ROWAN COLLEGE
CURRICULUM COMMITTEE

PROPOSAL TITLE: Patterns in Nature I: Visual Geometry 1763.365

1177H

X **UNDERGRADUATE** ___ **GRADUATE** 3 **CREDIT HOURS**

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

DEPARTMENT & TELEPHONE# Mathematics - Ext. 3871

CHECK ONE: X **COURSE** ___ **MINOR PROGRAM** ___ **CONCENTRATION** ___ **SPECIALIZATION**

___ **ACHIEVEMENT CERTIFICATE** ___ **CERTIFICATION PROGRAM** ___ **MAJOR PROGRAM**

STEP #1 (DEPARTMENT)

✓ APPROVED/DATE: 10/13/95

___ NOT APPROVED/DATE:

Larry Horn
DEPT. CURRICULUM CHR.

___ REVIEWED/DATE:

DEPT. CHR.

STEP #2 (RECEIPT)

SCC# 95-96-52

DATE RECEIVED:

I SENATE

OCT 26 1995

RECEIVED

SENATE CURRICULUM CHR.

STEP #3 (SCHOOL)

REVIEWED DATE:- 3/6/96

✓ RECOMMEND TO APPROVE

___ RECOMMEND NOT TO APPROVE

FORWARD FOR OPEN HEARING

___ WITHOUT RESERVATIONS

___ WITH RESERVATIONS

COMMENTS:

SCHOOL COMMITTEE CHR.

STEP #4 (ACADEMIC DEAN)

___ RECOMMEND

___ NOT RECOMMEND

___ CONDITIONALLY RECOMMEND
(SEE COMMENTS)

DATE & SIGNATURE, DEAN OF SCHOOL

COMMENTS:

STEP #5 (SENATE CURRICULUM COMMITTEE)

DATE OF OPEN HEARING 12-10-96

APPROVED BY SENATE CURRICULUM COMMITTEE (DATE) 12/10/96

___ RETURNED TO SPONSOR(S) FOR THE FOLLOWING REASONS:

#6 (SENATE)

DATE PRESENTED TO SENATE 12/11/96 ___ APPROVED ___ NOT APPROVED

NOTIFICATION TO EXECUTIVE VICE PRESIDENT/PROVOST (DATE)

SENATE CURRICULUM COMMITTEE CHAIR SIGNATURE/DATE

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) 11/3/97

SIGN[illegible] VICE PRESIDENT/PROVOST [signature]

REGISTRAR

DATE APPROVED COURSE DESCRIPTION RECEIVED 17 Nov 97

HEGIS TAXONOMY AND COURSE NUMBER ASSIGNED 1703.305

DATE/SIGNATURE OF REGISTRAR [signature]

NOTIFICATION FORWARD:

___SENATE CURRICULUM COMMITTEE CHAIRPERSON

___DEPARTMENT CHAIRPERSON(S)

___ACADEMIC DEAN(S)

___REGISTRAR

___SPONSOR(S)

COURSE PROPOSAL

PATTERNS IN NATURE I: VISUAL GEOMETRY

1. Details

   a. Course Title: Patterns in Nature I: Visual Geometry (1703.3xx)

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

   c. Credit Hours: 3

   d. Course Level: Undergraduate

   e. Curricular Effect: This course will be a required upper-level mathematics course for students in the Liberal Studies natural sciences track. It will initially be offered once a year. It will not be acceptable as an elective for the mathematics major.

   f. Prerequisites: Introduction to Programming, Statistics, Principles of Biology, Chemistry of Everyday Life, Physics of Everyday Life

   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.

   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.

2. Rationale:

This course will provide students in the natural sciences track of Liberal Studies with a thorough understanding of geometry and its connections to the natural sciences by using a variety of experiential teaching methods. Students in this course will draw upon their backgrounds in the sciences and in mathematics as they investigate the geometric concepts inherent in the world around them. This course is a much more advanced course than Introduction to Geometry, employing many of the concepts and techniques of precalculus and building upon the geometry learned in high school. The course is not as theoretical, however, as the Geometry I course which is required of preservice secondary mathematics teachers. This course is also different from the other geometry courses in that it will involve an explicit emphasis on the connections between geometry and science, requiring that students have sufficient backgrounds to recognize and understand these connections. This course will provide sufficient background in geometry for students to be able to read and understand journal articles as well as to teach the content in grades K-8.

3. Essence of the Course

This course will focus upon recent developments in geometry as well as fundamental concepts. Connections between geometry and the natural sciences will be investigated. Teaching methods will stress a visual approach to understanding concepts, making conjectures, and justifying reasoning. Students will use a variety of materials, from construction paper and pipecleaners to videotapes and computer sketching programs. Some proof will be included but will not be emphasized. Students will also be expected to read and analyze journal articles (e.g., *Journal of Recreational Mathematics, Scientific American,* World Wide Web sites such as the University of Minnesota's Geometry Center) independently.

a. Objectives

Students completing this course will be able to:

- use a variety of tools, physical models, and appropriate technology to demonstrate an understanding of geometric concepts and relationships and their use in describing the natural world;

- describe properties and relationships of shape, size, and symmetry in two- and three-dimensional space;

- use rotations, reflections, and translations in two- and three-dimensional space;

- present oral and written arguments to justify conjectures and generalizations based on explorations;

- describe the historical development of Euclidean and non-Euclidean geometries;

- read, understand, and summarize journal articles in geometry.

b. Topical Outline/Content

1. Shape
    a. Polygons
    b. Circles
        i. Robot arms
    c. Plane curves (e.g., cardioids and conic sections)
    d. Three-dimensional solids
    e. Connections to biology; patterns in nature
    f. Rigidity of structures
2. Transformations
    a. Rigid transformations - reflections, rotations, translations
    b. Symmetry
        i. Connections to biology

ii. Crystallography
c. Tessellations
d. Similarity (scaling) transformations
e. Circle-preserving transformations (inversions)

3. Dimension
   a. Measurement - perimeter, area, volume, surface area, star distances
   b. Spatial visualization
   c. Polyhedra
   d. Isometric drawings and perspective views
   e. Fractals and chaos - examples from the sciences
   f. Higher dimensions
   g. Cartography
3. Non-Euclidean Geometries
   a. Finite geometries
      i. Block designs
      ii. Applications to statistics and error-correcting codes
   b. Hyperbolic geometries (e.g., Poincare universe)
   c. Spherical geometry
   d. Relativity and the universe
   e. Historical development

c. Evaluation and Grading

Students in this course will be evaluated on the basis of quizzes and/or tests as well as on oral and written assignments, projects, constructions, and papers. Some work may be undertaken in small groups, and students may be asked to prepare work portfolios.

d. Course Evaluation

Initially, formative student evaluations will provide feedback about the course. Later, the course will be evaluated on a regular basis as one of the offerings of the Department of Mathematics. 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

1703.3xx Patterns in Nature I: Visual Geometry
Prerequisites: Introduction to Programming, Statistics, Principles of Biology, Chemistry of Everyday Life, Physics of Everyday Life

This course for students in the natural sciences track of the Liberal Studies major illustrates the connections between geometry and the natural sciences, using computers, manipulatives, and hands-on models. Geometric concepts covered include properties of two- and three-dimensional shapes, transformations, dimension, and non-Euclidean geometries.