ROWAN UNIVERSITY
Department of Mathematics

Syllabus
Math 03.160 - Discrete Structures

COURSE DESCRPTION:

Math 03.160 Discrete Structures, 3 s.h.

Prerequisites: Math 01.122 (Pre-Calculus), or permission of the Department of Mathematics, or permission of the department of computer science

This course covers mathematical topics essential for work in computer science. This material includes number bases, mathematical induction, sets, relations, functions, congruence, recursion, combinatorics, graphs, trees, logic, Boolean algebras, and proof techniques. While this is a course in mathematics, many of the examples and applications will be taken from computer science. The instructor may require use of a graphing calculator and / or computer. This course covers much of the same material as Discrete Mathematics (Math 03.150), but with a computer science focus. In no case will a student be allowed to receive credit for both courses. Both courses will be treated as equivalent for the purposes of satisfying prerequisites and course requirements.

OBJECTIVES IN RELATION TO STUDENT OUTCOMES:

Upon completion of this course, students should be able to:

1. Calculate using binary and hexadecimal arithmetic.
2. Understand and use mathematical induction and other techniques to prove mathematical results.
3. Understand and work with sets, relations, functions, and congruences.
4. Perform computations using recursively defined functions and structures.
5. Use methods of combinatorics to solve counting problems.
6. Illustrate the basic terminology and properties of graphs and trees, as well as relate graphs and trees to algorithms and counting.
7. Demonstrate knowledge of logical reasoning, manipulate formal prepositional logic, and evaluate Boolean expressions.

TOPICAL OUTLINE:

1. **Numbers**
   1.1 Binary and hexadecimal representations
   1.2 Base conversion
   1.3 Euclid Division Theorem
   1.4 Euclid GCD algorithm

2. **Sets, relations functions, congruences**
   2.1 Sets (Venn diagrams, complements, power sets, operations, laws)
   2.2 Inclusion-exclusion
   2.3 Relations (equivalence relations, equivalence classes)
   2.4 Congruence
   2.5 Functions (injective, surjective, inverse, composition, domain, codomain, range)

3. **Recursion**

3.1 Recursive sequences
3.2 Divide-and-conquer sequences (binary search and merge sort algorithms)
3.3 Other functions and sequences

4. **Combinatorics**
   4.1 Factorials
   4.2 Binomial coefficients and Pascal's triangle
   4.3 Counting arguments
   4.4 Permutations and combinations
   4.5 Pigeonhole principle
   4.6 Probability

5. **Graphs and trees**
   5.1 Directed graphs
   5.2 Undirected graphs
   5.3 Eulerian and Hamiltonian circuits
   5.4 Trees (binary, spanning)
   5.5 Shortest path problem

6. **Logic and Boolean algebras**
   7.1 Truth tables
   7.2 Propositional calculus
   7.3 Boolean algebra
   7.4 Boolean circuits (as time permits)

7. **Other proof techniques**
   8.1 Direct proof
   8.2 Proof by counterexample
   8.3 Proof by contrapositive
   8.4 Proof by contradiction
   8.5 Mathematical induction, strong induction
   8.6 Logical equivalence and circles of implication

Textbooks:

- Cliff L Stein, Robert Drysdale, and Kenneth Bogart, Discrete Mathematics for Computer Scientists, Addison-Wesley, 2010.
- Kenneth H. Rosen, Discrete Mathematics and Its Applications, McGraw-Hill, 2011.
- Susanna S. Epp, Discrete Mathematics with Applications, Brooks Cole, 2010.

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