



Mathematics Paper I
Graph Theory
[CORE COURSE]

Semester: II	Credits: 2	Subject Code: BS22003	Lectures: 40
--------------	------------	-----------------------	--------------

Course Outcomes:

At the end of this course, the learner will be able to:

- Know about the new branch of mathematics - Graph Theory and its applications which will help to construct a strong foundation in the subject.
- Define graphs, digraphs and trees, and identify their main properties.
- Classify different types of graphs and identify the areas of their applications.
- Formulate and relate real life situations with different types of graphs and techniques used in Graph Theory.
- Describe and apply some basic algorithms for graphs.
- Demonstrate different traversal methods for trees and graphs.
- Determine the wide nature of the subject through various key concepts in Graph Theory and their real-life applications.

Unit 1: Introduction to Graphs and Operations on Graphs

8

- 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
- Vertex deleted subgraphs; Edge deleted subgraphs
- Induced subgraphs
- Spanning Subgraphs
- Complement of Graph and Self Complementary graphs
- Union, Intersection and Product of Graphs
- Fusion of vertices, Decomposition

Unit 2: Connected Graphs

9

- Walk, Trail, Path- Definition, Examples and Properties

Board Of Studies	Name	Signature
Chairperson (HoD)	Ms. Gitanjali Phadnis	



<ul style="list-style-type: none"> • Connected graphs – Definition and Properties • Distance between two vertices, Eccentricity, centre, radius and diameter of a graph • Isthmus, Cut Vertex- Definition, Examples and Properties • Edge connectivity, Vertex connectivity • Dijkstra's Algorithm 	
---	--

Unit 3: Eulerian and Hamiltonian Graphs

6

<ul style="list-style-type: none"> • Konigsberg Bridges Problem • Eulerian Graphs- Definition, Examples, Necessary and Sufficient Condition (with proof) • Fleury's Algorithm • Hamiltonian Graphs- Definition, Examples and Theorems (2 without Proof) • Chinese Postman Problem, Travelling Salesman Problem 	
---	--

Unit 4: Trees

10

<ul style="list-style-type: none"> • Definition, Properties of Trees, Theorems • Centre of a tree • Spanning tree: <ul style="list-style-type: none"> ◦ Definition ◦ Properties ◦ Shortest spanning tree- Kruskal's Algorithm, Prim's Algorithm • Binary Tree – Definition and Properties. • Tree Traversal <ul style="list-style-type: none"> ◦ Ordered rooted tree, ◦ Preorder traversal ◦ In order traversal and Post order traversal, Prefix Notation. 	
---	--

Unit 5: Directed Graphs

7

<ul style="list-style-type: none"> • Definition, Examples, Elementary terminologies and Properties. • Types of digraphs. • Connectedness of digraphs. • Arborescence • Networks and Flow, MaxFlow-MinCut theorem, Ford Fulkerson Algorithm 	
---	--

Reference Books:

<ul style="list-style-type: none"> • C. L. Liu, <i>Elements of Discrete Mathematics</i>, Tata McGraw Hill, Fourth Edition • Douglas B. West, <i>Introduction to Graph Theory</i>, Pearson Education, Second Edition. 	
--	--

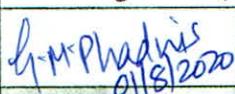
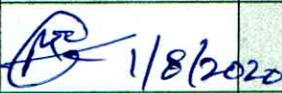
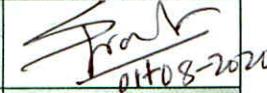
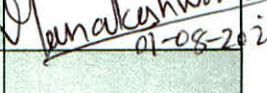
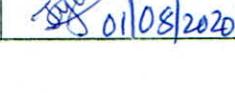
Board Of Studies	Name	Signature
Chairperson (HoD)	Ms. Gitanjali Phadnis	<i>G.M. Phadnis</i>

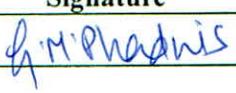


- Harary, *Graph Theory*, Narosa Publishing House Pvt. Ltd., New Delhi, 2013.
- John Clark and Derek Holton, *A first look at Graph theory*, Allied Publishers.
- Kenneth Rosen, *Discrete Mathematics and its applications*, Tata McGraw Hill, Seventh Edition.
- Narsingh Deo, *Graph Theory with applications to computer science and Engineering*, Prentice Hall.

E-Resources:

- <https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=25> for Unit 1 to unit 5
- <https://nptel.ac.in>
- <https://swayam.gov.in>

Board Of Studies	Name	Signature (in white cell)
Chairperson (HoD)	Ms. Gitanjali Phadnis	 01/08/2020
Faculty	Ms. Vrushali Paranjpe	 11/08/2020
Subject Expert (Outside SPPU)	Dr. Machchhindra Gophane	 1/8/2020
Subject Expert (Outside SPPU)	Dr. Prashant Malavadkar	 01/08/2020
VC Nominee	Dr. Vinayak Joshi	 01/08/2020
Industry Expert	Mr. Anup Manakeshwar	 01/08/2020
Alumni	Ms. Jyoti Sharma	 01/08/2020

Board Of Studies	Name	Signature
Chairperson (HoD)	Ms. Gitanjali Phadnis	 01/08/2020