MATH 510 Discrete Mathematics

Required of CS, CMPEN

Catalog Description: (3) I, II, S. Combinatorics and graph theory. Topics selected from counting principles, permutations and combinations, the inclusion/exclusion principle, recurrence relations, trees, graph coloring, Eulerian and Hamiltonian circuits, block designs, and Ramsey Theory.

Prerequisites: Sophomore standing and MATH 221.

Textbook: *Introductory Combinatorics*, Richard A. Brualdi, Prentice Hall, 2004, Fourth Edition.

Course Objectives: In this course students will learn problem-solving involved in real life examples and mathematical reasoning. Students will apply these skills in designing algorithms to solve problems closely related to computer programs. The emphasis will be on using computer programming to learn algorithm designing and mathematical reasoning. More specifically, the course will cover: the pigeonhole principle and many applications; counting principles and their application in counting situations that appear in real life such as permutations and combinations of sets and multi-sets; computation of binomial coefficients and application to study properties of the binomial coefficients; Inclusion-Exclusion principles and applications; generating functions and recursive relations; introduction to graph theory and algorithm design, such as finding the Eulerian path, stable marriages, distinct representatives, and max-matching. The course will differ substantially from students' earlier math courses such as calculus or differential equations. There will be no general formula for students to plug in numbers, and each situation will be different and will require students' careful analysis of the situation to devise a way to solve the problem. Students should gain broad experience in problem solving and applications of basic mathematical principles in real life situations for their future profession.

Sessions: Three 50 minute lecture/recitations per week.

Chapter	Topics	Sessions
2	Pigeonhole Principle: Simple and Strong Forms	2
	A Theorem of Ramsey	1
3	Two Basic Counting Principles	1
	Permutations and Combinations of Sets	2
	Permutations and Combinations of Multisets	2
5	Pascal's Formula	1
	The Binomial Theorem	1
	Indentities	1
	The Multinomial Theorem	1
	Newton's Binomial Theorem	1
6	The Inclusion-Exclusion Principle	1
	Combinations with Repetition	1
	Derangements	1
	Permutations with Forbidden Positions	1
	Another Forbidden Position Problem	1
7	Some Number Sequences	1
	Linear Homogeneous Recurrence Relations	1
	Generating Functions	1
	Recurrences and Generating Functions	1
9	General Problem Formulation	1
	Matchings	1
	Systems of Distinct Representatives	2
	Stable Marriages	2
11	Basic Properties	1
	Eulerian Trails	1
	Hamilton Chains and Cycles	1
	Trees	2
12	Digraphs	1
	Networks	2
13	Plane and Planar Graphs	2
	Independence Number and Clique Number	2
Reviews and Hour Exams		6
Total		46