

Departmental Syllabus **Math 3630 -- Differential Equations I**

Textbook: A First Course in Differential Equations with Modeling Applications (Eighth Edition), by Dennis Zill

Prerequisites: MATH 2840 with a grade of "C" or better.

Calculators: Graphing calculator required; TI-83, 84, 85 or 86 recommended.
(NOTE: On occasion, individual instructors may restrict the use of any type of calculator).

Course Description: Solutions of first order differential equations, linear homogeneous and non-homogeneous differential equations, Laplace transforms, linear systems and applications.

Topics and sections to be covered:

Chapter 1 – Introduction to Differential Equations

- 1.1 Definitions and Terminology
- 1.2 Initial-Value Problems
- 1.3 Differential Equations as Mathematical Models

Chapter 2 – First-Order Differential Equations

- 2.1 Solution Curves Without a Solution
 - 2.1.1 Direction Fields
 - 2.1.2* Autonomous First-Order DEs
- 2.2 Separable Variables
- 2.3 Linear Equations
- 2.4 Exact Equations (including Integrating Factors)
- 2.5 Solutions by Substitutions (Homogeneous and Bernoulli)
- 2.6* A Numerical Method (Euler's Method)

Chapter 3 – Modeling with First-Order Differential Equations

- 3.1 Linear Models (Growth and Decay, Newton's Law of Cooling, Mixtures, Falling Bodies and Air Resistance)
- 3.2 Nonlinear Models (Population Dynamics, Miscellaneous Models)

Chapter 4 – Higher-Order Differential Equations

- 4.1 Linear Differential Equations: Basic Theory
 - 4.1.1 Initial-Value and Boundary-Value Problems
 - 4.1.2 Homogeneous Equations
 - 4.1.3 Nonhomogeneous Equations
- 4.2 Reduction of Order

- 4.3 Homogeneous Linear Equations with Constant Coefficients
- 4.4 Undetermined Coefficients – Superposition Approach
- 4.5* Undetermined Coefficients – Annihilator Approach
- 4.6 Variation of Parameters
- 4.7 Cauchy-Euler Equation
- 4.8* Solving Systems of Linear Equations by Elimination

Chapter 5 – Modeling with Higher-Order Differential Equations

- 5.1 Linear Models: Initial-Value Problems
 - 5.1.1 Spring/Mass Systems: Free Undamped Motion
 - 5.1.2 Spring/Mass Systems: Free Damped Motion
 - 5.1.3 Spring/Mass Systems: Driven Motion

Chapter 7 – The Laplace Transform

- 7.1 Definition of the Laplace Transform
- 7.2 Inverse Transforms and Transforms of Derivatives
 - 7.2.1 Inverse Transforms
 - 7.2.2 Transforms of Derivatives
- 7.3 Operational Properties I
 - 7.3.1 Translation on the s -axis
 - 7.3.2 Translation on the t -axis
- 7.4 Operational Properties II
 - 7.4.1 Derivatives of a Transform
 - 7.4.2* Transforms of Integrals
 - 7.4.3* Transform of a Periodic Function
- 7.5* The Dirac Delta Function
- 7.6* Systems of Linear Differential Equations

NOTE: Due to time constraints, it is unlikely that all the starred (*) sections can be covered. In consultation with the course coordinator, individual instructors should select from among these starred (*) sections.