Theorems for Partial Orders, Posets and Lattices. Recapitulation of the Unit.

Unit IV: Number Theory **5 Lecture Hours**

Modular Arithmetic, Primes, Fundamental Theorem of Arithmetic, GCD/LCM, Euclidean Algorithm, Bézout's Identity, Solving Congruences, Linear Diophantine Equation, Chinese Remainder Theorem, Fermat's Little Theorem, Illustration through Examples in Cryptography and Internet Security, Discrete Log, Orthogonal Latin Squares. Recapitulation of the Unit

Unit V: Induction and Basic Counting Principles **10 Lecture Hours**

Induction, Strong Induction, Well-ordering Principle, Recursive Definitions and Structural Induction, Pigeonhole Principle, Binomial and Multinomial Coefficients and Identities, Elementary Applications to Discrete Probability, Recurrence Relations and Equations, Generating Function Techniques, Principles of Inclusion and Exclusion and their Applications. Recapitulation of the Unit.

Unit VI: Graph Theory **10 Lecture Hours**

Graphs and Graph Models, Basic Terminology and Special Types of Graphs, Representing Graphs and Graph Isomorphism, Vertex and Edge Connectivity, Adjacency and Incidence Matrices, Konigsberg Bridge Problem, Euler Graph, Travelling Salesman Problem, Hamiltonian Graphs, Shortest-Path Problems, Planar Graph, Euler's Formula, Graph Coloring, Welch Powell Algorithm, Decomposition Algorithm, Random Graphs. Recapitulation of the Unit.

Unit VII: Network Science **7 Lecture Hours**

Illustrative Examples of Real Networks, Network and Graph, Degree Distribution, Power-Law and Scale Free Property, Sparsity in Real Networks, Paths and Distances, Network Diameter, Connectedness and Clustering Coefficient, Random Network, Evolution of a Random Network, Small World Network: Watts-Strogatz Model, Emergence of Network Science. Recapitulation of the Unit.

Total lecture Hours 45

Textbooks

1. Rosen, K. H., "Discrete Mathematics and its Applications", 7th Edition, McGraw Hill, 2017. (Units - II, III, IV, VI)

2. R. C. Bose, and B. Manvel, "Introduction to Combinatorial Theory", Wiley Series in Probability and Mathematical Statistics, 1984. (Units - V)

3. Albert-László Barabási, "Network Science", 1st Edition, Cambridge University Press, 2016. (Unit-VI, VII)

Reference Books

1. W. K. Grassmann, and J-P Tremblay, "Logic and Discrete Mathematics: A Computer Science Perspective", 1st Edition, Pearson, 1995.

2. E. Lehman, F. T. Leighton, and A. R. Meyer, "Mathematics for Computer Science", Samurai Media Limited, 2017.

3. D. B. West, "Introduction to Graph Theory", 2nd Edition, Pearson Singapore, 2000.

4. J. L. Hein, "Discrete Structure, Logic, and Computability", 3rd Edition, Jones and Barlett Publishers, 2010.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme

Components	IA	MID SEM	End Sem	Total
Weightage (%)	50	20	30	100

Detailed breakup of Internal Assessment

Internal Assessment Component	Weightage in calculation of Internal Assessment (100 marks)
Quiz 1	15%
Quiz 2	15%
Class Test 1	15%
Class Test 2	15%
Assignment 1/Project	20%
Assignment 2/Project	20%