

Course Type	Course Code	Name	L	T	P	Credits
DE	NCSD506	Combinatorics and Graph Theory	3	0	0	3

Course Objective
To impart a comprehensive understanding of combinatorial and graph concepts and their direct applications in computer science, fostering problem-solving skills and algorithmic thinking.
Learning Outcomes
<ul style="list-style-type: none"> Develop a solid understanding of fundamental combinatorial principles and counting techniques Apply combinatorial and graph theory concepts to solve a variety of real-world problems in diverse fields Engage in independent study and research to deepen understanding of advanced topics in combinatorial theory and its applications.

Unit No.	Topics to be Covered	Lecture Hours	Learning Outcome
1.	Introduction: Permutations, Combinations, Binomial coefficients, Multinomial coefficients, Pigeonhole principle, Principle of Inclusion-Exclusion, Graph Theory basics	7	The students would learn the role and importance of combinatorics and graph theory, their applications and start with some basic problems
2.	Recurrence Relations: Fibonacci sequence, The characteristic equation method, Generating functions, Exponential Generating functions, Applications - double decks, counting with repetitions, Catalan numbers, Bell numbers	8	Learning basics of recurrence equations, their solutions and applications in various problems
3.	Polya's counting: Permutation and symmetry groups, Burnside's Theorem, Polya's Theorem of counting	7	Learning about permutation groups and their connection to geometrical transformations
4.	Stable Matching in Graphs: System of distinct representatives (SDR), existence of SDRs, Stable Marriage problem, The Gale-Shapley stable matching algorithm	6	Learning about SDRs and its connection with the stable marriage problem
5.	Spectral Graph Theory: Eigenvalues and graph parameters, regular graphs, Random walk and expander graphs	7	Applying algebraic techniques to determine properties of graphs
6	Ramsey Theory: Classical Ramsey numbers, Exact Ramsey numbers and bounds, Graph Ramsey Theory	7	Learning basics of Ramsey Theory and its applications
	Total	42	

Text Books:

1. Combinatorics and Graph Theory: John Harris, Jeffry L. Hirst and Michael Mossinghoff
2. Combinatorial Mathematics: Douglas B. West

Reference Books:

1. Introductory Combinatorics: Richard A. Brualdi
2. Extremal Combinatorics with Applications in Computer Science: Stasys Jukna