AP]
PEN
DIX
XII

Course Type	Course Code	Name of the Course	L	Т	Р	Credits
DE	CSD403	Combinatorics and Graph Theory	3	0	0	9

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

- 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.

Uni t 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

Text Books:

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

Reference Books:

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