EML5526 Finite Element Analysis

Basic Information

Catalog information: Credit 3, Prerequisite: EML4500, EGM 3520, EGM 4344
Instructor: Prof. Nam Ho Kim, MAEA 210, Phone: 846-0665, Email: nkim@ufl.edu
Prof. Raphael T. Haftka, MAEA 220, Phone: 392-9595, Email: Haftka@ufl.edu
Teaching assistant: Vijay Jagdale, NEB 235, Phone: 392-2524, vjagdale@ufl.edu, 4th period (TTh)
Class time and location: MWF 6th period (12:50 – 1:40 PM) in 102 NEB
Office hours: Instructor: MWF 5th(11:45AM – 12:35PM), Teaching Assistant: TTh 4th(10:40-11:30)
Text books: "Concepts and Applications of Finite Element Analysis" 4th Ed., by R. B. Cook, John Wiley & Sons (Required)

Course Objectives and Outcomes

Catalog description: Fundamentals of finite element analysis including, discrete system analysis, steady state and transient heat transfer analysis, static and dynamic analysis of structures. Modeling, analysis and design using FEA software

The objective of the course is to teach the fundamentals of finite element method with emphasize on the underlying theory, assumption, and modeling issues as well as providing hands on experience using finite element software to model, analyze and design systems of mechanical and aerospace engineers.

Program Objectives and Outcomes

Program objectives supported by this course include educating students to:
1. Comprehend quantitative and analytical methods
2. Understand and perform engineering analysis of machine systems
3. Apply mathematics, science and engineering to design
4. Communicate ideas graphically and in writing
5. Recognize the need for, and engage in life long learning

Course Assignment

Homework: assignments and reading materials are posted on the class website at http://www.mae.ufl.edu/nkim/eml5526. Late homework is not acceptable.

Examinations: There will be two examinations worth 40% of the final grade. Tentative Exam Schedule: Exam1: February 24th, Exam2: April 21th

Projects: These are design or analysis problem involving the use of finite element software. Here the students are encouraged to learn certain aspects of the software on their own as an exercise in self-education and life long learning. Projects must be submitted on time in class. Late projects submitted by the next class will receive 90% credit. Projects received later than that will not be accepted without medical or other valid reasons.

Grading: Examinations: 40%, Projects: 40%, Homework+Quiz: 20%.

Other Course Information

Attendance: is very important since some of the material covered in class is not in the textbooks. If you have to miss a class, arrange to get notes from a classmate and meet with TA or instructor during office hours to clarify any material you could not understand.

Finite Element Software: Many homework and projects will be carried out using commercial finite element software Abaqus. Students are expected to download and install the software on their personal computer. The software can be downloaded from http://campus.3ds.com/simulia/freese

Academic honesty: All students admitted to the University of Florida have signed a statement of academic honesty committing themselves to be honest in all academic work and understanding that failure to comply with this commitment will result in disciplinary action.

This statement is reminder to uphold your obligation as a student at the University of Florida and to be honest in all work submitted and exams taken in this class and all others.

Date	Course content	Reading Assignment
1/6 W	Introduction to finite element analysis	Chapter 1
1/8 F	1-D Bar element, assembly, applying boundary conditions	2.1, 2.2, 2.5, 2.7
1/11 M	Stress, strain, stiffness matrix, plane truss	2.4, 2.6
1/13 W	Space truss, sparsity, Mechanical load, stress	2.8, 2.9
1/15 F	Thermal strain, stress; modeling symmetry	2.10, 2.11
1/18 M	M. L. King Holiday, No class	
1/20 W	Introduction to Abaqus	
1/22 F	Beam theory	2.3, 4.1, 4.2
1/25 M	Potential energy	4.3, 4.4
1/27 W	Rayleigh-Ritz method, FE interpolation	4.5, 4.6
1/29 F	FE equation for beam, distributed load	4.8
2/1 M	Plane frame, convergence	4.9
2/3 W	FE analysis of beam using Abaqus	
2/5 F	CST, LST elements	3.1, 3.2, 3.3, 3.4, 3.5
2/8 M	Q4, Q8, Q9 elements	3.6, 3.7
2/10 W	Project 1 assignment	
2/12 F	Numerical integration	3.9
2/15 M	Drilling DOF, incompatible modes, reduced integration	3.10, 3.11
2/17 W	Stress calculation	3.12
2/19 F	FE analysis of stress concentration	
2/22 M	Review of exam	
2/24 W	In term exam	
2/26 F	Galerkin Method in one dimension	5.1,5.3
3/1 M	Galerkin Method in Two dimensions and mixed formulations	5.5, 5.6.
3/3 W	Review of formulation techniques.	Project 1 due
3/5 F	Isoparametric elements	6.1,6.2
3/8 M	Spring break, no class	
3/10 W	Spring break, no class	
3/12 F	Spring break, no class	
3/15 M	Quadrature and Q8,Q9 elements	6.3, 6.4
3/17 W	Incompatible modes, and static condensation	6.6, 6.7
3/19 F	Stress calculations	6.10, 6.11
3/22 M	Validity of isoparameteric elements and patch test	6.11, 6.12.
3/24 W	Review of Chapter 6.	
3/26 F	Isoparametric triangles and tetrahedral	7.1,7.2
3/29 M	Coordinate transformation	8.1, 8.2, 8.3
3/31 W	Connecting dissimilar elements and fracture mechanics	8.5, 8.7
4/2 F	Reanalysis.	8.9
4/5 M	Ill-conditioning and the condition number	9.1-9.3
4/7 W	Decay test, residual and convergence rate	9.4-9.6
4/9 F	Multi-mesh extrapolation	9.7
4/12 M	Mesh revision and gradient recovery	9.8, 9.9
4/14 W	Adaptive meshing	9.9, 9.11
4/16 F	Review of Chapter 9	
4/19 M	Review for second in-term exam.	
4/21 W	Second in-term exam.	