# BAKER COLLEGE
# STUDENT LEARNING OUTCOMES

MTH 3550 Differential Equations and Linear Algebra

4 Semester Hours

## Student Learning Outcomes and Enabling Objectives

1. Analyze First-Order Differential Equations.
    a. Differentiate between linear and non-linear differential equations
    b. Solve linear, separable, homogenous, exact, and Bernoulli differential equations
    c. Use method of substitution to solve differential equations
    d. Model real-world problems with first-order differential equations

2. Analyze Second-Order Differential Equations.
    a. Differentiate between linear and non-linear second order differential equations
    b. Differentiate between constant and non-constant second order differential equations
    c. Examine the principle of superposition
    d. Solve linear second-order differential equations whose characteristic equation has real, complex, and repeated roots.
    e. Examine and utilize methods of undetermined coefficients, annihilator, and variation of parameters to solve non-homogenous differential linear second order differential equations
    f. Use methods of reduction of order to solve to solve linear second order differential equations.
    g. Model real-world problems with second-order differential equations

3. Utilize Laplace Transforms to Solve Differential Equations
    a. Use definition and table to compute Laplace transform of a function
    b. Compute the inverse Laplace Transform of a function
    c. Examine piecewise continuous functions and shifting theorem
    d. Examine differential equations with discontinuous inputs
    e. Determine Laplace transforms using shifting theorems.
    f. Use Laplace transforms to solve various initial value problems
    g. Determine convolution of functions and the Laplace transform of a convolution

4. Analyze Systems of Linear Equations and Matrices
    a. Recognize different types of systems of linear equations
    b. Use elementary row operations to solving systems of linear equations
    c. Explore the concept of matrices as well as invertible matrices
    d. Examine operations with matrices and their properties
    e. Determine determinants of a square matrix as well as properties of determinants

f. Apply systems of linear equations and matrices to real-world situations

5. Understand the Concept of Vector Spaces
    a. Examine various types of vectors and vector operations as well as related properties
    b. Analyze various types of vector spaces, subspaces, spanning sets, as well as related properties
    c. Examine the concept of linear dependence and independence, bases, and dimension
    d. Write vectors as a linear combination of other vectors
    e. Determine basis for row and column spaces and nullspace of a matrix
    f. Find eigenvalues and associated eigenvectors and eigenspaces
    g. Compute length, distance, dot products, inner products, and orthogonal projections

6. Analyze Linear Transformation
    a. Examine conditions for when a function is a linear transformation
    b. Determine kernel, basis for range, rank, nullity, injectivity, surjectivity, and isomorphism of linear transformation
    c. Examine properties of similar matrices and diagonalization of matrices and linear transformations
    d. Apply properties of symmetric and orthogonal matrices

7. Solve Systems of Differential Equations
    a. Recognize different types of systems of first-order differential equations
    b. Solve homogenous linear systems using eigenvalue method
    c. Solve nonhomogeneous linear system by variation of parameters
    d. Solve a system of differential equation using Laplace transform
    e. Apply systems of differential equations to real-world situations

8. Utilize Numerical Methods for Differential Equations
    a. Use Euler and Runge-Kutta Methods to approximate solutions to differential equations

## Big Ideas and Essential Questions

**Big Ideas**

- First and Second Order Differential Equations
- Laplace Transformations
- Vector Spaces and Linear Transformations
- System of Differential Equations

**Essential Questions**

1. How can differential equations be utilized to model real world problems?
2. How can the concept of vector spaces and linear transformations be utilized to model real world problems?

# Required Elements

RE 1.

RE 2.

These SLOs are not approved for experiential credit.

**Effective: Fall 2017**