MATHEMATICS 180

CALCULUS AND ANALYTIC GEOMETRY I

I. Introduction

A. Catalog Description

There are two main topics in the calculus for functions of one variable: differentiation and integration. This course focuses on differentiation starting with limits and continuity, then introduces the derivative, and applications of the derivative in a variety of contexts. The course concludes with an introduction to integration. The central ideas are explored from the symbolic, graphic, numeric, and physical model points of view. Use is made of graphing calculators. Students who have received credit for MATH 121 may not receive credit for MATH 180. *Prerequisite: MATH 110, or its equivalent.* Satisfies the Mathematical Approaches core requirement.

B. Objectives

The primary goal for students in this course is to appreciate the power and the beauty of the calculus. Students will study concepts, techniques, and applications connected to the central ideas of function, limit, continuity, and derivative. Students will also sharpen their critical thinking, logical reasoning, and problem solving skills.

This course satisfies the Mathematical Approaches category of the university's core curriculum by developing an appreciation of the power of mathematics and formal methods to provide a way of understanding a problem unambiguously, describing its relation to other problems, and specifying clearly an approach to its solution. A student in this course will develop a variety of mathematical skills, an understanding of formal reasoning, and a facility with applications. Specifically, this course will expose students to formal logic to the extent that it is required to understand mathematical proof.

C. Prerequisites - Mathematics 111, or its equivalent.

II. Required Topics

A. Functions

1. Definition and notation
2. Representations of functions
3. Classes of elementary functions

B. Limits

1. Definition of limit
2. Properties
3. Techniques for analyzing limits

II. Required Topics (continued)

C. Continuity

1. Definition of continuity
2. Techniques for analyzing continuity
3. Intermediate Value Theorem
4. Extreme Value Theorem

D. Differentiation

1. Differentiable functions and derivatives
2. Derivative theorems (constant factor, sum, product, quotient, chain rule)
3. Interpretations of the derivative (slope and rate of change)
4. Notation for derivatives
5. Tangent line approximation
6. Implicit differentiation
7. Higher derivatives
8. Mean Value Theorem

E. Applications of differentiation

1. First derivatives and increasing vs. decreasing
2. Second derivatives and concavity
3. Optimization
4. Related rates

F. Introduction to integration

1. Integrable functions and definite integrals
2. Definite integral theorems
3. Antiderivatives
4. Fundamental Theorems of Calculus

III. Bibliography

M.J. Strauss, G. L. Bradley, and K. J. Smith, *Calculus*

A. Ostebee and P. Zorn, *Calculus: From Graphical, Numerical, and Symbolic Points of View*

D. Hughes-Hallett et al., *Calculus*

J. Stewart, *Calculus: Early Transcendentals*