MATH 211: DIFFERENTIAL EQUATIONS

Citrus College Course Outline of Record

Heading	Value
Effective Term:	Fall 2024
Credits:	5
Total Contact Hours:	90
Lecture Hours :	90
Lab Hours:	0
Hours Arranged:	0
Outside of Class Hours:	180
Total Student Learning Hours:	270
Prerequisite:	MATH 210.
District General Education:	A3. Mathematics
Transferable to CSU:	Yes
Transferable to UC:	Yes - Approved
Grading Method:	Standard Letter, Pass/No Pass

Catalog Course Description

Solve first and higher-order, linear and non-linear, differential equations with applications. Use the Existence and Uniqueness Theorem on differential equations with constant or variable coefficients, homogeneous or nonhomogeneous, whose order is second or higher. Apply linear algebra techniques to solve systems of linear differential equations and their applications. Use the method of Laplace Transforms to solve initial valued problems of 2nd and higher-order differential equations with constant or polynomial coefficients. using the method of Laplace Transforms. Estimate the solution to variable coefficient differential equations by using power series. 90 lecture hours.

Course Objectives

- Solve first order differential equations by separable, homogeneous, exact, linear, using special integrating factors, substitutions and transformation techniques.
- Solve applications to first and second-order differential equations such as mixture, population modeling, Newton's Law of Cooling, orthogonal trajectories, circuits, and harmonic oscillators problems.
- Use the Wronskian to determine the linear dependence of functions.
- Identify the fundamental solution set for a differential equation and apply the superposition principle to find the unique solution to a non-homogeneous with constant or variable coefficient, linear differential equation.
- Solve non-homogeneous, but linear differential equations using the method of undetermined coefficients, annihilation, or variation of parameters for second and higher-order.
- Solve second and higher-order homogeneous and non-homogeneous Cauchy-Euler differential equations.
- Use linear algebra techniques to solve systems of linear differential equations.
- Use the method of Laplace Transforms to solve differential equations with given initial conditions.\\n
- Find a power series to estimate the solution to a differential equation when the previously learned techniques delay the success of finding the solution.
- Advance to higher mathematics courses by applying the principles of differential equations to subsequent courses.

Major Course Content

1. Introduction to Differential Equations
   a. Definitions and terminology.
   b. Explicit or Implicit solutions and initial-value problems.
   c. Existence and Uniqueness Theorem for first-order differential equations.
   d. Directional fields and the method of Iscoclines.
2. First-Order Differential Equations
   a. Separable differential equation.
   b. Solving linear differential equations by using an integrating factor.
   c. Test for exactness and subsequently solve the exact differential equations.
   d. Using special integrating factors to transform the differential equation to an exact DE.
   e. Solve homogenous or linear coefficients by substitutions.
   f. Solve Bernoulli or Ricatti differential equations by transformations.
3. Modeling with First-Order Differential Equations
   a. Mixture problems.
   b. Population models.
   c. Newton's Law of Cooling.
   d. Newtonian Mechanics.
   e. Circuits (optional).
4. Linear Second-Order Differential Equations
   a. Existence and Uniqueness Theorem for second-order homogeneous differential equations.
   b. Linear Dependence of a set of two functions and the Wronskian.
   c. Representation of solutions to initial valued problems.
   d. Existence and Uniqueness Theorem for second-order nonhomogeneous differential equations.
   e. The fundamental solution set and the Superposition Principle.
   f. Method of Undetermined Coefficients.
   g. Variation of Parameters.
   h. Reduction of Order for Variable Coefficient DE.
   i. Cauchy-Euler DE.
5. Modeling with Second-Order Differential Equations
   a. Free mechanical vibrations (Spring-Mass system).
   b. Forced mechanical vibrations (external force exist).
6. Systems of Linear Differential Equations and Applications
   a. Solving linear systems of first and second-order differential equations.
   b. Mixture problems with interconnected tanks.
   c. Electrical Systems (optional).
7. Differential Equations of Higher Order
   a. Existence and Uniqueness Theorem for higher-order homogeneous differential equations.
   b. Linear Dependence of a set of more than two functions and the Wronskian.
   c. Representation of solutions to initial valued problems.

   d. Existence and Uniqueness Theorem for higher-order differential equations nonhomogenous DE.
   e. The fundamental solution set and the Superposition Principle.
   f. Method of Undetermined Coefficients.
   g. Annihilation method.
   h. Variation of Parameters.
   i. Higher-Order Cauchy-Euler DE.
8. Laplace Transforms.
   a. Definition and Linearity Properties.
   b. Conditions of Existence.
   c. Laplace Transform Tables.
   d. Properties of the Laplace Transform.
   e. Derivatives of the Laplace Transform.
   f. Definition of the Inverse Laplace Transform and Linearity Properties.
   g. Solving initial value problems using the method of Laplace Transforms.
9. Series Solutions of Linear Equations
   a. Review of power series.
   b. Analytic functions.
   c. Ordinary and Singular points.
   d. Power series solutions to linear differential equations.
   e. Power series solutions to differential equations with analytic coefficients.

Examples of Outside Assignments

Given a differential equation, classify it as ordinary versus partial, linear versus non-linear, and categorize it by the solution technique.
Recognize a first-order (linear and nonlinear) differential equation and solve it by the appropriate method, substitution, or transformation.
Solve an application problem.
Determine the linear dependency of a set of functions using the dependency equation or the Wronskian.
Use a learned technique to solve a second or higher-order, linear, homogeneous or nonhomogeneous differential equation with or without variable coefficient.
Solve a second or higher-order Cauchy-Euler differential equation with or without initial conditions.
Use linear algebra techniques to solve a system of differential equations with or without initial conditions of first or second order.
Use the Laplace transform method to solve an initial value problem at zero or at a nonzero value.
Find the first four nonzero terms of a power series expansion about x=0 for a general solution to a second-order differential equation with analytic coefficients.

Instruction Type(s)

Lecture, Online Education Lecture

IGETC Area 2: Mathematical Concepts and Quantitative Reasoning

Yes