UNSW Course Outline

MATS3006 Design and Application of Materials in Science and Engineering 3 - 2024

Published on the 22 May 2024

General Course Information

Course Code : MATS3006
Year : 2024
Term : Term 2
Teaching Period : T2
Is a multi-term course? : No
Faculty : Faculty of Science
Academic Unit : School of Materials Science & Engineering
Delivery Mode : In Person
Delivery Format : Standard
Delivery Location : Kensington
Campus : Sydney
Study Level : Undergraduate
Units of Credit : 6

Useful Links

Handbook Class Timetable

Course Details & Outcomes

Course Description

This capstone course introduces the use of computational modelling in design and applications

in material engineering. The principles and numerical methods of computer-aided design, computational fluid dynamics and finite element analysis will be covered in lectures. The course emphasizes hands-on experience in using cutting-edge CAD (computer-aided design), CFD (computational fluid dynamics) and FEA (finite element analysis) software packages to solve real-world problems in materials engineering involving mechanical structures and fluid flow. The course includes lectures to introduce the principles and methods and computer lab sessions to build high-level modelling practices. Students are expected to have basic knowledge on mechanical properties of materials, fluid dynamics and heat transfer

Course Aims

The aim of this course is to equip students with theoretical knowledge and practical tools to solve the complex problems relating to mechanical structures and transport phenomena.

Course Learning Outcomes

Course Learning Outcomes
CLO1 : Solve complex problems in materials engineering involving mechanical structure and fluid flows using commercial software packages.
CLO2 : Manually solve simple mechanical structure and fluid flow related problems based on the governing equations and basic numerical methods.
CLO3 : Critically assess the validity and accuracy of numerical solutions.
CLO4 : Provide sensible interpretation to the numerical solutions.
CLO5 : Communicate effectively to explain problems and solutions in written format.

Course Learning Outcomes	Assessment Item
CLO1 : Solve complex problems in materials engineering involving mechanical structure and fluid flows using commercial software packages.	• Assignment 2 • Mid-term Test • Assignment 1
CLO2 : Manually solve simple mechanical structure and fluid flow related problems based on the governing equations and basic numerical methods.	• Final Exam • Assignment 2 • Mid-term Test • Assignment 1
CLO3 : Critically assess the validity and accuracy of numerical solutions.	• Final Exam • Assignment 2 • Mid-term Test • Assignment 1
CLO4 : Provide sensible interpretation to the numerical solutions.	• Final Exam • Assignment 2 • Mid-term Test • Assignment 1
CLO5 : Communicate effectively to explain problems and solutions in written format.	• Final Exam • Assignment 1

Learning and Teaching Technologies

Moodle - Learning Management System | Echo 360

Learning and Teaching in this course

Lectures: The core concepts will be taught in lectures, students will have access to the lectures notes before class for annotation during the lecture. Students will be engaged in the learning process through class discussions and problem-solving questions independently and working together with partners and groups.

Tutorial: Tutorials will consolidate the students learning of the core concepts through shortanswer and problem-solving questions. Students will have the chance to work collaboratively in class and independently outside of class.

Lab practices: Lab practices are scheduled as appropriate with progress in theory. Students will learn how to use commercial software packages to solve real-world problems.

Assessments

Assessment Structure

Assessment Item	Weight	Relevant Dates
Assignment 2 Assessment Format: Individual	20%	Start Date: Not Applicable Due Date: Week 5: 24 June - 30 June
Mid-term Test Assessment Format: Individual	30%	Start Date: Not Applicable Due Date: Week 5: 24 June - 30 June
Assignment 1 Assessment Format: Individual	20%	Start Date: Not Applicable Due Date: Week 10: 29 July - 04 August
Final Exam Assessment Format: Individual	30%	Start Date: Not Applicable Due Date: Week 12: 12 August - 18 August

Assessment Details

Assignment 2

Assessment Overview

You will develop analytical solutions, using finite element theory, to basic mechanical loading problems. You will also use ANSYS FE software to numerically solve a complex mechanical loading problem involving a range of materials.

The assignment will be handed out in week 7 and submitted in week 10.

Feedback will be given two weeks after submission, including the solutions and your marked assignment with comments.

Course Learning Outcomes

- CLO1 : Solve complex problems in materials engineering involving mechanical structure and fluid flows using commercial software packages.
- CLO2 : Manually solve simple mechanical structure and fluid flow related problems based on

the governing equations and basic numerical methods.
- CLO3 : Critically assess the validity and accuracy of numerical solutions.
- CLO4 : Provide sensible interpretation to the numerical solutions.

Assignment submission Turnitin type

Not Applicable

Mid-term Test

Assessment Overview

The mid-term test will cover the CFD part and typically occurs in Week 5. It consists of a theoretical and a practical part.

The 100-min theoretical part includes short-answer and calculation questions.

The 90-min practical test is conducted in the computer lab to solve a complex CFD problem using software packages.

Feedback: Students will receive their marked exams indicating what questions were answered correctly and incorrectly. Overall comments and worked solutions may be provided to the class.

Course Learning Outcomes

- CLO1 : Solve complex problems in materials engineering involving mechanical structure and fluid flows using commercial software packages.
- CLO2 : Manually solve simple mechanical structure and fluid flow related problems based on the governing equations and basic numerical methods.
- CLO3 : Critically assess the validity and accuracy of numerical solutions.
- CLO4 : Provide sensible interpretation to the numerical solutions.

Assignment submission Turnitin type

Not Applicable

Hurdle rules

Satisfactory completion of the course includes the requirement to achieve >35% in the mid-term exam and >35% in the final exam, and >45% weighted average over the two exams. Students who fail to achieve this will be awarded an Unsatisfactory Fail (UF) grade for the course regardless if they receive over 50% in total for the course.

Assignment 1

Assessment Overview

You are required to solve problems relating to fluid flow and heat transfer either manually or using software packages and submit a report of your solutions in the format of a scientific paper.

The assignment will be handed out in week 3 and submitted in week 7.

Feedback will be given two weeks after submission, including the solutions and your marked assignment with comments.

Hurdle requirement: You are required to attend at least 3 lab sessions and submit your results before you can submit the assignment.

Course Learning Outcomes

- CLO1 : Solve complex problems in materials engineering involving mechanical structure and fluid flows using commercial software packages.
- CLO2 : Manually solve simple mechanical structure and fluid flow related problems based on the governing equations and basic numerical methods.
- CLO3 : Critically assess the validity and accuracy of numerical solutions.
- CLO4 : Provide sensible interpretation to the numerical solutions.
- CLO5 : Communicate effectively to explain problems and solutions in written format.

Assignment submission Turnitin type

Not Applicable

Final Exam

Assessment Overview

The exam will typically be 2 hours in duration held in the final exam period. It assesses understanding of the finite-element theory learnt in the second part of the course. The questions are in the form of short answers, which you are required to write your answers in short paragraphs to demonstrate your understanding of the basic concepts behind FEA, as well as solving simple FEA problems numerically.

Feedback may be available through inquiry with the course convenor.

Course Learning Outcomes

- CLO2 : Manually solve simple mechanical structure and fluid flow related problems based on

the governing equations and basic numerical methods.
- CLO3 : Critically assess the validity and accuracy of numerical solutions.
- CLO4 : Provide sensible interpretation to the numerical solutions.
- CLO5 : Communicate effectively to explain problems and solutions in written format.

Assignment submission Turnitin type

Not Applicable

Hurdle rules

Satisfactory completion of the course includes the requirement to achieve >35% in the mid-term exam and >35% in the final exam, and >45% weighted average over the two exams. Students who fail to achieve this will be awarded an Unsatisfactory Fail (UF) grade for the course regardless if they receive over 50% in total for the course.

General Assessment Information

Grading Basis

Standard

Requirements to pass course

Students who fail to achieve a mark of >30% on each exam and >45% exam weighted average (i.e., mid-session exam and final exam), but achieve a final mark >50% for the course, will be awarded a UF (Unsatisfactory Fail) for the course

Course Schedule

Teaching Week/Module	Activity Type	Content
Week 1 : 27 May - 2 June	Blended	• Introduction of the course • Revision of elastic theory • Lecture exercises • Lab practice
Week 2 : 3 June - 9 June	Blended	• Finite element modelling Bar and beam elements, the stiffness method • Lecture exercises • Lab practice Assignment handed out • Assignment 1 handed out
Week 3 : 10 June - 16 June	Blended	• Principle of virtual work • Lecture exercises • Lab practice
Week 4 : 17 June - 23 June	Blended	• Principle of virtual work • 4-noded rectangular element • Lab practice Assignment due • Assignment 1 due
Week 5 : 24 June - 30 June	Blended	• Tutorial and revision of FEM • Mid-term exam
Week 7 : 8 July - 14 July	Blended	• Introduction of CFD, revision of fluid dynamics and heat transfer • Computer-aided design • Lab on geometry creation using Ansys Spaceclaim
Week 8 : 15 July - 21 July	Blended	• Basic CFD discretisation and solution techniques • Lab on Meshing
Week 9 : 22 July - 28 July	Blended	• CFD Result analysis, consistence and stability, convergence criteria • Practical guideline for CFD simulations • Lab on Fluent
Week 10 : 29 July - 4 August	Blended	• Applications of CFD and multiphase flow • Lab on particle tracking • Tutorial and revision of CFD • Assignment 2 due

Attendance Requirements

Students are strongly encouraged to attend the lecture classes. While the lectures and the slides will be recorded, writting on the whiteboard will not be availabe in the recordings. Lab practices are not recorded and students are requird to attend all the lab practices.

Course Resources

Prescribed Resources

- *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)*
- *J. Tu, G. H. Yeoh and C. Liu, "Computational Fluid Dynamics – A Practical Approach" (Available online)*

Recommended Resources

- *E. Kreyzig, "Advanced Engineering Mathematics"*
- *R. F. Cooke, "Finite Element Modelling for Stress Analysis"*
- *J.D. Anderson, "Computational Fluid Dynamics – The Basics with Applications"*

Course Evaluation and Development

- *Students will receive feedback on in-class formative laboratory classes prior to the Census date.*
- *Assignments: Feedback will be given two weeks after submission of the assignment and take the form of the mark for the assignment, overall comments on how the class performed, any common areas that were not answered correctly. Additionally, personal feedback and how each student performed may be given.*
- *Midsession exams: Students will receive their marked exams indicating what questions were answered correctly and incorrectly. Overall comments and worked solutions may be provided to the class.*
- *Final exam: Students will receive their final mark from myUNSW.*

Staff Details

Position	Name	Email	Location	Phone	Availability	Equitable Learning Services Contact	Primary Contact
Convenor	Runyu Yang		Room 349 Hilmer Building E10		By appointment	Yes	Yes
Lecturer	Jack Yang				By appointment	No	No

Other Useful Information

Academic Information

Upon your enrolment at UNSW, you share responsibility with us for maintaining a safe, harmonious and tolerant University environment.

You are required to:

- Comply with the University's conditions of enrolment.
- Act responsibly, ethically, safely and with integrity.
- Observe standards of equity and respect in dealing with every member of the UNSW community.
- Engage in lawful behaviour.
- Use and care for University resources in a responsible and appropriate manner.
- Maintain the University's reputation and good standing.

For more information, visit the UNSW Student Code of Conduct Website.

Academic Honesty and Plagarism

Referencing is a way of acknowledging the sources of information that you use to research your assignments. You need to provide a reference whenever you draw on someone else's words,

ideas or research. Not referencing other people's work can constitute plagiarism.
Further information about referencing styles can be located at https://student.unsw.edu.au/referencing

Academic integrity is fundamental to success at university. Academic integrity can be defined as a commitment to six fundamental values in academic pursuits: honesty, trust, fairness, respect, responsibility and courage. At UNSW, this means that your work must be your own, and others' ideas should be appropriately acknowledged. If you don't follow these rules, plagiarism may be detected in your work.
Further information about academic integrity, plagiarism and the use of AI in assessments can be located at:

- The Current Students site,
- The ELISE training site, and
- The Use of AI for assessments site.

The Student Conduct and Integrity Unit provides further resources to assist you to understand your conduct obligations as a student: https://student.unsw.edu.au/conduct

Submission of Assessment Tasks

Penalty for Late Submissions

UNSW has a standard late submission penalty of:

- 5% per day,
- for all assessments where a penalty applies,
- capped at five days (120 hours) from the assessment deadline, after which a student cannot submit an assessment, and
- no permitted variation.

Any variations to the above will be explicitly stated in the Course Outline for a given course or assessment task.

Students are expected to manage their time to meet deadlines and to request extensions as early as possible before the deadline.

Special Consideration

If circumstances prevent you from attending/completing an assessment task, you must officially apply for special consideration, usually within 3 days of the sitting date/due date. You can apply by logging onto myUNSW and following the link in the My Student Profile Tab. Medical

documentation or other documentation explaining your absence must be submitted with your application. Once your application has been assessed, you will be contacted via your student email address to be advised of the official outcome and any actions that need to be taken from there. For more information about special consideration, please visit: https://student.unsw.edu.au/special-consideration

Important note: UNSW has a "fit to sit/submit" rule, which means that if you sit an exam or submit a piece of assessment, you are declaring yourself fit to do so and cannot later apply for Special Consideration. This is to ensure that if you feel unwell or are faced with significant circumstances beyond your control that affect your ability to study, you do not sit an examination or submit an assessment that does not reflect your best performance. Instead, you should apply for Special Consideration as soon as you realise you are not well enough or are otherwise unable to sit or submit an assessment.

Faculty-specific Information

Additional support for students

- The Current Students Gateway
- Student Support
- Academic Skills and Support
- Student Wellbeing, Health and Safety
- Equitable Learning Services
- UNSW IT Service Centre
- Science EDI Student Initiatives, Offerings and Guidelines