Graph Theory

1.1 Course Number: MA 411

1.2 Contact Hours: 40 (L) Credits: 09 [LTP: 3-0-0]

1.3 Semester-offered: Odd (VIIth)

1.4 Prerequisite: Algebra, number theory.

1.5 Syllabus Committee Member: Dr. C. Kundu (convener), Dr. M.K. Rajpoot, Dr. A. Kumar, Dr. G. Rakshit.

2. **Objective:** To explain basic concepts in graph theory, define new graphs serve as models for many standard problem.

3. **Course Content:**

Unit-wise distribution of content and number of lectures

Unit	Topics	Sub-topic	Lectures
1	**Introduction/ Basics**	Graphs, Subgraphs, Some basic properties of graphs and subgraphs, Isomorphism, Various types of graphs and their subgraphs, trails, walks, paths, circuits and cycles, connected graphs, disconnected graphs and components, various operations on graphs, Eulerian graphs, Hamiltonian paths and cycles, Adjacency and incidence matrices of a graph, shortest path, algorithms to find shortest path.	10
2	**Hamiltonian and Eulerian Graphs**	Necessary conditions for Hamiltonian graphs, sufficient conditions for Hamiltonian graphs, traveling salesman problem, characterization of Eulerian graphs, construction of Eulerian tour, The Chinese postman problem.	8
3	**Trees**	Characterization of trees, rooted and binary trees, spanning trees and their properties, spanning trees in weighted graphs, minimum spanning tree, algorithms for minimum spanning tree.	8
4	**Cut Vertices and Edge Connectivity**	Cut vertices, cut sets and their properties, the max-flow min-cut theorem, max-flow algorithm, connectivity and edge connectivity, Menger's theorem (without proof), max-flow algorithm.	7
5	**Coloring of Graphs**	Coloring, proper coloring, chromatic number, chromatic partitioning, a maximal independent set, matching, maximum matching in bipartite graphs and in general graphs.	7
		Total	**40**

4. Readings

4.1 Textbook:

- *Graph theory with applications to engineering and computer science* by Narishgh Deo, PHI.
- *Applied and Algorithmic Graph theory* by G. Chatrand, and O.R. Ollermann, McGraw Hill.

4.2 Reference books:

- ✓ *Graph Theory* by J. A. Bondy and U. S. R. Murthy, Springer.
- ✓ *Introduction to Graph Theory* by D. B. West, PHI.
- ✓ *Graph Theory* by R. Diestel, Springer

5 Outcome of the Course:

At the end of the course the students should be able to solve problems using basic graph theory and involving vertex and edge coloring, to determine whether graphs are Hamiltonian and/or Eulerian. They will also be able to model real world problems using graph theory.