ROWAN UNIVERSITY
Department of Mathematics

Syllabus
Math 03.150 - Discrete Mathematics

CATALOG DESCRIPTION:

Math 03.150 Discrete Mathematics, 3s.h.

This course studies a collection of mathematical objects and techniques lacking the continuous characteristics, but fundamental to all major branches of mathematics in some ways. The content includes sets, logic connectives, quantifiers, relations, functions, mathematical induction, combinatorics, recursions, graphs, proofs and algorithms. Emphasis is on intuitive examples, and practical roles which these topics play in proofs or solutions to problems. The use of graphing calculator is required.

OBJECTIVES:

In terms of outcomes, students will be able to:

- Use basic set theoretic terminology, perform the four operations on sets, and draw Venn diagrams.
- Understand and apply logic statements, such as implication, equivalence, converse and contrapositive, correctly in proofs.
- Verify an equivalence relation and describe its equivalence classes.
- Construct a proof using mathematical induction.
- Apply the basic counting principles and solve counting problems in combnatorics.
- Use graphs or algorithms in situations involving search, optimization, voting methods, and apportionment.

CONTENT:

1. **Set theory** (2.5 weeks)
   - Operations - union, intersection, complement, difference
   - DeMorgan's Laws
   - Subsets, power sets, Venn diagrams
   - Equal vs. equivalent sets
   - Countability
   - Sets of numbers (integers, reals, etc.)
   - Cartesian products
   - Proof by contradiction
   - History - Cantor, Mandelbrot, Descartes, Venn

2. **Relations and functions** (2.5 weeks)
   - Symmetry, transitivity, reflexivity
   - Equivalence classes
   - Congruence, partitions, domain, range, co-domain
   - One-to-one, onto, inverse
   - Modular numbers

- History - Pythagorean relationship, Descartes

3. **Combinatorics** (2 weeks)
   - Pigeonhole principle
   - Fundamental principles of counting
   - Permutations
   - Combinations
   - Binomial Theorem
   - History - Pascal's Triangle, Towers of Hanoi, Euclid's geometric progression

4. **Graph Theory** (4 weeks)
   - Euler and Hamiltonian networks
   - Graph coloring
   - Directed and undirected
   - Isomorphisms
   - Spanning (optional)
   - Traveling salesperson problems
   - PERT(Program Evaluation and Resource Technique)
   - CPM(Critical Path Method)
   - Expression trees (order of operations)
   - History - Euler, Hamilton, Bridges of Konigsberg

5. **Induction** (1 week)
   - History - Gauss formulas, classic plane geometry problems

6. **Recursion** - 1 week
   - History - Nim, Fibonacci, Pascal

7. **Algorithms** (2 weeks)
   - Voting methods
   - Apportionment
   - Search algorithms
   - Optimization algorithms

TEXTS:

Scheinerman, Edward, Mathematics: A Discrete Introduction, 2006, Cengage.

*Roman, Steven. An Introduction to Discrete Mathematics, 2nd edition, Saunders, NY.

Rosen, Kenneth h. Discrete Mathematics and Its Applications, 2 ed, McGraw/Hill

Barnett, Steven. Discrete Mathematics, Addison Wesley, Reading, MA (Accessory resource for number bases)

Dossey, John A. et al, Discrete Mathematics, 3rd edition, Addison-Wesley, Reading, MA.

Johnsonbaugh, Richard, *Essential Discrete Mathematics*,

MacMillan Publishing Co., NY. 2005

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