MTH5152: Graph Theory

Programme: M.Sc/B.Tech Year: 4th year Semester: Even
Course: Core/Open Elective/Math Credits: 4 Hours: 40

Course Context and Overview (100 words):

In engineering, graph theory is used extensively. The intension of this course is to introduce the subject of graph theory to engineering students in a thorough way. This course contains an introduction to basic concepts and results in graph theory, with a special emphasis put on the network-theoretic circuit-cut dualism. One of the usages of graph theory is to give a unified formalism for many different looking problems. It then suffices to present algorithms in this formalism. This has lead to the special class of algorithms, the so called graph algorithms. Graph-theoretic applications and models usually involve connections to the real world.

Prerequisites Courses: No

Course outcomes (COs):

On completion of this course, the students will have the ability to:
CO1: Understand the basic graph properties and their connections between the structures of different graphs.
C02: Understand and apply some of the classical theorems of graph theory.
C03 : Represent of networks of communication, data organization, computational devices, the flow of computation, etc.
C04: Dove lope the algorithms to solve the real life problem.

Course Topics:

Topics	**Lecture Hours**	
UNIT - I **Fundamental Concepts of Graphs**		
1.1 Graphs, Simple Graphs, finite Graphs and Infinite Graphs, Null graphs, Degree of graphs, Isolated and pendant Vertices	2	10
1.2 Isomorphic Graphs, Subgraphs, Edge-disjoint Subgraphs, Vertex-disjoint Subgraphs, Complement of a subgraph and simple graphs.	2	
1.3 Walk, Path, Circuits and Operations on Graphs.	2	

1.4 Connected Graphs and Components.	2	
1.5 Complete Graphs, Bipartite Graphs, and regular Graphs.	2	
UNIT - II **Euler Graphs and Hamiltonian Graphs and Weighted Graphs**		8
2.1 Euler graphs, Solution of Konigsberg Problem.	2	
2.2 Unicursal graphs, Randomly Eulerian graphs.	1	
2.3 Fleury's Algorithm, Hamiltonian graphs and its applications.	3	
2.4 Chinese Postman Problem, Dijkstra' Algorithm for shortest Path.	2	
UNIT - III **Trees and Cut-sets**		10
3.1 Basic concepts of Trees, Minimally connected Graph. Rank and Nullity of Graphs.	2	
3.2 Spanning Trees, Minimal Spannin tree Kruskal's Algorithm and Prim's Algorithm	3	
3.3 Cut-sets, Fundamental cut-sets, Edge-connectivity, Vertex Connectivity and Separability.	2	
3.4 Network-flows, Planarity, Kurotowski's Planar graphs,	2	
3.5 Regions and Euler's formula.	1	
UNIT - IV **Matrix Representation Graphs and Directed Graphs**		6
4.1 Incidence matrix, Adjacency Matrix, Edge sequences between vertices, Path Matrix, Circuit Matrix, Fundamental Circuit Matrix, and Cut-Set Matrix.	3	
4.2 Types of Digraphs, Rooted and Binary tree, Level and Height of tree, Arborescence.	2	
4.3 Algebraic Expression and Polish Notation.	1	
UNIT-V **Coloring of Graphs and Boolean Algebra**		6
5.1 Chromatic Number, Chromatic Polynomial, Coloring graphs, Welch Powell Algorithm.	3	
5.2 Boolean Algebra, Principal of Duality, Sub-algebra, Union and Intersection of Boolean algebra, Some questions on Boolean algebra.	3	

Textbook references (IEEE format):
Text Book:

1. N. Deo, "Graph Theory", Prentice Hall, 1980
2. D. B. West, "Introduction to Graph Theory", Prentice-Hall of India/Pearson, 2009.

Reference books:

1. J. A. Bondy and U.S. R. Murty, “Graph Theory”, Springer, 2008.
2. F. Harary, “Graph Theory”, Narosa, 1988.

Additional Resources (NPTEL, MIT Video Lectures, Web resources etc.):

Evaluation Methods:

Item	Weightage
Attendance	5
Quiz-2	15
Midterm	20
Presentation	20
End Term Examination	40

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