Math 286: Differential Equations Plus (4 credit hours)

Course Description
This is an introduction to both ordinary and partial differential equations with an emphasis on advanced applications. Math 286 is intended for engineering students and others who require a working knowledge of differential equations. Topics for this course include first-order, linear higher-order, and systems of differential equations, numerical methods, series solutions, eigenvalues and eigenvectors, Laplace transforms, Fourier series, and matrix applications.

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
DEPARTMENT OF MATHEMATICS

Math 286 Syllabus

- 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
  - Linear system matrices
- 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 286 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 286 are taken online.