(4-0-4) 4/30/25

Catalog Description: The first in a two term sequence on the solutions of ordinary differential equations. Introduction to differential equations, first and second order equations with applications.

Course Objectives: After completing this course, students will be able to

- 1. Classify and solve first order differential equations.
- 2. Model and solve applications of first order differential equations.
- 3. Solve second order differential equations.
- 4. Model and solve applications of second and higher order differential equations. notation.

Learning Outcomes and Performance Criteria

1. Classify and solve first order differential equations.

Core Criteria:

- (a) Sketch a solution to an initial value problem given a slope field.
- (b) Solve a separable differential equation.
- (c) Classify differential equations according to linearity, order, homogeneity, separable.
- (d) Identify equilibrium solutions of autonomous equations and classify them as stable, unstable, or semi-stable.
- (e) Sketch the solution of an IVP using a phase diagram (for an autonomous equation).
- (f) Verify that a given function is a solution of an initial value problem.
- (g) Solve a first order linear ordinary differential equation via integrating factor.
- (h) Implement Euler's method (using a computer or by hand).

Additional Criteria:

- (a) Solve an exact ODE.
- (b) Use reduction of order to find the second solution to a second-order ODE.
- (c) Solve a second order initial value problem as a system of two first order equations with a software package (for example ode-45 in Matlab).
- (d) Use the existence and uniqueness theorem to determine if an initial value problem has a unique solution.
- (e) Solve a first order ODE with a software package (for example ode-45 in Matlab).
- 2. Model and solve applications of first order differential equations. Core Criteria:
 - (a) Model population dynamics with an exponential or logistic equation.
 - (b) Construct a differential equation given a description of a problem.

- (c) Set up and solve a mixture problem.
- 3. Solve second order differential equations.

Core Criteria:

- (a) Determine if two functions are linearly independent.
- (b) Use the characteristic polynomial to solve homogenous constant-coefficient second order ODEs.
- (c) Use undetermined coefficients to find general and particular solutions of constant-coefficient second order ODEs.

Additional Criteria:

- (a) Use variation of parameters to solve a second order ODEs.
- (b) Convert a second order initial value problem to a system of two first order equations.
- (c) Solve a second order initial value problem as a system of two first order equations with a software package (for example ode-45 in Matlab).
- 4. Model and solve applications of second and higher order differential equations. Core Criteria:
 - (a) Use Newton's second law to model the vibration of a spring-mass system.
 - (b) Determine if a system exhibits resonance, beats, or neither.
 - (c) Use Newton's second law to model projectile motion possibly including friction.
 - (d) Identify solution terms as steady-state or transient.

Additional Criteria:

- (a) Model and solve RLC circuits.
- (b) Model and solve the beam equation and other boundary value problems.

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