MATHEMATICS 152, FALL 2003
METHODS OF DISCRETE MATHEMATICS

Last revised: September 10, 2003

Instructor: Paul Bamberg

Offices: SC 423, 495-1748 and Quincy House 102, 493-3100. Quincy 102 opens off the Quincy House courtyard, near the raised cubical library.

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Course Website: `http://www.courses.fas.harvard.edu/~math152` (That's a tilde before math152)

Goals and Prerequisites: This course will introduce you to a variety of topics in higher mathematics that are "discrete" in the sense that they are not dependent on limits and approximation. Ideas from geometry, group theory, rings and fields, graph theory, linear algebra, combinatorics, and probability will be studied, and surprising connections will emerge.

You are expected to have a background in linear algebra (probably Math 21b, but perhaps a course that you took elsewhere) and an interest in theoretical mathematics. Previous experience with proofs is not necessary. One of the aims of the course is to introduce you to the techniques of proof in higher mathematics.

Because the subject matter of the course is discrete, calculus is irrelevant.

If you are concentrating in Computer Science or Applied Mathematics, you will be expected to complete four programming projects in which you implement key mathematical ideas from the course in a C++ program with a standard modern graphical user interface. There are detailed instructions for doing the user interface in either Windows or Linux, but you will need good C++ skills (CS 51 or pre-Java AP Computer Science) to implement the mathematics. Students who are not Applied Math or CS concentrators will need to know how to download and run Windows application programs from the course Web site, but not how to write them.

Course Meetings: The course meets TTh from 1-2:30 P. M. in Science Center 116. There will also be an additional weekly problem session led by a course assistant. We will try to find a time for this session or late Monday afternoon or early Monday evening that is convenient for everyone.

The course will be run in a seminar style, with most of the topics presented by students in the class. This means that your classmates will be counting on you to prepare carefully and that you will gain lots of experience in presenting proofs at the blackboard.

Grades: Your course grade will be determined as follows:

- required homework, 50 points
- class presentations, 20 points
- exploratory homework and programming assignments, 40 points
- two best quizzes, 20 points each
- third quiz, 10 points
- final exam, 100 points

The total points available are thus 260, and the grading scheme is as follows:

Points	Minimum Grade
234	A
221	A-
208	B+
195	B
182	B-
169	C+
156	C

Exams: There will be three in-class quizzes and one final exam. The quizzes will be roughly one-half hour each, and the final is scheduled for three hours.

Three Quizzes:	Thursday, October 9
	Thursday, November 6
	Tuesday, December 2
Final Exam:	comprehensive, though weighted toward the later material

Texts:

"Discrete Mathematics," Norman L. Biggs, second edition, Oxford University Press, 2002, ISBN# 0-19-850717-8 (at the Coop)

"Calculus, Volume II, 2nd Ed." Tom M. Apostol, Wiley, 1969, ISBN# 0-536-00008-5 (Ch. 13 only – will be available as a course pack)

Office Hours:

- Tu 2:30-3:30 in Science Center 423
- W mornings in Quincy 102 (most any time, but phone 3-3100 first)
- M and W evenings in Quincy 102, but phone 3-3100 first)

You are encourage to come to office hours to discuss your upcoming presentations, but be warned that this should not be left to Tuesday or Thursday morning, since that is when my other course Math 191 meets!

Homework and Programming Assignments: Homework will be assigned weekly and will be due at the start of Tuesday's class. Your CA will return your corrected homework to you at the following class.

You are encouraged to discuss the course with other students, your CA and the instructors, *but you should always write your homework solutions out yourself in your own words.*

Required homework problems are the ones due weekly and are a necessary component of keeping up with the course.

In addition, there are two options for the second homework component of the grade. This work may be completed as late as Reading Period, though it is recommended that you begin long before then. The first option is a set of exploratory problems (2 points each) which will engage your creativity, consisting of some more difficult proofs and some open-ended questions. The second is a set of four programming assignments (10 points each) for those more interested in computer science. Students are encouraged to mix and match from among the exploratory problems and computer assignments, but Applied Math and CS concentrators must earn at least 25 points from the programming assignments.

Approximate Day-by-Day Syllabus:

Date		Sections	Topics
September	16	27.1-27-3	Counting, Symmetries and Platonic Solids
	18	3.6, 5.5–5.6, Ch. 21	Permutations
	23	Ch. 20	Groups
	25	Ch. 13	Congruence Arithmetic
	30	Ch. 20	Subgroups
October	2	1.5, 6.1–6.3	Quotient Groups
	7	Ch. 22	Rings
	9	Ch. 23	QUIZ #1 and Fields
	14	Ch. 23	Finite Fields
	16	23.6–23.7, supplement	Finite Affine Geometry
	21	23.6–23.7, supplement	Finite Affine Geometry
	23	review	Linear Algebra over Finite Fields
	28	review	Linear Transformations
	30	supplement	Group Isomorphisms
November	4	supplement	Group Isomorphisms
	6	supplement	QUIZ #2 and Isomorphisms
	11	Ch. 13 (Apostol)	Set Theory
	13	Ch. 13 (Apostol)	Probability
	18	Ch. 13 (Apostol)	Probability
	25	Ch. 13 (Apostol)	Countability and Uncountability
December	2	15.1–15.3	QUIZ #3 and Graph Theory
	4	15.4	Cycles and paths
	9	16.6	Weighted graphs, shortest-path algorithms
	11	16.5	Trees, spanning trees
	16	supplement	Generators and relations
January	7	supplement	Graphs and groups