

ROWAN COLLEGE
CURRICULUM COMMITTEE

4901-345

PROPOSAL TITLE: Patterns in Nature II: Projects in Calculus and Physics

~~1/1/97~~
1/1/97

UNDERGRADUATE GRADUATE CREDIT HOURS

SPONSOR(S): Janet Caldwell, Mathematics and Karen Magee-Sauer, Chemistry and Physics

DEPARTMENT & TELEPHONE# Mathematics - Ext. 3871

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

STEP #1 (DEPARTMENT)	STEP #2 (RECEIPT)	STEP #3 (SCHOOL)
<input checked="" type="checkbox"/> APPROVED/DATE: <u>10/13/95</u> <input type="checkbox"/> NOT APPROVED/DATE: <u>Janet Caldwell</u> DEPT./CURRICULUM CHR. <input checked="" type="checkbox"/> REVIEWED/DATE: <u>10/18/95</u> DEPT. CHR.	SCC# <u>95-96-87</u> DATE RECEIVED: <u>10/13/95</u> <u>Ronald J. Gochen</u> SENATE CURRICULUM CHR.	REVIEWED DATE:- <input checked="" type="checkbox"/> RECOMMEND TO APPROVE <input type="checkbox"/> RECOMMEND NOT TO APPROVE FORWARD FOR OPEN HEARING <input type="checkbox"/> WITHOUT RESERVATIONS <input type="checkbox"/> WITH RESERVATIONS COMMENTS: <u>Janet Caldwell</u> SCHOOL COMMITTEE CHR.

STEP #4 (ACADEMIC DEAN)	COMMENTS:
<input type="checkbox"/> RECOMMEND <input type="checkbox"/> NOT RECOMMEND <input type="checkbox"/> CONDITIONALLY RECOMMEND (SEE COMMENTS) DATE & SIGNATURE, DEAN OF SCHOOL	<div style="font-size: 2em; opacity: 0.5; text-align: center;">10</div> <u>Janet Caldwell</u>

STEP #5 (SENATE CURRICULUM COMMITTEE)
DATE OF OPEN HEARING <u>12-10-96</u>
APPROVED BY SENATE CURRICULUM COMMITTEE (DATE) _____
<input type="checkbox"/> RETURNED TO SPONSOR(S) FOR THE FOLLOWING REASONS: _____ _____

STEP #6 (SENATE)
DATE PRESENTED TO SENATE <u>1/1/97</u> <input type="checkbox"/> APPROVED <input type="checkbox"/> NOT APPROVED
NOTIFICATION TO EXECUTIVE VICE PRESIDENT/PROVOST (DATE) _____
SENATE CURRICULUM COMMITTEE CHAIR SIGNATURE/DATE <u>Ronald J. Gochen 1/1/97</u>

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) 1/31/97

SIGNATURE, EXECUTIVE VICE PRESIDENT/PROVOST [Signature]

REGISTRAR

DATE APPROVED COURSE DESCRIPTION RECEIVED 17 June 97

REGIS TAXONOMY AND COURSE NUMBER ASSIGNED 4901.315

DATE/SIGNATURE OF REGISTRAR 13 F. Kelly

NOTIFICATION FORWARD:

___ SENATE CURRICULUM COMMITTEE CHAIRPERSON

___ DEPARTMENT CHAIRPERSON(S)

___ ACADEMIC DEAN(S)

___ REGISTRAR

___ SPONSOR(S)

COURSE PROPOSAL

PATTERNS IN NATURE II: PROJECTS IN CALCULUS AND PHYSICS

1. Details

a. Course Title: PATTERNS IN NATURE II: PROJECTS IN CALCULUS AND PHYSICS (4901.3xx)

This course follows sequentially from Patterns in Nature I: Visual Geometry. It is, however, an interdisciplinary course to be team taught by both mathematics and physics.

b. Sponsor(s): Janet Caldwell, Mathematics
Karen Magee-Sauer, Chemistry and Physics

c. Credit Hours: 4

d. Course Level: Undergraduate

e. Curricular Effect: This course will be a required upper-level lab course for students in the liberal studies natural sciences program. It integrates the study of mathematics and physics. The course is not acceptable as an elective for either mathematics majors or majors in the physical sciences.

f. Prerequisites: Patterns in Nature I: Visual Geometry

g. Suggested Time and Scale of Implementation: To be offered on a regular basis, beginning in 1996. Initially, this course will be offered on an annual basis; it may be offered more frequently if the demand requires it. Since the course is a lab, it will have a maximum of 24 students.

h. Adequacy of Resources: It is anticipated that the new liberal studies track in the natural sciences will have approximately 20-30 majors each year initially. Thus, one section annually should be adequate. This course should be team taught by both a mathematics and a physics faculty member. In addition, new computer software will be needed.

2. Rationale:

Although most students in the natural sciences track of the liberal studies major will not need to use calculus themselves, they need to be able to understand what it does and how it is used, especially with respect to physics. Thus they need to have a thorough understanding of the essence of calculus, of mathematical modeling techniques, and of applications of calculus in physics. This course will provide that understanding by

developing the theory of calculus through hands-on physics lab projects. Technology (graphing calculators and computers) will be used to perform the computations needed. The specific physics topics selected for this course incorporate the traditional basis for calculus in the physics of Newton as well as more recent studies in the area of spectroscopy, thus permitting students to see how the study of science has changed over time.

3. Essence of the Course

This course actively involves students in developing mathematics and science concepts associated with calculus and physics while de-emphasizing algorithms. Problems arise from physics and are analyzed using mathematical models. Graphing calculators, computers, and physical models are used extensively.

a. Objectives

Students completing this course will be able to:

- use functions to model a variety of problem situations, investigating the properties of these functions through appropriate technologies, including graphing calculators;
- use physical models, charts, graphs, equations, and inequalities to describe real-world relationships;
- use graphs, diagrams, and physical models to interpret and relate the concepts of limit, differentiation, and integration;
- construct concrete examples of finite and infinite sequences and series, relating them to the meaning of approximation of nonterminating decimals and to the approximations of functions;
- apply quantitative techniques to the analysis of problems involving motion and spectra.

b. Topical Outline/Content - The following outline describes the topics to be included in the course; they will most likely not be taught in this order.

1. Problem Solving

- a. Strategies for solving problems
- b. The modelling process
- c. Reading mathematics and physics

2. Models

- a. Circular functions
- b. Vector geometry
- c. Wave functions (e.g., sound, light)
- d. Growth and decay phenomena (e.g., radioactive half-life, nuclear decay)

3. Calculus

- a. Concept of a limit
- b. Differentiation (rates of change, optimization)
- c. Integration (Numerical and algebraic)
- d. Simple differential equations (cooling curves, direction diagrams, numerical methods, growth and decay, carbon dating, area under curve for densities)
- e. Parametric equations
- f. Polynomial approximations

4. Motion

- a. Fundamental concepts
 - i. Velocity and acceleration
 - ii. Vectors and motion in two dimensions
 - iii. Circular motion
 - iv. Projectile motion
 - v. Forces
- b. Newton's Laws of Motion
- c. Conservation Laws (energy, momentum, angular momentum)

5. Spectroscopy

- a. Electromagnetic radiation (visible light, radio waves, x-rays, ultraviolet)
- b. Spectroscopes
- c. Spectrum analysis
- d. Luminescence
- e. Absorption spectra
- f. Applications
 - i. Lasers
 - ii. Chemical analysis
 - iii. Nuclear magnetic resonance imaging
 - iv. Astrophysics (Doppler effect, spectroscopic binaries)
 - v. Mossbauer effect and the docking of space vehicles
 - vi. Nuclear physics

c. Evaluation and Grading

Students will be evaluated on the basis of tests and quizzes as well as projects done in cooperative working groups.

d. Course Evaluation

Initially, formative student evaluations will provide feedback about the course. In addition, students in the liberal studies track in the natural sciences will be surveyed in their senior seminar concerning each of the courses taken in the major.

4. Results of Consultations

Consultations were made with the following faculty:

Dr. Gary Itzkowitz, Chairperson, Department of Mathematics

Dr. Robert Newland, Chairperson, Department of Chemistry and Physics

Dr. Joanne Scott, Biological Sciences

Dr. Eduardo Flores, Chemistry and Physics

Dr. Francis Masat, Mathematics

5. Catalog Description

4901.3xx Patterns in Nature II: Projects in Calculus and Physics

Prerequisites: Patterns in Nature I: Visual Geometry

This laboratory course for students in the natural sciences track of Liberal Studies provides an introduction through physics projects to techniques of mathematical modelling and quantitative reasoning, including the use of vectors, parametric equations, and calculus. Problem situations provide opportunities to investigate motion and spectra concretely. Graphing calculators and computers will be used.