Department of Mechanical Engineering
MECH 4660/6660 Finite Element Method in Mechanical Design
Fall Term, 2003

Instructor Dale Retallack, Ph.D., P.Eng. Room C 360

Schedule

Classes	MWF	10:35 – 11:25 am	B229
Lab / Tutorial	Tues	2:35 – 5:25 pm	B229/C300

Text Moaveni, Finite Element Analysis, Theory and Application with ANSYS, Prentice Hall, 2nd Ed., 2003, ISBN 0-13-111202-3

Calendar Description

The class deals with the application of the finite element method to stress analysis problems encountered in mechanical design. Introduction to the finite element method is followed by the necessary relationships from linear elasticity, beam and plate theory. Various categories of structural elements are discussed in order of increasing complexity. Stresses in one- and two-dimensional trusses, beams, axisymmetric solids, and plates are considered. A finite element program is introduced and used in the class assignments.

Objectives

1. To develop the skills necessary for the numerical solution of PDE's, whether for scalar-field problems (T, fluid flow, seepage, electric potential, acoustic P, …) or for tensor-field problems (stress-strain), or combinations thereof.
2. To build a basic understanding of how Finite-Element procedures **work** --- solid modeling, materials, nodes & elements, shape functions, elemental stiffness & load matrices, element assembly, loads & boundary conditions, … .
3. To learn to use the tools **safely**, e.g. which elements to use, mesh resolution, loads & BC's, cross-checks, …
4. To learn to use the tools **efficiently & effectively**, e.g. assumptions => dimensions => model complexity, again loads & BC's, graphical capabilities (e.g. contour plots, vector plots, path plots, …) and interpretation of results.

Week-by-Week Outline

[Note that this may change somewhat, as we move along.]

Week	Topic	Text
1.	General Introduction Fundamental Concepts, 1D Structural & Thermal Problems	Chapter 1
2.	Introduction, continued Matrix Algebra (quick) Trusses	Chapter 1 Chapter 2 Chapter 3
3.	Axial Members, Beams & Frames	Chapter 4
4.	1D Elements Analysis of 1D Problems	Chapter 5 Chapter 6
5.	Analysis of 1D Problems, continued 2D Elements	Chapter 6 Chapter 7
6.	2D Elements, continued More ANSYS **MID-TERM TEST**	Chapter 7 Chapter 8

7.	Analysis of 2D Heat Transfer.	Chapter 9
8.	2D Solid Mechanics	Chapter 10
9.	Other 2D Scalar-Field Problems	Chapter 12, and Section 10.1
10.	Analysis of 3D Problems	Chapter 13
11.	Transient Heat Transfer Structural Vibrations Problems	Section 9.5 Chapter 11
12.	Review	

Determination of Grades

	MECH 4660	**MECH 6660**
Assignments	20	15
Extra Assignments/Project		10
Midterm Test	30	30
Final Exam	50	45

The intention is to write the Midterm Test and Final Exam in the Computer Lab; thus, we will be able to include the usual 'written' problems and ANSYS problems as well. You can expect to be asked also to interpret and comment on ANSYS results.

These tests will be open-text + formula sheet (and we'll explain in class what may constitute your formula sheets), and you'll have your computer files accessible to you.

You will be able to bring with you only a basic, non-programming calculator.

Numerical results will be translated into letter grades (A+, A, A-, …) using the standard scheme which appears at www.dal.ca/~engiwww/grades.html .

To obtain credit for the 'Assignment' portions of the grade, a passing grade must be earned in the Test components. If a total of less than 50 % (70 %, for Grad Students) is earned in those Test components, they alone will determine the final result.

A 'Makeup Test' will not be available, except in the case of the Final Exam. If the Midterm Test is missed, for normally-excused reasons, presentation of the appropriate documentation will earn the right to write the Final Exam for enough extra credit to replace the missed Midterm.

Please note that there will be **no** supplemental examination in this class.

Possibilities for Grad Students in MECH 6660

[to be discussed with the group]

A Project related to the individual's graduate research area

Design Problems at ends of Text chapters

Extra Assignment Problems, perhaps with an Extra Quiz related to them

Investigation and Report on aspects of ANSYS a bit beyond the 'regular' class material, e.g. how to deal with :

- modal analysis, in more complex vibrations problems
- further aspects of transient analysis, for Thermal and/or stress-strain problems
- multiphysics problems, e.g. thermal + mechanical stresses, (non-ideal) fluid flow + thermal, …

Investigation and Report (Seminar ?) on FEMLAB