



# Introduction to the Finite Element Method

CV\_ENG 4001/7001  
MAE 4280/7280

## Instructor Info —



Oliver Giraldo-Londoño



Office Hrs: We 5:00 pm–6:00 pm



C2641 Lafferre Hall



www.ogiraldo.com



ogiraldo@missouri.edu

## Course Info —



Prereq: CV\_ENG 2200  
MAE 3100



Tu & Th



3:30 pm–4:45 pm



Lafferre Hall E3508



## Course Description

This course covers a variety of topics related to the finite element method when applied to the analysis of solid, structural, fluid, and heat transfer problems. Specifically, we will apply the finite element method to solve a variety of problems including trusses, beams, frames, thermal analysis, and fluid mechanics. Students are required to use FEA software for computer assignments.

## Course Objectives

- Students will demonstrate an ability to derive element matrix equation by different methods by applying basic laws in mechanics and integration by parts.
- Students will demonstrate an ability to apply the steps required for FEM solution to variety of physical systems and obtain engineering design quantities.
- Students will demonstrate an ability to determine engineering design quantities (deformation, force, strain, stress) for truss, beam and frame structures.
- Students will demonstrate an ability to use commercial software such as ANSYS to solve FEM-related problems.

## Book

### Recommended Text

Finite Element Analysis: Theory and Application with ANSYS, Saeed Moaveni, 4th Edition, 2014.

An Introduction to the Finite Element Method, J.N. Reddy, 3rd Edition, 2006.

### Other

Any additional material will be provided on Canvas.

## Grading

40%	Homework and Computer Assignments
30%	Midterm Exam
30%	Final Exam

Grades will follow the following scale:

A 93-100%	B 83-86%	C 73-76%	D 63-66%
A- 90-92%	B- 80-82%	C- 70-72%	D- 60-62%
B+ 87-89%	C+ 77-79%	D+ 67-79%	F <59%

## Homework Policy

Homework will be assigned roughly on a bi-weekly basis. Homework must be done individually; however, group discussion/problem solving is encouraged.

No late homework will be accepted.

Students are expected to show all their work in a neat and professional manner.

## Exam Policy

All exams are closed book and closed notes. If necessary, the instructor will provide a sheet with relevant formulae.

Make-up exams or assignments will only be allowed for students who have a substantiated excuse approved by the instructor *before the due date*. Leaving a phone message or sending an e-mail without confirmation is not acceptable.

## Course Content

1. Introduction
2. Trusses
3. Axial members, beams, and frames
4. Computer implementation
5. One dimensional elements
6. One dimensional problems - Solid mechanics
7. Introduction to ANSYS
8. Lab session with ANSYS - Trusses, beams, and frames
9. Lab session with ANSYS - 1D solid mechanics
10. Two dimensional problems
11. Two dimensional problems - Heat transfer
12. Two dimensional problems - Solid mechanics
13. Two dimensional problems - Fluid mechanics
14. Three dimensional problems
15. Lab session with ANSYS - 2D solid mechanics
16. Lab session with ANSYS - 2D heat transfer
17. Class overview

## Academic Dishonesty

Academic integrity is fundamental to the activities and principles of a university. All members of the academic community must be confident that each person's work has been responsibly and honorably acquired, developed, and presented. Any effort to gain an advantage not given to all students is dishonest whether or not the effort is successful. The academic community regards breaches of the academic integrity rules as extremely serious matters. Sanctions for such a breach may include academic sanctions from the instructor, including failing the course for any violation, to disciplinary sanctions ranging from probation to expulsion. When in doubt about plagiarism, paraphrasing, quoting, collaboration, or any other form of cheating, consult the course instructor.

## University of Missouri Notice of Nondiscrimination

The University of Missouri System is an Equal Opportunity/ Affirmative Action institution and is nondiscriminatory relative to race, religion, color, national origin, sex, sexual orientation, age, disability or status as a Vietnam-era veteran. Any person having inquiries concerning the University of Missouri-Columbia's compliance with implementing Title VI of the Civil Rights Act of 1964, Title IX of the Education Amendments of 1972, Section 504 of the Rehabilitation Act of 1973, the Americans With Disabilities Act of 1990, or other civil rights laws should contact the Assistant Vice Chancellor, Human Resource Services, University of Missouri-Columbia, 1095 Virginia Avenue, Columbia, MO 65211, (573) 882-4256, or the Assistant Secretary for Civil Rights, U.S. Department of Education.

## ADA Statement

If you anticipate barriers related to the format or requirements of this course, if you have emergency medical information to share with me, or if you need to make arrangements in case the building must be evacuated, please let me know as soon as possible.

If disability related accommodations are necessary (for example, a note taker, extended time on exams, captioning), please register with the Office of Disability Services (<http://disabilityservices.missouri.edu>), S5 Memorial Union, (573)882-4696, and then notify me of your eligibility for reasonable accommodations. For other MU resources for persons with disabilities, click on "Disability Resources" on the MU homepage.

## Intellectual Pluralism Statement

The University community welcomes intellectual diversity and respects student rights. Students who have questions or concerns regarding the atmosphere in this class (including respect for diverse opinions) may contact the Departmental Chair or Divisional Director; the Director of the Office of Students Rights and Responsibilities or the MU Equity Office or by email at [equity@missouri.edu](mailto:equity@missouri.edu). All students will have the opportunity to submit an anonymous evaluation of the instructor(s) at the end of the course.

## Grievance Policy

Information concerning student grade appeal procedures and non-academic grievances and appeals may be found in the Student Handbook.

## Recording

University of Missouri System Executive Order No. 38 lays out principles regarding the sanctity of classroom discussions at the university. The policy is described fully in Section 200.015 of the Collected Rules and Regulations. In this class, students may make audio or video recordings of course activity unless specifically prohibited by the faculty member. However, the redistribution of audio or video recordings of statements or comments from the course to individuals who are not students in the course is prohibited without the express permission of the faculty member and of any students who are recorded. Students found to have violated this policy are subject to discipline in accordance with provisions of Section 200.020 of the Collected Rules and Regulations of the University of Missouri pertaining to student conduct matters.

## Technical Communication Toolbox

Technical communication skills are critical to your success as an engineer. The Civil Engineering Department at Mizzou has developed a Technical Communication Toolbox (<https://engineering.missouri.edu/tech-toolbox-2019/>) that highlights how to create high quality and effective technical communications. The technical communication skills highlighted in the toolbox will be used across all your Civil Engineering courses and in your professional career. In this course, we will be specifically using the information on writing (clarity, conciseness, and completeness) as well as the format requirements for Figures and Tables.