MATHEMATICS 301

DIFFERENTIAL EQUATIONS

I. Introduction

A. Catalog Description

Ordinary differential equations (ODEs) are first introduced in the calculus sequence. This course provides a deeper look at the theory of ODEs and the use of ODEs in modeling real world phenomena. The course includes studies of first order ODEs (both linear and nonlinear), second and higher order linear ODEs, and first order systems of ODEs (both linear and nonlinear). Existence and uniqueness of solutions is discussed in each setting. Most topics are viewed from a variety of perspectives including graphical, numerical, and symbolic. Tools and concepts from linear algebra are used throughout the course. Other topics that may be covered include series solutions, difference equations, and dynamical systems. *Prerequisites: MATH 280 and 290 or permission of the instructor.*

B. Objectives

1. Facility with graphical, numerical, and symbolics approaches to ODEs and their solutions, including the ability to recognize which methods of analysis are appropriate for a specific problem.
2. General understanding of theory, including the existence-uniqueness theory.
3. Ability to model real world phenomena using ODEs when appropriate.

C. Prerequisites

Math 280 and Math 290 or permission of the instructor.

II. Course Topics

A. First order differential equations

Definition of solution; slope fields; symbolic techniques of solution, introduction to numerical techniques including use of appropriate technology; existence-uniqueness theory

B. Second and higher order linear differential equations

Symbolic methods of solution; introduction to simple harmonic motion; existence-uniqueness theory

C. Linear first order systems of differential equations

Symbolic and graphical analysis of linear systems; introduction to numerical techniques including use of appropriate technology; existence-uniqueness theory; conversion of single second or higher order ODE to system of first order ODEs

II. Course Topics (cont.)

D. Nonlinear first order systems of differential equations

Fixed points and linearization; global nonlinear features such as limit cycles; graphical/numerical analysis with use of appropriate technology

E. Optional topics

Further study of nonlinear systems as dynamical systems; series solutions; difference equations; Laplace transform methods

IV. Bibliography

Guterman and Nitecki, Differential Equations, A First Course, Saunders, 1992.

Blanchard, Devaney, Hall, Differential Equations, Brooks/Cole, 1998.

Boyce and DiPrima, Elementary Differential Equations, Wiley, 1992.

Braun, Differential Equations and Their Applications, Springer-Verlag, 1994.

Zill, A First Course in Differential Equations, PWS-Kent, 1993.