COURSE CODE**: CSC4066** COURSE NAME**: APPLIED GRAPH THEORY AND ALGORITHMS** COURSE TYPE**: ELECTIVE** NUMBER OF CREDITS**: 6**	L-T-P**: 4-2-0** CONTACT HOURS/WEEK**: 6** TOTAL MARKS**: 100** (INTERNAL**: 60,** EXTERNAL**: 40**) NATURE**: GRADED**

COURSE OBJECTIVES:

1. To introduce the students with a number of real life applications that can be treated and solved as graph theoretic problems.
2. To introduce the students with algorithms for graph theoretic problems.
3. To acquaint the students with domain dependent different representations of graphs.

COURSE PREREQUISITE:

- Basic knowledge of Programming, Discrete Mathematics and Graph Theory.

COURSE OUTCOMES:

At the end of the course, students will be able to:

- Analyze different shortest path problems
- Implement different graph matching problems
- Solve different graph colouring algorithms
- Explain different modeling of physical networks

COURSE CONTENT:

Unit No & Name	Components of the Unit	No of contact hours	Marks
UNIT-I: **Shortest path problems (SP)**	• Various versions of the SP problem. • Algorithms for single source SP problem. • Characterization and presence of SP, SP tree • Ford's labeling method and its correctness • Labeling and Scanning method - efficient scanning orders. Topological order for a cyclic networks. • Shortest-first search for non-negative network (Dijkstra), BFS search for several networks and its analysis, All-pair shortest path problem - Floyd's algorithm and its analysis.	25	20
UNIT-II: **Flows in Networks**	• Basic concepts, Max flow-min cut Theorem. • Ford and Fulkerson's augmenting path method. • The Edmonds-Karp algorithm to solve the maximum flow problem. • Integrality theorem - Maximum capacity	20	20

	augmentation and its analysis - Augmentation by blocking flows - Dinic's algorithm-analysis of number of blocking steps for general and unit networks.		
UNIT-III **Matching Problems**	• Basic concepts. Bipartite matching and network flows. Hall's marriage theorem. • Non-bipartite matching-basic concepts, Edmonds- Blossom shrinking algorithm and its analysis.	10	15
UNIT-IV **Planarity and Graph Isomorphism**	• Review of basic results about planarity. • Kuratowski's theorem • Polynomial algorithm for testing of planarity and applications. • Graph Isomorphism and its importance. Backtracking algorithm for general graphs. Isomorphism problem and its complexity. Isomorphism complete problems, polynomial time algorithm for planar graph isomorphism problem, Group theoretic methods and graph isomorphism problem.	15	20
UNIT-V **Graph Coloring**.	• Map and vertex coloring problem. • 6,5 and 4-colour theorems for planar graphs, coloring graphs on compact surfaces, chromatic number.	10	12
UNIT-VI **Physical Networks**	• Modeling physical networks, component equations. • Kirchoff's laws, dual networks. Fundamental cycle and cutest equations. • Matrix form of the network equations, state equations	10	13
	Total	90	100

TEXTBOOKS/ RECOMMENDED READINGS:

- Chartrand. G. and Ollermann.O.R, (1993), *Applied and Algorithmic Graph Theory*, Mc-Graw Hill.
- Tarjan T.E., (1983), *Data structures and Network Algorithms*, Siam.Society for Industrial and Applied Mathematics.
- Horowitz E. and Sahani S., (2nd Edition), *Fundamentals of Computer Algorithms*, Galgotia.
- Deo N., *Graph Theory with Applications to Engineering and Computer Science*, PHI.

COURSE ASSESSMENT DETAILS:

Internal assessment: Two/ Three mid semester examinations will be conducted. 60% of this evaluation will be added to the total marks for this course.

External assessment: End Semester Examination will be of 100 marks covering the entire course and the exam duration will be 3 hours. 40% of the mark obtained will be added to the total marks for this course.