COURSE: ME 160, SEC 01 – Introduction to Finite Element Method

This course is structured to introduce students with the basic theory of Finite Element Analysis and to provide a hands-on experience of its application. The course is taught in a lecture lab mode. There are two meetings per week, the first meeting is utilized to focus on the theory and the second meeting focuses on the application of FEA.

HOURS: LECTURE/LAB: MW 4:30 - 5:45 PM ROOM E 213, Class Code: 23402
CREDIT: 3
PREREQUISITES: ME 130 and CE 112
INSTRUCTOR: Dr. R. B. Agarwal, OFFICE: E 310D
EMAIL: raghu.agarwal@sjsu.edu
PREFERRED CONTACT: email
DEPARTMENT FAX: 924-3995
WEBSITE: www.engr.sjsu.edu/ragarwal (PW for Lecture notes: me160)

OFFICE HOURS: Tuesdays: 2:00 – 4:25 PM
Thursdays: 2:00 – 4:25 PM

Text

Course Goals
1) To learn the basics of finite element modeling and analysis.
2) To learn the theory and characteristics of finite elements that represent engineering structures.
3) To learn and apply FEA solution to problems in mechanical engineering.

Student Learning Objectives
By the end of the course, each student should be able to:
1. Describe the Finite Element Analysis (FEA) procedure
2. Develop stiffness equation for Spring, Beam, and 2-D Solid elements
3. Assemble element stiffness equations in to a global equation
4. Identify and apply boundary conditions to a global structural matrix and reduce it to a solvable form
5. Identify the application and characteristics of Spring, Beam, 2-D solid, and 3-D solid elements
6. Use Pro/ENGINEER to create 3-D models of engineering parts
7. Set up and solve 1-D, 2-D, and 3-D structural problems using Pro/MECHANICA
8. Optimize engineering parts using Pro/MECHANICA
9. Interpret results obtained in Pro/MECHANICA solutions
10. Write a comprehensive project report

**GRADING:**
- Home Work ........... 15%
- Class Participation .... 5%
- Mid-term ............... 30%
- Project ............... 15%
- Final Exam .......... 35%

**NOTE:** Homework assignments must be submitted on or before the deadlines. **No credit will be given for the work submitted after the deadline.**

**MIDTERM EXAM:** Thursday, March 21, 2013
**FINAL EXAM:** Wednesday, May 15, 2013, 14:45 – 17:00

**Course Outline**

<table>
<thead>
<tr>
<th>Topic</th>
<th>Lecture Hours</th>
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</thead>
<tbody>
<tr>
<td>FEA Overview: History; users; concept of FEA</td>
<td>1</td>
</tr>
<tr>
<td>FEA Process and Procedure: Analysis steps, element types, stiffness concept, solution procedure</td>
<td>3</td>
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</tbody>
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**Introduction to the Direct Method** 5
- Formation of stiffness matrix
- Assembly of global matrix
- Stiffness matrix for a spring Element
- Examples of Spring Structures

**Truss Element** 7
- FEA Process
- Transformation Matrix
- Stiffness Matrix
- Examples
- Symmetry Concept

**Beam Element** 6
- FEA Process
- Stiffness Matrix
- Examples

**2-D Plane and 3-D Solid Elements** 5
- FEA Process
- Stiffness Matrix
- Element Equation
- Examples
• Modeling Techniques

**Axisymmetric Element**

- FEA Process
- Stiffness Equation
- Element Equation

Applications – Pro/E and Pro/Mechanica

NOTE

Success in this course is based on the expectation that students will spend, for each unit of credit, a minimum of forty-five hours over the length of the course (normally 3 hours per unit per week with 1 of the hours used for lecture) for instruction or preparation/studying or course related activities including but not limited to internships, labs, clinical practica. Other course structures will have equivalent workload expectations as described in the syllabus.