MARYLAND APPLIED
GRADUATE ENGINEERING

Applied Finite Element Methods (ENPM652)

Term: *Summer/2025*
Professor: Francis (Frank) VanGessel
Pronouns: He/Him
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Office Hours: By Appt.
Credits: 3
Course Dates: From June 5, 2025 - Aug 20, 2025
Course Times: asynchronous
Classroom: asynchronous

Course Description

This course introduces 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.

Prerequisites
There are no prerequisites for this course although students are expected to have gone through a typical undergraduate curriculum in a STEM major. Students will generally benefit from a familiarity with basic concepts in linear algebra, calculus, differential equations, solid mechanics, and heat transfer.

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 time-dependent analyses.

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:

- ○ elms.umd.edu

  - ○ Gradescope.com: Gradescope will be used to submit assignments. Students must use their official UMD email account (not terpmail) to login. You will receive an email at your UMD account when the course page has been set up.

  - ○ Youtube Activity Videos: https://www.youtube.com/@peterwchung6782

- **Readings:** None
- **Hardware/Software:**
  - ○ EIT Virtual Lab: https://virtlab.eng.umd.edu/Citrix/AppsWeb/
    - ■ ANSYS APDL
    - ■ ANSYS Workbench
    - ■ CREO
    - ■ SolidWorks
  - ○ All registered students in this course have access to these tools through the EIT Virtual Lab. You must log in using your UMD credentials.
  - ○ If you have access to full versions of these tools, great! But don't use them. Different licenses have different features enabled. The contents of this course have been prepared using the Academic versions. Other versions are not recommended.

Supplemental Resources
- ▪ Lee & Chung, "Finite Element Methods for Solids and Structures: A Concise Approach," Cambridge University Press, 2021
- ▪ Applied Finite Element Methods: Lecture Notes on Principles and Procedures by Clayton, J.D. and Chung, P.W. 1st edition (2018). ISBN: 978-1721867462
- ▪ Finite Element Modeling and Simulation with *ANSYS Workbench*, 2nd Edition by *Xiaolin Chen* and *Yijun Liu* ISBN # 978-1138486294

Course Structure
Homework will be due weekly (see Course schedule for due dates)
The final exam will be held in the last week of the term.

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.

- 10 Homeworks
- Homework will be due **by midnight on Tuesdays** of each week and will generally cover topics from the previous week.
- The 2 lowest Homework assignment grades will be dropped to accommodate personal/family emergencies, medical excuses, or religious holidays. No questions asked. No requests for late or missed assignments need to be sent to the instructor(s). Students will still be responsible for the information that was missed.
- Due to the pace of information in this course, no late assignments will be accepted.

Final Exam (40%)

The Final Exam will cover concepts presented through the semester.

- Exam will be given ion the last week of the term. It will be a take-home format, open book and open notes.
- Must be uploaded to Gradescope by midnight of the date indicated in the schedule.

Grading Structure

Assignment	Percentage %
Homework	60%
Final Project	40%
Total	100%

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.

Tips for Success in this Course

1. **Participate.** I invite you to engage deeply, ask questions, and talk about the course content with your classmates. You can learn a great deal from discussing ideas and perspectives with your peers and professor. Participation can also help you articulate your thoughts and develop critical thinking skills.
2. **Manage your time.** Students are often very busy, and I understand that you have obligations outside of this class. However, students do best when they plan adequate time that is devoted to course work. Block your schedule and set aside plenty of time to complete assignments including extra time to handle any technology related problems.
3. **Login regularly.** I recommend that you log in to ELMS-Canvas several times a week to view announcements, discussion posts and replies to your posts. You may need to log in multiple times a day when group submissions are due.
4. **Do not fall behind.** This class moves at a quick pace and each week builds on the previous content. If you feel you are starting to fall behind, check in with the instructor as soon as possible so we can troubleshoot together. It will be hard to keep up with the course content if you fall behind in the pre-work or post-work.
5. **Use ELMS-Canvas notification settings.** Pro tip! Canvas ELMS-Canvas can ensure you receive timely notifications in your email or via text. Be sure to enable announcements to be sent instantly or daily.
6. **Ask for help if needed.** If you need help with ELMS-Canvas or other technology, IT Support. If you are struggling with a course concept, reach out to me and your classmates for support.

Policies and Resources for Graduate Courses

It is our shared responsibility to know and abide by the University of Maryland's policies that relate to all courses, which include topics like:

- Academic integrity
- Student and instructor conduct
- Accessibility and accommodations
- Attendance and excused absences
- Grades and appeals
- Copyright and intellectual property

Please see the University's website for graduate course-related policies at: https://gradschool.umd.edu/course-related-policies

Course Guidelines

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

Additionally, it is your choice whether to disclose how you identify in terms of your gender, race, class, sexuality, religion, and dis/ability, among all aspects of your identity (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.

Communication with Instructor:
Email: If you need to reach out and communicate with me, please email me at xxxxxxxxx@umd.edu. Please DO NOT email me with questions that are easily found in the syllabus or on ELMS (i.e. When is this assignment due? How much is it worth? etc.) but please DO reach out about personal, academic, and intellectual concerns/questions. While I will do my best to respond to emails within 24 hours, you will more likely receive email responses from me on Mondays, Wednesdays and Fridays from 8:00am-10:00am EST

ELMS: I will send IMPORTANT announcements via ELMS messaging. You must make sure that your email & announcement notifications (including changes in assignments and/or due dates) are enabled in ELMS so you do not miss any messages. You are responsible for checking your email and Canvas/ELMS inbox with regular frequency.

Communication with Peers:
With a diversity of perspectives and experience, we may find ourselves in disagreement and/or debate with one another. As such, it is important that we agree to conduct ourselves in a professional manner and that we work together to foster and preserve a virtual classroom environment in which we can respectfully discuss and deliberate controversial questions. I encourage you to confidently exercise your right to free speech—bearing in mind, of course, that you will be expected to craft and defend arguments that support your position. Keep in mind, that free speech has its limit and this course is NOT the space for hate speech, harassment, and derogatory language. I will make every reasonable attempt to create an atmosphere in which each student feels comfortable voicing their argument without fear of being personally attacked, mocked, demeaned, or devalued.

Any behavior (including harassment, sexual harassment, and racially and/or culturally derogatory language) that threatens this atmosphere will not be tolerated. Please alert me immediately if you feel threatened, dismissed, or silenced at any point during our semester together and/or if your engagement in discussion has been in some way hindered by the learning environment.

Academic Integrity
For this course, some of your assignments will be collected 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's Code of Academic Integrity is designed to ensure that the principles of academic honesty and integrity are upheld. In accordance with this code, the University of Maryland does not tolerate academic dishonesty. Please ensure that you fully understand this code and its implications because all acts of academic dishonesty will be dealt with in accordance with the provisions of this code. All students are expected to adhere to this Code. It is your responsibility to read it and know what it says, so you can start your professional life on the right path. **As future professionals, your commitment to high ethical standards and honesty begins with your time at the University of Maryland.**

It is important to note that course assistance websites, such as CourseHero, or AI generated content are not permitted sources, unless the instructor explicitly gives permission. Material taken or copied from these sites can be deemed unauthorized material and a violation of academic integrity. These sites offer information that might be inaccurate or biased and most importantly, relying on restricted sources will hamper your learning process, particularly the critical thinking steps necessary for college-level assignments.

Additionally, students may naturally choose to use online forums for course-wide discussions (e.g., Group lists or chats) to discuss concepts in the course. However**, collaboration on graded assignments is strictly prohibited unless otherwise stated**. Examples of prohibited collaboration include: asking classmates for answers on quizzes or exams, asking for access codes to clicker polls, etc. Please visit the **Office of Graduate Studies' full list of campus-wide policies** and reach out if you have questions.

Finally, on each exam or assignment you must write out and sign the following pledge: *"I pledge on my honor that I have not given or received any unauthorized assistance on this exam/assignment."* If you ever feel pressured to comply with someone else's academic integrity violation, please reach out to me straight away. Also, *if you are ever unclear* about acceptable levels of collaboration, *please ask*! To help you avoid unintentional violations, *the following table* lists levels of collaboration that are acceptable for each graded exercise. Each assignment will contain more specific information regarding acceptable levels of collaboration.

	OPEN NOTES	USE BOOK	LEARN ONLINE	GATHER CONTENT With AI	ASK FRIENDS	WORK IN GROUPS

Homework Assignments	✓	✓	✓	✓	✓	✓
Final Exam	✓	✓	✓	✓	✓	✓

Grades

Grades are determined by performance on the learning assessments in the course. 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 Outline

The format of this section will vary based on the design of your course and the semester, but our guidance is to aim for a clear and concise table that maps out all of the assignment assessments and deadlines and gives students a sense of the course's organization.

Week #	Topic	Assignment	Due Date
1	**Introduction, Math Review, Direct Method**	**HW #1**	**6/10**
2	**Truss Problems, Thermal Strain**	**HW #2**	**6/17**
3	**2D Truss Problems, Coordinate Rotation**	**HW #3**	**6/24**
4	**1D Finite Elements, Weak Form & Virtual Work**	**HW #4**	**7/1**
5	**Beam Elements**	**HW #5**	**7/8**
6	**Shape Functions, Lagrange Polynomials, Quadrature**	**HW #6**	**7/15**
7	**Heat Transfer Analysis**	**HW #7**	**7/22**
8	**Modal Analysis**	**HW #8**	**7/29**
9	**Time-Dependent FEM (First Order)**	**HW #9**	**8/5**
10	**Stability and Buckling**	**HW #10**	**8/12**
11	**Optimization**	**Final Exam**	**8/19**

Note: This is a tentative schedule, and subject to change as necessary – monitor the course ELMS page for current deadlines. In the unlikely event of a prolonged university closing, or an extended absence from the university, adjustments to the course schedule, deadlines, and assignments will be made based on the duration of the closing and the specific dates missed.

Resources & Accommodations

Accessibility and Disability Services
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 **Accessibility & Disability Service (ADS)** provides reasonable accommodations to qualified individuals to provide equal access to services, programs and activities. ADS cannot assist retroactively, so it is generally best to request accommodations several weeks before the semester begins or as soon as a disability becomes known. Any student who needs accommodations should contact me as soon as possible so that I have sufficient time to make arrangements.

For assistance in obtaining an accommodation, contact Accessibility and Disability Service at 301-314-7682, or email them at **adsfrontdesk@umd.edu**. Information about **sharing your accommodations with instructors, note taking assistance** and more is available from the **Counseling Center**.

Student Resources and Services

Taking personal responsibility for your own learning means acknowledging when your performance does not match your goals and doing something about it. I hope you will come talk to me so that I can help you find the right approach to success in this course, and I encourage you to visit the **Counseling Center's Academic Resources** to learn more about the wide range of campus resources available to you.

In particular, everyone can use some help sharpening their communication skills (and improving their grade) by visiting **UMD's Writing Center** and schedule an appointment with the campus Writing Center.

You should also know there are a wide range of resources to support you with whatever you might need. If you feel it would be helpful to have someone to talk to, visit **UMD's Counseling Center** or **one of the many other mental health resources on campus**.

Notice of Mandatory Reporting

Notice of mandatory reporting of sexual assault, sexual harassment, interpersonal violence, and stalking: As a faculty member, I am designated as a "Responsible University Employee," and I must report all disclosures of sexual assault, sexual harassment, interpersonal violence, and stalking to UMD's Title IX Coordinator per University Policy on Sexual Harassment and Other Sexual Misconduct.

If you wish to speak with someone confidentially, please contact one of UMD's confidential resources, such as CARE to Stop Violence (located on the Ground Floor of the Health Center) at 301-741-3442 or the Counseling Center (located at the Shoemaker Building) at 301-314-7651.

You may also seek assistance or supportive measures from UMD's Title IX Coordinator, Angela Nastase, by calling 301-405-1142, or emailing titleIXcoordinator@umd.edu.

To view further information on the above, please visit the Office of Civil Rights and Sexual Misconduct's website at ocrsm.umd.edu**.**

Basic Needs Security

If you have difficulty affording groceries or accessing sufficient food to eat every day, or lack a safe and stable place to live, please visit **UMD's Division of Student Affairs website** for information about resources the campus offers you and let me know if I can help in any way.

Veteran Resources

UMD provides some additional supports to our student veterans. You can access those resources at the office of Veteran Student life and the Counseling Center. Veterans and active duty military personnel with special circumstances (e.g., upcoming deployments, drill requirements, disabilities) are welcome and encouraged to communicate these, in advance if possible, to the instructor.

Netiquette Policy [Optional]

Netiquette is the social code of online classes. Students share a responsibility for the course's learning environment. Creating a cohesive online learning community requires learners to support and assist each other. To craft an open and interactive online learning environment, communication has to be conducted in a professional and courteous manner at all times, guided by common sense, collegiality and basic rules of etiquette.

Participation
- Given the interactive style of this class, attendance will be crucial to note-taking and thus your performance in this class. Attendance is particularly important also because class discussion will be a critical component for your learning.

- Each student is expected to make substantive contributions to the learning experience, and attendance is expected for every session.

- Students with a legitimate reason to miss a live session should communicate in advance with the instructor, except in the case of an emergency.

- Students who miss a live session are responsible for learning what they miss from that session.

- Additionally, students must complete all readings and assignments in a timely manner in order to fully participate in class.

Course Evaluation
Please submit a course evaluation through Student Feedback on Course Experiences in order to help faculty and administrators improve teaching and learning at Maryland. All information submitted to Course Experiences is confidential. Campus will notify you when Student Feedback on Course Experiences is open for you to complete your evaluations at the end of the semester. Please go directly to the **Student Feedback on Course Experiences** to complete your evaluations. By completing all of your evaluations each semester, you will have the privilege of accessing through Testudo the evaluation reports for the thousands of courses for which 70% or more students submitted their evaluations.

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