

# Syllabus for MECH 4326: Applied Finite Element Analysis Fall 2019

## Overview

This 3 credit hour class is intended to provide the students with an introduction to the theory, skills, and nomenclature to confidently, and intelligently, 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 particular software.

## Course Information

**CRN:16989**

**Instructor:** Dr. Methaq Abed

**Email:** msabed@utep.edu

**Office Hours:**(10:30-11:30) MTWR, and welcome any time I am available in my office.

**Office:** Engineering Annex, A104

**Textbook:** "A First Course in the Finite Element Method", 6th edition, by Daryl L. Logan

**Prerequisites:** MECH 3334& MECH 2351

**Location:** College of Business Admin. 323

**Meeting Time:** 1:30 to 2:50 pm MW

**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> installation instructions are here as well). 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:

- Formulate assemble and solve simple finite element problems by hand
- Understand the finite element interpolation and how it is used to model elasticity problems
- Understand the formulation of the following finite elements: bar, truss, beam, CST, LST and Quad4 2D elements, solid and shell elements
- Understand how various finite elements converge and how to test for the convergence
- Understand the basic elasticity partial differential equations and the 2D simplifications of plane stress, plane strain and axisymmetric

- How to choose appropriate boundary conditions
- Modeling errors and basic element deficiencies

## **Course Policies**

### ***Grading:***

- 1) Three exams will be given during the semester.
- 2) Final project
- 3) Homework assignments will be randomly collected and graded. A few unannounced quizzes during the semester
- 4) Attendance will be taken through Top Hat

The grade will be computed as follows:

$$\text{Final Score} = 50\% \text{ Exams} + 20\% \text{ Project} + 10\% \text{ Homework} + 20\% \text{ (Attendance and class Assignment)}$$

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:

$$88 \leq A \leq 100$$

$$75 \leq B < 88$$

$$62 \leq C < 75$$

$$50 \leq D < 62$$

$$F < 50$$

***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!*** If you miss an exam with reasonable justification, your grade will be based on three exams. Also, if you show up for an exam after the exam has started, you ***will not be allowed to take the exam.***

***Projects:*** There will be a group project given in the semester. This project is of such a scope that it will take a few weeks to complete. Typically, they will involve using FEA as a design tool and then involve design iteration.

***Homework and quizzes:*** Homework will be assigned at the end of each chapter. 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.*

Also, there will occasionally be an in-class quiz based on the homework. Very possibly exactly a problem or part of a problem from the homework. Also, as discussed in the next section, there will be problems that you will solve in class that will be graded through Top Hat ® and count to your grade.

## **Course Delivery**

This class will be delivered in a partially “flipped” modality. This means that much of the typical lecture material will be posted online, and it is expected that you view/read/digest this material before the lecture that it is due. The class time will be reserved for more active learning exercises such as solving problems and performing calculations. You will be graded on your efforts in class as a quiz grade.

So, it is essential that you come to class 1) with the assigned reading and materials covered, 2) a laptop with Matlab and Nastran installed to do the in-class assignments, and 3) a device with Top Hat ® installed.

**Top Hat:** We will be using the Top Hat ([www.tophat.com](http://www.tophat.com)) classroom response system in class. You will be able to submit answers to in-class questions using Apple or Android smartphones and tablets, laptops, or via text message (SMS).

You can visit <http://tinyurl.com/THStudentRegistration> for the Student Quick Start Guide, which outlines how you will register for a Top Hat account, as well as providing a brief overview to get you up and running on the system. An email invitation will also be sent to your email account (if you don't receive this email, you can register by visiting our direct Top Hat course URL: <https://app.tophat.com/e/398785>

**Course ID:** 398785

Top Hat will require a subscription. There are three options to choose from:

- \$24 for 4 months of unlimited access
- \$36 for 12 months of unlimited access
- \$72 for lifetime student access

**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.

Nastran input files will be checked to see that they execute and give results. Also, some of the in-class exercises will involve using Nastran. It is essential that you gain some experience in using this type of finite element program in a finite element class.

**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 that 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.***

**Attendance:** Attendance is expected and required. Attendance will be taken using Top Hat ® daily.

**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](mailto: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

## **Departmental Policy**

### **Academic Honesty**

During exams and quizzes, you are not allowed to use any form of wifi-enabled electronic device, including cell phones or other electronic communication devices or methods (wristwatches, earbuds, etc.). No wristwatch or another electronic device may be worn.

No electronic version of the book, loose paper print-outs of the book or extra sheets of paper of any kind is allowed unless explicitly mentioned in writing by the instructor. As a part of the zero-tolerance policy, if you have a cell phone or other electronic device capable of communication on your person; or if any proctor sees or hears any electronic device during the exam or if you share your work with someone else, you will be reported to the proper authorities, and you may receive a zero on the exam and an F in the class. Other actions, including suspension, may also be perused.

If you have a disability that requires the use of an electronic device during exams, you must have a letter of accommodation from the Center for Accommodations and Support Services (CASS). This accommodation must be coordinated in advance with the instructor.

During exams, you will not be allowed to leave the examination room until you complete the exam. This includes restroom breaks. Students with disabilities must have a letter of accommodation and coordinate this in advance with the instructor.

Instructors and/or proctors may record and/or use their personal cell phones to document activity during the exam. Recording devices may also be located at various locations in the room and may be out of sight of the students. These recordings will be managed according to the UTEP approved regulations for such media.

If you are suspected of scholastic dishonesty, you may not be directly confronted about your conduct by the instructor or proctor. You will, however, be reported to the Office of Student Conduct and Conflict Resolution (OSCCR) and your exam will not be admissible. Your grade in the class may not be available until OSCCR makes a final ruling; this may adversely impact your ability to enroll in other classes.

If you arrive more than 15 minutes late to an exam, you will not be allowed to enter the examination room.

There will be no makeup exams administered. If you have a university-approved excuse, your instructor will have a process for determining how to handle the missing grade outlined in the syllabus. However, no makeup exams will be given.

If you miss more than one exam, the instructor may choose to drop you from the class administratively. This may adversely impact a visa and financial aid.

No food or drinks will be allowed in the examination room.

Departmental policy allows for the use of assigned seats. All students must present their UTEP issued ID prior to and during every exam and may be required to sign in. Not having a UTEP issued ID when asked will result in forfeiture of the exam.

Scholastic dishonesty on homework, lab assignments, and all other class assignments will be held to the same standards and requirements of academic honesty as quizzes and exams.

### **Class Attendance Policy**

Attendance is mandatory. Anyone with 5 or more absences will be dropped from the class. A drop for not attending will count toward the State Allowed Six-Drop Limit. If you are failing the class at the time of the drop, you may also be given a WF designation. Be advised that a drop could adversely impact visa status, financial aid, and other programs.

As per UTEP rules, you may be asked to show a UTEP ID at any time during class. Anyone who is present and not registered in the class will be subject to disciplinary action unless the instructor gives prior approval.

### **Excused Absence for Exams**

The UTEP catalog allows Exam Absence to be excused ONLY for University-Recognized Activities and very specific other situations. Medical absence is NOT allowed in the UTEP catalog. For consistency with the catalog, students will NOT be excused from exams due to illness.

### **Harassment Policy**

The department has a zero-tolerance policy for harassment. Engagement in any behavior considered harassment would be reported to the proper authorities. In addition to generally understood forms of harassment, the department also treats the following behavior as harassment:

- Repeated emails and/or calls regarding subjects that have already been addressed. Once a decision has been made, or a question answered, a student who continues to ask the same question will be given a warning by the recipient of the email/call. If the student continues, the behavior will be reported. Questions that seek understanding of course material are not harassment, but repeated questions about a grade or an administrative decision are.
- Grades are NOT negotiable, ever. If you believe a grading mistake has been made, you must follow the process described in the UTEP catalog. Any request for a grade elevation that is NOT based on a mistake is considered harassment and will be reported immediately.
- Remaining in an office after the occupant requests you leave is considered harassment and potentially threatening. You will be reported immediately without warning and depending on the severity, may be reported to law enforcement.
- Similar behavior towards department staff and student advisors will also be treated as harassment, including persistent phone calls, emails, and badgering. Department staff and student advisors are there to help students and should be treated with due respect.