MMAN2700

Thermodynamics

Term One // 2021

School of Mechanical and Manufacturing Engineering // UNSW Engineering

Course Overview

Staff Contact Details

Convenors

Name	Email	Availability	Location	Phone
John Olsen	j.olsen@unsw.edu.au		Ainsworth Building J17, Room 311C	93855217

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

Course Details

Credit Points 6

Summary of the Course

Thermodynamic concepts, systems, property, state, path, process. Work and heat. Properties of pure substances, tables of properties and equations of state. First law of thermodynamics. Analysis of closed and open systems. Second law of thermodynamics, Carnot cycle, Clausius inequality, entropy, irreversibility, isentropic efficiencies. Air-standard cycles. Vapour cycles.

Course Aims

- Familiarise students with the terminology associated with thermodynamics. I would like students to develop an understanding of the deeper meanings of familiar words like energy, heat, work, temperature, reversible as well as not so familiar words like entropy.
- Teach students to identify whether a thermodynamic system is open, closed or isolated.
- Familiarise students with both the 1st and 2nd laws of thermodynamics and teach students how to apply these laws.
- Teach students how to use tabulated thermodynamic data for vapours, liquids and solids. Also to recognise under which circumstances it is best to use this data or the ideal gas laws.
- Familiarise students with air standard cycle analysis of reciprocating piston engines like spark ignition engines and compression ignition engines.
- Familiarise students with air standard cycle analysis for gas turbine engines.
- Familiarise students with the analysis of vapour power cycles for large power plants, and finally,
- Familiarise students with the analysis of vapour compression refrigeration cycles.

Course Learning Outcomes

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

Learning Outcome	EA Stage 1 Competencies
1. Use the first law of thermodynamics, including an understanding of heat and work, to solve steady-state and transient problems on closed and open systems.	PE1.1
2. Demonstrate knowledge of the second law of thermodynamics by solving steady-state problems on closed and open systems.	PE1.1, PE1.2, PE1.3
3. Apply the first and second laws to analyse the behaviour of internal combustion engines (air–standard cycles), Rankine power cycles (basic, regeneration, reheat) and Vapour compression refrigeration cycles.	PE1.1, PE1.2, PE1.3
4. Identify links between theoretical analysis methods learned in class and actual performance of thermodynamics machines and devices.	PE1.1, PE1.2, PE1.3

Teaching Strategies

Please refer to the information in Moodle

Additional Course Information

This is a 6 unit-of-credit (UoC) course, and involves 8-10 hours per week (h/w) of face-to-face contact. Additional time should be spent in making sure that you understand the lecture material, completing the set of formative and summative assignments, further reading, and revising for any examinations.

Assessment

Assessment Tasks

Assessment task	Weight	Due Date	Student Learning Outcomes Assessed
Mid-session Test	25%	31/3/2021	1, 2, 3, 4
Laboratories	20%	The lab work is due on the day of the lab	1, 2, 3, 4
Final Exam	40%	Exam Period	1, 2, 3
Thermodynamics Assignment	15%	3/3/2021	1, 2, 3, 4

Assessment Details

Assessment 1: Mid-session Test

Start date: 31/3/2021

Length: 1hr

Details:

Class Test covering understanding of First and Second Laws of Thermodynamics in single processes, either closed transient or open steady state steady flow.

Submission notes: Moodle Hand In at 12 noon

Assessment 2: Laboratories

Start date: Not Applicable

Length: 2 hours each

Details:

Laboratory work assessment comprised of Lab pre-work, laboratory attendance and completion of a final lab report.

Assessment 3: Final Exam

Start date: Not Applicable

Length: 2 hours

Details: Final Exam

Submission notes: Moodle Hand In

Assessment 4: Thermodynamics Assignment

Start date: 3/3/2021

Length: Short

Details:

An assignment designed to encourage students to compare theoretical analysis of thermodynamic devices with the operation of those devices in a real-world context.

Submission notes: Moodle Hand In

Attendance Requirements

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

Course Schedule

View class timetable

Timetable

Date	Type	Content
Week 1: 15 February - 19 February	Lecture	Basic concepts and definitions.
	Lecture	Topic 2: Energy balances • Ideal gases • Enthalpy • Moving boundary work • Isentropic and polytropic processes
Week 2: 22 February - 26 February	Lecture	Heat and work
Week 3: 1 March - 5 March	Lecture	1st law of thermodynamics for closed systems
Week 4: 8 March - 12 March	Lecture	Properties of pure substances
Week 5: 15 March - 19 March	Lecture	1st law of thermodynamics for open systems
Week 6: 22 March - 26 March		Flexibility Week
Week 7: 29 March - 2 April	Lecture	2nd law of thermodynamics for both closed and open systems
Week 8: 5 April - 9 April	Lecture	1st & 2nd laws of thermodynamics for both closed and open systems
Week 9: 12 April - 16 April	Lecture	1st & 2nd laws of thermodynamics for both closed and open systems
Week 10: 19 April - 23 April	Lecture	1st & 2nd laws of thermodynamics for both closed and open systems

Resources

Prescribed Resources

Textbooks

- Y.A. Cengel, M.A. Boles & M. Kanoglu, (2019) Thermodynamics, an engineering approach, 9th, S.I. Edition, McGraw Hill Education..
- G.F.C. Rogers & Y.R. Mayhew, Thermodynamic and Transport Properties of Fluids, S.I. Units, Basil Blackwell.

Both of these are available in the UNSW bookshop.

You really must buy these books. If you are going to be a professional engineer, you will need references in the future. Some of the questions you are expected to try are in the first reference. Although the first reference contains a set of steam tables, they are of a different type to those found in Mayhew & Rogers. You will be required to be able to use those found in Mayhew & Rogers as these will be supplied in the final exam.

Recommended Resources

Suggested additional reading

- M. J. Moran, H. N. Shapiro, D. D. Boettner & M. B. Bailey, (2018) Fundamentals of engineering thermodynamics, S.I. version, 9th Edition, John Wiley & Sons.
- R. Scruton, (2012) Green Philosophy. How to think seriously about the planet, Atlantic Books London.
- Schmidt, (2019) Technical thermodynamics for engineers, basics and applications, Springer.
- A. Bejan, (2006) Advanced engineering thermodynamics, 3rd edition, John Wiley & Sons.
- R.E. Sonntag and G.J. Van Wylen, (1991) Introduction to thermodynamics classical and statistical, 3rd Edition, John Wiley & Sons.
- D.S. Lemons, (2013) A students guide to entropy, Cambridge University Press.
- J.R. Reisel, (2016) Principles of engineering thermodynamics, S.I. edition, Cengage Learning.
- P.W. Atkins, (2008) Four laws that drive the universe, Oxford University Press, or
- P.W. Atkins, (2010) The laws of thermodynamics. A Very Short Introduction., Oxford University Press. They are the same book.
- P.W. Atkins, (1994) The 2nd Law, energy, chaos & form, Scientific American Publications.
- P.W. Atkins, (2003) Galileo's finger, the ten great ideas of science, Oxford University Press (Chapters 3 & 4).
- H.C. von Baeyer, (1999) Warmth disperses and time passes, the history of heat, (previously published as Maxwell's demon), The Modern Library, New York.

Most of these titles are all available in the UNSW Library and are useful as additional reading material, giving good descriptions.

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.

Laboratory Workshop Information

Laboratories

You are required to obtain a bound laboratory book (alternate lined and graph pages) to record results of each experiment and analysis carried out whilst in the laboratory.

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.

The laboratory demonstrators will give instructions on how to operate the equipment and will explain what is required of you. If in doubt, ask. It is important that you fully understand the experiment at the time it is being carried out, when instruction is available. In some experiments you are only required to take readings at intervals, use the intermediate time to ask questions and find out what other members of your group are doing. Little is learned merely by sitting waiting to make a measurement - much is learned by inquiry and discussion.

Attendance

Attendance at all laboratory experiments to which you are assigned is compulsory and a register is taken. If you are unable to attend, due to illness, it is important that you apply for Special Consideration and inform your lecturer as soon as possible so that you may be reassigned to that experiment at a later date.

Transferring between groups

Transfers between groups must be arranged through the lecturer.

Marking

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

Laboratory demonstrators will mark your preliminary work at the start of the laboratory period. Assessment of laboratory reports will contribute 20% to the final mark. Marks will be allocated for completion of preliminary analysis, results obtained and calculations made during the laboratory period (4 marks for preliminary work, 6 marks for measurements, data analysis and conclusions).

Submission of preliminary work which is not your own, or copying during the laboratory period, will result in a mark of zero for the laboratory.

Preparation

Preparation prior to the laboratory periods is essential. Study the laboratory notes so that you know what the experiment is about in advance of each laboratory session. If you arrive without the necessary preparation, you may not be allocated the laboratory mark.

Bring a calculator to all laboratory periods.

You will not be admitted to the laboratory unless you are appropriately dressed for safe working, have a laboratory book, a calculator and present the assigned preliminary work.

Laboratory Safety

All staff and students must observe all safety requirements in the laboratory. You must come to the laboratory dressed for work, NO LOOSE OR BAGGY CLOTHING, NO SANDALS OR BARE FEET. Before beginning any experiment, inspect all equipment you will use for potential hazards. While using laboratory equipment, keep alert for any developing hazard, e.g. unusual noise, vibration, unusual data trends etc.

Submission of Assessment Tasks

Assessment submission and marking criteria

Should the course have any non-electronic assessment submission, these should have a standard School cover sheet.

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.

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.

Late policy

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:

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

Examinations

You must be available for all quizzes, tests and examinations. For courses that have final examinations, these 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

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.

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.

Please note that students will **not** be required to provide **any** documentary evidence to support absences from any classes missed **because of COVID-19 public health measures such as isolation**. UNSW will **not** be insisting on medical certificates from anyone deemed to be a positive case, or when they have recovered. Such certificates are difficult to obtain and put an unnecessary strain on students and medical staff.

Applications for special consideration **will** be required for assessment and participation absences – but no documentary evidence **for COVID 19 illness or isolation** will be required.

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

Academic Information

Credit points

Course credit is calculated in Units-Of-Credit (UOC). The normal workload expectation for one UOC is approximately 25 hours per term. This includes class contact hours, private study, other learning activities, preparation and time spent on all assessable work.

Most coursework courses at UNSW are 6 UOC and involve an estimated 150 hours to complete, for both regular and intensive terms. Each course includes a prescribed number of hours per week (h/w) of scheduled face-to-face and/or online contact. Any additional time beyond the prescribed contact hours should be spent in making sure that you understand the lecture material, completing the set assignments, further reading, and revising for any examinations.

On-campus class attendance

Public distancing conditions must be followed for all face-to-face classes. To ensure this, only students enrolled in those classes will be allowed in the room. Class rosters will be attached to corresponding rooms and circulated among lab demonstrators. No over-enrolment is allowed in face-to-face class. Students enrolled in online classes can swap their enrolment from online to a **limited** number of on-campus classes by Sunday, Week 1. Please refer to your course's Microsoft Teams and Moodle sites for more information about class attendance for in-person and online class sections/activities.

Your health and the health of those in your class is critically important. You must stay at home if you are sick or have been advised to self-isolate by NSW health or government authorities. Current alerts and a list of hotspots can be found here. **You will not be penalised for missing a face-to-face activity due to illness or a requirement to self-isolate.** We will work with you to ensure continuity of learning during your isolation and have plans in place for you to catch up on any content or learning activities you may miss. Where this might not be possible, an application for fee remission may be discussed. Further information is available on any course Moodle or Teams site.

In certain classroom and laboratory situations where physical distancing cannot be maintained or there is a high risk that it cannot be maintained, face masks will be considered **mandatory PPE** for students and staff.

For more information, please refer to the
FAQs: https://www.covid-19.unsw.edu.au/safe-return-campus-faqs

Guidelines

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

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
- Equitable Learning Services

Image Credit

Synergies in Sound 2016

CRICOS

CRICOS Provider Code: 00098G

Acknowledgement of Country

We acknowledge the Bedegal people who are the traditional custodians of the lands on which UNSW Kensington campus is located.

Appendix: Engineers Australia (EA) Professional Engineer Competency Standard

Program Intended Learning Outcomes	
Knowledge and skill base	
PE1.1 Comprehensive, theory based understanding of the underpinning natural and physical sciences and the engineering fundamentals applicable to the engineering discipline	✓
PE1.2 Conceptual understanding of the mathematics, numerical analysis, statistics, and computer and information sciences which underpin the engineering discipline	✓
PE1.3 In-depth understanding of specialist bodies of knowledge within the engineering discipline	✓
PE1.4 Discernment of knowledge development and research directions within the engineering discipline	
PE1.5 Knowledge of engineering design practice and contextual factors impacting the engineering discipline	
PE1.6 Understanding of the scope, principles, norms, accountabilities and bounds of sustainable engineering practice in the specific discipline	
Engineering application ability	
PE2.1 Application of established engineering methods to complex engineering 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	
Professional and personal attributes	
PE3.1 Ethical conduct and professional accountability	
PE3.2 Effective oral and written communication in 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	

School of Mechanical and Manufacturing Engineering

Assignment Cover Sheet

- Please print clearly and complete all sections.
    - If group assessment, all group members must sign the declaration below.
- Before submitting this assignment, students are strongly recommended to review the course outline, assessment requirements and UNSW's Plagiarism and Academic Integrity website.
- Please retain a copy of this assignment for your records.

Course and Assignment Information

Course code: _____ Course name: _____

Course Convenor name: _____

Assignment: _____

Assignment due date: _____ Date submitted: _____

Group OR Individual Assignment: _____

Student Declaration

Instructions: *Read the following declaration and confirm your acceptance by signature on the next page.*

In preparing this assessment task I/we have followed the Student Code Policy. I/We certify that I/we have read and understand the University requirements with respect to student academic misconduct outlined in the Student Code Policy and the Student Misconduct Procedure. I/We declare that this assessment item is my/our own work, except where acknowledged, and has not been submitted for academic credit previously in whole or in part.

I/We acknowledge that the assessor of this item may, for assessment purposes:

- Provide a copy to another staff member of the University
- Communicate a copy of this assessment item to a plagiarism checking service which may then retain a copy of the assessment item on its database for the purpose of future plagiarism checking.

Continue to page 2

I/We have retained a copy of this, my/our assignment, which I/we can provide if necessary. By signing this declaration, I/we agree to the statements and conditions above.

zID	**Surname/Last Name:**	**Given/First name:**	**Signature**

For School use only	Received on: _____	Mark: _____
Marked by: _____		