



Mechanical and Manufacturing Engineering

Course Outline

Term 2 2019

MECH3610

ADVANCED THERMOFLUIDS

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1. Staff contact details

Contact details and consultation times for course convenor

Course Convenor

Name: Dr Charitha de Silva

Office location: J17 Ainsworth Building Room 311/H

Email: c.desilva@unsw.edu.au

Course Lecturer

Name: Naomi Tsafnat

Email: n.tsafnat@unsw.edu.au

Head Demonstrator

Name: Joshua Pham

Email: z5059367@zmail.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

Amin Hasanzadeh

Briscoe Kerferd

Kevin Chen

Matthew Brand

Momar Hughes

Moustafa Ali

Timothy Davis

Please see the course [Moodle](#).

2. Important links

- [Moodle](#)
- [Lab Access](#)
- [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 face-to-face 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

	Day	Time	Location
Lectures	Tuesday	4pm - 6pm	Rex Vowels Theatre (F17-LG3)
	Friday	11am - 1pm	Law Theatre(F8-G04)
Problem Solving Sessions	Wednesday	9am – 11am	Ainsworth 101 (J17-101)
		2pm – 4pm	
	Thursday	9am – 11am	Ainsworth 201 (J17-201)
		11am – 1pm	
		2pm – 4pm	
		4pm – 6pm	
Laboratories	Laboratories are held in Week 3 and 4 of Term in Willis Annexe 116A UG Lab (J18-116) Please refer to your enrolment details for which laboratory session you are booked to attend.		

Please refer to your class timetable for the learning activities you are enrolled in and attend only those classes.

Summary and Aims of the course

This course is split into 1 large component and 3 small components: heat transfer (45%), advanced fluids (25%), gas mixtures and psychrometric analysis (15%) and combustion (15%).

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 shock. Non-reacting gas mixtures and an introduction to psychrometric analysis will be covered. Finally, combustion, chemical equilibrium, chemical kinetics and emission control.

The aim of covering these smaller topics is to prepare students for later electives within the course of mechanical engineering and to raise at least 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.	Analyse combustion reactions and their energy release using chemical equilibrium and le Chatelier's principle.	PE1.2, PE1.3
4.	Appreciate the thermodynamics and human factor implications of humidity in air. Perform calculations to assess the absolute and relative humidity of air based on given data or after a process is performed.	PE1.3, 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.

Moodle 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	3 -7 June	Introduction to Heat Transfer / Conduction	Heat Transfer Overview; Units and Dimensions; Heat Diffusion Equation; Conduction	ÇG: 1 & 2
2	10 -14 June	Conduction and Transience	1D Steady State Conduction; Extended Fins; Transient Conduction; Lumped Capacitance Method.	ÇG 3, 4 & 5
3	17 -21 June	Convection	Convection; Forced / Free (Natural) Convection	ÇG: 6 & 7
4	23-28 June	Heat Exchangers / Radiation	Heat Exchanger Types; LMTD method; Blackbody Radiation; Radiative Heat Transfer	ÇG: 8, 9, 11, 12 & 13
5	30 June – 5 July	Radiation / Fluids	Compressible Flow; Mach Number Mid-Term Exam†	A: 7
6	7– 12 July	Fluids	Stagnation Flow conditions; Nozzles; Normal shocks	A: 8 & 10
7	15-19 July	Fluids	Oblique shocks; / Experimental Flow Diagnostics Assignment on Fluids†	A: 9
8	22-26 July	Mixtures	Ideal Gas Mixtures; Partial Pressures	ÇB: 3-7, 3-8 & 13
9	29 July – 2 Aug	Psychrometric Analysis	Humidity; Condensation; Human Comfort; Standards	ÇB: 14

Week	Date	Name	Topics	Reading**
10	5-9 Aug	Combustion	Maxwell's Relations; Chemical Equation Balancing; Heat of Combustion; Adiabatic Flame Temperature Chemical Equilibrium; Le Chatelier's principle	ÇB: 15 & 16
11	12 Aug	Revision		

**** 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

‡ See Section 6 for assessment details

6. Assessment

Assessment overview

Assessment	Length	Weight	Learning outcomes assessed	Assessment criteria	Due date and submission requirements	Deadline for absolute fail	Marks returned
Heat Transfer Formative Quiz	2 hours	0%	1	Understanding of Heat Transfer content delivered so far.	Friday Week 4 28 June 2019 On Moodle	N/A	On closure of the quiz
Heat Transfer Laboratories	10 pages	15%	1	Undertaking Laboratories; Demonstrating understanding through writing laboratory reports	Monday Week 7 15 Jul 2019, 5pm* On Moodle	Saturday Week 7 20 Jul 2019, 5pm	Week 9
Mid Term exam	2 hours	30%	1	Heat Transfer theory. Namely, content from Week 1 to 4 inclusive.	Friday Week 5 11am-1pm (during Lecture time)	N/A	Week 7
Assignment	10 pages	15%	2	Advanced Fluids, material from Week 5,6 & 7.	Friday Week 9 2 Aug 2019, 5pm* On Moodle	Wednesday Week 10, 7 Aug 2019, 5pm	With Final Results
Final exam	2 hours	40%	2, 3 & 4	Material from Weeks 5 to 10, focussing on content from Week 8, 9 & 10.	Exam period, date to be advised	N/A	Upon release of final results

* The laboratory report and assignment are due at 5pm, however no penalty will be applied until 11:55pm on the due date.

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 final Mid Term exam – although marking and feedback comments will be automatically applied by computer marking.

Assignments

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. *All digital assignments are due by 5pm on the due date.* An additional allowance will be granted automatically to submit assignments until 11:55pm without penalty, but you accept any risk of technical difficulties with submission. *If you try to submit between 5pm and 11:55pm and Moodle does not accept the submission for any reason, the assignment will be considered late.*

Work submitted late without an approved extension by the course coordinator or delegated authority is subject to a late penalty of 20 per cent (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. Late penalties are applied at 5pm on each subsequent day after the due date.

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 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.

Calculators

You will need to provide your own calculator of a make and model approved by UNSW for the examinations. The list of approved calculators is available at student.unsw.edu.au/exam-approved-calculators-and-computers

It is your responsibility to ensure that your calculator is of an approved make and model, and to obtain an “Approved” sticker for it from the [Engineering Student Support Services Centre](#) prior to the examination. Calculators not bearing an “Approved” sticker will not be allowed into the examination room.

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 sit 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 policies. In particular, students should be familiar with the following:

- [Attendance](#)
- [UNSW Email Address](#)
- [Computing Facilities](#)
- [Special Consideration](#)
- [Exams](#)
- [Approved Calculators](#)
- [Academic Honesty and Plagiarism](#)
- [Student Equity and Disabilities Unit](#)
- [Health and Safety](#)
- [Lab Access](#)

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