MA4027: GRAPH THEORY AND APPLICATIONS

Summer 2004

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Course website: follow link from http://www.math.nps.navy.mil/∼ras
Text: *Introduction to Graph Theory*, 2nd ed., Douglas B. West, Prentice-Hall 2001.

This course is designed to provide a comprehensive introduction to graph theory, to students of mathematics, operations research, electrical engineering, and computer science. The initial emphasis will be on the core of what can today be regarded as classical graph theory, much of which has been developed since the arrival of digital computers. During the final weeks of the quarter, we will look at either one or two sections from Chapter 8; in the attached syllabus, these are anonymously listed as "special topics". The instructor finds the theories of perfect graphs, random graphs, and matroids especially intriguing, but the choice of these special topics will depend upon student input as well. The classical core can be broadly sketched by a listing of the first seven chapter titles from the text:

1. Fundamental Concepts
2. Trees and Distance
3. Matchings and Factors
4. Connectivity and Paths
5. Coloring of Graphs
6. Planar Graphs
7. Edges and Cycles

It is assumed that the student has had exposure to the the fundamentals of enumerative combinatorics, complexity, and mathematical proof. Some familiarity with probability theory will be useful if we choose to look at random graphs. Similarly, some familiarity with the theory of linear and integer programming will lead to greater appreciation of the theory of perfect graphs. No formal knowledge of graph theory is assumed. Assignments will be given daily, and will include both proofs and computational problems. Solutions to selected problems will accumulate in a notebook that will be available online. Two takehome exams will be given, the first at or near the midpoint of the quarter, the second due during finals week. Each will contribute one third of the total grade. The remaining third will come from presentations in class and/or written projects.

Anticipated coverage is listed by section the on following page. Depending upon the number of in-class student presentations during the second half of the quarter, some topics listed might be omitted. For higher resolution, see the table of contents in the text.

Week	Sections	Topics
1	1.1	Definitions and Examples
	1.2	Paths, Cycles, and Trails
	1.3	Vertex Degrees and Counting
2	1.4	Directed Graphs
	2.1	Basic Properties of Trees
	2.2	Spanning Trees and Enumeration
3	2.3	Optimization and Trees
	3.1	Matchings and Covers
	3.2	Algorithms and Applications
4	3.3	Matchings in General Graphs
	4.1	Cuts and Connectivity
	4.2	k-connected Graphs
5	4.3	Network Flow Problems
	5.1	Vertex Colorings and Upper Bounds
	5.2	Structure of k-chromatic Graphs
6	5.3	Enumerative Aspects of Coloring
	6.1	Embeddings and Euler's Formula
		Midterm Exam Due
7	6.2	Characterization of Planar Graphs
	6.3	Parameters of Planarity
	7.2	Hamiltonian Cycles
9	8.x	Special Topics
10	8.x, 8.y	Special Topics
11	8.y	Special Topics
12		**Final Exam Due**