Course Syllabus

Course Title: Foundations of Algebra

Course Number: Math 2110 (Proposed number, 3110)

Credit Hours: 3

Prerequisite: Math 1210

Suggested Texts: Maddox, A Transition to Abstract Mathematics
Scheinerman, Mathematics: A Discrete Introduction

Learning Objectives:

1. Students will be introduced to rigorous aspects of algebra, number theory, and logic.
2. Students will be well prepared for abstract mathematics courses.
3. Students will develop proof writing skills.

Catalog Description:

An introduction to Abstract Algebra, Number Theory and Logic with an emphasis on problem solving and proof writing

Course Coverage:

The notion of proof is fundamental to all areas of mathematics. A major emphasis of this course will be on the notions of set theory, logic, definition, and proof. These concepts will be applied in various algebraic, number theoretic, and discrete settings. Definitions and properties of integers will be investigated at a proof-based level, particularly those properties related to divisibility, modular arithmetic, and the Euclidean Algorithm. The concept of a function will also be defined and studied from a rigorous, proof-based perspective. This concept, which permeates mathematics, connects naturally to the study of permutations, counting, recursion, symmetry groups, and eventually group theory. In addition to these topics, this course may include some study of rings, fields, or other modern algebraic constructs.

The depth of coverage of each topic and the number of optional topics depends on the instructor. It is suggested that at least half the course should be spent on covering topics in algebra.

Student Assessment:

The exact grading for this course will be determined by the instructor. However, assessment typically includes homework with substantial proof-writing, midterm examinations, and a cumulative final exam. Some instructors may wish to incorporate quizzes, or projects. The weighting of various components is determined by the instructor, but the following is typical:
Homework – 25%, **3 Midterm Exams** – 17% each, **Final Exam** – 24%
Homework assignments will be determined by the instructor.

Suggested Section Coverage[1]

Sec 2: Definitions
Sec 3: Theorems
Sec 4: Proof
Sec 5: Counterexample
Sec 6: Boolean algebra
Sec 7: Counting, multiplication
Sec 8: Factorial
Sec 9: Sets
Sec 10: Quantifiers
Sec 11: Set operations
Sec 13: Relations
Sec 14: Equivalence relations
Sec 16: Binomial Coefficients
Sec 19: Contradiction
Sec 21: Induction
Sec 22: Recurrence Relations
Sec 23: Functions
Sec 25: Composition of functions
Sec 26: Permutations
Sec 27: Symmetry
Sec 34: Dividing
Sec 35: Greatest common divisor
Sec 36: Modular arithmetic
Sec 38: Factoring
Sec 39: Groups
Sec 40: Isomorphism
Sec 41: Subgroups
Optional Topics: Rings, Fields

Suggested Homework

Sec 2: 2, 4, 5, 6
Sec 3: 1, 2, 5, 6
Sec 4: 2-10, 13, 15
Sec 5: 1, 2, 4, 5, 8, 9
Sec 6: 1, 3, 4, 6, 9, 10a, 11b, 12b
Sec 7: 1-6, 8, 9(a-d), 11, 13, 14
Sec 8: 1, 4, 5, 7, 8, 9
Sec 9: 1, 3, 5-8, 10
Sec 10: 1(e-k), 3, 4, 5(d-g)
Sec 11: 5, 17
Sec 13: 1, 6, 12
Sec 14: 2, 5(a-c), 8
Sec 16: 1-4, 6, 10, 14, 20, 22
Sec 19: 1(a,b,c), 2, 3, 4(a-d), 6, 7, 9
Sec 21: 3(b), 4(c), 6, 9, 15
Sec 22: 1(a-d), 2(d,j,k), 16(a-c)
Sec 23: 1(c,d-f), 7, 8, 9(a,b,c,e), 11, 12, 13
Sec 25: 1(a-d), 8, 9, 10, 12b
Sec 26: 1(a-e), 2, 3, 5(a-d), 12, 14, 15
Sec 27: 1-4, 7
Sec 34: 1, 2, 5, 6
Sec 35: 2(e,f), 9(a,b), 10, 11, 13, 16, 18
Sec 36: 1(a-d, h-k, n-q), 2, 4(d-f), 10, 14(b)
Sec 38: 1, 5, 8, 11, 12, 18
Sec 39: 4, 5, 6, 10, 13, 14, 16
Sec 40: 2, 3, 4, 5, 6, 7
Sec 41: 1, 2, 6, 11

[1]Homework assignment taken from **Scheinerman, Mathematics: A Discrete Introduction**