Course Type	Course Code	Name of Course	L	T	P	Credit
DE	**NMCD505**	Advanced Algorithms for Graphs	3	0	0	3

Course Objective

- The objective of the course is to give idea about variety of problems in algorithms and the associated algorithms for those problems and to give idea about emerging applications of the notion of graph theory in different areas.

Learning Outcomes

Upon successful completion of this course, students will:

- have a broad understanding of the algorithmic consequences of several parameters in graphs.
- have an ability to think and model different practical problems as graph theoretic problems and the difficulty in solving those.

Unit No.	Topics to be Covered	Contact Hours	Learning Outcome
1	Basic definitions, Graph representations: adjacency matrix, incidence matrix, adjacency list.	04	Students will learn the basic definitions on graphs and its representation on a computer.
2	Shortest path problems: Single source SP problem, SP tree, Ford's labelling method, labelling and scanning method, efficient scanning orders— topological order for acyclic networks, shortest first search for non-negative networks (Dijkstra), BFS search for general networks, correctness and analysis of the algorithms; All pair SP problem— Edmond-Karp method, Floyd's algorithm and its analysis	07	This unit will help the students in understanding the various shortest path problems and the efficient algorithms associated with those.
3	Flows in Networks: Basic concepts, maxfiow-mincut theorem, Ford and Fulkerson augmenting path method, integral flow theorem, maximum capacity augmentation, Edmond-Karp method, Dinic's method and its analysis, Malhotra-Kumar-Maheswari method and its analysis, Preflow- push method (Goldbergarj Ian) and its analysis; Better time bounds for simple networks. Minimum cost flow: Minimum cost augmentation and its analysis.	09	This will help in various advanced algorithms in network flows.
4	Matching problems: Basic concepts, bipartite matching— Edmond's blossom shrinking algorithm and its analysis; Recent developments	05	Students will learn the concepts of matchings in graphs and efficient algorithms to compute the matching in a graph.
5	Planarity: Basic fact about planarity, polynomial time algorithm.	06	Students will learn the planarity and the algorithm on testing planarity of a given graph.
6	Graph isomorphism: Importance of the problem, backtrack algorithm and its complexity, isomorphism complete problems, polynomial time algorithm for planar graphs, group theoretic	06	Students will learn the one of the difficult problem the graph isomorphism problem

7	Applications of graphs in various fields like telecommunications, networking, image processing, pattern recognition, graph cut algorithms	05	Students will learn the application of graphs in different areas.
Total		**42**	

Text Books:

1. D. Junknickel: Graphs, Networks, and Algorithms, Springer, 4th Edition, 2013
2. M. C. Golumbic, Algorithmic Graph Theory and Perfect Graphs, Annals of Discrete Maths. 57, Elsevier, 2nd Edition, 2004

Reference Books:

1. T. H. Cormen, C. E. Leiserson, R. L. Rivest, C. Stein: Introduction to algorithms, PHI, 3rd Edition, 2010
2. C. M. Hoffman: Group Theoretic Algorithms and Graph Isomorphisms, Springer-Verlag, Berlin, 1982
3. C. H. Papadimitriou, K. Stiglitz: Combinatorial Optimization: Algorithms and Complexity, PHI, 1997