MATH 321 : Applied Differential Equations I **(4-0-4)** 10/11/18

Catalog Description: The first in a two term sequence on the solutions of ordinary differential equations. Introduction to differential equations, first and second order equations with applications.

Course Objectives: After completing this course, students will be able to

1. Classify and solve first and second order differential equations and initial value problems.
2. Model physical phenomena with first and second order differential equations.
3. Solve applied problems in the context of first and second order differential equations.
4. Communicate mathematical ideas using correct and appropriate notation.

Learning Outcomes and Performance Criteria

1. Classify and solve first order differential equations.

   Core Criteria:

   (a) Sketch a solution to an initial value problem given a slope field.
   (b) Solve a separable differential equation.
   (c) Classify differential equations according to linearity, order, homogeneity, separable.
   (d) Identify equilibrium solutions of autonomous equations and classify them as stable, unstable, or semi-stable.
   (e) Sketch the solution of an IVP using a phase diagram (for an autonomous equation).
   (f) Verify that a given function is a solution of an initial value problem.
   (g) Solve a first order linear ordinary differential equation via integrating factor.
   (h) Solve a first order ODE with a software package (for example ode-45 in Matlab).

   Additional Criteria:

   (a) Solve an exact ODE.
   (b) Use reduction of order to find the second solution to a second-order ODE.
   (c) Solve a second order initial value problem as a system of two first order equations with a software package (for example ode-45 in Matlab).
   (d) Use the existence and uniqueness theorem to determine if an initial value problem has a unique solution.
   (e) Implement Euler's method.

2. Model and solve applications of first order differential equations.

   Core Criteria:

   (a) Model population dynamics with an exponential or logistic equation.
   (b) Construct a differential equation given a description of a problem.

(c) Set up and solve a mixture problem.

3. Solve second order differential equations.

   Core Criteria:

   (a) Determine if two functions are linearly independent.
   (b) Use the characteristic polynomial to solve homogenous constant-coefficient second order ODEs.
   (c) Use undetermined coefficients to find general and particular solutions of constant-coefficient second order ODEs.

   Additional Criteria:

   (a) Use variation of parameters to solve a second order ODEs.
   (b) Solve a second order initial value problem as a system of two first order equations with a software package (for example ode-45 in Matlab).

4. Model and solve applications of second order differential equations.

   Core Criteria:

   (a) Use Newton's second law to model the vibration of a spring-mass system.
   (b) Determine if a system exhibits resonance, beats, or neither.
   (c) Use Newton's second law to model projectile motion possibly including friction.
   (d) Model and solve RLC circuits.
   (e) Identify solution terms as steady-state or transient.

   Additional Criteria:

   (a) Model and solve the beam equation and other boundary value problems.