

**Course Title:** Introduction to Graph Theory

**Course Code:** MATH-103

**Course Type:** Major Math

**Prerequisites:** N/A

**Credit Hours:** 3 (3 + 0)

**Course Objectives:** After completion of this course, the students will be able to:

- Understand the basics of graph theory and their various properties.
- Understand the concepts of connectivity, planar graphs and colorings.
- Apply graph theory concepts to solve real world applications.

**Course Contents:**

**Graph Terminology:** History of graph theory, Definition of a graph, Directed graphs, Undirected graphs, Vertex, Edge, Adjacent (or neighbors), Neighborhood. Degree of vertices and edges, Hand-shaking Theorem, Adjacency matrix of a graph, Incidence matrix of a graph.

**Simple Graphs:** Types of simple graphs: Complete, Bipartite, Complete bipartite graphs, Wheels, Cubes. Subgraphs, Complement of a graph, Regular graphs, Representing graphs, Applications of simple graphs, Graph isomorphism.

**Connectivity:** Walks, Trails, Paths, Cycles, Connected and disconnected graphs, Edge and vertex connectivity, Bridge, Cut vertex, Euler and Hamiltonian paths and circuits.

**Trees:** Introduction to Trees, Binary tree, Forests, Applications of Trees, Spanning tree, Minimum spanning trees, Tree traversal.

**Planar graphs:** Planar and non-planar graphs, Euler formula, Dual graphs.

**Graph coloring:** Chromatic number, Chromatic index, Applications of graph coloring.

**Network Flow:** Digraphs, Weighted graphs, Maximum Flow, Max-Flow /Min-Cut Theorem, Algorithm to find Maximum flow in a Network.

**Recommended Books:**

1. Bondy J. A. and Murty, U. S. R., *Graph Theory with Applications*, American Elsevier Publishing Company, 1976.
2. Diestel, R., *Graph Theory*, Springer Berlin, Heidelberg, 2017.
3. Rosen, K., *Discrete Mathematics and Its Applications*, McGraw-Hill Education, 7th edition, 2011.
4. West, D. B., *Introduction to Graph Theory*, Pearson College Div., 2000.
5. Wilson, R. J., *Introduction to Graph Theory*, Pearson, 5th edition, 2010.

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