South Central College

MATH 231 Ordinary Differential Equations

Course Outcome Summary

Course Information

Description This is a traditional introductory course in ordinary differential equations for students pursuing careers in engineering, mathematics and the sciences; the focus is primarily on lower order equations. Topics include the solution of linear equations with constant coefficients, homogeneous and nonhomogeneous equations, assorted methods such as undetermined coefficients, variation of parameters and Laplace transforms. Also studied are existence and uniqueness theorems, numerical approximations, operator methods and various applications to physical phenomena. (Prerequisites: Calculus II with a grade of C or better.)

Total Credits 4

Total Hours 64

Types of Instruction

Instruction Type	Credits/Hours
Lecture	

Pre/Corequisites

Calculus II (MATH 132) with a grade of C or better.

Institutional Core Competencies

Critical and Creative Thinking - Students will be able to demonstrate purposeful thinking with the goal of using a creative process for developing and building upon ideas and/or the goal of using a critical process for the analyzing and evaluating of ideas.

Course Competencies

1. Explain how a differential equation arises

Learning Objectives

Define fundamental terms from the field of differential equations
Recognize common physical situations that lead to differential equations
Show how repeated differentiation can eliminate arbitrary constants in a primitive
Obtain the differential equations for various families of curves

2. Define the solution of a differential equation

Learning Objectives

State the relationship between a solution and a primitive
Define particular solution
Define general solution
Characterize the nature of an existence theorem
Characterize the nature of a uniqueness theorem
Represent a family of solutions graphically via a direction field and isoclines

3. Solve a first order, first degree differential equation with variables separable

Learning Objectives

Identify an equation with variables separable
Define a homogeneous function
Identify a homogeneous differential equation
Solve a first degree homogeneous differential equation
Solve a first degree nonhomogeneous differential equation
Transform certain types of equations to the variables-separable form and solve
Reduce certain equations by means of various substitutions

4. Solve a first order, first degree differential equation which is exact

Learning Objectives

State the necessary and sufficient conditions for exactness
Solve an exact equation
Transform an equation which is not exact by means of an integrating factor

5. Solve a general linear differential equation of first order

Learning Objectives

Define the form of this type of equation
Solve equations of this form
Reduce certain other equations to this form and solve
Find an integrating factor for equations whose coefficients are linear in two variables
Find an integrating factor for the Bernoulli equation and solve
Classify certain types of solutions involving non-elementary integrals

6. Classify the general linear differential equation

Learning Objectives

Apply various principles from linear algebra to assemble solutions
Intuitively generalize prior existence and uniqueness theorems to nth order equations
Compute the Wronskian
Specify the form of a homogeneous equation
Specify the form of a nonhomogeneous equation
Develop practical operator methods
Prove various properties of these operators

7. Solve the homogeneous linear differential equation with constant coefficients

Learning Objectives

Recapitulate essential ideas from linear algebra
Compute a solution when the auxiliary equation has distinct real roots
Compute a solution when the auxiliary equation has repeated real roots
Compute a solution when the auxiliary equation has complex number roots

8. Solve certain nonhomogeneous linear differential equations with constant coefficients

Learning Objectives

Construct a homogeneous equation from a specified solution
Solve an equation of this form by inspection
Solve an equation of this form with the help of partial fractions

9. Solve a differential equation by the method of variation of parameters

Learning Objectives

Define complementary function
Compute a solution by variation of parameters

Simplify certain equations by D'Alembert's reduction of order

10. Solve a differential equation by the method of undetermined coefficients

Learning Objectives

Specify the nature of a solution to a nonhomogeneous equation
Compute a solution by the method of undetermined coefficients
Compute a particular solution by inspection

11. Solve differential equations by means of the Laplace transform

Learning Objectives

Recapitulate the notion of transforming one function into another
Define the Laplace transform
Derive the Laplace transform of elementary functions
Transform certain initial value problems
Explain the notion of a piecewise continuous function
Develop the properties of functions of exponential order
Derive the transforms-of-derivatives and derivative-of-transforms relationships
Explain the use of Laplace transforms with periodic functions

12. Solve certain nonlinear differential equations

Learning Objectives

Solve a differential equation by factoring the left member (p)
Solve a differential equation by eliminating the dependent variable
Show the solution of Clairaut's equation
Compute a solution when the dependent variable is missing
Compute a solution when the independent variable is missing
Apply these results to the catenary curve

13. Solve systems of linear differential equations

Learning Objectives

Solve a system by repeated differentiation
Solve a system using differential operators
Solve a system using determinants

14. Approximate a solution of a differential equation

Learning Objectives

Iterate an approximation by means of Picard's method
Approximate a solution by means of a Taylor series
Extend Simpson's rule to Runge's method
Extend Simpson's rule to Kutta's method

15. Apply these methods to certain physical phenomena

Learning Objectives

Model the vibration of a spring
Describe resonance mathematically
Model damped and undamped vibrations
Describe the deflection of beams by means of differential equations
Simulate the actions of a simple pendulum
Derive the behavior of a certain mathematical curves

16. Apply these methods to assorted geometric curves

Learning Objectives

Recapitulate various results concerning tangent and normal lines
Recapitulate representation of curves in polar form
Represent a family of curves as a solution to a differential equation
Obtain the geometrical characteristics of various families of curves thus generated
Compute the orthogonal trajectories of various families
Derive the behavior of certain mathematical curves

SCC Accessibility Statement

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Additional information and forms can be found at: www.southcentral.edu/disability

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