Kadi Sarva Vishwavidyalaya

Faculty of Engineering & Technology

Third Year Bachelor of Engineering (Computer Engineering)

(In Effect From Academic Year 2019-20)

Subject Code: IT506E-N	**Subject Title:** Graph Theory
Pre-requisite	Discrete mathematics, Basic knowledge of Graphs, isomorphism, subgraphs, matrix representations, degree, operations on graphs, degree sequences

Teaching Scheme (Credits and Hours)

Teaching scheme				**Total Credit**	**Evaluation Scheme**					
L	**T**	**P**	**Total**		**Theory**		**Mid Sem Exam**	**CIA**	**Pract.**	**Total**
Hrs	**Hrs**	**Hrs**	**Hrs**		**Hrs**	**Marks**	**Marks**	**Marks**	**Marks**	**Marks**
03	00	02	05	04	03	70	30	20	30	150

Course Objective:

The course aims to introduce the notions of graphs, their use as a very powerful modeling tool and to give the students a degree of mathematical rigour and clarity. The latter aims are generally part of a course on discrete mathematics, but here it can be more focused, as the area is more specialized. See the applications of graphs in science, business and industry.

Outline Of the Course:

Sr. No	**Title of the Unit**	**Minimum Hours**
1	Fundamental Concepts	10
2	Trees and Distances	6
3	Matching and Factors	7
4	Connectivity and paths	6
5	Coloring of Graphs	6
6	Planar Graphs	6
7	Edges and Cycles	7

Total hours (Theory):48
Total hours(Lab):32
Total hours: 80

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Detailed Syllabus

Sr. No	Topic	Lect. Hours	Weightage(%)
1	**Fundamental Concepts** Definitions of graphs, representations, models and applications models and applications, Standard terminology and parameters of graphs (degree, girth, connectedness, connectivity, circumference, diameter, radius, eccentricity, chromatic number independence number etc.), Isomorphism, Counting of graphs, labelled and unlabelled graphs, graph properties related to the presence or absence of subgraphs. (e) Paths, cycles and related graph theoretic concepts, Eulerian trails, Eulerian cycles, chinese postman tour etc. Vertex degrees and basic properties, Havel-Hakimi Theorem. Analogous concepts for directed graphs, problems specific to directed graphs, oriented graphs,	10	21
2	**Trees and Distances** Basic Properties, Spanning Trees of graph, distances.	6	13
3	**Matching and Factors** Matchings, covers correlation to vertex covers, and other related concepts. Augmenting Paths theorem, Hall's Theorem, Tutte's Theorem for matchings in general graphs.	7	15
4	**Connectivity and paths** Cuts and connectivity, vertex and edge connectivity, the relation between them, connected graphs, Menger's Theorem and the relation between connectivity and alternative paths., Network Flow Problems	6	12
5	**Coloring of Graphs** Vertex colouring, basic properties of chromatic numbers, upper and lower bounds and corresponding algorithms. Relation to Independent Sets, Cliques. Edge colouring and vizing's theorem.	6	12
6	**Planar Graphs** Planar graphs, planarity, Kuratowski's Theorem	6	12
7	**Edges and Cycles** Line Graphs and Edge-coloring, Hamiltonian Cycles, Planarity, Coloring, and Cycles	7	15
	Total	48	100

Instructional Method and Pedagogy:

- At the start of course, the course delivery pattern, prerequisite of the subject will be discussed.
- Lectures will be conducted with the aid of multi-media projector, black board, OHP etc.
- Attendance is compulsory in lecture and laboratory which carries 10 marks in overall evaluation.
- One internal exam will be conducted as a part of internal theory evaluation.
- Assignments based on the course content will be given to the students for each unit and will be evaluated at regular interval evaluation.

- Surprise tests/Quizzes/Seminar/tutorial will be conducted having a share of five marks in the overall internal evaluation.
- The course includes a laboratory, where students have an opportunity to build an appreciation for the concepts being taught in lectures.
- Experiments shall be performed in the laboratory related to course contents.

Learning Outcome:

On successful completion of this course, the student should be able to:

- Solve problems using basic graph theory
- Identify induced subgraphs, cliques, matchings, covers in graphs
- Determine whether graphs are Hamiltonian and/or Eulerian
- Solve problems involving vertex and edge connectivity, planarity and crossing numbers
- Solve problems involving vertex and edge coloring
- Model real world problems using graph theory

e-Resources:

- https://nptel.ac.in/syllabus/111106050/

Reference Books:

1. D.B.West: Introduction to Graph Theory,Prentice-Hall ofIndia/Pearson, 2009
2. J.A.Bondy and U.S.R.Murty: Graph Theory and Applications Google-Bondy
3. R.Diestel: Graph Theory,Springer(low price edition) 2000

List of experiments

No	Name of Experiment
1	Implement Complete Bipartite graph.
2	Implement Chinese postman problem.
3	Implement job scheduling problem using bipartite graph.
4	Implement 2 color problem.
5	Implement 4 color problem.
6	Implement Traveling salesman problem.
7	Implement Network flow problem to find the shortest route.
8	Apply Max Flow - Min cut to network flow problem
9	Apply Bellman-Ford algorithm to identify the shortest path
10	Find maximum connection component and find the articulation point.