CEE 6501 Syllabus

Matrix Structural Analysis, Section A, 3 Credits

Class Meetings: Tuesdays and Thursdays, 12:30-1:45, ES&T L1175

Mode of Instruction: Hybrid. The class instruction will be in a hybrid "touch point" mode. Lectures will be delivered asynchronously (streamed on-line and made available through Canvas). We will meet at the classroom for discussions and work on assignments in a flipped classroom format, ***with protections and social distancing***. Attendance at these classroom meetings is strongly encouraged. A schedule of the in-class meetings will be posted prior to the start of the second week of classes.

Students interested in taking the class fully remotely are allowed to do so. No formal justification is needed. An e-mail to me requesting permission to attend the class remotely is enough.

Instructor Information

Instructor	**Email & Phone contact info**	**Virtual Office Hours**
Prof. Don White	dwhite@ce.gatech.edu 678-895-5451	MW 3:00-4:00 via link provided under Canvas CEE-6501-A/BlueJeans
Teaching Assistant	**Email**	**Virtual Office Hours**
Mr. Ajit Kamath	ajit.kamath@gatech.edu	T & Th 4:00-5:00

General Information

Description

This course provides the student with a broad understanding of the principles of matrix structural analysis and its efficient computational implementation. The student will be well versed on matrix methods for beams, plane and space trusses, grids, and plane and space frames. The course also emphasizes a basic introduction to nonlinear structural analysis, to the finite element method, and to other numerical structural analysis techniques. These methods are important for the student to have a command of, since they are becoming more and more commonplace and important in modern structural engineering practice.

The course will be taught in a hybrid touch-points format, where course concepts are presented asynchronously in streamed lectures (available at the Modules page on Canvas). Prior to viewing the recorded materials, students will go to Canvas/Modules to download partially completed "lecture shells" to annotate while viewing the lectures. Students will be expected to view course content on their own time, and can access materials as often as they wish. Students will be required to view recorded lectures and study selected materials during each

week, as listed on the Canvas/Modules page. This time commitment will be factored in to the assignment of other out-of-class work.

The in-person class sessions will focus on problem solving and reinforcement of key concepts from the recorded and assigned instruction materials. Class meetings will focus on advice and assistance with the assigned Coursework Exercises, working additional examples and other reinforcement of concepts from the asynchronous lectures.

Pre- &/or Co-Requisites

CEE 4550, Structural Analysis II or equivalent, or consent of instructor

If you have had little experience with MATLAB, there is a host of tutorial materials online, under the Help/Matlab/Get Started with MATLAB tab within Matlab. Much of our focus will be to refresh and/or ensure that you are reasonably proficient with the basics of Matlab programming during the first several weeks of the term, so that you can progress well throughout the term.

Course Goals and Learning Outcomes

Upon successful completion of this course, you should be able to:

(1) Understand the architecture of software commonly employed for the linear and nonlinear analysis of frame structures, with particular emphasis on computational efficiency, and evaluation of correctness.
(2) Evaluate and compare different analytical and finite element based formulations for beam and frame elements, including their relative merits.
(3) Understand the important attributes of different methods for solution of large systems of equations.
(4) Effectively and properly apply various types of modeling procedures including member releases, solving for the effects of support displacements, response to temperature loading, analyzing forces caused by fabrication errors, pretensioning, and/or designed lack-of-fit effects, analyzing for construction sequence effects, consideration of member shear deformations, and consideration of connection and joint responses.
(5) Implement, test and apply basic geometric and material nonlinear frame analysis capabilities.

Calendar

Attendance at classroom meetings is strongly encouraged. If you are potentially sick, or if you are uncomfortable with coming to class because of any health-related concerns, do not come to class. Students taking the class sessions remotely, or who cannot attend for other reasons, can connect to the live class sessions via the link provided under Canvas CEE-6501-A/BlueJeans.

Course Requirements & Grading

Homework Assignments, Fundamental "hand" calculations, discussion, etc. tentatively four assignments	16 %
Programming Assignments, building basic proficiency with topics discussed, tentatively four assignments, some coupling with the "hand" calculations	32 %
Mid-term Exam, October 23	26 %
Course project (team based), nonlinear frame analysis, due Dec. 7 (noon), individual online wrap-up meetings with project teams during final exam period, Dec. 8 (11:20 – 2:10)	26 %

All "hand" assignments are to be scanned and submitted as a pdf file. If you do not have a flatbed scanner, phone apps are available that permit generation a pdf file from photos of your work. All MATLAB assignments should be submitted as a zipped folder containing your MATLAB files and other related files per the assignment.

Solutions to the assignments will be posted under Canvas CEE-6501-A/Modules one day after the due date. A 10 % penalty will be applied to work submitted late. A 50 % penalty will be applied to work submitted more than one day late. These penalties may be waived given a valid excuse.

Your submitted "hand" work must be sufficiently neat and organized according to typical expected engineering design office practices:

- List given information, and state assumptions where appropriate.
- List what is being solved for.
- Don't write overly small.
- Use the whole page width.
- Leave plenty of white space.
- Highlight intermediate and final answers.
- Don't worry about your solution "wandering" toward the answer, e.g., there isn't any need to work out the solution on scrap paper, then reorganize and write a "formal" solution. Let your submission show your thought process in working through the solution.

Up to a 20 % deduction in grade may be taken for submissions that deviate significantly from these practices.

Programming assignments should follow practices of good programming style, including:

- Usage of mnemonic variable names.
- Avoidance of undue code repetition.
- Abstraction and isolation into functions and scripts having clear purpose, with clearly defined inputs and outputs.

A makeup mid-term exam will be given only in EXCEPTIONAL circumstances.

The class final project will be team based, teams of two to three students. Students will be allowed to self-select teammates. I will be available to assist you in forming teams. You may request to work the final project individually, if preferred or necessary.

If you are taking the class remotely, and in a distant time zone, you must notify me as to the time you would like to start the mid-term exam.

Grading Scale

Your final grade will be assigned as a letter grade according to the following scale:

A 85-100%
B 75-85%
C 65-75%
D 55-65%
F 0-55%

If you are close to a letter grade boundary at the completion of the term, class participation (contributing to discussions and/or being attentive with questions throughout the term, regular on-time and complete submittals of Coursework Exercises) and special circumstances (e.g., one or a few low grades due to special circumstances) will be considered in lowering a boundary to elevate you one letter grade.

According to policy, grades at Georgia Tech are interpreted as follows:

A Excellent (4 quality points per credit hour)
B Good (3 quality points per credit hour)
C Satisfactory (2 quality points per credit hour)
D Passing (1 quality point per credit hour)
F Failure (0 quality points per credit hour)

See http://registrar.gatech.edu/info/grading-system for more information about the grading system at Georgia Tech.]

Extra Credit Opportunities

No extra credit opportunities are available in this class. Please focus on the doing your best on each of the assignments throughout the term.

Course Materials

Course Website and Other Classroom Management Tools

We will using Canvas (https://gatech.instructure.com/) for all course management activities.

Canvas requires a login with your GT ID and password. For 24/7 assistance with Canvas, please contact the Canvas Help Desk at (877) 259-8498 or via email at support@instructure.com and one of the team members will respond to your needs.

The key specific tools we will be using on Canvas are:

- **Modules** – A running outline of the content for each week of the course will be maintained on the modules page.
- **Assignments** – The major communications with all course assignments will be via the Canvas Assignments page for the submission of your written work on Coursework Exercises, Quizzes and the Final exam. Links to all the assignments will be provided on the Modules page.
- **Piazza** – Piazza is an excellent online tool for general Q&A, forum discussions, and announcements. Please use Piazza (rather than e-mail) to send your questions. You can post anonymously if you prefer. You will be auto-registered in Piazza.
- **Media Gallery** – The class lectures be housed in your Media Gallery inside Canvas. However, links to all of the streamed lectures will be provided on the Modules page.
- **BlueJeans** – BlueJeans is a simple online meeting tool we will use for virtual office hours and any virtual meetings. To use BlueJeans, simply click on the BlueJeans button in Canvas.

Course Texts

Kassimali, A. (2012). *Matrix Analysis of Structures*, 2nd Edition, Cengage Learning.

McGuire, W., Gallagher, R.H. and Ziemian, R.E. (2000), *Matrix Structural Analysis*, 2nd Edition, Wiley (e-version available at no cost from www.mastan2.com).

Software

Information about downloading a standalone version of MATLAB under the Georgia Tech license for the software may be found at

We will be using Mastan2 V3.5, a linear and nonlinear frame analysis platform based on MATLAB, extensively in the course. You should download Version 1 of the software from www.mastan2.com. This allows you to use Mastan as a complement to your programming.

Additional Materials/Resources (Optional)

Pratap, R. (2017). *Getting Started with MATLAB: A Quick Introduction for Scientists and Engineers*, 7th Edition, Oxford University Press.

Attaway, S. (2019). *MATLAB, A Practical Introduction to Programming and Problem Solving*, 5th Edition, Elsevier.

Course Schedule

Week	Dates	Topics
1	Aug 17-23	Course Intro, Intro to programming in Matlab
2	Aug 24-30	Review of plane trusses; programming with Matlab & Mastan
3	Aug 31-Sep 6	Space trusses; Beam elements (analytical & finite element formulations)
4	Sep 7-13	Beam elements;
5	Sep 14-20	Planar frames; Solution of large systems of equations
6	Sep 21-27	Solution of large systems of equations; Member releases
7	Sep 28-Oct 4	Support displacements; Temperature forces; Fit-up forces, fabrication errors
8	Oct 5-11	Space frames
9	Oct 12-18	Shear deformations; Modeling connections; offsets; joints; construction seq.
10	Oct 19-25	Nonlinear analysis of trusses
11	Oct 26-Nov 1	Stability function based planar frame elements; Nonlinear planar frame finite elements
12	Nov 2-8	Planar nonlinear frame finite elements
13	Nov 9-15	Arc length methods
14	Nov 16-22	Metal plasticity; Material nonlinearity; 3D nonlinear frame elements
15	Nov 23-29	Final Instructional Days, Thanksgiving
16	Nov 30-Dec 6	Reading Day, Final Exams
17	Dec. 8	Final Exam Period

Course Expectations & Guidelines

Health-Related Considerations

In short, ***Jackets protect Jackets***. We are in this together, and the objective is to maximize learning and productivity while maintaining a high level of safety practices.

Please see Covid-19 Information for Students, for current information regarding Covid-19, including what you should do if you are sick. First rule, if you are potentially sick, do not come to class. The course is set up to accommodate your participation online.

Materials for sanitizing your workspace around you in the classroom will be available.

USG Language for Cloth Face Coverings

University System of Georgia (USG) institutions require all faculty, staff, students, and visitors to wear an appropriate face covering while inside campus facilities/buildings where six feet social distancing may not always be possible. All members of the campus community will be provided reusable cloth face coverings.

Face covering use will be in addition to and is **not** a substitute for social distancing. Anyone not using a face covering when required will be asked to wear one or must leave the area. Refusal to comply with the requirement may result in discipline through the applicable conduct code for faculty, staff or students.

For more information about face masks and coverings, please see **guidelines from Human Resources**.

Academic Integrity

Georgia Tech aims to cultivate a community based on trust, academic integrity, and honor. Students are expected to act according to the highest ethical standards. For information on Georgia Tech's Academic Honor Code, please visit http://www.catalog.gatech.edu/policies/honor-code/ or http://www.catalog.gatech.edu/rules/18/.

Any student suspected of cheating or plagiarizing assignment will be reported to the Office of Student Integrity, who will investigate the incident and identify the appropriate penalty for violations.

You are encouraged to work together with other students within a small cohort on the "hand" and programming assignments, keeping in mind the importance of social distancing (working together on-line via BlueJeans, etc.). Each student shall submit their own solution to the "hand" homework and programming assignments, and shall list their collaborators under their name. No collaboration is allowed on the mid-term exam. The mid-term will be closed book, with three pages of notes (handwritten or typed) allowed. The final project will be team based, communication only within each team.

Digital proctoring

Honorlock will proctor your mid-term exam this semester. You DO NOT need to create an account, download software or schedule an appointment in advance. Honorlock is available 24/7 and all that is needed is a computer with a microphone, a working webcam, and a stable Internet connection.

Honorlock is not compatible with Linux OS, Virtual Machines, tablets, or smartphones

To get started, you will need Google Chrome and to download the Honorlock Chrome Extension. You can download the extension at www.honorlock.com/extension/install

When you are ready to test, log into Canvas, go to your course, and click on your exam. The examinations in the course will be delivered using the Quiz function in Canvas. Clicking "Launch Proctoring" will begin the Honorlock authentication process, where you will take a picture of yourself, show your ID, and complete a scan of your room. If your webcam is mounted on a desktop computer that cannot be moved, please hold up a mirror to your webcam to show the room surroundings.

Honorlock will be recording your exam session by webcam as well as recording your screen. Honorlock also has an integrity algorithm that can detect search-engine use, so please do not attempt to search for answers. I will build in enough time in the exams to accommodate this start up procedure.

Good luck! Honorlock support is available 24/7/365. If you encounter any issues, you may contact them via live chat.

If you experience any problems, please let me know.

Accommodations for Students with Disabilities
If you are a student with learning needs that require special accommodation, contact the Office of Disability Services at (404)894-2563 or http://disabilityservices.gatech.edu/, as soon as possible, to make an appointment to discuss your special needs and to obtain an accommodations letter. Please also e-mail me as soon as possible in order to set up a time to discuss your learning needs.

Active Participation
You are highly encouraged to attend the class sessions unless you have a compelling reason not to do so, or you are taking the class fully remotely. If you are not attending the class session in person, you should connect to the class via the BlueJeans link on Canvas.

You will be assigned a numbered seat in the classroom, and you must only use that seat. This is essential for contact tracing should any of us become ill.

Student-Faculty Expectations Agreement
At Georgia Tech we believe that it is important to strive for an atmosphere of mutual respect, acknowledgement, and responsibility between faculty members and the student body. See this catalog page for an articulation of some basic expectations you can have of me and that I have of you. In the end, simple respect for knowledge, hard work, and cordial interactions will help build the environment we seek. Therefore, I encourage you to remain committed to the ideals of Georgia Tech while in this class.

Digital Etiquette: For synchronous (live) online meetings via BlueJeans, please turn off you camera and mic except when you are talking. This avoids distracting background noise and helps minimize any potential internet bandwidth problems.

Diversity Statement

I consider the class environment to be a place where you will be treated with respect, and I welcome individuals of all ages, backgrounds, beliefs, ethnicities, genders, gender identities, gender expressions, national origins, religious affiliations, sexual orientations, ability – and other visible and nonvisible differences. All members of this class are expected to contribute to a respectful, welcoming and inclusive environment for every other member of the class.

Disclaimer

When appropriate or necessary, the instructor reserves the right to adjust, amend, or otherwise modify the information presented on this syllabus at any time. Any changes will be posted prominently to the Canvas site.