CE 5305: Advanced Structural Analysis
Department of Civil Engineering

General Information

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Meeting Time and Location: Tuesday/Thursday: Classroom Building C304 from 4:30PM - 5:50PM

Final Exam: Tuesday May 12, 2020 from 4:00PM - 6:45PM

Course Description: From the university course catalog:

> Linear and nonlinear analysis of structural systems; plastic analysis; introduction to structural stability; and computational aspects of linear and nonlinear structural analysis.

My description:

> A study of structural forms, components, actions, and responses stemming from various loading scenarios including both classical and computer solutions

Class Approach: This course will pick up where Structural Analysis left off, focusing first on traditional methods of solving structures. While the typical practicing structural engineer does not necessarily use these methods on daily basis, I believe it is critical for young engineers to learn them. I am not alone in this sentiment. William Baker, the engineer behind the Burj Khalifa said the following, when asked about structural engineering education:

> *"I would put more emphasis on the theory of structures, engineering mechanics, and the behavior of materials: the true technology of our discipline. These are things that will not change unless you invent new materials. A building code has the shelf life of a banana: it's going to change and it's going to morph into something different. However, the underlying physics will stay the same. What is the use of the future structural engineer? If you go back a long time, you had to understand theory because you could not calculate very much. Today, we're in a computational age where we use a tremendous amount of brain power to manipulate the "box". In the future, computation will be so trivial, where it almost becomes unimportant, but the theory will be the paramount thing that the engineer will bring to design.*

We will complement traditional approaches with approximate methods and software approaches where appropriate. The overarching goal is to develop your skills in three critical areas – approximate methods, comprehensive hand calculations, and software approaches. Each of these tools has a role for practicing engineers, and none can exist without the others.

Textbook:

Required:

McGuire, W., Gallagher, R., and Ziemian, R. "Matrix Structural Analysis" 2nd Edition (2000) – Provided in PDF on Blackboard

Referenced:

Weaver, W. and Gere, J. "Matrix Algebra for Engineers" 1st edition (1965)

Weaver, W. and Gere, J. "Matrix Analysis of Framed Structures" 2nd Edition

Hibbeler, R.C. "Structural Analysis" 10th Edition (2018)

Leet, K., Uang, C., and Gilbert, A. "Fundamentals of Structural Analysis" 5th Edition (2018)

White, R., Gergely, P., and Sexsmith, R. "Structural Engineering: Combined Edition" 1st Edition (1972)

Wang, C. "Statically Indeterminate Structures" 1st Edition (1953)

Course Objectives:

By the end of this course you should be able to:

1. Solve statically indeterminate structures using the force method
2. Solve statically indeterminate structures using the displacement method
3. Solve complex structural analysis problems using approximate methods
4. Develop element stiffness matrices
5. Develop a global stiffness matrix and solve statically indeterminate structures using matrix methods
6. Develop an understanding of current structural engineering practice
7. Generate finite element model and interpret results of structural analysis software

Class Policies

Honor Code:

Students are expected to adhere to the Honor Code of the Department of Civil Engineering, which can be found here (http://ce.utep.edu/honorcode.htm). Instances of suspected cheating or other violations of the Honor Code will be handled according to the procedures in the UTEP Handbook of Procedures.

Attendance Policy:

I do not take attendance during class. Your work is your responsibility, and you make the decision to show up in person or not.

Neatness Policy:

Part of being an engineer is executing tasks in a neat, understandable and repeatable manner. This is a critical aspect of engineering education that is often overlooked. In this class, I ask that you do the following:

- Complete homework assignments on engineering paper (available in the bookstore or on Amazon). **Loose-leaf paper is not permitted.** Any work submitted on paper that is not engineering paper will be deducted 25%.
- Use sharp pencils and a straight-edge for your work. Write precisely and neatly.
- Include your name on every page of your homework.
- Number, title and date the pages of your homework.
- Clearly sketch out any diagrams with labels as required.
- Box answers so they can be readily identified.
- List any external references used in the homework (i.e., textbook tables)
- Make a clean digital copy for submission

Group Work Policy:

Working in groups is encouraged for homework assignments, but everyone must submit their own work. Blatant copying is not permitted and both the copier and the person who provided their work to be copied will lose credit for the assignment.

Computer Policy:

We will be writing code in Matlab throughout the term to conduct structural analysis. I am not a prolific coder, and neither are you (most likely). The goal is to get some exposure to the mechanics of how structural analysis software work, and to give you an idea of how

When you need to use software, it will be clearly assigned. You can feel free to check your solutions with software. Here are your options for software currently.

- STAADPro – part of the Bentley suite of software and available for installation on your laptop through ETC
- RISA2D – Should be available through ETC
- Strand7 – I have five licenses for this software available on the network that you may use.

- OpenSees – An open-source tool for solving responses of structures to earthquake. It can be integrated into Python scripts, run on Amazon-EC2 in the cloud, and is generally a flexible and powerful tool, but with a steep learning curve.

Calculator Policy: Only NCEES approved calculators will be permitted, as these are what is allowed for the Fundamentals of Engineering exam. Visit the NCEES website (http://ncees.org/exams/calculator/) for more information. No phones.

Coursework and Grading Expectations

Grading: Grade Breakdown:

Exams:	25% for Mid-term
	25% for Final Exam
Quizzes:	25%
Homework:	25%

Final Grade Thresholds:
$A \geq 89.5$
$89.5 > B \geq 79.5$
$79.5 > C \geq 69.5$
$69.5 > D \geq 59.5$
$59.5 > F$

Exams: Exams will be in-class and closed book. I make the exam questions up myself, and do not reuse questions. Makeup exams are only provided after **advance** discussion with me. If you miss an exam due to unexpected circumstances (e.g., car crash, family emergency, etc.), notify me immediately and we will discuss options.
Extended exams (longer than the allotted class period) are only provided through the Center for Accommodations and Support Services (https://www.utep.edu/student-affairs/cass). This includes exceptions that result from acute events that occur throughout the term.

Quizzes: Quizzes will be included at the start of class for the purpose of making sure you stay sharp with structural analysis. They can be about what we are covering in class or older structural topics. I am not obligated to announce them in advance. If you miss class, you miss the quiz.

Homework: Homework will primarily be solving problems either using approximate methods, full structural calculations, or with software. Homework will be due at the start of class. See the neatness policy for more information.