## Mathematics 3300 – Introduction to Abstract Mathematics

### Student Learning Outcomes

1. **Students will demonstrate factual knowledge of the mathematical notation and terminology used in this course.** Students will demonstrate the ability to read, interpret, and use the vocabulary and symbolism of propositional calculus, proof methods, set theory, functions, cardinality, and discrete structures.

2. **Students will demonstrate knowledge of fundamental methods of proof and problem solving.** Students will demonstrate the ability to read and comprehend mathematical arguments utilizing direct and indirect proof, case analysis, and mathematical induction.

3. **Students will apply course material along with techniques and procedures covered in this course to prove theorems and solve problems.** Students will use the knowledge gained in this course to determine appropriate methods of proof for specific problems and to develop and write formal mathematical arguments.

4. **Students will develop specific skills, competencies, and thought processes sufficient to support further study or work in this field or related fields.** Students will acquire proficiency in the fundamental concepts of set theory, logic, functions, properties of the real number system, and methods of proof, at a level necessary for more advanced mathematics courses such as linear and abstract algebra, real and complex analysis, and topology.

### Course Content

**Textbook:** *An Introduction to Abstract Mathematics*, by Bond and Keane.

**Ch. 1, Mathematical Reasoning:** Statements, Compound Statements, Implications, Contrapositive and Converse.

**Ch. 2, Sets:** Sets and Subsets, Combining Sets, Collections of Sets.

**Ch. 3, Functions:** Definition and Basic Properties, Surjective and Injective Functions, Composition and Invertible Functions.

**Ch. 4, Binary Operations and Relations:** Binary Operations, Equivalence Relations.

**Ch. 5, The Integers:** Axioms and Basic Properties, Induction, The Division Algorithm and Greatest Common Divisors, Primes and Unique Factorization, Congruences, Generalizing a Theorem.

**Ch. 6, Infinite Sets:** Countable Sets; Uncountable Sets, Cantor's Theorem, and the Schroeder-Bernstein Theorem; Collections of Sets.

**Ch. 7, The Real and Complex Numbers:** Fields, The Real Numbers, The Complex Numbers.

**Optional:** Portions of Ch. 8 (Polynomials, Unique Factorization, Polynomials over **C**, **R**, and **Q**), results from geometry, basic results from linear algebra, analysis, and numerical analysis.