Penn State University

Department of Mechanical Engineering

ME 461 – FINITE ELEMENT ANALYSIS

Course Objectives: This is an introductory course in the Finite Element Method. The *mathematical formulation of the method* will be presented and then applied to problems in elasticity and heat transfer. A combination of commercial finite element packages and programming exercises will be assigned and applied to demonstrate and teach the finite element method. Upon completion of this course, students should be able to:

1. Understand fundamentals of FE theory. This includes understanding: the strong to weak form, total potential energy and Galerkin approaches for solution methods, the use of shape functions, isoparametric formulation, guassian quadrature the and derivation of finite element matrices.
2. Given a general engineering problem, demonstrate the ability to develop a finite element model using a commercial code.
3. Demonstrate the ability to solve simple one- and two-dimensional problems using the finite element method.
4. Understand the programming format and reasoning of some basic finite element code.
5. Interpret results better through improved understanding of basic mechanics, and enhanced math and computer skills.
6. Demonstrate the ability to clearly communicate finite element simulation results in a report format.

Instructor: Reuben Kraft, Ph.D., Assistant Professor
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Email: reuben.kraft@psu.edu,
Website: https://psucompbio.org (Links to an external site.)

Prerequisites: E MCH 213, E MCH 210H or E MCH 210;CMPSC 200, CMPSC 201 or CMPSC 202

Text: T.Chandrupatla and A. Belegundu. Introduction to Finite Elements in Engineering, 4th Edition, Prentice Hall, 2001. ISBN-13: 978-0132162746, Link to Amazon: http://a.co/jfh3akY (Links to an external site.). The 3rd edition will also work.

Time & Place: World Campus: Lectures will be released on MWF. You can view them at any time, just be sure to keep up. Resident: N/A.

Teaching Assistant: N/A

Target Course Schedule: See topics and dates in the modules tab.

Office hours: By appointment. Just email and we will arrange a time to meet.

Grading:

Midterm Exam (2)	20% (10% each)
Homework (10 total)	50% (5% each)
Participation	15% (Evaluated using quizzes and Abaqus Screenshots)
Final Exam	15%
TOTAL	100%

Grading Scale:

Name:	**Range:**
A	100 % to 94.0%
A-	< 94.0 % to 90.0%
B+	< 90.0 % to 87.0%
B	< 87.0 % to 84.0%
B-	< 84.0 % to 80.0%
C+	< 80.0 % to 77.0%
C	< 77.0 % to 74.0%
C-	< 74.0 % to 70.0%
D+	< 70.0 % to 67.0%
D	< 67.0 % to 64.0%
D-	< 64.0 % to 61.0%
F	< 61.0 % to 0.0%

Course website: I will use Canvas to post homework, solutions and all other announcements.

Homework: No late homework will be accepted unless authorized. For Abaqus/FE work use the Linux Lab (if on campus - http://www.mne.psu.edu/mnelabs/LinuxLab.html (Links to an external site.)) or your personal computer with an Institute for Cyberscience (ICS) account (described below).

Attendance and Lateness: For resident students, attendance is required unless excused by myself.

Institute for CyberScience (ICS) Advanced Cyber Infrastructure (ACI)

For class applications, we will use Abaqus software with is installed on the Institute for CyberScience computing cluster. You can find out more information about ICS here:

https://ics.psu.edu/computing-services/ (Links to an external site.)
To request an account on ACI go to:https://ics.psu.edu/computing-services/account-setup (Links to an external site.). If you will need to provide some information for the account request. Here are the options you can enter:

Sponsor account (Professor Kraft): Enter "rhk12"
Research Description: Enter: "Finite Element Analysis"
Computational and Data Requirements: Enter: "No more than 8 standard cores"

Once you have an ICS account, you can access the system by using a program called "Exceed OnDemand" or EOD. Conveniently, you can access the ICS/ACI system from anywhere with an internet connection on your personal computer. Will need to download and install the Exceed OnDemand application from Penn State. The link is here:

Exceed OnDemand: https://ics.psu.edu/computing-services/ics-aci-user-guide/#05-04-connecting-aci (Links to an external site.)
XQuartz: For a Windows computer, you should be good to go, If you have a Mac, you may also need to download and install XQuartz on your computer (Available here: https://www.xquartz.org/ (Links to an external site.)). I would test Exceed OnDemand first, and if it does not work, then try to get Xquartz. After installing XQuartz, be sure to restart your computer before trying Exceed OnDemand again.

In order to use ICS/ACI, you will also need to turn on 2-factor authentication for your Penn State account. Here is the link to do that:

2-Factor Authentication: http://www.identity.psu.edu/services/authentication-services/two-factor/self-service-portal (Links to an external site.)

Make up Exams: No makeup exams are allowed. There will be two exceptions, (1) the student provides a medical certificate and (2) the student appeals to the undergraduate program director, Dr. Eric Marsh, and Dr. Eric Marsh directly requests me to administer the exam.

Academic Integrity http://www.engr.psu.edu/faculty-staff/academic-integrity.aspx (Links to an external site.)
The University defines academic integrity as the pursuit of scholarly activity in an open, honest and responsible manner. All students should act with personal integrity, respect other students' dignity, rights and property, and help create and maintain an environment in which all can succeed through the fruits of their efforts (refer to Senate Policy 49-20 (Links to an external site.)). Dishonesty of any kind will not be tolerated in this course. Dishonesty includes, but is not limited to, cheating, plagiarizing, fabricating information or citations, facilitating acts of academic dishonesty by others, having unauthorized possession of examinations, submitting work of another person or work

previously used without informing the instructor, or tampering with the academic work of other students. Students who are found to be dishonest will receive academic sanctions and will be reported to the University's Office of Student Conduct for possible further disciplinary sanctions (refer to Senate Policy G-9 (Links to an external site.)). You are encouraged to discuss the homework and design projects with your peers. However, *each individual is responsible for submitting his or her own **unique** assignment.* It is essential to your success in ME 461 that you make a mature effort to understand the homework problems. Careful consideration of each problem, even if by trial and error, develops your ability to solve real-world problems facing you upon graduation. Your colleagues may help you, but ultimately the responsibility is your own.

Disability - http://equity.psu.edu/ods/faculty-handbook/syllabus-statement (Links to an external site.)

Penn State welcomes students with disabilities into the University's educational programs. Every Penn State campus has an office for students with disabilities. The Office for Disability Services (ODS) Web site provides contact information for every Penn State campus: http://equity.psu.edu/ods/dcl. For further information, please visit the Office for Disability Services Web site: http://equity.psu.edu/ods (Links to an external site.).

In order to receive consideration for reasonable accommodations, you must contact the appropriate disability services office at the campus where you are officially enrolled, participate in an intake interview, and provide documentation: http://equity.psu.edu/ods/doc-guidelines. If the documentation supports your request for reasonable accommodations, your campus's disability services office will provide you with an accommodation letter. Please share this letter with your instructors and discuss the accommodations with them as early in your courses as possible. You must follow this process for every semester that you request accommodations.