1. Conceptual Understanding

By the end of this course, students will be able to:

1.1. Distinguish between different types of differential equations (e.g., ordinary vs. partial, linear vs. nonlinear, homogeneous vs. nonhomogeneous) and classify them based on order.

1.2. Explain the significance of initial conditions in determining the uniqueness and existence of solutions.

1.3. Interpret solutions of differential equations in the context of physical and engineering applications.

1.4. Understand the relationship between differential equations and their geometric interpretations through solution curves.

2. Analytical Solution Techniques

By the end of this course, students will be able to:

2.1. Solve different types of first-order differential equations including linear, separable, and exact equations.

2.2. Solve homogeneous linear second-order differential equations with constant coefficients using characteristic equations.

2.3. Apply the method of undetermined coefficients to find particular solutions to nonhomogeneous differential equations.

2.4. Apply variation of parameters to find particular solutions to nonhomogeneous differential equations.

2.5. Solve special equations such as Bernoulli and Cauchy-Euler equations.

2.6. Solve simple initial value problems and boundary value problems analytically.

2.7. Use the Laplace transform to solve linear differential equations, including those with discontinuous or impulsive forcing functions.

2.8. Determine power series solutions for linear differential equations with polynomial coefficients.

3. Qualitative Analysis

By the end of this course, students will be able to:

3.1. Identify autonomous differential equations, determine their equilibrium solutions, and explain the significance of these solutions.

3.2. Determine the stability of equilibrium solutions of autonomous differential equations.

3.3. Evaluate long-term behavior of solutions and classify equilibrium points.

4. Computational Tools

By the end of this course, students will be able to:

4.1. Solve differential equations using built-in MATLAB functions such as ode 45 and interpret the numerical results.

4.2. Use MATLAB to validate analytical solutions by comparing them with numerical approximations.

4.3. Develop scripts in MATLAB for automating repetitive computations and visualizing results effectively.