

# ROWAN UNIVERSITY CURRICULUM PROPOSAL

11

**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)	Step #2 (Receipt)	Step #3 (School)
<input checked="" type="checkbox"/> Approved (Date) <u>10/21/97</u> <input type="checkbox"/> Not Approved (Date)  <u>[Signature]</u> Dept. Curriculum Chr.  <u>10/21/97</u> Reviewed (Date)  <u>T.R. Chandrupatla</u> Dept. Chr.	SCC# <u>97-98-82</u>  <u>10-22-97</u> Date Received Senate  <u>[Signature]</u> Senate Curriculum Chr.	Reviewed Date: _____ <input checked="" type="checkbox"/> Recommend to Approved <input type="checkbox"/> Recommend NOT to Approve Forward for Open Hearing: <u>RAD</u> <input checked="" type="checkbox"/> WITHOUT Reservations <input type="checkbox"/> WITH Reservations: Comments:  <u>Robert P. Hesbath</u> School Committee Chr.

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

Comments:

Dean Signature/Date: [Signature] 10/22/97

**Step #5 (Senate Curriculum Committee):** Open Hearing Date: \_\_\_\_\_ Approved by Curriculum Committee Date 10/21/97

Returned to Sponsor(s) for the following reason: changes received 1/99

**Step #6 (Senate)** Date announced/voted on at Senate 12/12/97 if voted on:  Approved     NOT Approved

Forwarded to Executive Vice President/Provost 1/4/99

Senate Curriculum Committee chair Signature/Date: [Signature] 2/15/99

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

Approved

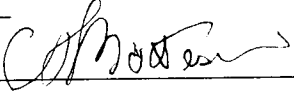
NOT Approved If no, reasons are as follows:

Student Credit Hours 3

Faculty Load Hours 3

Equalized Credit Hours \_\_\_\_\_

Official Copy & Approval Sheet Filed (Date) \_\_\_\_\_

Executive Vice President/Provost Signature 

**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)

TML 3/31/99

## 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
- f) **Prerequisites:** Solid Mechanics (0901.272) and Math for Engineering Analysis II (1701.335) or equivalent
- g) **Suggested Time/  
Scale of Implementation** One section during spring 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 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.