UNSW Course Outline

MECH3610 Advanced Thermofluids - 2024

Published on the 12 Jul 2024

General Course Information

Course Code : MECH3610
Year : 2024
Term : Term 2
Teaching Period : T2
Is a multi-term course? : No
Faculty : Faculty of Engineering
Academic Unit : School of Mechanical and Manufacturing Engineering
Delivery Mode : In Person
Delivery Format : Standard
Delivery Location : Kensington
Campus : Sydney
Study Level : Postgraduate, Undergraduate
Units of Credit : 6

Useful Links

Handbook Class Timetable

Course Details & Outcomes

Course Description

How is heat transferred between objects? What are the challenges of supersonic flight, and how are rockets designed? These are some of the questions you will be able to answer after this course.

Welcome to ‘Advanced Thermofluids’, which aims to further develop your foundational knowledge introduced in your Thermodynamics and Fluid Mechanics courses. This course will cover the main modes of heat transfer, conduction, convection, and radiation. Knowledge of these areas will be applied to heat exchanger and cooling fin design through both theory and experiments. We will explore the fluid dynamics of high-speed compressible flows and shock waves. Finally, non-reacting gas mixtures/combustion and their energy release will be discussed. We will delve into how these topics play a role in our everyday lives and are linked with many facets of Engineering roles in industry.

The topics covered will prepare students for later electives within their programs and to raise a fundamental awareness of these fields for those who do not take the elective extension subjects later in their program.

Course Aims

This course further develops foundational Thermofluids concepts first introduced in Thermodynamics and Fluid Mechanics courses. This course is split into one large component and two small components and aims to introduce students to:

- Heat transfer modes conduction, convection and radiation modes of heat transfer to idealized analysis cases
- Compressible flow analysis and assess whether compressibility needs to be considered for a stated case, particularly the design of nozzles and shocks.
- Thermodynamic analysis of gas mixtures and combustion and their energy release

Course Learning Outcomes

Course Learning Outcomes
CLO1 : Apply steady-state and transient conduction, convection and radiation modes of heat transfer to idealized analysis cases. Extend this analysis to the particular cases of heat exchangers and cooling fins.
CLO2 : Undertake compressible flow analysis and assess whether compressibility needs to be considered for a stated case.
CLO3 : Undertake thermodynamic analysis of gas mixtures /combustion and their energy release

Course Learning Outcomes	Assessment Item
CLO1 : Apply steady-state and transient conduction, convection and radiation modes of heat transfer to idealized analysis cases. Extend this analysis to the particular cases of heat exchangers and cooling fins.	• Laboratory Report • Mid Term Quiz
CLO2 : Undertake compressible flow analysis and assess whether compressibility needs to be considered for a stated case.	• Assignment • Final exam
CLO3 : Undertake thermodynamic analysis of gas mixtures / combustion and their energy release	• Final exam

Learning and Teaching Technologies

Moodle - Learning Management System | Microsoft Teams

Assessments

Assessment Structure

Assessment Item	Weight	Relevant Dates
Laboratory Report Assessment Format: Individual	20%	Start Date: 10/06/2024 12:00 AM Due Date: 12/07/2024 11:59 PM
Mid Term Quiz Assessment Format: Individual	30%	Start Date: 26/06/2024 04:30 PM Due Date: 26/06/2024 06:30 PM
Assignment Assessment Format: Individual	20%	Start Date: 08/07/2024 12:00 AM Due Date: 26/07/2024 11:59 PM
Final exam Assessment Format: Individual	30%	Due Date: Exam Period, date TBC

Assessment Details

Laboratory Report

Assessment Overview

Assessment length: ~10 pages

This task will involve completing two laboratories in small groups. It will enable you to validate the theory with practical laboratory exercises, including a laboratory report demonstrating your knowledge of heat transfer theory and data analysis. This report will develop your technical writing and communication skills and analytical ability regarding heat transfer.

Marks will be returned two weeks after submission with individualised feedback.

Course Learning Outcomes

- CLO1 : Apply steady-state and transient conduction, convection and radiation modes of heat transfer to idealized analysis cases. Extend this analysis to the particular cases of heat exchangers and cooling fins.

Assessment Length

10 pages

Submission notes

Via Moodle

Assignment submission Turnitin type

This assignment is submitted through Turnitin and students do not see Turnitin similarity reports.

Mid Term Quiz

Assessment Overview

Assessment length: 2 Hours

This quiz will cover the Heat Transfer content delivered, which includes the main modes of heat transfer, conduction, convection, radiation and the application of heat transfer analysis to heat exchangers and cooling fins.

Marks will be returned two weeks after submission with individualised feedback.

Course Learning Outcomes

- CLO1 : Apply steady-state and transient conduction, convection and radiation modes of heat transfer to idealized analysis cases. Extend this analysis to the particular cases of heat exchangers and cooling fins.

Detailed Assessment Description

This assessment will be conducted **in-person** on Wednesday from 4:30 pm to 6:30 pm during Week 5. Students are required to be present 30 minutes before the commencement time. Further information on the Mid-Term and venue will be provided.

Students will be required to submit both their handwritten working (answer booklet) and their final answers (directly in the Moodle quiz).

Assessment Length

2 Hours

Submission notes

Via Moodle and hand written working

Assignment submission Turnitin type

This is not a Turnitin assignment

Assignment

Assessment Overview

Assessment length: ~10 pages

This assignment will test your understanding of the compressible flow material covered in this course.

Marks will be returned two weeks after submission with individualised feedback

Course Learning Outcomes

- CLO2 : Undertake compressible flow analysis and assess whether compressibility needs to be considered for a stated case.

Assessment Length

10 pages

Submission notes

Via Moodle

Assignment submission Turnitin type

This assignment is submitted through Turnitin and students do not see Turnitin similarity reports.

Final exam

Assessment Overview

Assessment length: 2 Hours

Final exam covering compressible flow, mixtures and combustion components of the course.

Course Learning Outcomes

- CLO2 : Undertake compressible flow analysis and assess whether compressibility needs to be considered for a stated case.
- CLO3 : Undertake thermodynamic analysis of gas mixtures /combustion and their energy release

Assignment submission Turnitin type

This is not a Turnitin assignment

General Assessment Information

Formative Quiz

There will be a Moodle quiz held in Week 4 to allow students to verify that they have understood the material so far. This quiz has a zero percent (0%) weighting and does not contribute to your overall course mark; however, students are encouraged to participate.

Start date: 17/06/2024 12:00 AM
Assessment length: 2 hours
Due date: 21/06/2024 11:59 PM
Deadline for absolute fail: N/A
Marks returned: Individual submission and marks returned after submission

Grading Basis

Standard

Course Schedule

Teaching Week/Module	Activity Type	Content
Week 1 : 27 May - 2 June	Lecture	Introduction / Conduction Topics: Heat Transfer Overview; Units and Dimensions; Conduction
	Workshop	Topics: Week 1 Lecture material
Week 2 : 3 June - 9 June	Lecture	Conduction and Transience Topics: 1D Steady-State Conduction; Extended Fins; Lumped Capacitance Method.
	Workshop	Topics: Week 2 Lecture material
Week 3 : 10 June - 16 June	Lecture	Convection Topics: Forced / Free (Natural) Convection
	Workshop	Topics: Week 3 Lecture material
	Laboratory	Topic: Convection (Further details will be provided on Moodle)
Week 4 : 17 June - 23 June	Lecture	Heat Exchangers / Radiation Topic: Heat Exchanger Types; LMTD method; Blackbody Radiation
	Workshop	Topics: Week 4 Lecture material
	Laboratory	Topic: Heat Exchangers (Further details will be provided on Moodle)
	Assessment	Formative Quiz
Week 5 : 24 June - 30 June	Lecture	Radiation / Fluids Topic: Radiative Heat Transfer / Compressible Flow
	Workshop	Topics: Week 5 Lecture material
	Assessment	Mid Term Quiz
Week 7 : 8 July - 14 July	Lecture	Fluids Topic: Mach Number / Stagnation Flow conditions; Nozzles;
	Workshop	Topics: Week 7 Lecture material
	Assessment	Laboratory Report submission: Via Moodle
Week 8 : 15 July - 21 July	Lecture	Fluids Topic: Normal shocks; Oblique shocks
	Workshop	Topics: Week 8 Lecture material
Week 9 : 22 July - 28 July	Lecture	Mixtures / Combustion Topic: Ideal Gas Mixtures; Partial Pressures
	Workshop	Topics: Week 9 Lecture material
	Assessment	Assignment submission: Via Moodle
Week 10 : 29 July - 4 August	Lecture	Mixtures / Combustion Topic: Chemical Equation Balancing; Heat of Combustion; Adiabatic Flame Temperature
	Workshop	Topics: Week 10 Lecture material

Attendance Requirements

Students are strongly encouraged to attend all classes and review lecture recordings.

Course Resources

Recommended Resources

ÇG: Heat and Mass Transfer, Fundamentals and Applications, 5th/6th Edition in SI Units by Yunus Çengel and Afshin Ghajar

A: Fundamentals of Aerodynamics, 6th Edition by John Anderson

ÇB: Thermodynamics, An Engineering Approach, 8th Edition in SI Units by Yunus Çengel and Michael Boles

UNSW Library website: https://www.library.unsw.edu.au/

Moodle: https://moodle.telt.unsw.edu.au/login/index.php/

Course Evaluation and Development

Feedback on the course is gathered periodically using various means, including the UNSW myExperience process, informal discussion in the final class for the course, and the School's Student/Staff meetings. Your feedback is taken seriously, and continual improvements are made to the course based, in part, on such feedback.

In this course, recent improvements resulting from student feedback include restructuring the course to group the heat transfer material and related content which may be useful to a graduate engineer in industry. Also, online classes and communication is via Microsoft Teams.

Staff Details

Position	Name	Email	Location	Phone	Availability	Equitable Learning Services Contact	Primary Contact
Convenor	Charitha de Silva		J17 Ainsworth Building Room 311/ H	Teams	Contact via Microsoft Teams Chat	No	Yes

Other Useful Information

Academic Information

I. Special consideration and supplementary assessment

If you have experienced an illness or misadventure beyond your control that will interfere with your assessment performance, you are eligible to apply for Special Consideration prior to, or within 3 working days of, submitting an assessment or sitting an exam.

Please note that UNSW has a Fit to Sit rule, which means that if you sit an exam, you are declaring yourself fit enough to do so and cannot later apply for Special Consideration.

For details of applying for Special Consideration and conditions for the award of supplementary assessment, please see the information on UNSW's Special Consideration page.

II. Administrative matters and links

All students are expected to read and be familiar with UNSW guidelines and polices. In particular, students should be familiar with the following:

- Attendance
- UNSW Email Address
- Special Consideration
- Exams
- Approved Calculators
- Academic Honesty and Plagiarism
- Equitable Learning Services

III. Equity and diversity

Those 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 Equitable Learning Services. 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.

IV. Professional Outcomes and Program Design

Students are able to review the relevant professional outcomes and program designs for their streams by going to the following link: https://www.unsw.edu.au/engineering/student-life/student-resources/program-design.

Note: This course outline sets out the description of classes at the date the Course Outline is published. The nature of classes may change during the Term after the Course Outline is published. Moodle or your primary learning management system (LMS) should be consulted for the up-to-date class descriptions. If there is any inconsistency in the description of activities between the University timetable and the Course Outline/Moodle/LMS, the description in the Course Outline/Moodle/LMS applies.

Academic Honesty and Plagarism

UNSW has an ongoing commitment to fostering a culture of learning informed by academic integrity. All UNSW students have a responsibility to adhere to this principle of academic integrity. Plagiarism undermines academic integrity and is not tolerated at UNSW. *Plagiarism at UNSW is defined as using the words or ideas of others and passing them off 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. UNSW has produced a website with a wealth of resources to support students to understand and avoid plagiarism, visit: student.unsw.edu.au/plagiarism. The Learning Centre assists students with understanding academic integrity and how not to plagiarise. They also hold workshops and can help students one-on-one.

You are also reminded that careful time management is an important part of study and one of the identified causes of plagiarism is poor time management. Students should allow sufficient time for research, drafting and the proper referencing of sources in preparing all assessment tasks.

Repeated plagiarism (even in first year), plagiarism after first year, or serious instances, may also be investigated under the Student Misconduct Procedures. The penalties under the procedures can include a reduction in marks, failing a course or for the most serious matters (like plagiarism in an honours thesis or contract cheating) even suspension from the university. The Student Misconduct Procedures are available here:

www.gs.unsw.edu.au/policy/documents/studentmisconductprocedures.pdf

Submission of Assessment Tasks

Work submitted late without an approved extension by the course coordinator or delegated authority is subject to a late penalty of five percent (5%) of the maximum mark possible for that assessment item, per calendar day.

The late penalty is applied per calendar day (including weekends and public holidays) that the assessment is overdue. There is no pro-rata of the late penalty for submissions made part way through a day. This is for all assessments where a penalty applies.

Work submitted after five days (120 hours) will not be accepted and a mark of zero will be awarded for that assessment item.

For some assessment items, a late penalty may not be appropriate. These will be clearly indicated in the course outline, and such assessments will receive a mark of zero if not completed by the specified date. Examples include:

- Weekly online tests or laboratory work worth a small proportion of the subject mark;
- Exams, peer feedback and team evaluation surveys;

- Online quizzes where answers are released to students on completion;
- Professional assessment tasks, where the intention is to create an authentic assessment that has an absolute submission date; and,
- Pass/Fail assessment tasks.

Faculty-specific Information

Engineering Student Support Services – The Nucleus - enrolment, progression checks, clash requests, course issues or program-related queries

Engineering Industrial Training – Industrial training questions

UNSW Study Abroad – study abroad student enquiries (for inbound students)

UNSW Exchange – student exchange enquiries (for inbound students)

UNSW Future Students – potential student enquiries e.g. admissions, fees, programs, credit transfer

Phone

(+61 2) 9385 8500 – Nucleus Student Hub

(+61 2) 9385 7661 – Engineering Industrial Training

(+61 2) 9385 3179 – UNSW Study Abroad and UNSW Exchange (for inbound students)

School-specific Information

Short Extensions

Short extensions are not currently applicable to Mechanical and Manufacturing Engineering Courses.

Review of Results

The purpose of a review of results is if there was a marking error. Review of results is for when you have cause to believe that there is a marking error. Review of Results cannot be used to get feedback. If you would like feedback for assessments prior to the final exam, you are welcome to contact the course convenor directly. No feedback will be provided on final exams.

Use of AI

The use of AI is prohibited unless explicitly permitted by the course convenor. Please respect this and be aware that penalties will apply when unauthorised use is detected, such as through Turnitin. If the use of generative AI, such as ChatGPT, is allowed in a specific assessment, they must be properly credited, and your submissions must be substantially your own work.

School Contact Information

Location

UNSW Mechanical and Manufacturing Engineering

Ainsworth building J17, Level 1

Above Coffee on Campus

Hours

9:00–5:00pm, Monday–Friday*

*Closed on public holidays, School scheduled events and University Shutdown

Web

School of Mechanical and Manufacturing Engineering

Engineering Student Support Services

Engineering Industrial Training

UNSW Study Abroad and Exchange (for inbound students)

UNSW Future Students

Phone

(+61 2) 9385 8500 – Nucleus Student Hub

(+61 2) 9385 7661 – Engineering Industrial Training

(+61 2) 9385 3179 – UNSW Study Abroad and UNSW Exchange (for inbound students)

(+61 2) 9385 4097 – School Office**

**Please note that the School Office will not know when/if your course convenor is on campus or available

Email

Engineering Student Support Services – current student enquiries

- e.g. enrolment, progression, clash requests, course issues or program-related queries

Engineering Industrial Training – Industrial training questions

UNSW Study Abroad – study abroad student enquiries (for inbound students)

UNSW Exchange – student exchange enquiries (for inbound students)

UNSW Future Students – potential student enquiries

- e.g. admissions, fees, programs, credit transfer

School Office – School general office administration enquiries

- NB: the relevant teams listed above must be contacted for all student enquiries. The School will only be able to refer students on to the relevant team if contacted

Important Links

- Student Wellbeing
- Urgent Mental Health & Support
- Equitable Learning Services
- Faculty Transitional Arrangements for COVID-19
- Moodle
- Lab Access
- Computing Facilities
- Student Resources
- Course Outlines
- Makerspace
- UNSW Timetable
- UNSW Handbook