Course: Logic and Set Theory

Level: PS II

Course Description: This course provides an introduction to the basic concepts and results of mathematical logic and set theory. The course introduces some basic notions that will be needed as background for most of the computer science courses. Also, the course will familiarize students with abstract mathematical thinking. We will present and explain how different mathematical theories can be modeled inside the set theoretic universe, and discuss the role of the axiom of choice.

Course Goals: Upon completion of this course, the student should be able to:

- Properly use the vocabulary and symbolic notation of higher mathematics in definitions, theorems, and problems.
- Analyze the logical structure of statements symbolically, including the proper use of logical connectives, predicates, and quantifiers.
- Construct truth tables, prove or disprove a hypothesis, and evaluate the truth of a statement using the principles of logic.
- Solve problems and write proofs using the concepts of set theory, including the methods of Venn diagrams and truth tables.
- Solve problems and write proofs using the basic definitions and the fundamental properties of subsets and operations on the real numbers, integers, rational and irrational, even and odd, multiples or factors of whole numbers.

Course Objectives: This course is designed to expand an understanding in the fundamental concepts of logic and set theory. After completing this course, the student will have a better understanding of logic and should be able to apply the knowledge to everyday matters. Topics will include:

The Logic of Compound Statements

- Logical Form and Logical Equivalence
- Conditional Statements
- Valid and Invalid Arguments

The Logic of Quantified Statements

- Introduction to Predicates and Quantified Statements
- Statements of Containing Multiple Quantifiers
- Arguments with Quantified Statements

Elementary Number Theory and Statement of Proof

- Direct Proof and Counterexample
- Indirect Argument: Contradiction and Contrapositive

Set Theory

- Basic Definitions of Set Theory
- Properties of Sets
- Disproofs, Algebraic Proofs, and Boolean Algebras