MATH 322 : Applied Differential Equations II **(4-0-4)** 01/18/11

Catalog Description: The second in a two term sequence on the solutions of ordinary differential equations. Introduction to systems of equations, the Laplace transform and series solutions.

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

1. Solve a matrix system of differential equations.
2. Use Laplace transforms to solve differential equations.
3. Solve differential equations via power series.
4. Communicate mathematical ideas using correct and appropriate notation.

Learning Outcomes and Performance Criteria

1. Understand how to set up and solve a matrix system of differential equations.

   Core Criteria:

   (a) Given several linear differential equations, write an equivalent matrix system.
   (b) Transform a higher-order differential equation into a system of first order equations.
   (c) Use the eigenvalue method to solve a system of linear differential equations (consider real or complex eigenvalues and repeated eigenvalues of multiplicity two).
   (d) Find critical points and classify their stability both analytically and graphically.
   (e) Solve problems from at least two applications of systems of differential equations from the following: predator-prey, coupled oscillators, RLC-circuits, mixing problems.

   Additional Criteria:

   (a) Linearize a non-linear system.
   (b) Solve a system of initial value problems with a software package (for example ode-45 in Matlab).
   (c) Perform the first few steps of a solution to an initial value problem (by hand) with a numerical method.

2. Understand how to use Laplace transforms to solve differential equations.

   Core Criteria:

   (a) Compute both Laplace transforms and inverse Laplace transforms of basic functions.
   (b) Use a table to determine both Laplace transforms and inverse Laplace transforms of basic functions.
   (c) Use Laplace transforms to solve an initial value problem.
   (d) Use convolution to solve an initial value problem via Laplace transforms.
   (e) Use the Dirac delta function to solve an initial value problem with a discontinuous forcing function.

3. Understand how to solve differential equations via power series.

   Core Criteria:

   (a) Construct a power-series solution to a polynomial-coefficient, second-order differential equation.

   (b) Use the method of Frobenius to solve a second order differential equation with a regular singular point.

   (c) Generate solutions of the first and second kind to the Bessel equation.