Mechanical and Manufacturing Engineering

Course Outline

Term 2 2020

MECH 3610

ADVANCED THERMOFLUIDS

Contents

1. Staff contact details

Contact details and consultation times for course convenor

Name: Dr Charitha de Silva
Office location: J17 Ainsworth Building Room 311/H
Email: c.desilva@unsw.edu.au
Moodle: Charitha De Silva
Microsoft Teams Chat Hours: Contact via teams Chat or Moodle Forum page

Contact details and consultation times for additional lecturers/demonstrators/lab staff

Head Demonstrator

Name: Momar Hughes
Email: momar.hughes@unsw.edu.au

All non-personal matters should be addressed through forums in the first instance. Personal administrative matters should be directed to the Head Demonstrator, then to the Course Convener only if matters remain unresolved.

Other Demonstrators

Joshua Pham
Kevin Chen
Matthew Brand
Timothy Davis
Shantanu Kumthekar

Please see the course Moodle.

2. Important links

- Moodle
- Lab Access
- Health and Safety
- Computing Facilities
- Student Resources
- Course Outlines
- Engineering Student Support Services Centre
- Makerspace
- UNSW Timetable
- UNSW Handbook
- UNSW Mechanical and Manufacturing Engineering

3. Course details

Credit points

This is a 6 unit-of-credit (UoC) course and involves 6 hours per week (h/w) of scheduled online contact.

The normal workload expectations of a student are approximately 25 hours per term for each UOC, including class contact hours, other learning activities, preparation and time spent on all assessable work.

You should aim to spend about 15 h/w on this course. The additional time should be spent in making sure that you understand the lecture material, completing the set assignments, further reading, and revising for any examinations.

Contact hours

<table>
<tr><th></th><th>Day</th><th>Time</th><th>Location</th></tr>
<tr><td rowspan="2">Lectures</td><td>Monday</td><td>11am - 1pm</td><td rowspan="2">Microsoft Teams</td></tr>
<tr><td>Wednesday</td><td>1pm - 3pm</td></tr>
<tr><td></td><td></td><td></td><td></td></tr>
<tr><td rowspan="6">Problem Solving Sessions</td><td rowspan="4">Thursday</td><td>9am – 11am</td><td rowspan="6">Microsoft Teams</td></tr>
<tr><td>11am – 1pm</td></tr>
<tr><td>2pm – 4pm</td></tr>
<tr><td>4pm – 6pm</td></tr>
<tr><td rowspan="2">Friday</td><td>11am – 1pm</td></tr>
<tr><td>1pm – 3pm</td></tr>
<tr><td></td><td></td><td></td><td></td></tr>
<tr><td>Laboratories</td><td colspan="3">See Moodle for details</td></tr>
</table>

All classes in T2 2020 will be online. Please consult this course's Moodle module for details about delivery.

Summary and Aims of the course

This course is split into 1 large component and 2 small components: heat transfer (50%), advanced fluids, gas mixtures /combustion.

The heat transfer component of the course aims to teach students the basic concepts of heat transfer, units, dimensions and exchange mechanisms. This includes steady-state conduction, multi-dimensional conduction and radiative heat transfer. Knowledge of these areas will be applied to heat exchanger and cooling fin design, which will include experiments on heat transfer mechanisms to validate theoretical calculations.

Heat transfer is commonly an important aspect of design and analysis in mechanical engineering whenever a component or process has a significant temperature differential.

Advanced fluids will also be covered, including the structure of boundary layers, internal and external laminar flow and turbulent forced convection. Also covered are compressible flows and shocks. Finally, non-reacting gas mixtures / combustion will be introduced.

The aim of covering these smaller topics is to prepare students for later electives within the course of mechanical engineering and to raise a fundamental awareness of these fields for those who do not take the elective extension subjects later in their program.

Student learning outcomes

This course is designed to address the learning outcomes below and the corresponding Engineers Australia Stage 1 Competency Standards for Professional Engineers as shown. The full list of Stage 1 Competency Standards may be found in Appendix A.

After successfully completing this course, you should be able to:

Learning Outcome		EA Stage 1 Competencies
1.	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.	PE1.3, PE2.1
2.	Undertake compressible flow analysis and assess whether compressibility needs to be considered for a stated case.	PE1.2, PE1.3
3.	Appreciate the thermodynamics of gas mixtures /combustion and their energy release	PE 1.2, 1.3, PE1.6

4. Teaching strategies

Lectures are designed to cover the theoretical aspects of the course listed in the course schedule. Students are encouraged to attend and actively participate to gain the greatest understanding from these lectures.

The Textbooks are recommended reading throughout the course to supplement theory covered in class.

Problem solving sessions provide the opportunity for students to test their conceptual framework on problems.

The Laboratories focus on the Heat Transfer component of the course and provide students the opportunity to compare specific parts of the theory to practical results in a controlled environment. This is to encourage students to consider the practical implications of their theoretical learning.

The Assignment will cover theory from the second half of the course and give students the opportunity to research a specific area of engineering knowledge in depth.

Forum discussions provide an opportunity to further explore and discuss content. Students are encouraged to seek other learning resources and share them on the forums for the benefit of all.

5. Course schedule

Week	Date	Name	Topics	Reading**
1	1 -5 June	Introduction / Conduction	Heat Transfer Overview; Units and Dimensions; Conduction	ÇG: 1 & 2
2	8 -12 June	Conduction and Transience	1D Steady State Conduction; Extended Fins; Lumped Capacitance Method.	ÇG 3, 4 & 5
3	15 -19 June	Convection	Convection; Forced / Free (Natural) Convection	ÇG: 6 & 7
4	22-26 June	Heat Exchangers / Radiation	Heat Exchanger Types; LMTD method; Blackbody Radiation;	ÇG: 8, 9, 11, 12 & 13
5	29 June – 3 July	Radiation / Fluids	Radiative Heat Transfer / Compressible Flow **Mid-Term Exam**	ÇG:: 14 & A: 7
6	6– 10 July	Revision		
7	13-17 July	Fluids	Mach Number / Stagnation Flow conditions; Nozzles;	A: 8
8	20-24 July	Fluids	Normal shocks; Oblique shocks	A: 9 & 10
9	27 July – 31 July	Mixtures	Ideal Gas Mixtures; Partial Pressures	ÇB: 3-7, 3-8 & 13
10	3-7 Aug	Combustion	Chemical Equation Balancing; Heat of Combustion; Adiabatic Flame Temperature	ÇB: 15 & 16

**** Notes on recommended readings:**
ÇG: *Heat and Mass Transfer, Fundamentals and Applications*, 5th 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

6. Assessment

Assessment overview

Assessment	Group Project? (# Students per group)	Length	Weight	Learning outcomes assessed	Assessment criteria	Due date and submission requirements	Deadline for absolute fail	Marks returned
Heat Transfer Formative Quiz	No	2 hours	0%	1	Understanding of Heat Transfer content delivered so far.	Friday Week 4 26 June 2020 **via Moodle**	N/A	On closure of the quiz
Heat Transfer Laboratories	No	~10 pages	20%	1	Demonstrating heat transfer theory knowledge and data analysis through writing a laboratory report	Friday Week 8 24 Jul 2020 **via Moodle**	29 July 2020	Two weeks after submission
Mid-Term exam	No	2 hours	30%	1	Heat Transfer theory. Namely, content from weeks 1 to 4 inclusive.	Wednesday Week 5 1 July 2020 **via Moodle**	N/A	Two weeks after submission
Assignment	No	~10 pages	15%	2	Advanced Fluids, material from weeks 5-7.	Friday Week 9 31 July 2020 **via Moodle**	5 August 2020	Upon release of final results
Final exam	No	2 hours	35%	2, 3	Material from weeks 5 to 10	Exam period, date TBC	N/A	Upon release of final results

Assignments

Formative Quiz

There will be a Moodle quiz held in Week 4 to give students the opportunity 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.

The quiz will be open at the start of Week 4.

It is intended that the style and difficulty of the Moodle quiz will be representative of that in the Mid Term exam – although marking and feedback comments will be automatically applied by computer marking.

Presentation

All submissions are expected to be neat and clearly set out. Your results are the pinnacle of all your hard work and should be treated with due respect. Presenting results clearly gives the marker the best chance of understanding your method; even if the numerical results are incorrect.

Submission

The submission of online material should follow the instructions given on the appropriate Moodle page. Online submissions are required to be submitted via Moodle. No cover sheet is required as all assignments will be identified through your Moodle account.

Work submitted late without an approved extension by the course coordinator or delegated authority is subject to a late penalty of 20 percent (20%) 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.

Work submitted after the ‘deadline for absolute fail’ is not 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 are clearly indicated in the course outline, and such assessments receive a mark of zero if not completed by the specified date. Examples include:

a. Weekly online tests or laboratory work worth a small proportion of the subject mark, or
b. Online quizzes where answers are released to students on completion, or
c. Professional assessment tasks, where the intention is to create an authentic assessment that has an absolute submission date, or
d. Pass/Fail assessment tasks.

Marking

Marking guidelines for assignment submissions will be provided at the same time as assignment details to assist with meeting assessable requirements. Submissions will be marked according to the marking guidelines provided.

Examinations

You must be available for all quizzes, tests and examinations.

Final examinations for each course are held during the University examination periods: February for Summer Term, May for T1, August for T2, and November/December for T3.

Please visit myUNSW for Provisional Examination timetable publish dates.

For further information on exams, please see the Exams webpage.

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 submitting an assessment or sitting an exam.

Please note that UNSW now has a Fit to Sit / Submit rule, which means that if you attempt an exam or submit a piece of assessment, 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.

7. Expected resources for students

The following are the recommended textbooks for the course:

- *Heat and Mass Transfer, Fundamentals and Applications*, 5th Edition in SI Units by Yunus Çengel and Afshin Ghajar
- *Fundamentals of Aerodynamics*, 6th Edition by John Anderson
- *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

8. 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.

9. Academic honesty and plagiarism

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.

If plagiarism is found in your work when you are in first year, your lecturer will offer you assistance to improve your academic skills. They may ask you to look at some online resources, attend the Learning Centre, or sometimes resubmit your work with the problem fixed. However more serious instances in first year, such as stealing another student's work or paying someone to do your work, may be investigated under the Student Misconduct Procedures.

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) even suspension from the university. The Student Misconduct Procedures are available here:
www.gs.unsw.edu.au/policy/documents/studentmisconductprocedures.pdf

10. 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

Appendix A: Engineers Australia (EA) Competencies

Stage 1 Competencies for Professional Engineers

	Program Intended Learning Outcomes
PE1: Knowledge and Skill Base	PE1.1 Comprehensive, theory-based understanding of underpinning fundamentals
	PE1.2 Conceptual understanding of underpinning maths, analysis, statistics, computing
	PE1.3 In-depth understanding of specialist bodies of knowledge
	PE1.4 Discernment of knowledge development and research directions
	PE1.5 Knowledge of engineering design practice
	PE1.6 Understanding of scope, principles, norms, accountabilities of sustainable engineering practice
PE2: Engineering Application Ability	PE2.1 Application of established engineering methods to complex problem solving
	PE2.2 Fluent application of engineering techniques, tools and resources
	PE2.3 Application of systematic engineering synthesis and design processes
	PE2.4 Application of systematic approaches to the conduct and management of engineering projects
PE3: Professional and Personal Attributes	PE3.1 Ethical conduct and professional accountability
	PE3.2 Effective oral and written communication (professional and lay domains)
	PE3.3 Creative, innovative and pro-active demeanour
	PE3.4 Professional use and management of information
	PE3.5 Orderly management of self, and professional conduct
	PE3.6 Effective team membership and team leadership