

**MOREHOUSE COLLEGE
DEPARTMENT OF MATHEMATICS**

**SET THEORY
MATH 255**

PREREQUISITE: Math 161 with a grade of “C” or better.

TEXT: *Introduction to Advanced Mathematics*, 2nd Edition, by Barnier and Feldman

COVERAGE: Chapters 1-6

COURSE OUTLINE

- 1. Introduction to logic**
 - 1.1. Introduction to propositional logic
 - 1.2. Logical equivalence and Tautologies
 - 1.3. Rules of Inference

- 2. Methods of proof**
 - 2.1 Proof techniques
 - 2.2 More proof techniques
 - 2.3 Introduction to mathematical induction
 - 2.4 Predicates and quantifiers
 - 2.5 Counterexamples, proofs, and conjectures

- 3. Set theory**
 - 3.1 Introduction to sets
 - 3.2 Venn Diagrams and conjectures
 - 3.3 The algebra of sets
 - 3.4 Arbitrary Union and intersections

- 4. Cartesian products and functions**
 - 4.1 Product sets
 - 4.2 Functions
 - 4.3 Compositions, bijections, and inverse functions
 - 4.4 Images and inverse images of sets

- 5. Relations**
 - 5.1 Relations
 - 5.2 Equivalence relations
 - 5.3 Partially ordered sets

- 6. Cardinality**
 - 6.1 The cardinality of finite sets
 - 6.2 The cardinality of infinite sets
 - 6.3 Two ways of looking at infinity (if time)

COURSE OBJECTIVES

This course is designed to provide the student with an intense foundation in fundamental concepts of mathematics used in advanced mathematics. After completing the course the student should be able to work basic problems and proofs in logic, predicate calculus, set theory, relations, functions, equivalence relations, partial orders, cardinality, Boolean Algebra, the Integers, and Real Numbers.

A student should have mastered and demonstrated the following skills after completing Math 255:

- the student is able to think logically, reason and recognize patterns, make conjectures; to use mathematical symbols and discern truth values of arguments; to work with existence, quantification, and validation conditions; to understand induction and prove propositions using induction.
- the student is able to explain what a proof is and discern between a valid proof and claim that a proof has been performed, but in reality has not; to read a proof of a statement and construct a valid proof using different methods which include: direct, proof by cases, indirect, contradiction, induction, and contraposition.
- the student is able to construct valid counterexamples to propositions which are false; to recognize and avoid common fallacies in arguments including begging the question, circular reasoning, affirming the conclusion, and denying the hypothesis.
- the student knows the basic rules of propositional logic and use the basic rules of propositional logic in order to construct proofs.
- the student is able to construct valid counterexamples to propositions which are false; to perform set - theoretic operations and know the notation and terminology of set-theory; to use Venn diagrams to assist in the construction of a proof or counterexample of a claim in set-theory.
- the student is able to define a binary relation between sets and an equivalence relation and show that a relation is or is not an equivalence relation; to define a function between sets and the image and inverse image of subsets of the domain and codomain, respectively; to define the union and composition of functions, and injective, surjective, or bijective functions.
- the student is able to prove statements combining the concepts of the image and inverse image of subsets of the domain and codomain, the union and composition of , or injective, surjective, or bijective functions.
- the student is able to understand cardinality of sets: denumerability, countability, infinite, finite, uncountable, and be able to give examples or counterexamples of a claim that a set is one or more of the previous.

A syllabus is not a contract between instructor and student. The instructor reserves the right to alter, based on new materials, class discussions, or other legitimate pedagogical objectives. Morehouse College is committed to equal opportunity in education for all students, including those with documented disabilities. Students with disabilities or those who suspect they have a disability must register with the Office of Disability Services ("ODS") in order to receive accommodations. Students currently registered with the ODS are required to present their Disability Services Accommodation Letter to faculty immediately upon receiving the accommodation. If you have any questions, contact the Office of Disability Services, 104 Sale Hall Annex, Morehouse College, 830 Westview Dr. S.W., Atlanta, GA 30314, (404) 215-2636, FAX: (404) 215-2749.