PROPOSED SYLLABUS FOR MATH 111
TRANSITION TO ADVANCED MATHEMATICS

Fall 2005

Time and place:
Web page:
Units: 3
Prerequisites: Math 76

Instructor:
Office and office hours:
Phone:
Email:

Textbook: G. Chartrand, A.D. Polimeni, P. Zhang *A transition to Advanced Mathematics*, Addison-Wesley.

Catalog description: Introduction to the language and problems of mathematics. Topics include set theory, symbolic logic, types of proofs, and mathematical induction. Special emphasis is given to improving the student's ability to construct, explain, and justify mathematical arguments.

Course objectives

The objective of this course is to introduce students to the language of mathematics and to teach them how to write proofs. Upon completion of this course, students should know:

- Why it is important to prove mathematical statements.
- Various ways to approach problems and conjectures.
- How to explain and justify a mathematical argument.
- How to choose a proper notation.
- Basic properties of sets, integers, real numbers, functions, and relations.

Learning Outcomes

Upon completion of this course, students should be able to:

- Use the basic language of mathematics (logic, sets, relations, functions).
- Outline, write and criticize mathematical proofs about numbers, sets, and functions.

Attendance

It is important to attend every class because every lecture is based on previous material. Attendance will not be taken, but occasionally, a quiz will be given.

If you miss a class, you should contact one of your classmates or the instructor to find out what was done in class and whether important announcements were made or homework was assigned, and read the appropriate sections of the book.

Homework

There will be weekly homework. No late papers will be accepted except in case of an illness or a serious family emergency. Working with your classmates is allowed and encouraged, but every student must write his or her own papers. If you work with someone, please indicate that on your paper.

Tests

There will be three hour tests and a comprehensive final exam. Make-up exams will be given only in case of an illness or a serious family emergency. No notes, books, or calculators will be allowed.

Extra help

It is important not to fall behind. Every class is based on previous material. If you need extra help, you are encouraged to

- ask your instructor in class
- come to the instructor's office hours or make an appointment
- work with your classmates

Grading procedures

Your grade will be based on your performance on quizzes, tests, and homework according to the following tables.

Quizzes	50 points
Test 1	50 points
Test 2	50 points
Test 3	50 points
Homework	100 points
Final Exam	100 points
Total	400 points

Points earned	Letter grade
360-400 (90%-100%)	A
320-359 (80%-89%)	B
280-319 (70%-79%)	C
240-279 (60%-69%)	D
0-239 (0%-59%)	F

Classroom behavior

Any disruptive behavior in class that interferes with the learning environment will not be tolerated. University policies on disruptive behavior are followed and enforced in every instance.

Academic honesty

Cheating in this class will not be tolerated. University policies on plagiarism and cheating are followed and enforced in every instance.

Students with disabilities

University student disability policies are followed. Contact the Disabled Student Services office (located in the Madden Library) for specific arrangements and information.

Tentative schedule

Week	Topic
1	**Communicating Mathematics.** Mathematical writing, using symbols, writing mathematical expressions, common words and phrases in mathematics.
2	**Sets.** Describing a set, special sets, subsets, set operations, indexed collection of sets, partitions of sets, Cartesian products of sets.
3-4	**Logic.** Mathematical statements, the negation of a statement, the disjunction and conjunction of a statement, the implication, the biconditional, tautologies and contradictions, logical equivalence and its fundamental properties, characterizations of statements, quantified statements and their negations.
5-6	**Direct Proof and Proof by Contrapositive.** Trivial and vacuous proofs, direct proofs, proof by contrapositive, proof by cases, proof evaluations, proofs involving divisibility of integers, proofs involving congruence of integers, proofs involving real numbers, proofs involving sets, fundamental properties of set operations, proofs involving Cartesian products of sets.
7	**Proof by Contradiction.** The three prisoners problem, the irrationality of $\sqrt{2}$, and other examples.
8	**Prove or Disprove.** Conjecture in mathematics, existence proofs, counterexamples, disproving statements, testing statements.
9	**Equivalence Relations.** Reflexive, symmetric, and transitive relations, equivalence relations, properties of equivalence classes, congruence modulo n, integers modulo n.
10	**Functions.** The definition of a function, the set of all functions from A to B, one-to-one and onto functions, bijective functions, inverse functions, permutations.
11	**Mathematical Induction.** The well-ordering principle, the principle of mathematical induction, mathematical induction and sums of numbers, mathematical induction and inequalities, mathematical induction and divisibility, other examples of induction proofs, proof by minimum counterexample, the strong form of induction.
12	**Cardinalities of Sets.** Numerically equivalent sets, denumerable sets, uncountable sets, comparing cardinalities of sets.
13	**Proofs in Number Theory.** Divisibility properties of integers, the division algorithm, greatest common divisors, the Euclidean algorithm, relatively prime integers, the fundamental theorem of arithmetic, concepts involving sums of divisors.
14-15	**Proofs in Calculus.** Limits of sequences, infinite series, limits of functions, fundamental properties of limits of functions, continuity, differentiability.