MISSOURI WESTERN STATE UNIVERSITY

COLLEGE OF LIBERAL ARTS AND SCIENCES

DEPARTMENT OF COMPUTER SCIENCE, MATHEMATICS, AND PHYSICS

COURSE NUMBER: MAT 317

COURSE NAME: Differential Equations

COURSE DESCRIPTION:

Common types of ordinary differential equations, differential operators, LaPlace transforms, systems of differential equations, partial differential equations, Fourier series, and applications. 3 credit hours, offered spring semester.

PREREQUISITE:

MAT 287 and MAT 306 or consent of instructor.

TEXT:

Differential Equations-w/Access, Blanchard, Edition 4th 12, Cengage L,
ISBN 9781133109037

COURSE OBJECTIVES:

The purpose of this course is to provide a sound and accurate exposure to theory, techniques, and applications of ordinary differential equations. Students will learn how to:

1. Verify that an indicated function is a solution of given differential equations.
   (MoStep Mathematics Competencies 1.1)

2. Find a differential equation describing certain situations.
   (MoStep Mathematics Competencies 1.1, 1.2, 1.4)

3. Find a solution to initial value problems.
   (MoStep Mathematics Competencies 1.1)

4. Use various techniques for solving differential equations.
   (MoStep Mathematics Competencies 3.5, 5.5, 8.2)

5. Apply linear and nonlinear differential equations in the mathematical analysis of population growth, radioactive decay, and chemical mixtures.
(MoStep Mathematics Competencies 1.6, 1.9, 3.5)

6. Identify linear second-order differential equations as to being homogeneous or nonhomogeneous.

7. Use the Wronskian of two differentiable functions to determine linear dependence or independence.
(MoStep Mathematics Competencies 5.5)

8. Find the general solution of homogeneous and nonhomogeneous linear second-order differential equations.
(MoStep Mathematics Competencies 3.5)

9. Apply second-order differential equations to vibrational models.
(MoStep Mathematics Competencies 1.4, 1.6)

10. Solve differential equations with variable coefficients using fourier transforms.
(MoStep Mathematics Competencies 3.4)

11. Apply the LaPlace transform to a linear differential with constant coefficients.

12. Use matrices to obtain the general solution to a homogeneous system of linear differential equations.
(MoStep Mathematics Competencies 1.11, 3.5)

13. View a vector as a matrix.
(MoStep Mathematics Competencies 1.11, 3.5, 5.5)

14. Sketch a direction field associated with a differential equation.
(MoStep Mathematics Competencies 1.10, 1.11)

15. Obtain an approximate numerical value solution of an initial value problem using Euler's formula, Taylor formula, Runge-Kutta formula, and Milne formulas.
(MoStep Mathematics Competencies 1.11)

16. Solve linear partial differential equations.
(MoStep Mathematics Competencies 1.6)

STUDENT COMPETENCIES:

1. Determine that an indicated function may or may not be a solution of a given differential equation.

2. Find the differential equation of a given family of curves.

3. Derive the appropriate differential equation(s) describing a given physical situation.
4. Find solution(s) of initial-value problems.

5. Be able to classify equations as to separable, homogeneous exact, linear, Bernoulli, Ricatti, or Clairaut.

6. Be able to solve equations of the type mentioned in number 5.

7. Use differential equations to solve analysis problems of population growth, radioactive decay, and chemical mixtures.

8. Find the Wronskian of two differential functions to determine whether the functions are linearly independent or dependent.

9. Determine general solution and particular solution of differential equations.

10. Solve simple harmonic, damped, forced motion problems.

11. Find power series solution of differential equations.

12. Use the LaPlace transform to solve a given differential equation.

13. Use the LaPlace transform to solve a system.

14. Use the concept of eigenvalues and eigenvectors to solve a system.

15. Sketch direction fields.

16. Obtain approximate numerical solutions.

17. Find Fourier series of functions on a given interval.

18. Solve given partial differential equations.

COURSE OUTLINE:

I. An Introduction to Differential Equations

1. Basic Definitions and Terminology
2. Origins of Differential Equations

II. First-Order Differential Equations

1. Preliminary Theory
2. Separate Variables
3. Homogeneous Equations
4. Exact Equations
5. Linear Equations
6. The Equations of Bernoulli, Ricatti, and Clairaut

III. Applications of First-Order Differential Equations

1. Orthogonal Trajectories
2. Applications of Linear Equations
3. Applications of Nonlinear Equations

IV. Linear Differential Equations of Higher Order

1. Preliminary Theory
2. Constructing a Second Solution From a Known Solution
3. Homogeneous Linear Equations with Constant Coefficients
4. Undetermined Coefficients
5. Variation of Parameters

V. Applications of Second-Order Differential Equations: Vibrational Models

1. Simple Harmonic Motion
2. Damped Motion
3. Forced Motion
4. Analogous Systems

VI. Differential Equations with Variable Coefficients

1. The Cauchy-Euler Equation
2. Power Series Solutions
3. Solutions Around singular Points
4. Two Special Equations

VII. The LaPlace Transform

1. The LaPlace Transform
2. Operational Properties
3. Applications

VIII. Systems of Differential Equations

1. The Operator Method
2. The LaPlace Transform Method
3. Systems of Linear First-Order Equations
4. An Introduction to Matrices
5. Matrices and Systems of Linear First-Order Equations
6. Homogeneous Linear Systems
7 Variation of Parameters

IX. Numerical Methods

1. Direction Fields
2. The Euler Methods
3. The Three-Term Taylor Method
4. The Runge-Kutta Method

X. Partial Differential Equations

1. Orthogonal Functions
2. Fourier Series
3. Fourier Cosine and Sine Series
4. Partial Differential Equations
5. Boundary-Value Problems