MATH 331: INTRO TO DIFFERENTIAL EQUATIONS

Prerequisites: Math 131 & 132; Math 235 or equivalent highly recommended; Math 233 is a corequisite.

Recommended Text: W. Boyce and R. DiPrima, "Elementary Differential Equations", 8th ed., Wiley, 2005.

Alternative Texts: Blanchard, Devaney & Hall; Conrad; Edwards & Penney; others of comparable standard.

Course Description: This is a first course in Differential Equations (ODEs): modeling physical systems with ODEs and interpreting results; solution of first order equations (analytical, numerical and graphical); second order linear ODE with forcing; Laplace Transform; other topics as time permits.

Learning Goals: This course can be regarded as the application of Calculus to physical problems. Upon successful completion of the course, students will be able to:

- develop and interpret ODE models from verbal descriptions of physical problems;
- solve many first order ODE analytically, graphically and numerically;
- understand what it means for solutions to exist and be unique, and apply existence and uniqueness theorems to obtain qualitative information about solutions;
- describe various physical problems using ODE: Newton's law, linear springs, electrical circuits, and reinterpret mathematical statements in their physical contexts;
- determine long-term behavior of solutions;
- recast (linear) ODE problems as algebraic problems.

Required topics:

At a minimum, all sections should cover the following topics, as well as alternative topics as time permits, according to the instructor's taste.

- Modeling using ODEs;
- Classification of ODEs;
- Analytic solution of first order ODE: linear and separable equations;
- Numerical solution with Euler's Method;
- Existence and Uniqueness theorems (statements and applications);
- Systems of two equations;
- Second Order Linear equations: general solutions, real, complex and repeated roots;
- Phase planes and qualitative behavior of solutions;
- Inhomogeneous equations: forcing and resonance;
- Laplace transforms, including discontinuous forcing and δ-functions.

Suggested Additional Topics:

We expect that most instructors will be able to cover one or more extra topics, which may include some of these alternatives:

- Higher order equations and Systems;
- More numerical methods: improved Euler, Runge-Kutta, etc;
- Series solution of linear 2nd order ODE.