ROWAN UNIVERSITY
Department of Mathematics

Syllabus

Math 01.330 - Introduction to Real Analysis I

CATALOG DESCRIPTION:

Math 01.330 Introduction to Real Analysis I, 3 s.h.
Prerequisites: Math 01.230 (Calculus III) and Math 03.150 (Discrete Math) with a grade of C- or better in both courses

This course introduces students to rigorous mathematical thought processes in Analysis, and prepares them for more advanced courses in the related areas. Topics included are: sets, functions, the real number system, sequences, limits, continuity and derivatives.

OBJECTIVES:

Students will demonstrate the ability to use rigorous mathematical thought processes in the following areas: sets, functions, sequences, limits, continuity, and derivatives.

CONTENTS:

1.0 Introduction

- 1.1 Real numbers
  - 1.1.1 Absolute values, triangle inequality
  - 1.1.2 Archimedean property, rational numbers are dense
- 1.2 Sets and functions
  - 1.2.1 Set relations, Cartesian product
  - 1.2.2 One-to-one, onto, and inverse functions
- 1.3 Cardinality
  - 1.3.1 One-to-one correspondence
  - 1.3.2 Countable and uncountable sets
- 1.4 Methods of proof
  - 1.4.1 Direct proof
  - 1.4.2 Contrapositive proof
  - 1.4.3 Proof by contradiction
  - 1.4.4 Mathematical induction

2.0 Sequences

- 2.1 Convergence
  - 2.1.1 Cauchy's epsilon definition of convergence
  - 2.1.2 Uniqueness of limits
  - 2.1.3 Divergence to infinity

2.1.4 Convergent sequences are bounded

2.2 Limit theorems

2.2.1 Summation/product of sequences

2.2.2 Squeeze theorem

2.2.3 Cauchy sequences and Cauchy criteria for convergence

2.2.4 Completeness axiom

2.2.5 Bounded monotone sequences are convergent

2.3 Subsequences and limit points

2.3.1 Bolzano-Weierstrass theorem

2.4 Supremum and infimum

2.4.1 A bounded set has a unique least upper bound

3.0 Continuity

3.1 Limits of functions

3.1.1 Definition of continuity based on sequences

3.1.2 Definition of continuity based on open intervals

3.1.3 Summation/product/composition of continuous functions

3.2 Properties of continuous functions on a closed interval

3.2.1 A continuous function is bounded

3.2.2 A continuous function attains its supremum/infimum

3.2.3 Intermediate-value theorem

3.2.4 Uniform continuity

4.0 Differentiation

4.1 Derivatives

4.1.1 Limit definition of a derivative

4.1.2 Rules of differentiation

4.1.3 Chain rule

4.1.4 Higher-order derivatives

4.2 Properties of differentiable functions

4.2.1 Differentiability implies continuity

4.2.2 Continuously differentiable functions

TEXT:

*Michael Reed, FUNDAMENTAL IDEAS OF ANALYSIS, WILEY & SON, 1998

Bartle, Robert G. & Sherbert, Donald R., INTRODUCTION TO REAL ANALYSIS, third ed., John Wiley & Sons, Inc., 2000.

Mattuck, Arthur, INTRODUCTION TO ANALYSIS, first ed., Prentice Hall, 1999.