



Mechanical and Manufacturing Engineering

# Course Outline

Semester 2 2017

**MECH9761**

**Automobile Engine Technology**

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# 1. Staff contact details

## Contact details and consultation times for course convenor

The lecturer and demonstrators will be available to answer questions regarding the course during normal office hours and by e-mail (preferred).

Name: Associate Professor Shawn Kook

Office location: Room 402E, Ainsworth Building (J17)

Tel: (02) 9385 4091

Email: [s.kook@unsw.edu.au](mailto:s.kook@unsw.edu.au)

Moodle: <https://moodle.telt.unsw.edu.au/login/index.php>

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

|                     |              |  |  |
|---------------------|--------------|--|--|
| Demonstrator (Head) | Lingzhe Rao  | <a href="mailto:lingzhe.rao@unsw.edu.au">lingzhe.rao@unsw.edu.au</a> | Room 402,<br>Ainsworth Building<br>(J17) |
| Demonstrator        | Harsh Goyal  | <a href="mailto:harsh.goyal@unsw.edu.au">harsh.goyal@unsw.edu.au</a> |  |
| Demonstrator        | Dongchan Kim | <a href="mailto:h.d.kim@unsw.edu.au">h.d.kim@unsw.edu.au</a>         |  |

# 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 3 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

|                       | <b>Week</b>       | <b>Day</b> | <b>Time</b> | <b>Location</b>   |
|-----------------------|-------------------|------------|-------------|---|
| <b>Lectures</b>       | 1-5, 8, 9, 11, 12 | Monday     | 2pm – 4pm   | Tyree Energy Technology (H6) Room G16   |
| <b>Demonstrations</b> | 2-5, 8, 9, 11-13  | Monday     | 4pm – 5pm   | Postgraduate:<br>Webster Building (G14) Room 256 or Quadrangle G044<br><br>Undergraduate:<br>Civil Engineering (H20) Room G8 or Quadrangle G054 |
| <b>Laboratories</b>   | 6, 7              | Monday     | 2pm – 5pm   | Willis Annexe (J18) Room 116C Undergraduate Teaching Lab  |

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 introduces the fundamentals of how the design and operation of automobile engines affect the performance and emissions. The fluid flow, thermodynamics, combustion, and fuel properties are studied with reference to engine power, efficiency, and pollutants formation. Students examine the design features and operating characteristics of different types of automobile engines including petrol engines and diesel engines, as well as the next-generation combustion engines including homogeneous-charge compression-ignition (HCCI) and gasoline compression ignition (GCI) engines. The key features of alternative fuels (including biofuels), hybrid, fuel cell, and electricity powered engines are also discussed. The course includes a lab for the performance test experiments of petrol and diesel engines.

## 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.               | Identify advantages and disadvantages of the operation and efficiency of automobile engines of all types;                                    | PE1.5, PE2.3, PE3.3     |
| 2.               | Describe the key pollutants associated with combustion in engines and explain their significance with respect to health and the environment; | PE1.6, PE3.1, PE2.2     |
| 3.               | Perform basic calculations relating to the performance and emissions of automobile engines and analyse engine performance chart.             | PE1.1, PE1.3, PE2.1     |
| 4.               | Provide technical explanations to the opportunities and limitations of alternative fuel engines, hybrid engines, and electric vehicles.      | PE3.2, PE3.4, PE3.6     |

## 4. Teaching strategies

For the lectures, students are highly encouraged to study the given topics before they attend the class. The suggested readings and the lecture notes uploaded to the Moodle page prior to the class are minimum requirements. Students should keep an eye on the latest news and journal articles regarding the engine technologies and try to relate those to the topics taught in the lecture. Refer to section 6 “Expected resources for students”.

Weekly demonstrations will be run for the example problems, lab preparation and review as well as the assignment submission/return. Students will take hands-on experiences by solving the example problems from the engine data and the lab assignment based on the actual data obtained from the lab. Not only calculation-type questions but also description-type questions will be tackled so that students can develop their skills to explain what they understand about the new technology in an effective way. An engineer’s ability to explain new concepts and technologies in their own language is equally important as one’s capability to understand them. This postgraduate/elective course will provide the opportunity to develop both skills using one of the most attractive engineering applications – car engines.

## 5. Course schedule

| Week | Lecture (2-4pm)   | Suggested Readings   | Demonstration (4-5pm)   |
|------|---|--|---|
| 1    | Automobile Industry<br>Why still combustion engines?  |  |   |
| 2    | Engine classification<br>Thermodynamic Cycle Analysis   | Heywood book pp. 7-12, 161-173<br>Otto & Diesel cycle section of the Thermodynamics text book    | - Thermodynamic cycle review.<br>- Guideline for <b>“technical writing”</b> assignment.                           |
| 3    | Engine Performance Parameters   | Heywood book pp. 42-54, 383-388, 508-511   | - <b>Technical writing</b> assignment submission due.<br>- Demonstration questions                                |
| 4    | Spark Ignition (SI) Engine  | Heywood book pp. 294-296, 301-304, 314-316, 326-336, 371-375, 390-404, 413-418, 437-443, 450-457 | - Demonstration questions.  |
| 5    | Guest lecture by a UNSW graduate working in the auto industry<br><br>Compression Ignition (CI) Engine | Heywood book pp. 491-493, 517-532, 536-549, 555-561  | - Marked <b>technical writing</b> assignment returned.<br>- <b>Lab</b> preparation.<br>- Demonstration questions. |
| 6    | <b>Lab</b> for group 1~3  |  |   |
|      |   |  | <b>Mid-session test</b> for group 4-6   |
| 7    | <b>Lab</b> for group 4~6  |  |   |
|      |   |  | <b>Mid-session test</b> for group 1-3   |
| 8    | Pollutants and After-treatment  | Heywood book Chapter 11<br>An Introduction to Combustion: Chapter 15                             | - <b>Lab report</b> submission due for group 4-6<br>- Demonstration questions                                     |
| 9    | Fuels and Alternative Fuels Engine  | Heywood book Chapter 3<br>An Introduction to Combustion: Chapter 2                               | - <b>Lab report</b> submission due for group 1-3<br>- Demonstration questions                                     |
| 10   | Labour Day Holiday on Mon 2 Oct (no lecture and no demo)  |  |   |
| 11   | Hybrid Engines<br><br>Guest lecture by a battery expert (TBC)   | Heywood book pp. 64-68, 470-478, 541-542, 550-552  | - Marked <b>mid-session test</b> papers to be returned<br>- Demo questions  |
| 12   | Future of Mobility: New Combustion Engines, EV, and Fuel Cell   |  | - Demo questions  |
| 13   |   |  | - Marked <b>lab report</b> to be returned<br>- Revision   |

## 6. Assessment

### Assessment overview

| Assessment        | Length     | Weight                        | Learning outcomes assessed | Assessment criteria                           | Due date and submission requirements   | Deadline for absolute fail | Marks returned                |
|-------------------|------------|-------------------------------|----------------------------|---|--|----------------------------|-------------------------------|
| Technical Writing | 300 words  | 10%                           | 1, 4                       | Data search and compilation, Writing skill    | One paper uploaded to Moodle Turnitin in pdf format by week 3 demo                         | One week from the due date | Week 5 demo                   |
| Mid-session test  | 1 hour     | 20%                           | 1, 2, 3, 4                 | Course content from week 1-5 inclusive.       | Week 6 or 7 when you do not attend the lab   | N/A                        | Week 11 demo                  |
| Lab assignment    | Four tasks | Lab attendance 5%, Report 15% | 1, 4                       | Lecture materials from weeks 3-5              | A pdf file uploaded to Moodle Turnitin by week 8 or 9 demo, depending on your lab schedule | One week from the due date | Week 13 demo                  |
| Final exam        | 2 hours    | 50%                           | 1, 2, 3, 4                 | All course content from weeks 1-12 inclusive. | Exam period, date TBC  | N/A                        | Upon release of final results |

All the assessment tasks are found on Moodle.

All submissions should follow the instructions provided to each assignment

## Assignments

### *Presentation*

All submission should be uploaded to Moodle in a pdf format.

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*

Late submissions will be penalised 5 marks per calendar day (including weekends). An extension may only be granted in exceptional circumstances. Special consideration for assessment tasks must be processed through [student.unsw.edu.au/special-consideration](http://student.unsw.edu.au/special-consideration).

It is always worth submitting late assessment tasks when possible. Completion of the work, even late, may be taken into account in cases of special consideration.

Where there is no special consideration granted, the 'deadline for absolute fail' in the table above indicates the time after which a submitted assignment will not be marked, and will achieve a score of zero for the purpose of determining overall grade in the course.

### *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](http://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 [School intranet](#), and the information on UNSW’s [Special Consideration page](#).

## **7. Attendance**

You are required to attend a minimum of 80% of all classes, including lectures, labs and seminars. It is possible to fail the course if your total absences equal to more than 20% of the required attendance. Please see the [School intranet](#) and the [UNSW attendance page](#) for more information.

## **8. Expected resources for students**

Lecture notes will be uploaded to Moodle prior to the lecture.

Moodle: <https://moodle.telt.unsw.edu.au/login/index.php>

Text book reading is suggested for improved understanding; however, all the assessments are based on the materials provided by the lecturer and demonstrators. Please refer to the course schedule for the suggested reading from the text books. The selected text books are:

*Internal Combustion Engine Fundamentals*, J. B. Heywood, McGraw-Hill, 1988

*An Introduction to Combustion*, S. R. Turns, Mc-Graw-Hill, 2000

Copies of these text books are available in the UNSW bookshop and library:

<https://www.library.unsw.edu.au/>

Additional readings for the up-to-date engine technologies and combustion science can be found in the variety of journals. Students can get free access to the full contents of the articles from the following websites (need access through the UNSW IP address):

*SAE (Society of Automotive Engineers) Digital Library*

<http://digitallibrary.sae.org/quicksearch/>

*Progress in Energy and Combustion Science*

<http://www.sciencedirect.com/science/journal/03601285>

*Fuel (the journal)*

<http://www.sciencedirect.com/science/journal/00162361>

*Energy and Fuels*

<http://pubs.acs.org/journal/enfuem>

*Combustion and Flame*

<http://www.sciencedirect.com/science/journal/00102180>

*Proceedings of the Combustion Institute*

<http://www.sciencedirect.com/science/journal/15407489>

## 9. 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 much clearer marking criteria on the assignments and much more attractive lecture times (previously it was on Fri afternoon).

## 10. 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](http://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](http://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](#).

## 11. 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)
- [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

|  | <b>Program Intended Learning Outcomes</b>   |
|--|---|
| <b>PE1: Knowledge and Skill Base</b>             | 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 |
| <b>PE2: Engineering Application Ability</b>      | 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      |
| <b>PE3: Professional and Personal Attributes</b> | 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   |