

MATH S-15, SUMMER 2001
GROUPS, GRAPHS, AND ALGEBRAIC STRUCTURES FOR
COMPUTING

Instructors: John D. Boller, SC 320, 495-5377, oller@math.harvard.edu
and Paul Bamberg, SC ???, xxx-xxxx, bamberg@tiac.net

Goals and Prerequisites: This course will introduce the student to a wide variety of interconnected topics in higher mathematics not dependent on limits and approximation. Ideas from geometry, group theory, graph theory (including trees and networks), linear algebra, and combinatorics will be studied to address problems in counting, algorithms, sorting, and classification.

The student is expected to have a strong background in pre-Calculus mathematics. Familiarity with the trigonometric functions and coordinate geometry and strong algebraic skills are necessary. Some familiarity with elementary probability, summation notation, and mathematical induction are desirable but not necessary.

Course Meetings: The course meets Monday and Wednesday afternoons from June 25 through August 8 from 3:30–6:00 P.M. in Science Center 102b. There will also be a course assistant (CA), Mihaela Enachescu, who will lead an additional weekly problem session, TBA.

Grades: Your course grade will be determined as follows:

- homework, 50 points
- programming assignments (graduate students only), 40 points
- two better quizzes, 20 points each
- third quiz, 10 points
- final exam, 100 points

The total points available are thus 200 for undergraduates and 240 for graduate students. The grading scheme is as follows, though the instructors reserve the right to be more generous.

Points (U)	Points (G)	Minimum Grade
180	216	A
170	204	A-
160	192	B+
150	180	B
140	168	B-

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

Three Quizzes: July 9 (covering through July 2)
 July 23 (covering July 11–18)
 July 30 (covering July 23–25)
Final Exam: August 14, 6:15–9:15 P. M. comprehensive
 though weighted toward Graph Theory (July 30–August 8).

Text: The textbook is “Discrete Mathematics with Combinatorics” by James A. Anderson (ISBN # 0-13-086998-8), and it is available in the Harvard COOP.

Office Hours: By appointment. Please e-mail to suggest a meeting time.

Homework and Programming Assignments: Homework will be assigned daily and will be due at the start of the next class. Your CA will return your corrected homework to you 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.*

The homework in this course will differ from what many may have experienced in previous courses. Each homework set will have “required” and “exploratory” problems. Required problems are the more conventional ones, which will be computational in nature, and they make up 80% of the homework grade. Exploratory problems will engage the student’s creativity, and there will some proofs and some open-ended questions. The student may turn in as many exploratory problems as desired, but the only the two best will count for the other 20% of the homework grade.

There will be four programming assignments required of graduate students. Programming should be done in Visual C++, and those students who do not already know C++ are welcome to sit in on the first three lectures of Computer Science S-F on MW 6:10–8:15 in Lecture Hall D in the Science Center, which will teach all the Visual C++ needed to complete these assignments. For each assignment, the instructors will provide a model program, and the students will be expected to produce one for similar problem. Undergraduates may turn in a programming assignment to replace two exploratory problems from the standard homework assignments.

Day-by-Day Syllabus:

<u>Date</u>		<u>Sections</u>	<u>Topics</u>
June	25	4.2 and notes	Symmetries, Platonic Solids, and Permutations
June	27	3.6, 9.4 and notes	Group Theory and Congruence Arithmetic
July	2	20.1, 20.4 and notes	Groups and Fields
July	4		HOLIDAY
July	9	9.5 and notes	Permutations, Rotation Groups, and Isomorphisms
July	11	4.3 and notes	Linear Algebra and Matrices
July	16	5.8, 8.11 and notes	Determinants, eigenvalues, and eigenvectors
July	18	notes	Matrices over Finite Fields
July	23	8.1–8.4	MIDTERM and Combinatorics
July	25	12.1–12.3	Combinatorics and Probability
July	30	Ch. 6	Graph Theory
August	1	14.1–14.4	Graph, colorings, planarity
August	6	14.5	Weighted graphs, shortest-path algorithms
August	8	Ch. 15	Trees, spanning trees
August	14		FINAL EXAM