MARYLAND APPLIED GRADUATE ENGINEERING

Applied Finite Element Methods

ENPM652 Summer 2021

Course Overview

This course provides an introduction to the Finite Element Method (FEM), a ubiquitous numerical approach for solving differential equations. The FEM approach is widely used to perform analyses in areas such as structural/solid mechanics, fluid mechanics, heat transfer, and electromagnetics. This course presents an introduction to the mathematical and physical concepts underpinning the FEM framework. ANSYS Workbench software will be used to demonstrate engineering-scale examples for stress and thermal analysis problems. There are no formal requirements for this course although students will benefit from a familiarity with basic concepts in linear algebra, calculus, differential equations, solid mechanics, and heat transfer. Basic problem-solving procedure will be developed for using finite element analysis.

Learning Outcomes

After successfully completing this course you will be able to:

- Understand the physical and mathematical basis of FEM, specifically governing equations and their discretization, used in any modern simulation code.
- Set up and solve problems and interpret solutions for static mechanical stress analysis and thermal analysis using analytical and numerical FEM.
- Use the ANSYS Workbench FEM to solve more advanced problems involving structural dynamics and wave propagation.

Dr. Frank VanGessel (He/Him)
fvangess@umd.edu

Class Meets
Thursday
5:30-8:45
JMP2222/Virtual

Office Hours
Virtual
Tues 3:00 – 4:00 pm
and by appointment

Teaching Assistants
n/a

Prerequisites
Must not have completed ENME674; and must not have completed ENAE652

Course Communication
Course-wide messages such as assignment announcements will be posted to ELMS. E-mail will be used for individual communications (e.g. questions, absences, or accommodations)

Required Resources

Course website: None

Readings: None

Hardware/Software:

ANSYS Workbench

Supplemental Resources

Readings:

- Applied Finite Element Methods: Lecture Notes on Principles and Procedures by Clayton, J.D. and Chung, P.W. 1st edition (2018). ISBN: 978-1721867462

Hardware/Software:

MATLAB (Optional)

Python (Optional)

Campus Policies

It is our shared responsibility to know and abide by the University of Maryland's policies that relate to all courses. Please visit https://academiccatalog.umd.edu/graduate/policies/academic-record/ for the Office of Graduate Studies' list of campus-wide policies.

Activities, Learning Assessments, and Expectations

Teams of 1 to 3 students will be formed for all HomeWorks and Final Project.

HomeWorks will be due by midnight on Thursday (see Course schedule for due dates)

The Final Project will be assigned midway through the semester and is due the Thursday prior to the final class.

HomeWorks (60%)

Each homework assignment will reinforce a specific, or cohesive group of, concepts covered in class. HomeWorks will include components focused on theory as well as application of FEA software.

Final Project (60%)

The Final Project will involve students solving a specific FEA problem by incorporating a range of FEA concepts presented throughout the semester.

Expectations:

Every effort has been made to evenly distribute the course requirements, and to support your understanding of the course material. However, it is likely that some weeks will require more effort on your part, and some material will require additional help beyond what is immediately available. Please reach out to me for these course-related questions, and please be prepared to put in the additional effort.

Course Specific Policies

- HomeWorks and Final Project are due by 11:59 pm on the due date
- Images of handwritten work are acceptable. However, handwriting must be legible and any worked solution should include a description of the problem solving process (e.g. do not submit an image of only equations)

For this course, some of your assignments will be checked via Turnitin on our course ELMS page. I have chosen to use this tool because it can help you improve your scholarly writing and help me verify the integrity of student work. For information about Turnitin, how it works, and the feedback reports you may have access to, visit Turnitin Originality Checker for Students.

"The University of Maryland, College Park has a nationally recognized Code of Academic Integrity, administered by the Student Honor Council. This Code sets standards for academic integrity at Maryland for all undergraduate and graduate students. As a student you are responsible for upholding these standards for this course. It is very important for you to be aware of the consequences of cheating, fabrication, facilitation, and plagiarism. For more information on the Code of Academic Integrity or the Student Honor Council, please visit: http://www.studenthonorcouncil.umd.edu/whatis.html."

Accessibility and Reasonable Accommodations

The University of Maryland is committed to creating and maintaining a welcoming and inclusive educational, working, and living environment for people of all abilities. The University of Maryland is also committed to the principle that no qualified individual with a disability shall, on the basis of disability, be excluded from participation in or be denied the benefits of the services, programs, or activities of the University, or be subjected to discrimination. The University of Maryland provides reasonable accommodations to qualified individuals. Reasonable accommodations shall be made in a timely manner and on an individualized and flexible basis.

Discrimination against individuals on the grounds of disability is prohibited. The University also strictly prohibits retaliation against persons arising in connection with the assertion of rights under this Policy.

Accessibility & Disability Service (ADS) facilitates reasonable accommodations to qualified individuals. For assistance in obtaining an accommodation, contact Accessibility and Disability Service at 301.314.7682, or adsfrontdesk@umd.edu. More information is available from the Counseling Center.

Get Some Help!

You are expected to take personal responsibility for your own learning. This includes acknowledging when your performance does not match your goals and doing something about it. Everyone can benefit from some expert guidance on time management, note taking, and exam preparation, so I encourage you to consider visiting http://ter.ps/learn (there are specific resources for graduate students under handouts, but please explore to find what you need). Sharpen your communication skills (and improve your grade) by visiting https://gradschool.umd.edu/graduate-school-writing-center and schedule an

appointment with the campus Graduate Writing Center. Finally, if you just need someone to talk to, visit http://www.counseling.umd.edu.

Everything is free because you have already paid for it, and **everyone needs help**… all you have to do is ask for it.

Names/Pronouns and Self Identifications

The University of Maryland recognizes the importance of a diverse student body, and we are committed to fostering equitable classroom environments. I invite you, if you wish, to tell us how you want to be referred to both in terms of your name and your pronouns (he/him, she/her, they/them, etc.). The pronouns someone indicates are not necessarily indicative of their gender identity. Visit trans.umd.edu to learn more.

Additionally, how you identify in terms of your gender, race, class, sexuality, religion, and dis/ability, among all aspects of your identity, is your choice whether to disclose (e.g., should it come up in classroom conversation about our experiences and perspectives) and should be self-identified, not presumed or imposed. I will do my best to address and refer to all students accordingly, and I ask you to do the same for all of your fellow Terps.

Grades

Grading Procedures: Tentative Final Grades will be determined as a weighted average as described below.

- Group HomeWorks (6 Total): 60%
- Final Project: 40%
- Total: 100%

Your grade is determined by your performance on the learning assessments in the course and is assigned individually (not curved). If earning a particular grade is important to you, please speak with me at the beginning of the semester so that I can offer some helpful suggestions for achieving your goal.

All assessment scores will be posted on the course ELMS page. If you would like to review any of your grades (including the exams), or have questions about how something was scored, please email me to schedule a time for us to meet in my office.

Late work will not be accepted for course credit so please plan to have it submitted well before the scheduled deadline. I am happy to discuss any of your grades with you, and if I have made a mistake I will immediately correct it. Any formal grade disputes must be submitted in writing and within one week of receiving the grade.

Final Grade Cutoffs									
+	97.00%	+	87.00%	+	77.00%	+	67.00%		
A	94.00%	B	84.00%	C	74.00%	D	64.00%	F	<60.0%
-	90.00%	-	80.00%	-	70.00%	-	60.00%		

Course Schedule

Week	Class Date	Tentative Lecture Topics	Assignments	Due Date
1	Thursday, 6/2	Introduction to FEM		
2	Thursday, 6/9	1-D Problem: Direct Method	HW #1	Thursday, June 16

3	Thursday, 6/16	1-D Bar/Truss: FEM	HW #2	Thursday, June 23
4	Thursday, 6/23	Beams/Frames		
5	Thursday, 6/30	2-D Planar Elasticity	HW #3	Thursday, July 7
6	Thursday, 7/7	Axisymmetric Analysis		
7	Thursday, 7/14	3-D Static Analysis	HW #4	Thursday, July 21
8	Thursday, 7/21	3-D Transient Analysis	HW #5	Thursday, July 28
9	Thursday, 7/28	Modal Analysis	HW #6	Thursday, August 4
10	Thursday, 8/4	Thermal Analysis		
11	Thursday, 8/11	Design Optimization		Final Project Due (8/11)
12	Thursday, 8/18	TBD		