Course Prefix and Number: MATH 225
Course Title: Discrete Mathematics I
Number of Credit Hours: 3 Lecture Hours: 3 Laboratory Hours: 0

Catalog Description: This course provides a foundation in formal mathematics and theorem-proving. Topics include functions, relations, sets, simple proof techniques, Boolean Algebra, propositional logic, elementary number theory, the fundamentals of counting, recursion, and an introduction to languages (finite state machines). Prerequisites: Grade of C or higher in MATH 150; or score of 23 or above on the ACT math portion.

Prerequisite(s)/Corequisite(s): Grade of C or higher in MATH 150; or score of 23 or above on the ACT math portion.

Text(s): Most current editions of the following:


Course Objectives:

- To model and analyze computational processes using analytic and combinatorial methods.
- To use logical notation to define and reason about fundamental mathematical concepts such as sets, relations, functions, and integers.
- To learn the algorithmic approach to problem solving.
- To display an understanding of the nature of rigorous proof.
- To write elementary proofs, especially proofs by induction and basic number theory proofs.
- To reason mathematically about basic data types and structures used in computer algorithms and systems.

Measurable Learning Outcomes:

- Calculate numbers of possible outcomes of elementary combinatorial processes using the sum and product rules, permutations and combinations.
- Illustrate the use of quantifiers to form mathematical statements and arguments.
- Apply the fundamental laws of logic and rules of inference to analyze arguments and to form logical arguments.
- Demonstrate an understanding of basic set theory definitions and use the set theoretic operations.
- Demonstrate understanding of the well-ordering
principles and use in the method of proof by induction.  
- Employ the basic properties of integers such as divisibility, primes, and congruences to solve basic number theory problems.  
- Demonstrate a thorough knowledge of the concept of a function including the concepts: range, domain, one-to-one, into, onto, and inverse.  
- Demonstrate an understanding of the recursive definition of sequences and functions.  
- Recognize a binary relation on a set and a function as a special case of a finery relation.  
- Classify a binary relation on a set as being an equivalence relation, a partial order or neither.  
- Use equivalence relations to partition sets.  
- Determine the complexity of an algorithm.  
- Demonstrate basic understanding of languages and finite state machines as applications of discrete structures.

Topical Outline (major areas of coverage):

- Fundamental Principles of Counting:  
  - The Rules of Sum and Product.  
  - Permutations.  
  - Combinations: The Binomial Theorem.  
  - Combinations with Repetition.  
- Fundamentals of Logic:  
  - Basic Connectives and Truth Tables.  
  - Logical Equivalence: The Laws of Logic.  
  - Logical Implication: Rules of Inference.  
  - The Use of Quantifiers.  
  - Quantifiers, Definitions, and Proofs of Theorems.  
- Set Theory:  
  - Sets and Subsets.  
  - Set Operations and the Laws of Set Theory.  
  - Counting and Venn Diagrams.  
- Properties of the Integers: Mathematical Induction:  
  - The Well-Ordering Principle: Mathematical Induction.  
  - Recursive Definitions.  
  - The Division Algorithm: Prime Numbers.  
  - The Greatest Common Divisor: The Euclidean Algorithm.  
- The Fundamental Theorem of Arithmetic.  
- Relations and Functions:  
  - Cartesian Products and Relations.  
  - Functions, one-to-one, and onto.  
  - Special Functions such as the floor and ceiling functions.  
  - The Pigeonhole Principle.  
  - Function Composition and Inverse Functions.  
- Computational Complexity.  
- Analysis of Algorithms.  
- Languages: Finite State Machines:  
  - Language: The Set Theory of Strings.  
  - Introduction to Finite State Machines.  
  - More on Relations:
Properties of Relations.
Equivalence Relations.
Partial Orders.
Computer Recognition: Zero-One Matrices and Directed Graphs.
Hasse Diagrams.
Equivalence Relations and Partitions.

Recommended maximum class size for this course: 20

Library Resources: Online databases are available at http://www.ccis.edu/offices/library/resources.asp. You may access them from off-campus using your eServices login and password when prompted.

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Name
Signature

Date: March 8, 2006

NOTE: The intention of the master syllabus is to provide an outline of the contents of this course, as specified by the faculty of Columbia College, regardless of who teaches the course, when it is taught or where it is taught. Faculty members teaching this course for Columbia College are expected to facilitate learning pursuant to the course objectives and cover the subjects listed in the topical outline. However, instructors are also encouraged to cover additional topics of interest so long as those topics are relevant to the course's subject. The master syllabus is, therefore, prescriptive in nature but also allows for a diversity of individual approaches to course material.

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