



Mechanical and Manufacturing Engineering

Course Outline

Semester 2 2018

MECH3610

ADVANCED THERMOFLUIDS

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1. Staff contact details

Course Convenor

Name: Mr Phillip Howlin

Office location: J17 Ainsworth Building Room 311E

Tel: (02) 9385 4180

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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 Convenor only if matters remain unresolved.

Much of the course content will be taught by other lecturers. Their details are included here; however it is not expected that students will contact them.

Course Lecturers

Name: Dr Naomi Tsafnat

Office location: J17 Ainsworth Building Room 402A

Tel: (02) 9385 6158

Email: n.tsafnat@unsw.edu.au

Name: Prof Con Doolan

Office location: J17 Ainsworth Building Room 408

Tel: (02) 9385 5696

Email: c.doolan@unsw.edu.au

Name: Dr Chris Menictas

Office location: J17 Ainsworth Building Room 402F

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Email: c.menictas@unsw.edu.au

Name: Prof Evatt Hawkes

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Other Demonstrators

Jacky Sze Ho

Timothy Rowan Davis

Amin Hassanzadehbarforoushi

Please see the course [Moodle](#).

2. Important links

- [Moodle](#)
- [UNSW Mechanical and Manufacturing Engineering](#)
- [Course Outlines](#)
- [Student intranet](#)
- [UNSW Mechanical and Manufacturing Engineering Facebook](#)
- [UNSW Handbook](#)

3. Course details

Credit Points

This is a 6 unit-of-credit (UoC) course and involves 5 hours per week (h/w) of face-to-face contact.

The UNSW website states “The normal workload expectations of a student are approximately 25 hours per semester for each UoC, including class contact hours, other learning activities, preparation and time spent on all assessable work. Thus, for a full-time enrolled student, the normal workload, averaged across the 16 weeks of teaching, study and examination periods, is about 37.5 hours per week.”

This means that you should aim to spend about 9 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 (Week 1-13) | Tuesday | 10am - 12pm | CLB 7 |
| | Wednesday | 2pm - 3pm | Rex Vowels Theatre |
| Demonstrations (Week 2-13) | Wednesday | 3pm - 5pm | Ainsworth 101 |
| | Thursday | 9am - 11am | Quad G035 |
| | Thursday | 11am - 1pm | Quad G035 |
| | Friday | 9am - 11am | Quad G035 |
| | Friday | 11am - 1pm | Quad G035 |

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 (50%), advanced fluids (15%), gas mixtures and psychrometric analysis (15%) and combustion (20%).

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 flow 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 in order 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 | Lecturer* | Topics | Reading** |
|------|----------------|--|-----------|--|------------|
| 1 | 23-29 Jul | Introduction to Heat Transfer | NT | Rate Equations; Units and Dimensions; Relevance of Topic; Introduction to Conduction | I: 1 & 2 |
| 2 | 30 Jul - 5 Aug | Steady State Conduction | NT | 1D and 2D Stead State Conduction | I 3 & 4 |
| 3 | 6-12 Aug | Forced & Free Convection | NT | Introduction to Convection; Boundary Layer Equations; Free Convection | I: 6 & 9 |
| 4 | 13-19 Aug | Convection: External & Internal Flow Systems | NT | External Flow; Internal Flow | I: 7 & 8 |
| 5 | 20-26 Aug | Transient Systems, Heat Exchangers | NT | Transient Conduction & Convection; Heat Exchanger Types and Analysis | I: 5 & 11 |
| 6 | 27 Aug - 2 Sep | Radiation Heat Transfer | NT | Blackbody Radiation; Real Surfaces; Heat Exchange | I: 12 & 13 |
| 7 | 3-9 Sep | Fluids | CD | Internal and External Compressible Flow | TBC |
| 8 | 10-16 Sep | Fluids | CD | Normal and Oblique Shock & Mid-Session Exam[†] | TBC |
| 9 | 17-23 Sep | Mixtures | PH | Ideal Gas Mixtures; Partial Pressures | R: 9 |

| Week | Date | Name | Lecturer* | Topics | Reading** | |
|-------|-----------|-------------------|-----------|---|-----------|--|
| Break | 24-30 Sep | Mid-Session Break | | | | |
| 10 | 1-7 Oct | Psychrometrics | CM | Humidity; Condensation; Human Comfort; Standards | R: 10 | |
| 11 | 8-14 Oct | Combustion | EH | Maxwell's Relations; Chemical Equation Balancing; Heat of Combustion; Adiabatic Flame Temperature | R: 11 | |
| 12 | 15-21 Oct | Combustion | EH | Chemical Equilibrium; Le Chatelier's principle | R: 11 | |
| 13 | 22-28 Oct | Revision | PH | | | |

* **NT:** Dr Naomi Tsafnat; **CD:** Prof Con Doolan; **PH:** Mr Phil Howlin; **CM:** Dr Chris Menictas; **EH:** Prof Evatt Hawkes

** Readings are for advice only and subject to change. **I:** Incropera; **R:** Reisel (See Section 7 for details)

‡ 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. | Monday Week 6 27 Aug 2018 On Moodle | Monday Week 6 27 Aug 2018 11:55pm | On closure of the quiz |
| Heat Transfer Laboratories | 10 pages | 15% | 1 | Undertaking Laboratories; Demonstrating understanding through writing laboratory reports | Monday Week 9 17 Sep 2018, 5pm* On Moodle | Saturday Week 9 22 Sep 2018, 5pm | Tuesday Week 10 2 Oct 2018 |
| Mid-semester exam | 2 hours | 35% | 1 | Heat Transfer theory. Namely, content from Week 1 to 6 inclusive. | Tuesday Week 8 10am-12noon (during Lecture time) | N/A | Tuesday Mid-Break 25 Sep 2018 |
| Assignment | 10 pages | 10% | 2 | Advanced Fluids, material from Week 7 and 8. | Monday Week 11 8 Oct 2018, 5pm* On Moodle | Saturday Week 11 13 Oct 2018, 5pm | Monday Week 13 22 Oct 2018 |
| Final exam | 2 hours | 40% | 2, 3 & 4 | Material from Weeks 7 to 12 inclusive, with a focus on content from Week 9 to 12. | 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 6 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 for the ~24 hours between 00:05 and 23:55 (12:05am and 11:55pm) on Monday of Week 6.

It is intended that the style and difficulty of the Moodle quiz will be representative of that in the final mid-semester 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, which are June for Semester 1 and November for Semester 2.

Provisional Examination timetables are generally published on myUNSW in May for Semester 1 and September for Semester 2

For further information on exams, please see the [Exams](#) section on the intranet.

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 shown 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 School Office or the Engineering Student Centre prior to the examination. Calculators not bearing an “Approved” sticker will not be allowed into the examination room.

Special consideration and supplementary assessment

For details of applying for special consideration and conditions for the award of supplementary assessment, see the information on UNSW’s [Special Consideration page](#).

7. Expected resources for students

- F. P. Incropera, D. P. Dewitt, T. L. Bergman, and A. S. Lavine, *Fundamentals of Heat and Mass Transfer*, 8th ed. Hoboken, NJ: Wiley, 2007.

- J. R. Reisel, *Principles of Engineering Thermodynamics SI Edition*, 1st ed. Boston, MA: Cengage Learning, 2016.

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: 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

Further information on School policy and procedures in the event of plagiarism is available on the [intranet](#).

10. Administrative matters and links

All students are expected to read and be familiar with School guidelines and policies, available on the intranet. In particular, students should be familiar with the following:

- [Attendance, Participation and Class Etiquette](#)
- [UNSW Email Address](#)
- [Computing Facilities](#)
- [Assessment Matters](#) (including guidelines for assignments, exams and special consideration)
- [Exams](#)
- [Approved Calculators](#)
- [Academic Honesty and Plagiarism](#)
- [Student Equity and Disabilities Unit](#)
- [Health and Safety](#)
- [Student Support 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 |