

## Syllabus – Math 455 – Mathematical Logic (3)

### Course Description:

A system of first order logic. Formal notions of well-formed formula, proof, and derivability. Semantic notions of model, truth, and validity. Completeness Theorem.

Pre: 321 or graduate standing in a related field or consent. Recommended: 454

**Suggested text:** *A Mathematical Introduction to Logic*, by Herbert Enderton.

### Course Outline:

1. Useful facts about sets
2. Sentential Logic
  - (a) the language of Sentential Logic
  - (b) Truth Assignments
  - (c) Induction and Recursion
  - (d) Compactness and Effectiveness
  - (e) Sentential connectives
3. First-Order Logic
  - (a) First-Order languages
  - (b) Truth and Models
  - (c) A deductive calculus
  - (d) Soundness and completeness theorems
  - (e) Models of theories
  - (f) Interpretations between theories
  - (g) Nonstandard analysis
4. Undecidability
  - (a) Recursive functions
  - (b) Undecidability in Number Theory; Gödel's Theorem

**Course Objectives and Student Learning Outcomes:** Upon successful completion of Math 455, the student will have a rigorous foundation in the basic topics in mathematical logic, as listed above in the syllabus. Emphasis on theory will provide students with the deeper understanding of concepts they need to be successful in graduate work, and in understanding the scientific and logical foundations of mathematics.

**Program Objectives:** Mathematical logic and set theory form a foundation for all of mathematics and with that, in a way, for all of science. Math 454 and 455 introduce the underlying theory in a rigorous and formal way. The course will develop the ability of students to understand the world from such a point of view and to find proofs of mathematical statements.