MATHEMATICS 152, FALL 2004
METHODS OF DISCRETE MATHEMATICS

Last revised: September 14, 2004

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.
Email: `bamberg@tiac.net`

Office Hours:

- Tu 2:30-3:30 in Science Center 423
- Tu 10AM-noon(if no second section meets then), Wed 9AM-12:30PM and Th 8AM-noon in Quincy 102 (phone 3-3100 first).
- Tu evenings in Quincy 102, (phone 3-3100 first)

You are encouraged to come to office hours, especially to Quincy House, to discuss your upcoming presentations.
Early morning and evening availability are not guaranteed until the Red Sox are out of the playoffs.
Icosahedron Assembly: If you do not have scissors and tape with you, come to Quincy 102 between 3 and 5 PM on Wednesday, September 22 to assemble your models of the five Platonic solids from the kits distributed in class. I have lots of scissors and colored tape, plus some snacks. If you have a Windows laptop computer, bring it along and we can install PHP on it.
Course Assistants: to be determined
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.

Placement Tests: This year there are some experimental online math placement tests designed to help freshmen who are considering taking math courses

numbered higher than 21. We need to know how students like you, who are clearly qualified for such courses, score on these tests, so that next year we can give accurate placement advice based on the tests.

The tests will only be online for the first couple of weeks of the term. During that period, please log on to `math.placement.fas.harvard.edu` and take the tests called "Math 21b-mastery" and "more fun math." Doing this will be a public service and will also help your grade slightly. To get credit, just send an email to `bamberg@tiac.net` with the information from the "receipts" that are created when you finish the test.

Computing Projects: If you are concentrating in Computer Science or Applied Mathematics, you are encouraged to complete three programming projects in which you implement key mathematical ideas from the course in interactive Web pages using PHP. You need only follow step-by-step instructions to create the user interface, but you will need programming experience in a language like C or Java (CS 50 or AP Computer Science) to implement the mathematics. PHP is an easy language to learn, so no previous experience with it is necessary. You can see what the finished projects will look like by following the link under Programming Projects on the course Web site.

If you like to program but have no interest in learning how to create Web pages, you may, for roughly half credit, just implement the mathematics in programs with no user interface at all.

If you program in C++ and have access to Microsoft Visual C++ or to KDevelop under Linux, you can do the projects in C++. There are detailed instructions on the course Web site. If you choose to use Java, you are completely on your own, but it has been done!

If you are interested in installing PHP on your own Windows computer in order to do the programming projects, you can pick up a CD in class that has all the necessary files.

Course Meetings: The course meets TTh from 1-2:30 P. M. in Science Center 310. There will also be an additional weekly problem session led by the course assistant. We will try to find a time for this session on late Monday afternoon or early Monday evening that is convenient for everyone. If enrollment is large, there may be two problem sessions.

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.

In the event that enrollment exceeds 16, we will try to find a time and place for a second section on Tuesdays and Thursdays at 10 or at 11:30, so that everyone can have more frequent opportunities to do presentations. On the accompanying registration sheet, please indicate whether either of those times would work for you.

Grades: Your course grade will be determined as follows:

- required homework, 50 points
- class presentations, 20 points
- exploratory homework and programming assignments, 50 points
- two best quizzes, 20 points each
- third quiz, 10 points
- final exam, 100 points
- 2 placement tests, 10 points each (also added to the total possible points)

The total points available are thus 270 or 290, depending on whether you do the placement tests. The grading scheme is as follows:

Percentage	Minimum Grade
92%	A
86%	A-
80%	B+
74%	B
68%	B-
62%	C+
56%	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 14
	Tuesday, November 9
	Thursday, December 9
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)

Homework and Programming Assignments: Homework will be assigned weekly and will be due at the start of Tuesday's class. The 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.

There are two options for the second homework component of the grade. 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 three programming assignments (45 points total) for those more interested in computer science. You are encouraged to mix and match from among the exploratory problems and computer assignments to achieve a total of 50 points.

Due dates for the exploratory problems and computer assignments are flexible, but to get full credit you must earn

- at least 10 points before the first quiz
- at least 20 points before the second quiz
- at least 30 points before the third quiz
- at least 40 points before the end of reading period.

This lets you save 10 points' worth to do in reviewing for the final exam, and there will be a few exploratory problems reviewing the last topic that are good practice for the final.

Approximate Day-by-Day Syllabus:

Date		Reading	Topics
September	21		Counting, Symmetries and Platonic Solids
	23	3.6, 5.5–5.6, Ch. 21	Permutations
	28	Ch. 20	Groups
	30	Ch. 13	Congruence Arithmetic
October	5	Ch. 20	Subgroups
	7	Ch. 20	Quotient Groups
	12	Ch. 22	Rings
	14	Ch. 23	QUIZ #1 and Fields
	19	Ch. 23	Finite Fields
	21	23.6–23.7, supplement	Finite Affine Geometry
	26	23.6–23.7, supplement	Finite Affine Geometry
	28	any linear algebra text	Linear Algebra over Finite Fields
November	2	any linear algebra text	Linear Transformations
	4	supplement	Group Isomorphisms
	9	supplement	QUIZ #2 and Isomorphisms
	16	supplement	Isomorphisms
	18	Ch. 13 (Apostol)	Set Theory
	23	Ch. 13 (Apostol)	Probability
	30	Ch. 13 (Apostol)	Probability
December	2	Ch. 13 (Apostol)	Countability and Uncountability
	7	15.1–15.3	Graph Theory
	9	15.4	QUIZ #3 and Cycles and paths
	14	16.3-16.5	Trees, spanning trees
	16	supplement	Generators and relations
	21	supplement	Graphs and groups