Course Outline

Semester 1, 2015

MMAN4410

Finite Element Methods

Contents

Units of credit

This is a 6 unit-of-credit (UoC) course, and involves 4 hours per week (h/w) of face-to

In addition to the face-to-face teaching, a range of blended techniques will be used through Moodle to engage the students with independent learning. The major assignment, for example, includes a significant research component which will allow each individual student to study an engineering problem which is specific to their own interests.

Assignment 1 – FE Fundamentals

Finite Element Analysis is numerically intensive and is exclusively solved by powerful computers for all real engineering problems. Modern software packages hide the majority of complex tasks from the user. Unfortunately, this level of automation can lead to the false belief that FEA is an infallible tool. It is important that you as an engineer understand the computations being conducted on your behalf in order to understand their limitations and possible errors that can appear in your analyses.

This assignment will teach you the fundamentals of the Finite Element Method through hand calculations and simple programming.

Assignment 2 – Good FE Practice

Proper planning, execution and reporting of analyses are crucial skills for any engineering graduate. When using FE analysis techniques to solve and report on a problem, there are countless opportunities to exercise poor technique. At best, poor technique detracts from the quality of the solution and at worst leads to dangerous or negligent results.

During this assignment you will study a very simple engineering problem using FEM but will learn best practice techniques to ensure you produce high quality results and write an excellent report.

FE Fundamentals Exam

A mid-session exam will use a combination of short answer questions, derivations and long form calculations to test your understanding and application of FE fundamentals.

You will need to bring a UNSW approved calculator to the examination:
https://student.unsw.edu.au/exam-approved-calculators-and-computers

Major Project

A flexible major project will be given to you at the beginning of semester and will form the larges e

7. COURSE SCHEDULE

Lectures

Week	Name	Date	Topics
1	**Introduction to FEM**	**2-Mar**	Introduction to FEA; Discretisation; FE Terminology; Stiffness Matrices for Bars, Trusses and Beams; Element Library Introduction.
2	**Numerical Solution Procedure**	**9-Mar**	Applying Loads and Boundary Conditions; Assembly; Solving for Nodal Displacements; Constitutive Laws; Interpolation of Stress and Strain
3	**The Element Library**	**16-Mar**	2D Triangles and Quads; Shells; 3D Tets and Hexes; Solid Shells; Isoparametric Elements; Quadratic and Higher Order Elements; Benefits and Limitations of Different Element Types
4	**Good FE Practice**	**23-Mar**	A General FE Problem Solving Approach; Modelling Assumptions; Meshing Strategy; Convergence; Validation; Sources of Error in FE; Computational Resources; Interfacing with CAD; FE Reporting
5	**Buckling and Non-linear Analyses**	**30-Mar**	Eigenvalue Solutions; Linear Buckling; Material Non-linearity; Geometric Non-linearity and Buckling; Iteration Schema and Incremental Analysis; Contact
Break			

8. RESOURCES FOR STUDENTS

Learning Management System

Moodle LMS, https://moodle.telt.unsw.edu.au/ will be used for this course. Lecture notes, software laboratories, assignments, links and forums will be available on Moodle. Moodle is a powerful tool that you are encouraged to use for all course needs.

Textbooks

Recommended Resources

Cook, R. D., Malkus, D. S., Plesha, M. E., Witt, R. J. (2002). Concepts and Applications of Finite Element Analysis, 4th Ed, John Wiley & Sons.
Chandrupatla, T. R., Belegundu, A. D. (2011) Introduction to Finite Elements in Engineering, 4th Ed, Prentice Hall (Pearson)

Other Resources

If you wish to explore any of the lecture topics in more depth, then other resources are available and assistance may be obtained from the UNSW Library. One starting point for assistance is the library website: www.library.unsw.edu.au/.

9. COURSE EVALUATION AND DEVELOPMENT

Finite Element Methods is a brand new course for 2015. In response to the School of Mechanical and Manufacturing Engineering Curriculum Review Project in 2013, it was decided that the finite element method needed to be offered as a professional elective to all MechEng students on a level playing field. As a result, a number of smaller FE offerings in different streams were discontinued (MECH3540, AERO3410, AERO4410, etc.). This course takes the best elements of the previous offerings as well as a broad swathe of new content specifically designed to fit the course.

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email seadu@unsw.edu.au or via the website www.studentequity.unsw.edu.au. The office is located on the Ground Floor of the Goodsell building (F20).

Issues to be discussed may include access to materials, signers or note-takers, the provision of services and additional exam and assessment arrangements. Early notification is essential to enable any necessary adjustments to be made.

G Pearce
February 2015