ROWAN UNIVERSITY CURRICULUM PROPOSAL

(R)

PROPOSAL TITLE: 170/.386

Introduction to Partial Differential Equations

CHECK APPROPRIATE: X UNDERGRADUATE ___ GRADUATE 3 SEMESTER HOURS

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

DEPARTMENT/TELEPHONE # Mathematics 4844

CHECK ONE: X COURSE ___MINOR PROGRAM ___CONCENTRATION ___SPECIALIZATION

___ACHIEVEMENT CERTIFICATE ___CERTIFICATION PROGRAM ___MAJOR PROGRAM

Step #1 (Department)

___ Approved (Date)

___ Not Approved (Date)

Dept. Curriculum Chr.

Reviewed (Date)

Dept. Chr.

Step #2 (Receipt)

SCC# 97-98-87

12-22-97

Date Received Senate

Senate Curriculum Chr.

Step #3 (School)

Reviewed Date:

___ Recommend to Approved

___ Recommend NOT to Approve

Forward for Open Hearing:

___WITHOUT Reservations

___WITH Reservations:

Comments:

School Committee Chr.

Step #4 (Academic Dean): ___Recommended ___ NOT Recommended ___ Conditionally Recommended (See Comments)

Comments:

Dean Signature/Date

Step #5 (Senate Curriculum Committee): Open Hearing Date 1/2/98 Approved by Curriculum Committee Date 1/2/98

Returned to Sponsor(s) for the following reason:

Step # 6 (Senate) Date announced/voted on at Senate 1/27/98 If voted on: ___Approved ___NOT Approved

Date forwarded to Executive Vice President/Provost _____

Senate Curriculum Committee chair Signature/Date: 1/27/98

Step #7 (Executive Vice President/Provost): Date Received JAN 2 [illegible]

✓ Approved

___ NOT Approved If no, reasons are as follows:

Student Credit Hours _____

Faculty Load Hours _____

Equalized Credit Hours _____

Official Copy & Approval Sheet Filed (Date) _____

Executive Vice President/Provost Signature [signature]

Registrar

Date Approved Course Description Received 2-9-98

Hegis Taxonomy and Course Number Assigned 1701.38 E

Date/Signature of Registrar [signature] 2-9-98

Notification Forward:

_____ Senate Curriculum Committee Chairperson

_____ Department Chairpersons

_____ Academic Dean(s)

_____ Registrar

_____ Sponsor(s)

Rowan University
Department of Mathematics

Course Proposal

Introduction to Partial Differential Equations

I. Details

a) **Course Title:** Introduction to Partial Differential Equations

b) **Sponsors:** Dr. Thomas Osler and Dr. Marcus Wright, Department of Mathematics

c) **Credit Hours:** 3 credit hours

d) **Course Level:** Junior or Senior

e) **Curricular Effect:** Elective course for students majoring in Mathematics, Engineering, Physics and other sciences.

f) **Prerequisites**: 1701.231 Ordinary Differential Equations

g) **Suggested Time, Implementation:** This course will be offered once each year.

h) **Resources:** Faculty, equipment and library resources are adequate.

II. Rationale:

Since the discovery of the calculus some 300 years ago, the major area of applications of mathematics has been through the use of differential equations. These equations are of two types: ordinary differential equations and partial differential equations. The former treat problems in one independent variable (often time), while the latter treat problems in more than one independent variable (often the coordinates of space and time). The existing course called Differential Equations treats only ordinary differential equations. Since many applications in physics, engineering and other sciences require partial differential equations, and since most engineering schools have traditionally offered such a course at the undergraduate level, it seems natural to offer this course here at Rowan.

III. **Essence of the Course**

a) **Objectives in Relation to Student Outcomes**

Students in this course will become familiar with the three main types of partial differential equations (PDEs) and how they arise from physical problems. The important technique of separation of variables will be used to reduce the PDE to a system of ODEs (ordinary differential equations). The use of Fourier series and integrals will be explained. Solutions in other orthogonal functions will be examined. The use of a high level mathematics programming language (such as Mathematica) to simplify the analytical computations will be encouraged.

b) **Topical Outline:**

1. Partial Differential Equations of Physics

   Linear Boundary Value Problems
   The Vibrating String
   Other examples of Wave Equations
   Conduction of Heat
   Laplace's Equation
   Cylindrical and Spherical Coordinates
   Types of Equations and Conditions

2. Superposition of Solutions

   Linear Combinations
   Series Solutions
   Separation of Variables
   A Plucked String

3. Fourier Series

   The Basic Series
   Examples
   Fourier Sine and Cosine Series

4. Orthogonal Sets of Functions

   Functions as Vectors
   Inner Products and Orthonormal Sets
   Generalized Fourier Series
   Sturm-Liouville Problems

5. Fourier Integrals

The Fourier Integral Formula
Sine and Cosine Forms
Exponential Form

6. Boundary Value Problems

Formal and Rigorous Solutions
The Vibrating String, Initially Displaced
Nonhomogeneous Differential Equations
Elastic Bar
Temperatures in a Bar
A Dirichlet Problem

7. Bessel Functions and Applications

Bessel's Equation
Bessel Functions
Differentiation and Recurrence Formulae
Zeroes of the Bessel Functions
Temperatures in a Long Cylinder
Vibration of a Circular Membrane

8. Legendre Polynomials and Applications

Derivation of Legendre Polynomials
Legendre's Series
Temperatures in a Hemisphere

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:

1. Dr. T. R. Chandrupatla, Dept. of Mechanical Engineering
2. Dr. Eduardo Flores, Dept. of Chemistry and Physics

Their letters of support are attached.

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

Catalogue description:

1701.335 Introduction to Partial Differential Equations

(Prerequisite: 1701.231 Ordinary Differential Equations)

This course is a study of partial differential equations and their applications. Topics include the derivation of the wave equation, Laplace's equation and the heat equation, Fourier series and integrals, boundary value problems, Bessel functions and Legendre Polynomials.

Rowan
Glassboro, NJ 08028-1701

Dr. Eduardo Flores
Department of Chemistry & Physics
(609) 256-4500 Ext. 3598 Fax (609) 256-4921
e-mail: flores@rowan.edu

MEMO

TO: Gary Itzkowitz
FROM: Eduardo Flores
RE: A New Course Proposal
Partial Differential Equations
DATE: October 7, 1997

In practically all of our physics courses, from introductory to advanced levels, partial derivatives and partial differential equations are fundamental mathematical tools. I think that the course you propose, Partial Differential Equations, can greatly benefit all science and engineering majors but specially physics majors. I will strongly recommend that all our majors to take this course when available.

Sincerely,

Eduardo Flores

Dr. Eduardo Flores
Head of Physics Section

ROWAN UNIVERSITY

Department of Mechanical Engineering
201 Mullica Hill Road, Glassboro, NJ 08028-1701

MEMO

TO: Gary Itzkowitz

FROM: T.R. Chandrupatla T R Chandrupatla

REF: New course proposed "Introduction to Partial Differential Equations"

DATE: October 10, 1997

I have gone through the proposal for "Introduction to Partial Differential Equations" at Junior or Senior level. Partial differential equations (PDEs) play an important role in science and engineering. Offering such a course at Junior/Senior level will be very useful. The course will also be useful in the graduate program where our students need to develop a mathematical background in order to formulate and solve problems in solid, fluid, thermal, and electromagnetic systems.

I strongly support the offer of a course on partial differential equations.