ENGG*4470: Finite Element Analysis
Fall 2017

UNIVERSITY of GUELPH
School of Engineering

1. INSTRUCTIONAL SUPPORT

1.1 Instructor

Instructor: Alexander Bardelcik
Office: Richards 2501
Email: abardelc@uoguelph.ca
Office Hours: Wednesday 2:30PM – 3:30PM

1.2 Teaching Assistants

GTA	Email	Office Hours
Caryn Vowles	cvowles@uoguelph.ca	TBD
Siyu Wu	swu09@uoguelph.ca	TBD

1.3 Lab Technicians

Technician	Email	Phone
SOE IT Help	soeithelp@uoguelph.ca	Ex. 54113

2. LEARNING RESOURCES

2.1 Course website

Course material, news, announcements, and grades will be regularly posted to the ENGG*4470 CourseLink site. You are responsible for checking the site regularly.

2.2 Required Resources

- Kim and Sankar Introduction to Finite Element Analysis and Design Wiley, 2008

2.3 Recommended Resources

- Reddy, J.N, An Introduction to the Finite Element Method, 2nd Edition, New York ; Montreal Mcgraw-Hill, 1984.
- 3. Petyt, M. Introduction to finite element vibration analysis, 2nd ed., New York : Cambridge University Press 2010.

2.4 Additional Resources

Lecture Information: Some of the lecture notes will be posted on the course website (CourseLink) throughout the semester. You will be granted access to the website when you register for the course.

Assignments: The assignments will be posted on CourseLink. The solutions will be posted after the due date of the assignment.

Lecture Information: Lectures are the main source of material which includes important discussions and worked examples that might not be found elsewhere. Other information related to this course will also be posted on CourseLink.

2.5 Communication and Email Policy

Please use lectures and tutorials as your main opportunity to ask questions about the course. Electronic communication should be limited to the course forum, however topics of a personal and confidential nature (e.g. marks) should be emailed to the instructor: abardelc@uoguelph.ca . Please note that all email communication must be made through your University of Guelph email account.

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3. ASSESSMENT

3.1 Dates and Distribution

Assignments:	6 Unmarked Assignments
Project:	30% (Due **November 29**, last day of lectures)
Midterm Exam:	30% (Each student will write two midterms that will be held on Monday, **October 16** and Wednesday, **October 18**, regular lecture time and location)
Final Exam:	40% (Wednesday, **December 13**, Room and time TBA)

3.2 Course Grading Policies

Academic Consideration: If you are unable to meet an in-course requirement due to medical, psychological, or compassionate reasons, please email the course instructor. See the undergraduate calendar for information on regulations and procedures for Academic Consideration:
http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-ac.shtml

Accommodation of Religious Obligations: If you are unable to meet an in-course requirement due to religious obligations, please email the course instructor within two weeks of the start of the semester to make alternate arrangements. See the undergraduate calendar for information on regulations and procedures for Academic Consideration of Religious Obligations:
http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-accomrelig.shtml

Passing Grade: Students must obtain a grade of 50% to pass this course. In order to pass the course, you must meet the following two criteria:

- Score 35% or higher out of the 70% allocated to the exam (midterm and final) portion of the course.
- Score 15% or higher out of the 30% allocated to the project portion of the course.

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4. AIMS, OBJECTIVES & GRADUATE ATTRIBUTES

4.1 Calendar Description

The theory of finite element analysis is presented including element derivation and solution procedures. Students use a finite element package to solve problems based on static and dynamic applications in mechanical systems. Examples are chosen from classical machines as well as biological systems.
Prerequisite(s): ENGG*2340, MATH*2130, MATH*2270
Corequisite(s): None

4.2 Course Aims

This course aims at: (1) equipping the students with an understanding of theory and practice of the finite element method, (2) developing the ability to analyze and design using FEA software.

4.3 Learning Objectives

At the successful completion of this course, the student will have demonstrated the ability to:

1. Utilize approximate numerical methods in solving structural problems such as the Ritz and the Galerkin methods.
2. Derive of expressions describing the stiffness matrices and equivalent nodal load vectors for simple linear truss, beam and plane finite elements.
3. Perform co-ordinate transformation and its use in the finite element method.
4. Apply principles of the isoparametric formulation.
5. Write special-purpose finite element programs within a procedural programming computer environment, such as MATLAB.
6. Use professional-level finite element software to solve engineering problems in solid mechanics.
7. Assess the accuracy and reliability of finite element solutions and troubleshoot problems arising from errors in a given finite element analysis.
8. Develop finite element formulations of engineering problems from a variety of application areas.
9. Utilize finite elements to conduct an analysis of a mechanical system
10. Demonstrate their ability to communicate their analysis and design ideas through technical reporting and presentation.

4.4 Graduate Attributes

Successfully completing this course will contribute to the following CEAB Graduate Attributes:

Graduate Attribute	Learning objectives	Assessment
1. Knowledge Base for Engineering	1-4	Exams
2. Problem Analysis	9	Exams, Project
3. Investigation	-	-
4. Design	-	-
5. Use of Engineering Tools	5,6	Labs, Project
6. Individual and Teamwork	-	-
7. Communication	-	-
8. Professionalism	-	-
9. Impact of Engineering on Society and the Environment	-	-
10. Ethics and Equity	-	-
11. Environment, Society, Business, & Project Management	-	-
12. Life-Long Learning	-	-

4.5 Instructor's Role and Responsibility to Students

The instructor's role is to develop and deliver course material in ways that facilitate learning for a variety of students. Selected lecture notes will be made available to students on CourseLink but these are not intended to be stand-alone course notes. During lectures, the instructor will expand and explain the content of notes and provide example problems that supplement posted notes. Scheduled classes will be the principal venue to provide information and feedback for assessments.

4.6 Students' Learning Responsibilities

Students are expected to take advantage of the learning opportunities provided during lectures and tutorials. Students, especially those having difficulty with the course content, should also make use of other resources recommended by the instructor. Students who do (or may) fall behind due to illness, work, or extra-curricular activities are advised to keep the instructor informed. This will allow the instructor to recommend extra resources in a timely manner and/or provide consideration if appropriate.

4.7 Relationships with other Courses & Labs

Previous and/or Current Courses:
ENGG*1210: Mechanical system fundamentals such as force, torques, free body diagrams
ENGG*1500: Solving systems of linear equations, matrix algebra, and complex numbers
MATH*1200, MATH*1210 & MATH*2270: Limits, differentiation, integration, series, DE
ENGG*2400: Second order system, natural frequency
ENGG*2160: Fundamentals of stress analysis
ENGG*2130: Fundamentals of numerical analysis
Follow-on Courses:
ENGG*4160: Application of mechanical design principles
ENGG*4220: Interdisciplinary Mechanical Engineering Design.

5. TEACHING AND LEARNING ACTIVITIES

5.1 Timetable

Lectures:

Day	Time	Location
Monday	1:30PM – 2:20PM	MCKN 117
Wednesday	1:30PM – 2:20PM	MCKN 117
Friday	1:30PM – 2:20PM	MCKN 117

Labs:

Day	Time	Location	Section(s)
Friday	2:30PM – 4:20PM	THRN 2313	01
Thursday	12:30PM – 2:20PM	THRN 2313	02

5.2 Lecture Schedule

Lecture Topics	References	Learning Objectives
Math Preliminaries	Ch 0	1
Stress-strain analysis	Ch 1	1, 2
Uniaxial bar and truss elements – direct method	Ch 2	1,2
Weighted residual & energy methods for 1D Problems	Ch 3	2, 3, 5
Finite element analysis of beams and frames	Ch 4	3
Finite elements for plane solids	Ch 6	2, 3, 4, 5
Finite element procedure and modeling	Ch 7	2, 3, 4
Structural design using finite elements	Ch 8	-

5.3 Lab Schedule (* Tentative, subject to change)

Week	Topic
1	No Lab
2	2 MATLAB Introduction + Assign 0 (using MATLAB)
3	3 Assign 1 (using MATLAB)
4	4 Assign 2
5	5 No Lab
6	6 ANSYS Workbench Introduction I
7	7 ANSYS Workbench Introduction II
8	8 Assign 3 / ANSYS
9	9 Assign 4
10	Assign 5
11	ANSYS Help (Project)

5.4 Important Dates

Thursday, September 7: First day of classes
Monday, October 9: Thanksgiving Holiday (no classes)
Tuesday, October 10: Fall Study Break
Friday, November 3: drop date - 40th class
Friday, November 29: last day of class
Wednesday, December 13: Final exam for this course

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6. LAB SAFETY

Safety is critically important to the School and is the responsibility of all members of the School: faculty, staff and students. As a student in a lab course you are responsible for taking all reasonable safety precautions and following the lab safety rules specific to the lab you are working in. In addition, you are responsible for reporting all safety issues to the laboratory supervisor, GTA or faculty responsible.

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7. ACADEMIC MISCONDUCT

The University of Guelph is committed to upholding the highest standards of academic integrity and it is the responsibility of all members of the University community faculty, staff, and students to be aware of what constitutes academic misconduct and to do as much as possible to prevent academic offences from occurring. University of Guelph students have the responsibility of abiding by the University's policy on academic misconduct regardless of their location of study; faculty, staff and students have the responsibility of supporting an environment that discourages misconduct. Students need to remain aware that instructors have access to and the right to use electronic and other means of detection.

Please note: Whether or not a student intended to commit academic misconduct is not relevant for a finding of guilt. Hurried or careless submission of assignments does not excuse students from responsibility for verifying the academic integrity of their work before submitting it. Students who are in any doubt as to whether an action on their part could be construed as an academic offence should consult with a faculty member.

7.1 Resources

The Academic Misconduct Policy is detailed in the Undergraduate Calendar:
http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-amisconduct.shtml

A tutorial on Academic Misconduct produced by the Learning Commons can be found at:
http://www.academicintegrity.uoguelph.ca

Please also review the section on Academic Misconduct in your Engineering Program Guide.

The School of Engineering has adopted a Code of Ethics that can be found at:
http://www.uoguelph.ca/engineering/undergrad-counselling-ethics

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8. ACCESSIBILITY

The University of Guelph is committed to creating a barrier-free environment. Providing services for students is a shared responsibility among students, faculty and administrators. This relationship is based on respect of individual rights, the dignity of the individual and the University community's shared commitment to an open and supportive learning environment. Students requiring service or accommodation, whether due to an identified, ongoing disability for a short-term disability should contact the Centre for Students with Disabilities as soon as possible.

For more information, contact CSD at 519-824-4120 ext. 56208 or email csd@uoguelph.ca or see the website: http://www.uoguelph.ca/csd/

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9. RECORDING OF MATERIALS

Presentations which are made in relation to course work-including lectures-**cannot** be recorded or copied without the permission of the presenter, whether the instructor, classmate or guest lecturer. Material recorded with permission is restricted to use for that course unless further permission is granted.

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10. RESOURCES

The Academic Calendars are the source of information about the University of Guelph's procedures, policies and regulations which apply to undergraduate, graduate and diploma programs:
http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-amisconduct.shtml