THE UNIVERSITY OF NEW SOUTH WALES

SCHOOL OF MATERIALS SCIENCE AND ENGINEERING

MATS5342

Computational Modelling & Design in Materials Engineering

Course Outline

Session 2, 2009

Course staff

Staff	Responsibility	Contact details	Consultation policy
Prof. Mark Hoffman	Lecturer/ Course Co-ordinator	Room: 102, Ph: 9385 4432 mark.hoffman@.unsw.edu.au	Open door, but make an appointment if important
Dr Runyu Yang	Lecturer	Room: 218, Ph: 9385 6787 r.yang@.unsw.edu.au	

Timetable

Lecture/Tutorial	Day	Time	Location
Lecture/laboratory	Wednesday	12:00-14:00	Lectures: Law 388 Labs: Materials G14
Lecture/laboratory	Friday	9:00-11:00	Lectures: Webst 251 Labs: Materials G14

Course outline:

1. Introduction - What is computational modelling and design? Why do we need it and where is it used?
2. Computer-aided drawing and Pro/Engineer, dimensioning, tolerancing and standard drawing symbols, principles of detail design drawings and assembly drawings
3. Computational fluid dynamics (CFD): principles and governing equations, discretisation techniques, finite difference (FD) and finite volume (FV) methods, direct and iterative methods, determination of convergence and accuracy.
4. Basic CFD techniques and applications: grid generation, boundary conditions, SIMPLE algorithm and turbulence modelling, reporting of results. Use of ANSYS FLUENT software.
5. Application of finite difference modelling to steady-state and transient heat transfer:- use of FD modelling to solve conduction and convectional steady-state and transient heat transfer problems.
6. Revision of elasticity theory: - Airy's stress function, plane stress and plane strain elasticity, beam theory, axisymmetrix and Cartesian coordinates.
7. Finite element modelling (FEM): - building a numerical model using FE modelling: Bar, beam and plate elements and equations. Principle of virtual work
8. Application of finite element modelling to stress/strain situations: application of FE modelling to solution of mechanical load problems.
9. Use of ANSYS FE software: model design, meshing, solving and analysis of results.

Course information

Units of credit	6
Parallel teaching involved in this course	None
How the course relates to other course offerings and overall program(s) in the discipline	• Course applies theories learnt in fluid dynamics, heat transfer, mechanical properties of materials and mathematics to provide a mechanism for solving real world problems.
Course aims	To learn and apply numerical modelling principles to materials science and engineering
Graduate attributes which will be gained through the course	• Research, inquiry and analytical thinking abilities • Capability and motivation for intellectual development • Communication • Computer and information literacy.
Expected learning outcomes	Students should gain understanding of: 1. Necessity of numerical modelling to apply physical theory to complicated engineering problems. 2. Principles of computer aided design and basic drafting skill with Pro/E software 3 Basic discretisation techniques and their solutions 4. CFD fundamentals and its application to heat and fluid transfer problems 5. Principles of finite element modelling 6. Application of finite element modelling to trusses and plates and axisymmetric analysis 7. Use of commercial software to solve real problems in material engineering
Teaching strategies	• Theory and concepts will be addressed in lectures. • Principles of application will be learnt in laboratory class. • Problem design and solution will be learnt through assignments • Teaching material, including course outline, notes, problems, assignments, examples of solutions of problems, and course announcements are available on the Course WebCT Vista website.

Assessment

Assignment 1	25%
Assignment 2	25%
Practical Exam	25%
Written exam	25%

Assignments will include 1-2 problems which may be challenging and are designed to develop analytical and problem solving skills.

Assignment Dates:	Issue	Submission
Assignment 1	week 2	week 7
Assignment 2	week 2	week 12

Assignments will be made available on the course website and should be submitted on time using this site.

Practical exam will take place in a computer laboratory. Students will be expected to develop and solve models using principles developed in the course.

Written exam will address the theories used in developing numerical models

The learning and teaching philosophy underpinning the course (based on UNSW Learning Guidelines)

- **Students are actively engaged in the learning process.**
  It is expected that in addition to attending classes, students read, write, discuss, and are engaged in solving numerical modelling problems. Class input will be required and laboratories student driven.

- **Effective learning is supported by a climate of inquiry where students feel appropriately challenged.**
  Numerical modelling will be a new concept to most students although the basic building blocks will be familiar. Assignment exercises are considered an important part of the learning process.

- **Learning is more effective when students' prior experience and knowledge are recognised and built on.**
  Fundamental fluid dynamics, heat transfer and mechanical properties knowledge will be applied to complicated real-world situations familiar to students.

- **Students become more engaged in the learning process if they can see the relevance of their studies to professional and disciplinary contexts**
  Assignments and class exercises will involve problems and situations which should be familiar to students in every day professional life.

Recommended Reference Materials

- D. Gaskell, "An Introduction to Transport Phenomena in Materials Engineering"
- R. Toogood, "Pro/Engineering Wildfire 4.0 Tutorial"
- J.D. Anderson, "Computational Fluid Dynamics – The Basics with Applications"
- J. Tu, G. H. Yeoh and C. Liu, "Computational Fluid Dynamics – A Practical Approach"
- E. Kreyzig, "Advanced Engineering Mathematics"
- R. F. Cooke, "Finite Element Modelling for Stress Analysis"
- O.C. Zienkiewicz, R.L. Taylor, J.Z. Zhu, "Finite Element Method - Its Basis and Fundamentals (6th Edition)" (Available online)
- J. Fish, T. Belytschko, "A First Course in Finite Elements" (Available online)

Continual course improvement

- Students will be asked to provide evaluative feedback through the UNSW's Course and Teaching Evaluation and Improvement (CATEI) Process near the end of session
- A feedback facility will be provided on Vista
- Students are encouraged to raise any matters of concern with the lecturer.
- Students' comments on teaching during the session are welcome and will be appreciated.

Administrative Matters

- Students should attend at least 80% of all classes.
- Assignments submitted after the deadline will receive a 10% of max. grade penalty for every day late, or part thereof.
- Students unable to submit assignments on time or attend the final exams on health grounds should make a request for special consideration by submitting the form available from the Student Desk in the Chancellery. Medical certificates or other appropriate documents must be included. Students should also advise the lecturer.

Students who have a disability that requires some adjustment in their teaching or learning environment are encouraged to discuss their study needs with the course convener prior to, or at the commencement of, their course, or with the Equity Officer (Disability) in the Equity and Diversity Unit (9385 4734 or www.equity.unsw.edu.au/disabil.html). Early notification is essential to enable any necessary adjustments to be made. Information on designing courses and course outlines that take into account the needs of students with disabilities can be found at: www.secretariat.unsw.edu.au/acboardcom/minutes/coe/disabilityguidelines.pdf

Plagiarism

Plagiarism is using the words or ideas of others and presenting them as your own. Plagiarism is a type of intellectual theft. It can take many forms, from deliberate cheating to accidentally copying from a source without acknowledgement.

Plagiarism is viewed very seriously. All students are expected go to the following website and make themselves familiar with the definition of plagiarism: www.lc.unsw.edu.au/onlib/plag.html and UNSW penalties: my.unsw.edu.au/student/academiclife/assessment/AcademicMisconductStudentMisconduct.html