ENGG*4470 Finite Element Analysis
Fall 2013

UNIVERSITY of GUELPH
School of Engineering

(Revision 0: September 5, 2013)

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1 Instructional Support

1.1 Instructor

Instructor:	Marwan Hassan, Ph.D., P.Eng.
Office:	THRN 2405, ext. 52429
Email:	mahassan@uoguelph.ca
Office hours:	TBA on Courselink or by appointment

1.2 Lab Technician

Technician:	Ross Cochrane
Office:	THRN 2332, ext. 54113
Email:	rcochran@uoguelph.ca

1.3 Teaching Assistants

GTA	Email	Office Hours
Ali Jahanfar	mjahanfa@uoguelph.ca	TBA on Courselink

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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

1. Kim and Sankar *Introduction to Finite Element Analysis and Design* Wiley, 2008

2.3 Recommended Resources

1. Reddy, J.N, *An Introduction to the Finite Element Method*, 2nd Edition, New York ; Montreal : Mcgraw-Hill, 1984.
2. 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 are posted on the web page.

Assignments: Download the assignments according to the schedule given in this handout. All the solutions will be posted as indicated.

Miscellaneous Information: Other information related to Finite Element Analysis and Solid Mechanics are also posted on the web page.

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3 ASSESSMENT

3.1 Dates and Distribution

Quizzes: 10% (best 4 of 5)
Quizzes will be held in the lab time.

Quiz 1 The week of Sept. 23, 2013.

Quiz 2 The week of Oct. 7, 2013.

Quiz 3 The week of Oct. 21, 2013.

Quiz 4 The week of Nov. 4., 2013.

Quiz 5 The week of Nov. 18, 2013.

Project: 30%
Progress Report, Thu in class
Final Report: Thu Nov 28, in class
Note: Both paper and electronic copies are to be submitted

Midterm test 1: 20%
Wed Oct 17, 17:30-19:30, Room TBA on Courselink

Midterm test 2: 20%
Wed Nov 14, 17:30-19:30, Room TBA on Courselink

Final Exam: 20%
Thurs Dec 10, 07:00PM - 09:00PM, Room TBA on Webadvisor

3.2 Course Grading Policies

Missed Assessments: 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: In order to pass the course, you must pass exam portion of the course. Students must obtain a grade of 50% or higher on the exam portion of the course in order for the project portion of the course to count towards the final grade.

Missed midterm tests or quizzes: If you miss a test due to grounds for granting academic consideration or religious accommodation, the weight of any missed test/quiz will be added to the final exam weight. There will be no makeup midterm tests.

Lab Work: You must attend and submit all project milestone reports. If you miss a project report due to grounds for granting academic consideration or religious accommodation, arrangements must be made with the teaching assistant to complete a makeup project.

Late Lab Reports: Late submissions of reports will not be accepted.

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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 solids mechanics, fluid mechanics, heat transfer and electromagnetism.
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 including stress, heat transfer, and vibration analysis.
9. Utilize finite element 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	Quizzes, Exams
2. Problem Analysis	9	Project
3. Investigation	-	-
4. Design	9	project
5. Use of Engineering Tools	6	Labs, Project
6. Communication	10	Project
7. Individual and Teamwork	9	project
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/D2L 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 tests and project.

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 Courses:

ENGG*1210: Mechanical system fundamentals such as force, torques, friction, moments, free body diagrams

ENGG*1500: Solving systems of linear equations, matrix algebra, complex numbers

MATH*1200, MATH*1210 & MATH*2270: Limits, differentiation, integration, series expansion, Differential Equations

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: Application of mechanical design principles

5 TEACHING AND LEARNING ACTIVITIES

5.1 Timetable

Lectures:

Tuesday		08:30AM - 09:50AM	MACK, Room 237
Thursday		08:30AM - 09:50AM	MACK, Room 237

Laboratory:

Monday	Sec 01	09:30PM - 11:20PM	THRN, Room 1004
Monday	Sec 02	01:30PM - 03:20PM	THRN, Room 1004

5.2 Lecture Schedule

Lectures	Lecture Topics	References	Learning Objectives
1-3	Stress-Strain Analysis	Chapter 1	1,2
4-6	Uniaxial Bar and Truss Elements - Direct Method	Chapter 2	1,2
7-9	Weighted Residual and Energy Methods for One Dimensional Problems	Chapter 3	2,3,5
10-12	Finite Element Analysis of Beams and Frames	Chapter 4	2,3,5
13-15	Finite Elements for Heat Transfer Problems	Chapter 5	3
16-18	Finite Elements for Plane Solids	Chapter 6	3,4,5
19	Finite Element Procedure and Modeling	Chapter 7	2,3,4,5
20	Structural Design Using Finite Elements	Chapter 8	2,3,4
21-22	Dynamics Problems	notes	5
23-24	Miscellaneous	notes	6,7

5.3 Design Lab Schedule

Week	Topic	Due
1	Introduction to the FEA Lab	-
2	Matlab Introduction	-
3	Matlab Lab I	-
4	Matlab Lab II	-
5	Project Identification	TBA
6	FEA Software Lab I	-
7	FEA Software Lab II	-
8-9	Project Part I	TBA
10	Progress Report	TBA
10-12	Project Part II	TBA

5.4 Other Important Dates

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.

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