

ROWAN COLLEGE
CURRICULUM COMMITTEE

PROPOSAL TITLE: NONLINEAR DIFFERENTIAL EQUATIONS

 UNDERGRADUATE GRADUATE CREDIT HOURS

SPONSOR(S): Dr. Thomas Osler, Dr. John Sooy and Dr. Marcus Wright

DEPARTMENT & TELEPHONE# Mathematics - Ext. 3864

CHECK ONE: COURSE MINOR PROGRAM CONCENTRATION SPECIALIZATION
 ACHIEVEMENT CERTIFICATE CERTIFICATION PROGRAM MAJOR PROGRAM

<p>STEP #1 (DEPARTMENT)</p> <p><input checked="" type="checkbox"/> APPROVED/DATE: <u>10/13/95</u></p> <p><u> </u> NOT APPROVED/DATE:</p> <p><u>Larry Howe</u> DEPT. CURRICULUM CHR.</p> <p><u> </u> REVIEWED/DATE:</p> <p><u> </u></p> <p>DEPT. CHR.</p>	<p>STEP #2 (RECEIPT)</p> <p>SCC# <u>95-96-51</u></p> <p>DATE RECEIVED:</p> <p>1 SENATE</p> <p><u>10 18 1995</u></p> <p>RECEIVED</p> <p>SENATE CURRICULUM CHR.</p>	<p>STEP #3 (SCHOOL)</p> <p>REVIEWED DATE: <u>11/1/95</u></p> <p><input checked="" type="checkbox"/> RECOMMEND TO APPROVE</p> <p><u> </u> RECOMMEND NOT TO APPROVE</p> <p>FORWARD FOR OPEN HEARING</p> <p><u> </u> WITHOUT RESERVATIONS</p> <p><u> </u> WITH RESERVATIONS</p> <p>COMMENTS:</p> <p><u> </u></p> <p>SCHOOL COMMITTEE CHR.</p>
---	---	--

STEP #4 (ACADEMIC DEAN)

RECOMMEND

 NOT RECOMMEND

 CONDITIONALLY RECOMMEND (SEE COMMENTS)

DATE & SIGNATURE, DEAN OF SCHOOL Paul Whittell

COMMENTS: I have checked the proposal to conform with engineering.

STEP #5 (SENATE CURRICULUM COMMITTEE)

DATE OF OPEN HEARING 11/1/95

APPROVED BY SENATE CURRICULUM COMMITTEE (DATE) 11/1/95

 RETURNED TO SPONSOR(S) FOR THE FOLLOWING REASONS:

STEP #6 (SENATE)

DATE PRESENTED TO SENATE 4/27/96 APPROVED NOT APPROVED

NOTIFICATION TO EXECUTIVE VICE PRESIDENT/PROVOST (DATE) 5/13/96

SENATE CURRICULUM COMMITTEE CHAIR SIGNATURE/DATE Paul Whittell 5/13/96

STEP #7 (EXECUTIVE VICE PRESIDENT/PROVOST)

DATE RECEIVED _____

APPROVED: YES NO

IF NO, REASONS ARE AS FOLLOWS:

STUDENT CREDIT HOURS _____

FACULTY LOAD HOURS _____

EQUALIZED CREDIT HOURS _____

OFFICIAL COPY & APPROVAL SHEET FILED (DATE) 5/20/90

SIGNATURE, EXECUTIVE VICE PRESIDENT/PROVOST [Signature]

REGISTRAR

DATE APPROVED COURSE DESCRIPTION RECEIVED 5/30/90

HEGIS TAXONOMY AND COURSE NUMBER ASSIGNED 1701.521

DATE/SIGNATURE OF REGISTRAR B. F. Kelley

NOTIFICATION FORWARD:

___ SENATE CURRICULUM COMMITTEE CHAIRPERSON

___ DEPARTMENT CHAIRPERSON(S)

___ ACADEMIC DEAN(S)

___ REGISTRAR

___ SPONSOR(S)

Rowan College of New Jersey
Department of Mathematics

Course Proposal

Nonlinear Differential Equations

I. Details

- a) Course Title: Nonlinear Differential Equations
- b) Sponsors: Dr. Thomas Osler, Dr. John Sooy and Dr. Marcus Wright, Department of Mathematics
- c) Credit Hours: 3
- d) Course Level: Graduate
- e) Curricular Effect: Elective course for all students in the Master of Arts in Mathematics and in the Masters Degree Program in Engineering
- f) Prerequisites: A course in Ordinary Differential Equations at the undergraduate level
- g) Suggested Time, Implementation: One section of the course offered each year.
- h) Resources: Faculty, equipment and library resources are adequate for a first offering but the library holdings will need to constantly be enhanced.

II. Rationale:

Since the seventeenth century, differential equations have been the principal means by which mathematics is applied to the natural sciences. Thus it is important not only as a branch of pure mathematics, but for its highly useful applications to science and engineering.

Many undergraduate students majoring in mathematics, physics, chemistry, biology, economics and the several branches of engineering traditionally study a one semester course in Ordinary Differential Equations. This course builds on that experience by including deeper traditional, theoretical material on the existence of solutions, as well as modern approaches using computers, to investigate applications of the equations that were not possible 30 years ago.

III. Essence of the Course

a) Objectives in Relation to Student Outcomes

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.

b) Topical Outlines:

Topics will be selected from second order differential equations in the phase plane, geometrical and computational aspects of the phase diagram, averaging methods, perturbation methods, stability, Liapunov methods, existence of periodic solutions, bifurcations and chaos.

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

c) Evaluation and Grading:

Students will be evaluated by the traditional methods of grading homework problems and through written tests. In addition, students will prepare computer solutions of assigned problems.

d) Course Evaluation:

This course will be evaluated through customary student evaluations as well as regular departmental review.

IV. Consultation

The content and nature of this course was discussed with Professor Chris Rhorres, Chairperson, Department of Mathematics at Drexel University. The basic modern thrust of the course, stressing items like phase space and global analysis over the more traditional existence and uniqueness proofs, was the result of this discussion.

Also consultations with the new Engineering School are attached.

V. This proposal has been reviewed by the Department of Mathematics' Curriculum Committee and the Mathematics Masters Committee.

VI. Additional Information:

Recommended 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

Catalogue description:

1703/5xx Nonlinear Differential Equations
(Prerequisite: 1701-320 Ordinary Differential Equations.)

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, perturbation methods, stability, Liapunov methods, existence of periodic solutions, bifurcations and chaos. Applications are also included that are of use in science and engineering.

MEMO

From: T.R.Chandrupatla, School of Engineering

To: Abera Abay, Mathematics

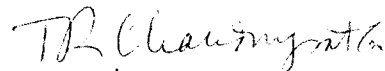
Subject: Nonlinear Differential Equations

Date: March 6, 1996

The course 'Nonlinear Differential Equations' proposed by Professors Osler, Sooy, and Wright deals with a wide variety of ordinary differential equations. Solution techniques, computational aspects, and stability criteria are covered.

The contents of the course satisfy the needs of controls area in engineering.

The course can be included as a possible mathematics course in the graduate engineering program.



T.R.Chandrupatla