

GRAPH THEORY AND APPLICATIONS

MATH/CSCI 4150/8156

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1.0 Course Description

- 1.1 Overview of Content and Purpose:** (3 hours) Introduction to graph theory. Representations of graphs and graph isomorphism. Trees as a special case of graphs. Connectivity, covering, matching, and coloring in graphs. Directed graphs and Planar graphs. Applications of graph theory in several fields such as networks, social sciences, VLSI, chemistry, and parallel processing.
- 1.2 For whom Intended:** Junior (and above) mathematics and computer science majors and minors.
- 1.3 Prerequisite:** MATH/CSCI 2030 or permission of Instructor

2.0 Objectives

- 2.1 Performance Objectives for the Student:** The main objective of this course is to study the main concepts of graph theory and to recognize graphs as an important modeling technique in several applications. At the end of this course, a student should be able to apply the abstract concepts of graph theory in several practical problems.

3.0 Content and Organization

- 3.1 Topics**
- The course covers the basic definitions and concepts related to classical graph theoretic problems. The course also covers a number of applications in which graph modeling are known to be useful.
1. Introduction and basic definitions
 2. Graph representations and graph isomorphism
 3. Trees and their special properties and applications
 4. Connectivity, Euler tours and Hamiltonian cycles
 5. Coverings and matchings
 6. Cliques and independent sets
 7. Vertex colorings and edge colorings
 8. Directed graphs and applications
 9. Planar graphs and networks
 10. General applications: includes linear programming, parallel processing, Chemistry applications, and formal language theory.

4.0 Teaching Methodology

- 4.1 Methods to be Used:** The coverage will be primarily through lectures, with homework assignments and individual projects.

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5.0 Evaluation

- 5.1 Basis for Evaluating Student Performance:** Course grade will be based on exams, quizzes, homework, and individual reading projects. A possible scheme might be roughly as follows:
- Three one-hour exams 45%
 - Quizzes and homework 15%
 - Individual reading project 15%
 - Final exam 25%
- Projects of a higher degree of difficulty are expected from graduate students. Graduate students will also be given extra homework.

6.0 Resource Material

- 6.1 Textbook(s) or Other Required Readings:** J.A. Bondy and U.S.R. Murty, *Graph Theory with Applications*, North Holland, 1985.
- 6.2 Current Bibliography of Resources:** Frank, Harry, *Graph Theory*, Addison-Wesley, 1972.
Fred S. Roberts, *Graph Theory and Applications to Problems of Society*, SIAM, 19873.
G. Chartrand and L. Lesniak, *Graphs and Digraphs*.