Syllabus for

MECH 4326: Applied Finite Element Analysis

Fall 2016

Overview

This 3 credit hour class is intended to provide the students with an introduction to the theory, skills, and nomenclature to confidently perform linear elastic and basic dynamic finite element analysis for mechanical engineering systems and structures. This will be done with exposure to the basic theory of finite element analysis with hands-on applications solved using Matlab, MSC.Nastran, and Altair Hypermesh. This is not a class to teach you how to use a particular software.

Course Information

Instructor: Dr. Jack Chessa
Email: jfchessa@utep.edu
Office Hours: W 1:30-4:00 pm, email, IM, blackboard or by appointment.
Office: A118

Textbook: "A First Course in the Finite Element Method'', 6th edition, by Daryl L. Logan
Prerequisites: Mechanical Design, MECH 3334
Meeting Times: T,TH 12:00-1:50 am, LART 323
Software: You are expected to have access to the following software: Matlab, MSC.Nastran, and Altair Hyperworks (available on ETC FTP site http://etc.utep.edu/software/repository.htm see http://etc.utep.edu/software/repository.htm for installation instructions). You should not use MyDesktop or some other virtual connection. These are typically unreliable. Issues with MyDesktop will not be considered a valid excuse for not completing homework,

Course Objectives

At the end of this class the typical students should be well prepared in the following areas:

1. Formulate assemble and solve simple finite element problems by hand
2. Understand the finite element interpolation and how it is used to model elasticity problems
3. Understand the formulation of the following finite elements: bar, truss, beam, CST, LST and Quad4 2D elements, solid and shell elements

4. Understand how various finite elements converge and how to test for the convergence
5. Understand the basic elasticity partial differential equations and the 2D simplifications of plane stress, plane strain and axisymmetric
6. How to choose appropriate boundary conditions
7. Modeling errors and basic element deficiencies
8. Modal and dynamic response analysis
9. Heat conduction

Course Policies

Grading: The grade in this class will be based on 1) three exams, and a few unannounced quizzes during the semester, 2) a final project and on 3) graded homework assignments that will be randomly collected. The grade will be computed as follows:

$$\text{Final Score} = 0.75\ \text{Exams} + 0.10\ \text{Project} + 0.15\ \text{Homework}$$

There is no curve, dropping of exams, or room for negotiation on this part.

The letter grade that will be assigned is given as follows:

$$88 \le A \le 100$$
$$75 \le B < 88$$
$$62 \le C < 75$$
$$50 \le D < 62$$
$$F < 50$$

Exams: The exams will be announced at least one week in advance so that there is no excuse for missing an exam. ***There will be no make-up exams given!*** Also, if you show up to an exam after the exam has started ***you will not be allowed to take the exam.***

Homework: Homework will be assigned at each lecture and due the typically at the next lecture. I will not grade every homework, but I will randomly ask to grade some homework assignments. That means you need to bring the homework to class in a manner that is acceptable to be handed in at the beginning of the lecture that is due. Please do not come in late to class to hand them in – they will not be accepted. ***Also, homework is expected to be neatly done. I reserve the right not to grade any homework that I am not able to follow***. Solutions will be posted after the class when the assignment is due.

Computational Assignments: Several homework problems will involve using computer programs in the solution. I will post an example of how to hand these types of problems in. Again I will not grade computational homework that is not in an appropriate form. The most important part of a computational assignment is the analysis done on the results or the post-processing. I do not want to just see the print out from Nastran! Typically these assignments should be typed up.

Readings: I do not explicitly cover everything that is in the text, but that does not mean you are not responsible for the material. Each lecture I will state what sections I am covering and you are to read those outside of class. I try to lecture so that I supplement the text not simply recite it.

YouTube: I have posted several videos of solutions to problems on YouTube as well as additional lecture material that are meant to supplement your understanding of the material in this class or to fill in any background that might be missing***. This material is not optional it is assumed that you will go through this as well.***

Blackboard: We will use Blackboard in this class to assign homework as well as posting additional materials. Also, I highly encourage you to use the discussion boards. I check these daily and this is probably one of the better ways to get a question answered. I would like students to respond to others questions on the discussion board. I will also try to keep an up-to-date list of what lectures correspond to what sections in the book.

Attendance: Attendance is expected and required. We will sometimes take attendance, and you do run the risk of missing a quiz if you are absent or late. If you are attending a conference or academic competition you need to see me first for approval. Typically, if you are not presenting any work or directly in the competition I will not accept this as a valid excuse or missing class.

Academic Dishonesty: If any academic dishonesty is suspected, the student will be referred to the Office of Student Life. This includes copying during an exam, receiving outside help, etc. as well as copying Nastran and Matlab input files. If you are unsure about what constitutes academic dishonesty please consult the following site:

http://studentaffairs.utep.edu/Default.aspx?tabid=4386

Students with Special Needs: Students with disabilities or special needs, including both permanent disabilities (including learning disabilities, Attention Deficit Disorder, visual, mobility and hearing impairments, psychological disabilities, and chronic systemic disorders) as well as some temporary medical conditions (e.g. a broken arm), are encouraged to see the UTEP Disabled Student Services Office (DSSO) located at Union East Room 106 or contact them at (915) 747-5148 or at dss@utep.edu.

Topics covered:

- The general finite element approach
- Displacement method
- Energy method
- 1D spring, rod elements
- 2D and 3D truss elements
- 1D beam and 2D and 3D frame elements
- Plane stress and plane strain elements
- Isoparametric elements
- 3D stress elements
- Plate and shell elements
- Structural dynamics and time-dependent problems

In addition, you will learn the following computational skills:

- Programming and solving simple finite element problems in Matlab
- Writing ASCII input files for Nastran
- Use and formulation of various Nastran
- Preprocessing with Altair Hypermesh