ROWAN UNIVERSITY
Department of Mathematics

Syllabus

Math 01.521 - Nonlinear Differential Equations

CATALOG DESCRIPTION:

Math 01.521 Nonlinear Differential Equations
(Prerequisite: Math 01.231 Ordinary Differential Equations or its equivalent)

This course examines analytic and computer methods for the solution of ordinary differential equations which are of interest in applications. Topics are selected from differential equations in the phase plane, geometrical and computational aspects of the phase plane, averaging methods, perturbations methods, stability, Liapunov methods, existence of periodic solutions, bifurcations and chaos. Applications are also included that are of use in science and engineering.

OBJECTIVES:

Students in this course will examine simple analytic and computer methods for the solution of ordinary differential equations, which are readily accessible for use in applications.

Applications to many areas of science and engineering will be included. These could include fluid mechanics, nonlinear diffusion, nonlinear waves and mathematical models of biology.

CONTENT:

The professor can choose from a variety of topics. A course in classical nonlinear differential equations might include:

1. Second Order Differential Equations in the Phase Plane
2. First Order Systems in Two Variables and Linearization
3. Geometrical and Computational Aspects of the Phase Plane
4. Averaging Methods
5. Perturbation Methods
6. Singular Perturbation methods
7. Forced Oscillations: Harmonic and Subharmonic Response, Stability, Entrainment
8. Stability
9. Determination of Stability by Solution Perturbation
10. Liapunov Methods for Determinating Stability
11. The Existence of Periodic Solutions
12. Bifurcations, Structural Stability and Chaos

A course taught from the following outline of topics would be less traditional than the above. The professor might consider including some of these.

1. Review of Linear Ordinary Differential Equations
2. Transformations of Nonlinear Ordinary Differential Equations
3. Series Solutions of Nonlinear Differential Equations

4. Local and global Analysis of Nonlinear Differential Equations
5. Existence Theory For Boundary Value Problems via Shooting Techniques
6. Phase Space Study of Autonomous Systems

TEXTS:

Jordan, D, W and Smith P., Nonlinear Ordinary Differential Equations (2nd Ed.), Oxford University Press, 1987.

Sachdev, P.L., Nonlinear Ordinary Differential Equations and Their Applications, Marcel Dekker, Inc., 1991.

Blanchard, Devaney, & Hill, Differential Equations, Brooks/Cole, 1998.

Glendinning, P., Stability, Instability, and Chaos: An Introduction to the Theory of Nonlinear Differential Equations, Cambridge Univ. Pr., 1994.