



Math 285: Differential Equations (3 credit hours)

Course Description

This is an introduction to ordinary differential equations with an emphasis on applications. Topics for this course include first-order, linear higher-order, and systems of differential equations, numerical methods, series solutions, eigenvalues and eigenvectors, Laplace transforms, and Fourier series.

Prerequisite: Calculus III

Course Objectives

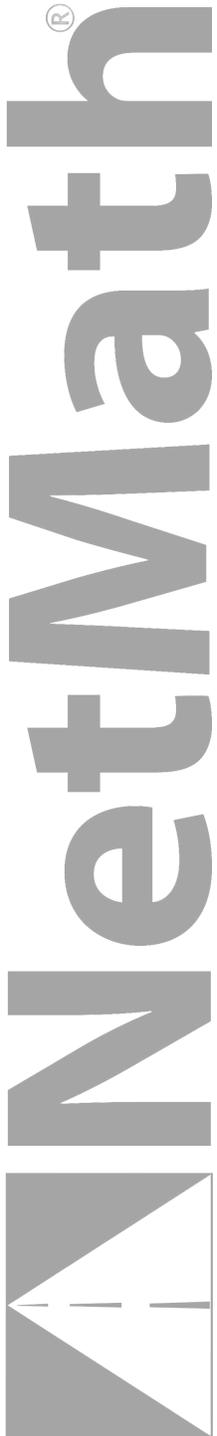
After completing this course a successful student will be able to understand and apply the topics listed above. He/she will also be able to apply numerical, computational, and estimation techniques. Through exploration, a successful student will be able to use differential equations to model and analyze physical phenomena. He/she will also have the necessary tools to formulate and solve problems in mathematical situations and connect concepts to other disciplines. Most importantly, a student completing this course will be able to communicate ideas through descriptive language as well as mathematical symbols.

Course Content and Format

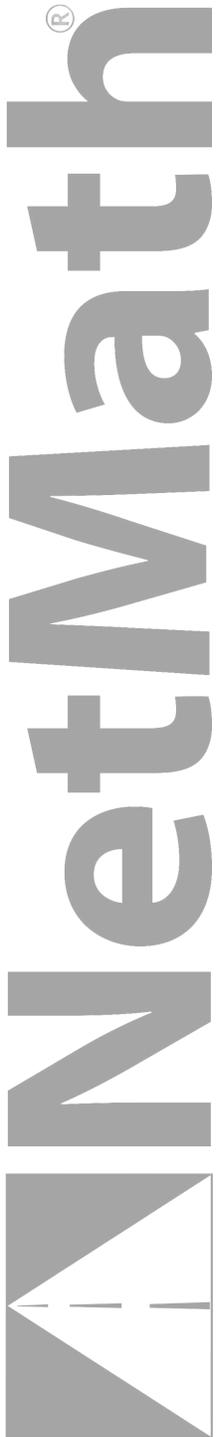
Content

A brief outline of topics for this course appears below:

- Exponential differential equation
 - Forced vs. unforced exponential differential equations
 - Application to personal finances
- Forced oscillator differential equation
 - Underdamped and overdamped oscillators
 - Characteristic equations
 - Impulse and Ramp forced oscillators
- Laplace Transform and Fourier Analysis
 - Periodic functions and trigonometric series
 - General Fourier series and convergence
 - Creating formulas for forced exponential and oscillator diff. equations
 - Approximating periodically forced oscillators



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- Modern differential equation issues
 - Euler's method of faking a solution plot
 - Sensitive dependence on starter data
- First order differential equations
 - Phase lines
 - Slope fields and solution curves
 - Reading bifurcation plots
 - Separation of variables
- Systems and Flows
 - Flow analysis
 - Interpreting vector fields
- Eigenvectors and Eigenvalues for Linear Systems
 - Generating solutions for linear systems
 - Eigenvalue trajectory analysis
 - Traces and determinants
- Linearizations
 - Finding equilibrium points
 - Lyapunov's rules
 - Linearizing the pendulum oscillator
- The Heat Equation and the Wave Equation
 - Fast Fourier fit
 - Fourier integral fit
 - Generating solutions with a list of starting conditions

Format

Course content is drawn from *Differential Equations* written by Bill Davis, Horacio Porta and Jerry Uhl ©2006-2010.

Math 285 utilizes the CAS-ILE system. See <https://cas-ile.illinois.edu/> for more information. This online system helps students learn math topics through dynamic exploration and visualization.

Exams for Math 285 are taken with pencil and paper.