ROWAN UNIVERSITY
Department of Mathematics

Syllabus
Math 01.115-Contemporary Mathematics

CATALOG DESCRIPTION:

Math 01.115 - Contemporary Mathematics 3 S.H.

Prerequisites: Basic Algebra II

This course is designed to develop an appreciation of what mathematics is and how it is used today. Topics covered include: statistics and probability; graphs, trees and algorithms; geometrical perspectives including transformations, symmetry, and similarity; and the mathematics of social choice. Students are expected to have completed equivalents of Basic Algebra and Basic Skills Reading.

OBJECTIVES:
This course will help students to:
· develop their problem solving and critical thinking skills
· expand their understanding of and appreciation for modern mathematics and its applications
· understand both continuous and discrete applications of mathematics, highlighting some of the more recent developments in mathematics
· improve their mathematical and computer skills, through the use of computational and computer-related algorithms

CONTENT:

I. Statistics (4 weeks)
A. Elementary Sampling Theory and Experimental Design
1. Random sampling and bias
2. Experimental design

B. Descriptive Statistics
1. Graphical descriptions and exploratory data analysis
2. Measures of location and variability with a discussion of computer algorithms and computational efficiency
3. Regression line - graphical description, with little emphasis on computation

C. Probability
1. The frequency concept of probability

2. Mathematical description of probability and expectation - Students should appreciate how these are used in gambling, lotteries, and insurance
3. Sampling distributions with an emphasis on the difference between discrete and continuous distributions
4. Central limit theorem

II. DISCRETE MATHEMATICAL MODELS (3 weeks)

A. Euler Circuits
1. Graphs as mathematical models
2. Graphs, edges, and vertices and their applications
3. Valence and the existence of Euler circuits

B. Hamiltonian Circuits
1. Algorithms for finding a minimum-cost Hamiltonian circuit
2. Trees, sets, and counting techniques
3. Traveling Salesman Problem (TSP) and the need for computationally efficient algorithms

C. Directed Graphs and Scheduling
1. Directed Graphs
2. Critical Paths
3. Priority list scheduling

III. TOPICS IN THE MATHEMATICS OF SOCIAL CHOICE (2 weeks)

(Choose from the following.)

A. Discrete and Continuous Versions of Fair Division Problems (optional)
1. Formulations of fair division problems used to illustrate intuitive and precise meaning of "continuous" and "discrete"
2. The procedures used to solve these problems can be thought of as algorithms
3. The assumptions needed in order that the procedures achieve fair division can be thought of as axioms

B. The Mathematics of Voting (optional)
1. Plurality Method and Condorcet Criterion
2. Borda Count Method
3. Sequential Pairwise Voting and the Pareto Condition
4. Arrow's Impossibility Theorem
5. Weighted Voting and the Banzaf Power Index

C. Discrete Models of Continuous Data (optional)

1. Relationship between Integers and Rational Numbers with respect to apportionment problems
2. Examples of apportionment problems:

a. Electoral College

b. House of Representatives

c. College class scheduling

3. Undesirable outcomes in apportionment schemes turn out to be a feature of any reasonable apportionment scheme (Balinsky-Young Theorem)

IV. GEOMETRY (4 weeks)

A. Symmetry, Patterns, Tilings

1. Symmetry

a. As an aesthetic or non-mathematical idea

b. Isometry of the plane (this mathematical concept gives precision to what should be meant by symmetry in a two-dimensional context)

c. Using the classification of all isometries of the plane, a complete classification of all 1- and 2- dimensional patterns can be given

d. Concept of a Group

2. Tilings

a. Regular, periodic, and nonperiodic tilings of the plane

b. Plane geometry, algebra, and deduction are used to show that only the equilateral triangle, rectangle, and hexagon can tile the plane edge-to-edge

B. Mensuration, Growth, and Form

1. Review of mensuration formulae for areas and volumes of common geometrical shapes
2. Geometric similarity and the scaling of real objects
3. How surface area and volumes increase as dimensions increase; the implications for the growth of animate and inanimate objects

C. Fractal Geometry (optional)

TEXTBOOK(s):

- Excursions in Modern Mathematics, Peter Tannenbaum, Pearson, 9th edition