32044 Introduction to Ordinary Differential Equations (3)

Knowledge

Classification of ordinary differential equations (ODEs): order, linear vs nonlinear, homogeneous vs nonhomogeneous. Wronskian test for linear independence of solutions of linear ODEs.

Comprehension

Ability to classify 1st-order ODEs by type: exact, separable, linear. Understand the structure of the general solution of a linear ODE: integration constants, particular integrals/solutions. Understand the various dynamical behaviors of a forced spring-mass-damper system: simple harmonic motion, damped oscillations, beating, resonance.

Application

Solve 1st-order ODEs by several methods: direct integration, exact, integrating factors, separable, linear. Solve 2nd-order, linear, constant-coefficient, homogenous ODEs using characteristic polynomials and roots, reduction of order. Find particular integrals of 2nd-order linear constant-coefficient nonhomogeneous ODEs by two methods: undetermined coefficients, variation of parameters. Solve 2-by-2 linear, constant-coeffiecent, homogeneous ODE coupled systems using matrix eigenvalues and eigenvectors.

Analysis

Analyze the qualitative behavior of solutions of 1st-order ODEs using direction fields and isoclines. Analyze the nature of singular points using the method of Frobenius expansions.

Synthesis

Develop/formulate mathematical models of simple evolution processes in terms of 1st-order ODEs: population growth, radioactive decay, mixing, Newton's Law of Cooling. Develop/formulate a mathematical model of a forced spring-mass-damper system as a 2nd-order linear constant-coefficient non-homogeneous ODE.

Evaluation

Interpret the solutions of the spring-mass-damper system model in different parameter regimes (e.g., over-damped vs under-damped).

Class Activities

Lectures: development, exposition, examples, and illustrations. Hourly exams.

Out of Class Activities

Written homework.