Introduction to Abstract Mathematics
Math 2230

1.0 Overview

1.1 Course Description: Provides a transition from the calculus to more abstract mathematics. Topics include logic, sets and functions, an introduction to mathematical proof, mathematical induction, relations. Important prerequisite material for a number of more advanced abstract mathematics courses is studied. Credit will not be given for both Math 2030 and Math 2040.

1.2 For Whom Intended: Primarily for mathematics majors and secondary education majors preparing to teach mathematics. Also, for anyone planning to take more advanced abstract mathematics courses or simply interested in learning the foundations and processes of mathematical reasoning.

1.2 Prerequisite: Math 1960 or permission from instructor

1.3 Contact Hours: 3

2.0 Objectives

The student will appreciate the difference between those mathematics courses that primarily involve problem solving and those that require a more abstract type of mathematical reasoning, and gain experience in the latter kind of thinking. The student will gain an understanding of the axiomatic method, the importance of definition, and methods of proof through deductive reasoning. To learn specific tools and techniques needed in certain future courses, such as working with sets and functions, symbolic logic, direct and indirect proofs and mathematical induction. The student will begin to develop a mathematical style for presenting proofs in a clear and concise manner.

3.0 Content and Organization

3.1 Topics

1.) Symbolic logic
   a. Logical connectives
   b. Truth tables
   c. Implication and equivalence
   d. Quantifiers – especially negation
2.) Introduction to proof
   a. Direct proof
   b. Indirect proof
      by contradiction, by contrapositive

c. Counterexamples
d. Mathematical induction

3.) Sets and functions
   a. Union, intersection, complement, set difference
   b. Infinite families of sets
   c. Relations and functions
   d. One-one, onto functions; inverse functions
   e. The power set and induced functions by $f:X \rightarrow Y$ relation to unions, intersections, complements

4.) More on relations
   a. Especially equivalence relations

5.) Specific topics, as examples and foundation for later courses
   a. Elementary number theory
   b. Elementary topology of the real line

6.) Additional topics if time allows
   a. Elementary counting and probability
   b. Cardinality

4.0 Teaching Methodology

4.1 The course will be taught using a combination of lecture, class discussion and collected homework exercises.
4.2 Students will have weekly homework assignments. They will be encouraged to bring questions and discuss the problems before they are collected. Graded homework will be returned and discussed further.

5.0 Evaluation

5.1 Grades will be based on class participation (0-10%), graded homework exercises or projects (10-30%), two or more tests during the semester (40-70%), and a comprehensive final examination (20-40%). The exact percentages will be communicated by the instructor at the beginning of the semester.

5.2 Grading Scale

90-100 = A
86-89 = B+
80-85 = B
76-79 = C+
70-75 = C
66-69 = D+
60-65 = D
Below 60 = F

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Current Text

Devlin, *Sets, Functions and Logic*, Chapman and Hall, CRC.

Possible Texts

Barnier, Feldman, *Introduction to Advanced Mathematics*, Prentice Hall.

Chartrand, Polimeni, Zhang, *Mathematical Proofs, A Transition to Advanced Mathematics*, Addison-Wesley.

Maddox, *Mathematical Thinking and Writing*, Harcourt/Academic Press.

Smith, Eggen, St. Andre, *A Transition to Advanced Mathematics*, Brooks Cole.

Schwartz, *Conjecture and Proof, An Introduction to Mathematical Thinking*, Saunders.

Sundstrom, *Mathematical Reasoning , Writing and Proof*, Prentice Hall.

Other Sources

Solow, *How to Read and Do Proofs*, *an Introduction to Mathematical Thought Processes*, Wiley.

D'Angelo, West, *Mathematical Thinking, Problem-Solving and Proofs*, Prentice Hall.

Meyer, *An Introduction to Axiomatic Systems*, Prindle, Weber and Schmidt.

Schumacher, *Chapter Zero, Fundamental Notions of Abstract Mathematics*, Addison Wesley.

Eisenberg, *The Mathematical Method, A Transition to Advanced Mathematics*, Prentice Hall.