# Course Outline

Semester 1, 2015

# MMAN2700 THERMODYNAMICS

# Contents

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# COURSE OUTLINE

## 1. STAFF CONTACT DETAILS

**Contact details and consultation times for course convener**

Dr John Olsen
Building F21, Room 107J
Tel (02) 9385 5217
Fax (02) 9663 1222
Email j.olsen@unsw.edu.au

Consultation with me concerning this course will be available at a time to be decided. Consultation by email should only be used as a last resort as it is clumsy and inefficient.

**Contact details and consultation times for additional lecturers and demonstrators/laboratory teaching staff**

Nil.

## 2. COURSE DETAILS

**Class contact**

The class contact will include the following sessions:

**Lecture periods**

| | |
|---|---|
| Monday | 4:00pm to 6:00pm (Central Lecture Block 7) |
| Friday | 9:00am to 10:00am (Science Theatre) |

***There will be two, one-hour, mid-session tests during the semester.***

**Consultation periods with demonstrators.**

You have already enrolled in consultation periods and so you already have the details.

**Consultation periods**

It is essential that you make full use of the consultation periods and attempt relevant problems as soon as possible after a topic has been covered in lectures and consultation periods. The problems are essential to consolidate understanding of the subject and to reveal aspects of the course which you have not understood. The problems in the mid-session tests will be similar to these problems. You should use a notebook for your worked solutions.

**Units of credit**

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 ñThe 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.ò

For a standard 24 UoC in the session, this means 600 hours, spread over an effective 15 weeks of the session (thirteen weeks plus stuvac plus one effective exam week), or 40 hours per week, for an average student aiming for a credit grade Various factors, such as your own ability, your target grade, etc., will influence the time needed in your case. Some students spend much more than 40 h/w, but you should aim for not less than 40 h/w on coursework for 24 UoC.

This means that you should aim to spend not less than about 10 h/w on this course, i.e. an additional 4 h/w of your own time. This should be spent in making sure that

- are familiar with air standard cycle analysis of reciprocating piston engines like spark ignition engines and compression ignition engines.
- are familiar with air standard cycle analysis for gas turbine engines.
- are familiar with the analysis of vapour power cycles for large power plants, and finally,
- are familiar with the analysis of vapour compression refrigeration cycles.

## Graduate attributes

UNSW's graduate attributes are shown at

## 3. RATIONALE FOR INCLUSION OF CONTENT AND TEACHING APPROACH

This course is intended to give you the skills to analyse thermodynamic systems. My hope is that you ultimately will be able to develop how thermodynamics relates to other subjects such as heat transfer and fluid mechanics. I would like to develop skills within you that will enable you to learn for the rest of your life. A subject such as thermodynamics should help you to become more environmentally aware. The inclusion of a section of work on the generation of power should help here.

Effective learning is supported when you are actively engaged in the learning process and by a climate of enquiry, and these are both an integral part of the lectures and consultation periods. You become more engaged in the learning process if you can see the relevance of your studies to professional, disciplinary

**Transfer from other groups.** The laboratory groups are large so transfers between groups must be arranged through the lecturer.

Assessment of laboratory reports will contribute 10% to the final mark. Marks will be allocated for completion of preliminary analysis, results obtained and calculations made during the laboratory period (2 marks for preliminary work, 3 marks for measurements, data analysis and conclusions). You do not have to submit a formal report; results of any calculations must be shown to the laboratory demonstrators for checking during the laboratory period.

**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. **Submission of**

You will need to provide your own calculator, of a make and model approved by UNSW, for the examination. The list of approved calculators is shown at: https://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 ñApprovedòsticker for it from the School Office or the Engineering Student Centre prior to the examination. Calculators not bearing an ñApprovedòsticker 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 *Administrative Matters for All Courses*, available from the School website.

## 6. ACADEMIC HONESTY AND PLAGIARISM

Plagiarism is using the words or ideas of others and presenting them 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 booklet which provides essential information for avoiding plagiarism:

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

Further information on School policy and procedures in the event of plagiarism is presented in a School handout, *Administrative Matters for All Courses*, available on the School website.

## 7. COURSE SCHEDULE

| Week | Topic | Text Reference |
|---|---|---|
| 1 | 1. *Basic Concepts and Definitions*<br>Systems, property, state, path, process, cycle<br>Units, Specific volume, density and pressure<br>Temperature and the zeroth law<br>The equation of state for a perfect gas<br>P-v-T surfaces for a perfect gas | Read Chapters 1 and 2 and sections 9, 12, 13 and 15 from Chapter 3. |
| 2 | 2. *Work and Heat*<br>Definition of work<br>Work processes<br>Work done at the moving boundary of a closed system<br>Definition of heat<br>Examples of work and heat | |
| 3 | 3. *First Law of Thermodynamics for a Closed System*<br>The first law<br>Internal energy and enthalpy- thermodynamic properties, specific heats and property relations | |
| 4 | 4. *Properties of a Pure Substance*<br>Vapour-liquid equilibrium in a pure substance<br>P-v-T surfaces for real substances<br>Tables of Thermodynamic properties (steam)<br>Equations of state for real substances | Sections 1, 2, 3, 4, 5 and 6 of Chapter 3. |

| | | |
|---|---|---|
| | 5. *First Law of Thermodynamics for an Open System* | |
| | Energy entering the system, enthalpy | |
| 5 | The first law | Chapter 4. |
| | Steady flow steady state system - examples | |
| | 6. *Analysis of Open and Closed Systems* | |
| 5 | | |

## 8. RESOURCES FOR STUDENTS

### Textbooks

| |
|---|
| M. J. Moran, H. N. Shapiro, D. D. Boettner & M. B. Bailey, (2012) Fundamentals of Engineering Thermodynamics, SI version, 7th Edition, John Wiley & Sons.<br>Y.R. Mayhew and G.F.C. Rogers, *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.

### Suggested additional readings

## 10. ADMINISTRATIVE MATTERS

You are expected to have read and be familiar with Administrative Matters, available on the School website. This document contains important information on student responsibilities and support, including special consideration, assessment, health and

# LABORATORY TIMETABLE

| | | Week number and date at beginning of week | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **01 MONDAY 9am - 11am** | **GROUP** | **3** 16/3 | **4** 23/3 | **5** 30/3 | **6** | **7** | **8** | **9** | **10** |

## CONSULTATION PERIODS

| Group | Day | Time | Location |
|---|---|---|---|
| 1 | Tuesday | 9am-10am | RC Theatre |
| 2 | Tuesday | 12pm-13pm | WEBST 256 |
| 3 | Tuesday | 2pm-3pm | WEBST 256 |
| 4 | Wednesday | 12pm-1pm | WEBST 256 |
| 5 | Thursday | 10am-11am | OMB145 |
| 6 | Thursday | 5pm-6pm | WEBST 256 |
| 7 | Thursday | 5pm-6pm | ElecEng418 |
| T | Monday | 10am-11am | WEBST 256 |

Consultation periods start in week 2 and finish in week 13.