

Course Outline for MATH 3055, Graph Theory

MATH 3055 Graph Theory (3 units)

Prerequisite: Junior standing, MATH 248, or [MATH 2031](#).

Introduction to graph theory and its applications: isomorphism, paths and searching, connectedness, trees, planarity, graph colorings, matching theory, network flow, graph matrices. Further areas may include the theory of finite state machines, Ramsey theory, spectral theory and extremal theory. 3 lectures. Formerly MATH 335.

Course Learning Objectives	
1	Use matrix algebra to characterize graph properties.
2	Determine whether or not two given graphs are isomorphic.
3	Provide graph theoretic models for specific applications.
4	Paraphrase proofs of classical theorems in graph theory.
5	Demonstrate the non-planarity of specific graphs.
6	Illustrate graph algorithms on examples.
7	Produce bounds on the chromatic number of a graph.

Expanded Course Content

Textbooks, materials, and/or other resources
Combinatorics and Graph Theory, by Harris, Hirst and Mossinghoff

Week	Readings	Topics of Discussion
1	Combinatorics and Graph Theory: Sections 1.1.1, 1.1.2	Graphs and their relatives, basic definitions
2	Combinatorics and Graph Theory: Sections 1.1.3, 1.2.1	Special types of graphs, distance in graphs and related definitions
3	Combinatorics and Graph Theory: Section 1.2.2	Properties involving distance in graphs
4	Combinatorics and Graph Theory: Sections 1.2.2, 1.2.3	Graphs and matrices with applications

Week	Readings	Topics of Discussion
5	Combinatorics and Graph Theory: Sections 1.3.1, 1.3.2	Trees: definitions and examples, properties of trees
6	Combinatorics and Graph Theory: Sections 1.3.3, 1.3.4	Spanning trees and algorithms
7	Combinatorics and Graph Theory: Sections 1.3.4	Counting trees, Matrix-tree Theorem
8	Combinatorics and Graph Theory: Sections 1.4.1, 1.4.2, 1.4.3	Eulerian trails and circuits, Hamiltonian paths and cycles
9	Combinatorics and Graph Theory: Sections 1.5.1, 1.5.2	Definitions involving planarity, Euler's formula
10	Combinatorics and Graph Theory: Sections 1.5.3, 1.5.4	Regular Polyhedra, Kuratowski's Theorem
11	Combinatorics and Graph Theory: Sections 1.6.1, 1.6.2	Definitions involving graph coloring, chromatic numbers and their bounds
12	Combinatorics and Graph Theory: Sections 1.6.3, 1.6.4	The four color problem, chromatic polynomials.
13	Combinatorics and Graph Theory: Sections 1.7.1-1.7.3	Definitions involving matchings, Hall's Theorem and SDRs, the Konig-Egervary Theorem
14	Combinatorics and Graph Theory: Sections 1.7.4, 1.8.1	Perfect matchings, classical Ramsey numbers
15	Combinatorics and Graph Theory: Sections 1.8.2-1.8.3	Exact Ramsey numbers, bounds, graph Ramsey theory

Method of Assessment

The possible methods of assessment are written individual examinations, quizzes, in-class worksheets or presentations, projects, and homework. One or more midterms and a cumulative final exam are required.

Instructional Mode

The instructional mode for this class is face-to-face. This designation means that the essential academic standards of the course require in-class student engagement, and thus remote instruction is not appropriate.