ENGG*6050 Finite Element Methods
Spring 2014

UNIVERSITY
of GUELPH
School of Engineering

(Revision 0: April 30, 2014)

1 INSTRUCTIONAL SUPPORT

1.1 Instructor

Instructor: Bahram Gharabaghi, Ph.D., P.Eng.
Office: THRN 2417, ext. 58451
Email: bgharaba@uoguelph.ca
Office hours: TBA on Courselink or by appointment

2 LEARNING RESOURCES

2.1 Course Website

Course material, announcements, and grades will be regularly posted to the Courselink site. You are responsible for checking the site regularly.

2.2 Required Readings

1. Required readings will be assigned throughout the term.

2.3 Recommended Resources


3 ASSESSMENT

3.1 Dates and Distribution

Assignments: 50% - to be submitted electronically through CourseLink Dropbox.
   Assignment 1, due May 21st
   Assignment 2, due May 28th
   Assignment 3, due June 4th
   Assignment 4, due June 11th
   Assignment 5, due June 18th

Class Presentations: 20%
   Presentation and Discussion of Assignment Problems in Class – Week 2 to 6

Term Project: 30% - due July 30th - to be submitted electronically through CourseLink Dropbox.

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. Please note the passing grade in graduate courses is 65%. See the graduate calendar for information on regulations and procedures for Academic Consideration:
   http://www.uoguelph.ca/registrar/calendars/graduate/current/genreg/sec_d0e1400.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 Accommodation of Religious Obligations:
   http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-accomreli.shtml

4 AIMS & OBJECTIVES

4.1 Course Description

This course focuses on the fundamentals of Finite Element Theory, including the numerical methods that provide solutions to the governing differential equation systems, which quantitatively describe several processes of interest. Key topics that will be covered include: boundary-value problems, methods of approximation, time dependent problems, isoparametric elements, numerical integration, computer implementation, automatic mesh generation algorithms, and two-dimensional finite elements. This course places emphasis on hands-on experience with the state-of-the-art computer programs, and understanding the assumptions and limitations of the finite element methods in analyzing engineering problems.

Prerequisite(s): none
Restriction(s): none
4.2 Course Aims

This course aims to introduce both the capabilities and limitations of numerical methods for solving the complex non-linear governing differential equations, and techniques for using commercially available software to build and solve virtual models in practical engineering applications. This course aims at equipping the students with an understanding of theory and practice of the finite element methods and developing the ability to analyze and design using the finite element analysis software.

4.3 Learning Objectives

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

1. an understanding of the theory and application of the finite element method
2. the ability to formulate a finite element analysis for a variety of problems
3. the ability to use a general purpose finite element computer program
4. knowledge of the assumptions and limitations of the finite element method
5. articulate the major approximations in the analysis and associated errors
6. recognize the limits of the tool and assessing the validity of the conclusion
7. interpret and communicate computational results in a final report

4.4 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.

4.5 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.

E-mail Communication: As per university regulations, all students are required to check their <uoguelph.ca> e-mail account regularly: e-mail is the official route of communication between the University and its students.

Recording of Materials: Presentations which are made in relation to course work—including lectures—cannot be recorded in any electronic media without the permission of the presenter, whether the instructor, a classmate or guest lecturer.
5 Teaching and Learning Activities

5.1 Class Time and Location

Lectures/Seminars:
Wednesday 6:00 – 8:50 pm THRN 1002

5.2 Class Schedule

<table>
<thead>
<tr>
<th>Week</th>
<th>Lecture/Seminar Topics</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>1a</td>
<td>Introduction – Basic Concepts</td>
<td>Chapter 1</td>
</tr>
<tr>
<td>1b</td>
<td>One-Dimensional Linear Element</td>
<td>Chapter 2</td>
</tr>
<tr>
<td>2a</td>
<td>A Finite Element Example</td>
<td>Chapter 3</td>
</tr>
<tr>
<td>2b</td>
<td>Element Matrices: Galerkin Formulation</td>
<td>Chapter 4</td>
</tr>
<tr>
<td>3a</td>
<td>Two-Dimensional Elements</td>
<td>Chapter 5</td>
</tr>
<tr>
<td>3b</td>
<td>Coordinate Systems</td>
<td>Chapter 6</td>
</tr>
<tr>
<td>4a</td>
<td>Two-Dimensional Field Equation</td>
<td>Chapter 7</td>
</tr>
<tr>
<td>4b</td>
<td>Derivative Boundary Conditions</td>
<td>Chapter 9</td>
</tr>
<tr>
<td>5a</td>
<td>Irrotational Flow</td>
<td>Chapter 10</td>
</tr>
<tr>
<td>5b</td>
<td>Heat Transfer by Conduction and Convection</td>
<td>Chapter 11</td>
</tr>
<tr>
<td>6a</td>
<td>Time-Dependent Field Problems</td>
<td>Chapter 14</td>
</tr>
<tr>
<td>6b</td>
<td>Practical Considerations</td>
<td>Chapter 15</td>
</tr>
<tr>
<td>7 - 12</td>
<td>Term Projects Guidance and Progress Review</td>
<td></td>
</tr>
</tbody>
</table>

5.3 Other Important Dates

Drop Date: The last date to drop one-semester courses, without academic penalty, is the 40th class day for one-semester courses (Friday July 4th, 2014). Two-semester courses must be dropped by the last day of the add period in the second semester. Refer to the Graduate Calendar for the schedule of dates: http://www.uoguelph.ca/registrar/calendars/graduate/current/sched/sec_d0e736.shtml

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.

8 RESOURCES

- The Academic Misconduct Policy is detailed in the Graduate Calendar: http://www.uoguelph.ca/registrar/calendars/graduate/2013-2014/genreg/sec_d0e1911.shtml
- A tutorial on Academic Misconduct produced by the Learning Commons can be found at: http://www.academicintegrity.uoguelph.ca/
- The Graduate Calendar is the source of information about the University of Guelph’s procedures, policies, and regulations which apply to graduate programs: http://www.uoguelph.ca/registrar/calendars/graduate/current/
- Refer to the Graduate Calendar for the schedule of dates: http://www.uoguelph.ca/registrar/calendars/graduate/current/sched/sec_d0e736.shtml