ROWAN UNIVERSITY CURRICULUM PROPOSAL

PROPOSAL TITLE: Introduction to Engineering Optimization

CHECK APPROPRIATE: ✓ UNDERGRADUATE ___ GRADUATE ___ SEMESTER HOURS

SPONSOR(S): Tirupathi R. Chandrupatla and Dept. of Mechanical Engineering Curriculum committee

DEPARTMENT/TELEPHONE # 4632

CHECK ONE: ✓COURSE __MINOR PROGRAM __CONCENTRATION __SPECIALIZATION

__ACHIEVEMENT CERTIFICATE __CERTIFICATION PROGRAM __MAJOR PROGRAM

Step #1 (Department)

✓ Approved (Date) 10/21/97

___ Not Approved (Date)

Dept. Curriculum Chr.

10/21/97
Reviewed (Date)

TRChandrupatla
Dept. Chr.

Step #2 (Receipt)

SCC# 97-98-80

10-22-97
Date Received Senate

Senate Curriculum Chr.

Step #3 (School)

Reviewed Date:_____

✓ Recommend to Approved

___ Recommend NOT to Approve RAD

Forward for Open Hearing:

✓ WITHOUT Reservations

___ WITH Reservations:

Comments:

Robert P. Hesketh
School Committee Chr.

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

Comments:

Dean Signature/Date 10/23/97

Step #5 (Senate Curriculum Committee): Open Hearing Date: _____ Approved by Curriculum Committee Date 2/12/97

Returned to Sponsor(s) for the following reason:

Changes received 1/99

S' # 6 (Senate) Date announced/voted on at Senate 2/12/97 If voted on: ___Approved ___NOT Approved

L orwarded to Executive Vice President/Provost 3/4/97

Senate Curriculum Committee chair Signature/Date: 4/22/99

Step #7 (Executive Vice President/Provost): Date Received _____

___ Approved

___ NOT Approved If no, reasons are as follows:

Student Credit Hours 3

Faculty Load Hours 3

Equalized Credit Hours _____

Official Copy & Approval Sheet Filed (Date) _____

Executive Vice President/Provost Signature C J Mottes

Registrar

Date Approved Course Description Received _____

Hegis Taxonomy and Course Number Assigned [redacted]

Date/Signature of Registrar [illegible]

Notification Forward:

✓ Senate Curriculum Committee Chairperson

✓ Department Chairpersons

✓ Academic Dean(s)

✓ Registrar

_____ Sponsor(s)

TM 3/31/99

Course Proposal

1. Details:

a) Course Title:	Introduction to Engineering Optimization
b) Sponsor:	Dr. Tirupathi R. Chandrupatla and College of Engineering Curriculum Committee
c) Credit Hours:	3 credit hours
d) Course Level:	Senior undergraduate (0901.402)
e) Curricular Effect:	Elective course for chemical, civil, electrical, and mechanical engineering senior undergraduate students
f) Prerequisites:	Math for Engineering Analysis II (1701.335) or equivalent
g) Suggested Time/ Scale of Implementation	One section during fall semesters
h) Resources:	Faculty: Existing faculty can teach this course Library: No library acquisitions will be required Equipment: No laboratory equipment will be required Computers: Computer laboratory access will be required and additional software may be acquired.

2. Rationale:

The proposed course is an additional engineering elective that would supplement the Engineering Curriculum Proposal approved by the College Senate in December 1994. The proposed course is consistent with the establishment of the School of Engineering approved by the Board of Trustees in February 1995.

The course introduces students to the concept of optimization and its applications to various fields of engineering. The course covers both linear and non-linear programming. The course deals with engineering problems in design and analysis.

3. Essence of the Course:

a) Objectives:

Upon completion of the course, the students will be able to

1. Formulate optimization problems by defining the objective function and the problem constraints.
2. Make the choice of the right method for finding the optimum solution.
3. Understand and use linear, non-linear, and discrete optimization concepts.

4. Apply basic computer software to solve optimization problems.

5. Develop and extend the computer source codes for additional capabilities.

b) Topical Outline:

The topics to be covered are listed below. The instructor will supply the students with a syllabus during the first week of classes. The instructor will assess any technology advances in the subject matter prior to the course and make topic changes deemed to be appropriate to maintain the level and currency of instruction.

Fundamental concepts and problem formulation strategies
- Objective function for minimization
- Unconstrained problems
- Origin of the constraints
- Types of constraints
- Engineering problem formulation
- Taylor series
- Gradient and Hessian
- Convexity

One dimensional search
- Sectioning methods
- Polynomial fit methods
- Hybrid methods
- Computer experiments

Unconstrained optimization
- Gradient based methods
- Quasi-Newton methods
- Second order methods
- Applications to problems

Linear programming
- Simplex method
- Interior methods
- Duality
- Sensitivity analysis
- Problem formulation and solution

Constrained optimization
- Karush-Kuhn-Tucker conditions
- Optimality criteria methods

Gradient projection methods
Reduced gradient approach
Method of feasible directions
Exterior and interior penalty methods
Applications to engineering problems

Direct methods of optimization
Algorithms of Hooke and Jeeves, Nelder-Meade, Box
Conjugate directions
Genetic algorithms
Simulated annealing techniques
Computer implementation and engineering problems

Multicriteria optimization
Engineering problems involving multiple objectives
Solution techniques

Integer programming
Branch and bound algorithm
Cutting plane algorithm
Discrete engineering problems and their solution

Design sensitivity analysis
Sensitivity in engineering problems
Interfacing of optimization and finite element analysis
Sensitivity of finite element response

c) Evaluation and Grading Procedure of Students:

Student grades will be determined on the basis of examinations, homework and/or projects, laboratory projects and reports. A course syllabus with stated method of arriving at the final grade, e.g., number of exams, projects homework, percentage of grade, will be distributed to the students during the first week of classes.

d) Course Evaluation:

The proposed course will be evaluated on the basis of student evaluations and curriculum review by appropriate faculty.

4. Results of Consultations:

The proposed course is an additional elective that would supplement the Engineering Curriculum Proposal approved by the Faculty Senate in December 1994. Consultations were submitted with original proposal as specified by the Curriculum Committee. The course ran under the special topics category in Fall 1997.

Catalog Description:

Introduction to Engineering Optimization (0901.402)
Prerequisites: Math for Engineering Analysis II (1701. 335) or equivalent

The formulation and modeling aspects of engineering optimization problems are presented. These steps involve setting up of the objective function to be minimized and the resource and system constraints to be satisfied. Solution techniques using gradient based methods, zero order methods, and penalty techniques are discussed. Formulation and solution of linear programming, non-linear programming, integer and discrete programming problems in engineering are covered. Algorithms are implemented in computer programs for problem solution.