

Graph Theory

Semester : II

Subject Code: BS21503

Lectures : 40

Objectives:

The syllabus aims in equipping the students with

- ability to develop the skills of mathematical reasoning : Deduction, Proof and Recursive Thinking.
- a solid foundation in the newest and different branch of Mathematics : Graph Theory
- capacity to represent the given information in the mathematical form using mathematical techniques and draw the relevant conclusion.
- ability to inculcate a positive attitude towards Mathematics and enjoy the triumph of solving interesting problems from different areas of the subject.
- sufficient knowledge of the subject ranging from basic concepts to wide applications of Graph Theory in different areas.

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Mr. Sachin Suresh Sashital

Ms. Chetna Rajput

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Unit 1: Graphs and Operations on Graphs

No. of
Lects.
10

- Introduction
- Elementary Terminologies and Results
- Handshaking lemma
- Corollary of Handshaking lemma
- Types of graph
- Isomorphism- Definition and Problems
- Adjacency & Incidence Matrix
- To check degree sequence (Sequence is graphical or not)
Havel - Hakimi Theorem (Only Statement)
- Subgraphs- Definition, Examples
Types of subgraphs: i) Vertex deleted subgraphs, Edge deleted subgraphs
ii) Induced subgraphs
iii) Spanning Subgraphs
- Complement of Graph and Self Complementary graphs
- Union, Intersection and Product
- Fusion of vertices, Decomposition

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Unit 2: Connected Graphs

No.of
Lects.
12

- Walk, Trail, Path- Definition, Examples and Properties (1 with proof)
- Connected graphs – Definition and Properties (2 with proof)
- Distance between two vertices, Eccentricity, centre, radius and diameter of a graph
- Isthmus, cutvertex- Definition, Examples and properties (without proof)
- Edge connectivity, Vertex connectivity
- Dijkstra's Algorithm
- Konigsberg Bridges Problem
- Eulerian Graphs- Definition, Examples, N-S condition(with proof)
- Fleury's Algorithm
- Hamiltonian Graphs- Definition, Examples and Theorems (2 without Proof)
- Chinese Postman Problem, Travelling Salesman Problem

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Unit 3: Trees

No.of
Lects.
8

- Definition, Properties of Trees, Theorems (2 with proof)
- Centre of a tree and Theorem (1 with proof)
- Spanning tree: Definition, Properties, Shortest spanning tree- Kruskal's Algorithm, Prim's Algorithm.
- Binary Tree – Definition and Properties.
- Tree Traversal –Ordered rooted tree.Preorder traversal, Inorder traversal and Post order traversal, Prefix Notation.

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Unit 4: Directed Graphs

No.of
Lects.
6

- Definition, Examples, Elementary terminologies and Properties.
- Special types of digraphs.
- Connectedness of digraphs.
- Network and Flows- Definition and Examples, Ford- Fulkerson Algorithm and Problems.

Unit 5: Matchings and Coverings in Graph Theory

No.of
Lects.
4

- Matching : Definition , Examples.
- Covering : Definition , Examples.
- Colouring : Introduction and Problems

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Recommended Text Books:

- Narsingh Deo. *Graph Theory With Applications to Engineering and Computer Science*. PHI Learning Private Limited. Delhi. 2013.
- Olympia Nicodemi. *Discrete Mathematics*. CBS Publishers & Distributors. Delhi. 2001.

Reference Books:

- Kenneth Rosen. *Discrete Mathematics and It's Applications*. Tata McGraw Hill. 2011.
- Bernard Kolman, Robert C. Busby, Sharon Cutler Ross and Nadeem-ur-Rehman. *Discrete Mathematical Structures*. Indian Subcontinent Adaptation: Pearson Education, 2004.
- Harary. *Graph Theory*. Narosa Publishing House. 2001.
- John Clerk and Derek Holton. *A First Look at Graph Theory*. World Scientific Publishing Co. Pte. Ltd. 1991.

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