# Rowan University Curriculum Proposal

**Proposal Title:**
Introduction to Finite Element Analysis

**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)
- **__** Review (Date) 10/21/97

**Dept. Curriculum Chair:**

**Step #2 (Receipt)**

- **SCC# 97-98-82**
- **10-22-97** Date Received Senate

**Step #3 (School)**

- **Reviewed Date:**
- **✓** Recommend to Approved
- **__** Recommend NOT to Approve
- **__** Forward for Open Hearing:
- **✓** WITHOUT Reservations
- **__** WITH Reservations:
- **Comments:**

**School Committee Chair:**

## Step #4 (Academic Dean)

- **✓** Recommended
- **__** NOT Recommended
- **__** Conditionally Recommended (See Comments)

**Comments:**

**Dean Signature/Date:**

10/22/97

## Step #5 (Senate Curriculum Committee)

- **Open Hearing Date:**
- **Approved by Curriculum Committee Date:** 1/12/97

**Returned to Sponsor(s) for the following reason:**

**Chair:**

1/12/97

## Step #6 (Senate)

- **Date announced/voted on at Senate:** 1/12/97
- **If voted on:**
- **✓** Approved
- **__** NOT Approved

**Sent to Executive Vice President/Provost:**

**Senate Curriculum Committee chair Signature/Date:**

1/12/97
Step #7 (Executive Vice President/Provost): Date Received __________

___ 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 __________

Registrar

Date Approved Course Description Received __________
Hegis Taxonomy and Course Number Assigned __________
Date/Signature of Registrar __________

Notification Forward:

___ Senate Curriculum Committee Chairperson

___ Department Chairpersons

___ Academic Dean(s)

___ Registrar

___ Sponsor(s)
Course Proposal

1. Details:

   a) Course Title:           Introduction to Finite Element Analysis
   b) Sponsor:               Dr. Tirupathi R. Chandrupatla and College of Engineering
                              Curriculum Committee
   c) Credit Hours:          3 credit hours
   d) Course Level:          Senior undergraduate (0901.401)
   e) Curricular Effect:     Elective course for chemical, civil, electrical, and
                              mechanical engineering undergraduate students
                              Solid Mechanics (0901.272) and Math for
                              Engineering Analysis II (1701.335) or equivalent
   f) Prerequisites:         One section during spring semesters
   g) Suggested Time/Scale of Implementation:
       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 finite element analysis and its
   applications to various fields of engineering. Structural deformation and stress analysis are
   covered. 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 and model structural design problems and solve them using finite
         elements.

      2. Formulate and solve field problems in the areas of potential flow, seepage
         flow, duct flow, heat transfer, and electrical and magnetic fields.

      3. Create finite element meshes, determine nodal loads, and define the boundary
conditions.

4. Apply basic computer software to solve stress and deformation analysis problems.

5. Develop stiffness matrices for various finite elements extending the capabilities of existing software.

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
- Stresses and equilibrium
- Strain-displacement relations
- Stress-strain relations
- Temperature effects
- Potential energy and equilibrium
- Galerkin’s method

One dimensional problems
- Finite element modeling
- Coordinates and shape functions
- Element stiffness for bar element
- Global stiffness
- Treatment of boundary conditions

Trusses
- Plane trusses
- Space trusses

Two dimensional problems
- Finite element modeling
- Constant strain triangle (CST)
- Quadrilateral elements
- Orthotropic materials

Axisymmetric solids
- Triangular quadrilateral elements
- Quadrilateral elements
Problem modeling

Beams and frames
  Beam element
  Two dimensional and three dimensional frames
  Elastic supports
  Problem modeling

Three dimensional problems
  Tetrahedral element
  Hexahedral element
  Frontal method

Scalar field problems
  Steady state heat transfer
  Torsion
  Potential flow, seepage flow, duct flow
  Electric and magnetic fields

Dynamics of structures
  Mass matrices for various elements
  Natural frequency analysis

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.
Catalog Description:

Introduction to Finite Element Analysis (0901.401)
Prerequisites: Solid Mechanics (0901.272), and Math for Engineering Analysis II (1701.335) or equivalent

Fundamental concepts for the development of finite element analysis are introduced. The element stiffness matrices are developed using shape functions defined on the elements. Aspects of global stiffness formation, consideration of boundary conditions, and nodal load calculations are presented. Mesh division and problem modeling considerations are discussed in detail. Topics of scalar field problems and natural frequency analysis are covered. Computer applications are included.