HOSTOS COMMUNITY COLLEGE

DEPARTMENT OF MATHEMATICS AND COMPUTER SCIENCE

DISCRETE MATHEMATICS

Course Number: CSC 205
Course Title: Discrete Mathematics
Credit Hours: 4.0
Equated Hours: 4.0
Class Hours: 4.0

Pre Requisite MAT 160 Pre-Calculus
Pre/Co-requisite: ENG 93/ESL 91/ESL 93 or equivalent/higher

Required Text: Grimaldi, Ralph P.: Discrete and Combinatorial Mathematics
5th Edition Pearson
Suggested Text: Discrete Math with Applications Susanna S. Epp

Course Description:

The course introduces fundamental ideas in discrete structures, serving as a basis for subsequent courses required for students in Computer Science: Sets, relations, and functions; propositional calculus, Boolean algebras, and combinatorial circuits, counting methods; proof techniques; analysis of algorithms; graphs and trees, puzzles; finite machines, sequential circuits, and recognizers and coding theory

Examinations: A minimum of three quizzes, midterm/project, and comprehensive final exam

Grades: A, A-, B+, B, B-, C+, C, D, INC, F.

Student Learning Objectives

Upon completion of this course students should be able to do the following:

- Discuss definitions and diagram strategies for potential proofs in logical sequential order
- Construct mathematical arguments using logical connectives and quantifiers.
- Verify the correctness of an argument using symbolic logic and truth tables.
- Construct proofs using direct proof, proof by contradiction, and proof by cases, or mathematical induction.
- Solve problems using counting techniques and combinatorics.
- Perform operations on discrete structures such as sets, functions, relations or sequences.

- Solve problems involving recurrence relations and generating functions.
- Construct functions and apply counting techniques on sets in the context of discrete probability.
- Apply algorithms and use definitions to solve problems to proof statements in elementary number theory
- construct and verify simple mathematical proofs,
- translate between recursive and iterative algorithms,
- solve counting problems using combinatorial analysis,
- use matrices to represent relations and graphs, and
- analyze the complexity of common graph algorithms.
- explain and use the concepts of graphs and trees.
- Apply algorithms to problem situations involving search, optimization, voting methods, and apportionment.
- Write proofs formally, including writing proofs using symbolic logic and Boolean Algebra.
- Understand the basics of set theory, including solving problems in combinatorics.
- Use recursive thinking and method to solve recurrence relations, including using recursion to analyze algorithms and programs.
- Draw and analyze graphs and trees, including applying matrices to analyze graphs and trees

Course Outline:

1. Fundamental Principles of Counting
Three fundamental principles, Permutation and Combination,
Binomial Theorem, Binomial Coefficients, Pascal's triangle, Arrangement and selections with repetitions.

2. Fundamentals of Propositional Logic
Statement and Connectives, procedures and quantifies Truth Table, Logical Equivalence, Rules of Inference: Fallacies, Methods of Proof.
Compound Statements
Proofs in Mathematics
Truth Tables
The Algebra of Propositions

3. Set Theory
Sets and subsets, power sets. Operations on Sets
Binary Relations
Equivalence Relations
Partial Orders
Venn Diagrams
Logical Arguments
Computer representation of sets

4. Relations and Functions
Cartesian products, Relations, Equivalence Relations, Functions, the Pigeonhole Principle
Domain, Range, One-to-One, and Onto functions
Inverses and Composition of functions
One-to-One Correspondence and the Cardinality of a Set
Elementary Matrix arithmetic: transpose and powers

5. Mathematical Induction, Recurrence relations and Applications.
Mathematical Induction
Recursively Defined Sequences
Solving Recurrence Relations: The Characteristic Polynomial
Solving Recurrence Relations: Generating Functions
Recursive Algorithms

6. Graph Theory
Graphs and their representations-models
The basic notions of graph theory are introduced - vertices, edges, degree of a vertex, connected components, directed and undirected graphs, and acyclic graphs, Paths and Circuits. Shortest Path and Distance, Directed Graph and Multigraphs. Graph theory: explored Eulerian and Hamiltonian graphs, graph isomorphism, graph coloring, minimal spanning trees, etc. - as well as the representation of graphs in computers and their applications to real world problems.

7. Trees
Definition and Properties of Trees, Spanning (minimal spanning trees), Rooted Trees, Binary Trees and Traversals, Depth-First Search.

8. Boolean Algebra
9. Groups and Coding Theory
10. Algorithms-pseudocode: Voting methods, Apportionment, Search algorithms, Optimization algorithms, sorting algorithms
11. Finite-state machines