McMaster University
Department of Mechanical Engineering

Course Outline: ME 4T3/6T3, Fall 2018
FINITE ELEMENT APPLICATIONS

Instructor: ▪ Dr. Peidong Wu, JHE 339, x20092, peidong@mcmaster.ca

Objective:
This course is designed to provide a fundamental understanding of the theory and application of finite element methods for mechanical systems. Upon completion of the course, the student will be knowledgeable in the capabilities and limitations of the finite element method, and will gain proficiency in the use commercial finite element package ANSYS.

Lecture Schedule: Thursdays 7:00-10:00 PM, BSB 137
Tutorial and Computer Lab: JHE219A

TAs: TBA

Office Hours: We are all available by appointment. You are also welcome to stop by our offices to see if we are in and to determine whether we have a few minutes to meet with you.

Textbook: ▪ Logan, "A First Course in the Finite Element Method", Brooks/Cole (3rd or 4th edition)

Grading Scheme:		
	Assignments	40%
	Project	20%
	Final Exam	40%

Assignments:
Four problem sets are planned for this course. The purpose of these assignments is to provide students with an opportunity to individually work out fundamentals related to the course material. This will involve both theoretical solutions, and the use of some simple numerical methods to solve algebraic equations. Some assignments will use ANSYS.

Exercises:
Along with the assignments are exercises to provide instruction in the use of ANSYS. These exercises are not part of the grading system, but rather they provide an efficient path to using and exploring features of finite element analysis.

Project:
A project is intended to give students practical experience in the application of a fully functional finite element package. The commercial finite element package ANSYS is to be used to analyze a problem of complexity relevant to real world situations.

Final exam: A 2.5-hour final exam will cover the theoretical aspects of the course.

LEARNING OUTCOMES: Upon successful completion of the course the student will be expected to have demonstrated the ability to:

1. Derive element equations and formulate global stiffness.
2. Utilize commercial finite element package ANSYS to solve solid mechanics problems.
3. Develop and validate various ANSYS models for problems such as bending of a beam and tensile loading of a thin plate with a hole.
4. Analyze numerical results obtained from the analysis.

COURSE TOPICS:

Introduction
- What are finite elements and why do we need them?

Direct Stiffness Method
- Discrete Spring Systems as Finite Elements
- Plane Truss Elements (coordinate transformation)
- Assembly, Boundary Conditions and Solution of Equations

Continuous Systems
- Principle of Minimum Potential Energy
- Approximation with Piece-wise Functions (shape functions)
- Method of Weighted Residuals for Approximating Continuous Systems

Two Dimensional Elasticity Elements
- Basic Theory of Elasticity
- Constant Strain Triangle Element
- Bilinear Quadrilateral and Higher Order Elements

Beam Elements
- Beam elements
- Plane Frame Elements

Practical Considerations
- Symmetry
- Mesh Sensitivity
- Troubleshooting

Solid Mechanics Applications **(graduates only)**
- Dynamic Problems

POLICY NOTICE

Academic dishonesty consists of misrepresentation by deception or by other fraudulent means and can result in serious consequences, e.g. the grade of zero on an assignment, loss of credit with a notation on the transcript (notation reads: "Grade of F assigned for academic dishonesty"), and/or suspension or expulsion from the university. It is your responsibility to understand what constitutes academic dishonesty. For information on the various kinds of academic dishonesty please refer to the Academic Integrity Policy, specifically Appendix 3, located at

http://www.mcmaster.ca/senate/academic/ac_integrity.htm

The following illustrates only three forms of academic dishonesty:

1. Plagiarism, e.g. the submission of work that is not one's own or for which other credit has been obtained. (Assignments must be one's own work. Submission of any part of an assignment copied from someone else constitutes plagiarism.)
2. Improper collaboration in group work. (Assignments and projects in this course represent individual work and therefore must be done entirely by each student. It is appropriate to work in pairs/groups to learn how to solve the problems, but it is unacceptable for individuals in a group to share/copy solutions.)
3. Copying or using unauthorized aids in tests and examinations.