UNSW Course Outline

MECH9761 Automobile Engine Technology - 2024

Published on the 29 Aug 2024

General Course Information

Course Code : MECH9761
Year : 2024
Term : Term 3
Teaching Period : T3
Is a multi-term course? : No
Faculty : Faculty of Engineering
Academic Unit : School of Mechanical and Manufacturing Engineering
Delivery Mode : In Person
Delivery Format : Standard
Delivery Location : Kensington
Campus : Sydney
Study Level : Undergraduate, Postgraduate
Units of Credit : 6

Useful Links

Handbook Class Timetable

Course Details & Outcomes

Course Description

This course introduces a range of automobile powertrain systems including petrol/diesel engines, alternative fuel engines, hybrid engines and electric drives powered by batteries and fuel cells. The fluid flow, thermodynamics, combustion, and fuel properties are studied with reference

to engine power, efficiency and emissions. Students examine the design features and operating characteristics of different types of automobile engines before studying advanced engine technologies. Students learn about formation principles and impacts of air-polluting emissions and their reduction technologies. Students also learn about alternative fuels and their use in powertrains as well as design features and operation principles of hybrid engines and electric drives. The course includes a lab for the performance test experiments of petrol and diesel engines.

Course Aims

This course aims to improve understanding of the latest technologies in automobile powertrain systems and their operation and to use them to experience how materials on fluid mechanics, thermodynamics, and heat transfer studied in previous years integrates into a total engineering concept. The course also aims to advance student's problem-solving skills, which are applicable to real research and engineering challenges.

Relationship to Other Courses

From this course, students will learn how theoritical analysis can be applied to practical problems, and how they are related to fundamental knowledge gained from earlier stage courses. Solid mechanics and mechatronics courses are also directly linked to this course in selecting materials depending on the types of engines used for certain applications and in systematically controlling power/efficiency of hybrid engines and electric drives.

Course Learning Outcomes

Course Learning Outcomes
CLO1 : Identify advantages and disadvantages of the operation and efficiency of automobile engines of all types
CLO2 : Evaluate the key engine technologies implemented in the current and future automobiles
CLO3 : Describe the key pollutants associated with combustion in engines and explain their significance with respect to health and the environment
CLO4 : Provide technical explanations to the opportunities and limitations of alternative fuel engines, hybrid engines, and electric-drives

Course Learning Outcomes	Assessment Item
CLO1 : Identify advantages and disadvantages of the operation and efficiency of automobile engines of all types	• Online interactive lectures • Mid-term test • Lab report • Final exam
CLO2 : Evaluate the key engine technologies implemented in the current and future automobiles	• Online interactive lectures • Mid-term test • Lab report • Final exam
CLO3 : Describe the key pollutants associated with combustion in engines and explain their significance with respect to health and the environment	• Mid-term test • Lab report • Final exam
CLO4 : Provide technical explanations to the opportunities and limitations of alternative fuel engines, hybrid engines, and electric-drives	• Online interactive lectures • Final exam

Learning and Teaching Technologies

Moodle - Learning Management System

Learning and Teaching in this course

You are highly encouraged to take this course completely face to face - come to the lecture theatre and demo classroom. The real world is here and it is where you meant to be. Your in-person attendance of the lab, mid-term exam and final exam is mandatory - there will be no online labs and exams in this course. In case you cannot make it to the lecture, recordings are provided on Moodle.

You are encouraged to attempt interative online lecture modules before you come to the lecture to know what you are going to learn and how to develop background knowledge. You can re-attempt the lecture module after the lecture to find out how much you improved the understanding of technologies. There is no limit set for the number of attempts (yes, it is designed to give you 10% point mark as you complete all ten modules).

You are required to come to the demo sessions to learn it with your cohort and ask questions. In case you miss the demo, recordings are made available on Moodle after the demo.

Lab is face to face only. No video livestreaming or recordings are provided. Lab sessions are scheduled for only one hour - there will be six repeating sessions and during the demo, you will be instructed about how to select your lab session on Moodle. The in-person attendance is marked.

Mid-term and final exams are pen and paper based and are supervised. The mid-term exam is scheduled on week 5 demo. You will be instructred about how to attend the exams. The final exam is centrally managed.

Assessments

Assessment Structure

Assessment Item	Weight	Relevant Dates
Online interactive lectures Assessment Format: Individual	10%	Start Date: 08/09/2024 12:00 AM Due Date: 23/11/2024 11:59 PM
Mid-term test Assessment Format: Individual	20%	Start Date: 10/10/2024 04:00 PM Due Date: 10/10/2024 05:00 PM
Lab report Assessment Format: Individual	20%	Start Date: Not Applicable Due Date: 31/10/2024 04:00 PM
Final exam Assessment Format: Individual	50%	

Assessment Details

Online interactive lectures

Assessment Overview

A total of 10 online lecture modules need to be completed by students. Each module will take an hour to complete. Each module counts 1%, which can be earned by completing quizzes included within the lecture modules. The automated feedback is provided at the completion of each module, and the students are given a chance to reattempt.

Course Learning Outcomes

- CLO1 : Identify advantages and disadvantages of the operation and efficiency of automobile engines of all types
- CLO2 : Evaluate the key engine technologies implemented in the current and future automobiles
- CLO4 : Provide technical explanations to the opportunities and limitations of alternative fuel engines, hybrid engines, and electric-drives

Assessment Length

1 hour per module

Submission notes

Grades are automatically recorded on Moodle.

Assignment submission Turnitin type

This is not a Turnitin assignment

Generative AI Permission Level

Not Applicable

Generative AI is not considered to be of assistance to you in completing this assessment. If you do use generative AI in completing this assessment, you should attribute its use.
For more information on Generative AI and permitted use please see here.

Mid-term test

Assessment Overview

1-hour mid-term exam to check students' learning progress of the basic knowledge of engine-related theory and technology taught in early weeks. Students are required to provide correct answers to the questions. Marked papers are returned to students to receive individual feedback.

Course Learning Outcomes

- CLO1 : Identify advantages and disadvantages of the operation and efficiency of automobile engines of all types
- CLO2 : Evaluate the key engine technologies implemented in the current and future automobiles
- CLO3 : Describe the key pollutants associated with combustion in engines and explain their significance with respect to health and the environment

Assessment Length

1 hour

Submission notes

Exam answer book submitted to the exam supervisor

Assignment submission Turnitin type

This is not a Turnitin assignment

Generative AI Permission Level

Not Applicable

Generative AI is not considered to be of assistance to you in completing this assessment. If you do use generative AI in completing this assessment, you should attribute its use.
For more information on Generative AI and permitted use please see here.

Lab report

Assessment Overview

Three tasks should be answered in a lab report, which typically is formulated in 10 pages. Data reporting and technical discussion of the observed trends from the lab tests should be presented clearly. In the report instruction, detailed assessment criteria are provided so that students can prepare the report in advance and during the lab sessions. The marked report is returned back to students by week 10 or earlier with individualised feedback.

Course Learning Outcomes

- CLO1 : Identify advantages and disadvantages of the operation and efficiency of automobile engines of all types
- CLO2 : Evaluate the key engine technologies implemented in the current and future automobiles
- CLO3 : Describe the key pollutants associated with combustion in engines and explain their significance with respect to health and the environment

Assessment Length

Three tasks

Submission notes

Due by the start of week 8 demo. Submission through TurnitIn.

Assignment submission Turnitin type

This assignment is submitted through Turnitin and students do not see Turnitin similarity reports.

Generative AI Permission Level

No Assistance

This assessment is designed for you to complete without the use of any generative AI. You are not permitted to use any generative AI tools, software or service to search for or generate information or answers.
For more information on Generative AI and permitted use please see here.

Final exam

Assessment Overview

Assessment length: 2 hours

Final exam questions covering whole lecture weeks. Answer questions correctly based on your full understanding of automobile powertrain systems, their working principles and impacts.

Course Learning Outcomes

- CLO1 : Identify advantages and disadvantages of the operation and efficiency of automobile engines of all types
- CLO2 : Evaluate the key engine technologies implemented in the current and future automobiles
- CLO3 : Describe the key pollutants associated with combustion in engines and explain their significance with respect to health and the environment
- CLO4 : Provide technical explanations to the opportunities and limitations of alternative fuel engines, hybrid engines, and electric-drives

Detailed Assessment Description

The exam is a centrally scheduled/managed/supervised pen and paper test.

Assessment Length

2 hours

Assignment submission Turnitin type

Not Applicable

Generative AI Permission Level

Not Applicable

Generative AI is not considered to be of assistance to you in completing this assessment. If you do use generative AI in completing this assessment, you should attribute its use.
For more information on Generative AI and permitted use please see here.

General Assessment Information

Information about the assessment tasks are found on the relevant Moodle sections. All submissions should be made via Moodle following the instructions provided to each assignment.

Re-weighting is not an option for the school.

Grading Basis

Standard

Course Schedule

Teaching Week/Module	Activity Type	Content
Week 0 : 2 September - 8 September	Online Activity	Check the course Moodle page and get familiarised with the course structure, schedule and people. Keep checking the announcement section to know what changes are being made and how the course progresses. Search news articles about new internal combustion engine, hybrid, fuel cell and battery electric drive vehicles. Try to select your favourate powertrain type and manufacturer/model.
Week 1 : 9 September - 15 September	Lecture	Automobile Industry & Why still combustion engines? You learn about how automobile industry has progressed for over a century and what exciting changes are happening now. The international combustion engine is introduced as a dominant technology of today and then new technologies penerating into the market and under development are studied. Suggested readings: online lecture module 1 and your own internet search
	Online Activity	Complete interactive online lecture module 1
	Workshop	Solve demonstration questions about week 1 lecture contents
Week 2 : 16 September - 22 September	Lecture	Engine classification & thermodynamic cycle analysis Suggested readings: Online lecture module 2, Heywood Book Chapter 1 & Chapter 5, Otto & Diesel cycle section of the Thermodynamics textbook
	Online Activity	Complete interactive online lecture module 2
	Workshop	Solve demonstration questions about week 2 lecture contents
Week 3 : 23 September - 29 September	Lecture	Engine performance parameters Suggested readings: Online lecture module 3, Heywood Book Chapter 2, Chapter 4 and Chapter 15
	Online Activity	Complete interactive online lecture module 3
	Workshop	Solve demonstration questions about week 3 lecture contents
Week 4 : 30 September - 6 October	Lecture	Spark Ignition (SI) Engines Suggested readings: Online lecture module 4, Heywood Book Chapter 6.8, Chapter 7, Chapter 8.4 and Chapter 9
	Online Activity	Complete interactive online lecture module 4
	Workshop	Solve demonstration questions about week 4 lecture contents
	Laboratory	If you chose lab session 1, 2, or 3, you attend your one-hour lab session this week. You work with demonstrators to conduct petrol and diesel engine operation and reading of performance parameters.
Week 5 : 7 October - 13 October	Lecture	Compression Ignition (CI) Engines Suggested readings: Online lecture module 5, Heywood Book Chapter 8.3 and Chapter 10
	Online Activity	Complete interactive online lecture module 5
	Laboratory	If you chose lab session 4, 5, or 6, you attend your one-hour lab session this week. You work with demonstrators to conduct petrol and diesel engine operation and reading of performance parameters.
	Assessment	A closed book, pen and paper based mid-term test for the course content taught in week 1, 2, 3 and 4. The test takes place during the demo time and in your demo classroom. If the space is limited, we might have to allocate you in a different room. This is confirmed and advised in week 4.
Week 6 : 14 October - 20 October	Online Activity	Flexibility week with no course activities. Good time to complete the overdue online interactive lecture modules. Good time to revise week 1-5 content in preparation for more advanced topics taught in week 7 - 10.
Week 7 : 21 October - 27 October	Lecture	Pollutants and After-treatment Suggested readings: Online lecture module 6, Heywood Book Chapter 11
	Online Activity	Complete interactive online lecture module 6
	Workshop	Solve demonstration questions about week 5 and week 7 lecture contents
	Assessment	Marked mid term test papers are returned to students in week 7 demo. Grades are available on Moodle.
Week 8 : 28 October - 3 November	Lecture	Alternative/Renewable Fuel Engines including natural gas, methanol, ethanol, hydrogen and ammonia Suggested readings: Online lecture module 7
	Workshop	Solve demonstration questions about week 8 lecture contents

	Assessment	Lab report submission due by the start of week 8 demonstration via Turnitin (accessed through the course Moodle page)
Week 9 : 4 November - 10 November	Lecture	Hybrid Engines Suggested readings: Online lecture module 8
	Online Activity	Complete interactive online lecture module 8
	Workshop	Solve demonstration questions about week 9 lecture contents
Week 10 : 11 November - 17 November	Lecture	Electric Drives (Electric motors, batteries and fuel cells) Suggested readings: Online lecture module 9 and module 10
	Online Activity	Complete interactive online lecture module 9 and module 10.
	Workshop	Solve demonstration questions about week 10 lecture contents
	Assessment	Marked lab reports will be returned to students by the start of week 10 demonstration

Attendance Requirements

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

General Schedule Information

The course comprises 9 Wed lectures for week 1 to 5 and 7 to 10 (1pm - 3:30pm), 8
Thu demonstrations for week 1 to 4 and 7 to 10 (4pm - 5pm), 1 mid-term exam session in week 5 demo (4pm - 5pm) and 1 Friday lab session in week 4 or week 5 (depending on your selection of 1-hr session from a total of 6 repeating 1-hr sessions). The lab session selection will be done via Moodle and informed during the demo session.

Course Resources

Prescribed Resources

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

Demonstration questions will be uploaded to Moodle prior to the demonstration session.

Interative online lectures will be available at the course Moodle page - this is your online textbook written by Professor Kook.

Additional textbook reading is suggested for improved understanding; however, all of 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 textbook. The selected additional textbook is:

Internal Combustion Engine Fundamentals Second Edition, J. B. Heywood, McGraw-Hill, 2018

Copies of these textbooks are available in the UNSW bookshop, e-book stores and Main Library Level 6.

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

Recommended Resources

Keen to learn more about the current and future engine technologies? Firstly, check innovative research performed at the UNSW Engine Research Laboratory: https://research.unsw.edu.au/projects/engines

Additional readings of various journals are recommended for enhanced understanding of up-todate engine/powertrain technologies. Students can get a free access to the full contents of the articles from the following websites (need an access through the UNSW IP address or visit the UNSW Library website to find these journals). Professor Kook has published over 130 papers in these journals with some of your demonstrators co-authoring them. Why don't you search their papers and find out UNSW's state-of-the-art engine research? If you want to be someone who leads it, you can join in Professor Kook's research group as a PhD research candidate (PhD stands for Philosophy of Doctor, the highest academic degree offerred at UNSW and an effective route for you to grow as a leading researcher/engineer).

SAE (Society of Automotive Engineers) Digital Library http://digitallibrary.sae.org/quicksearch/

(Professor Kook is elected SAE Fellow and an associate editor of SAE International Journal of Engines).

Applied Thermal Engineering https://www.journals.elsevier.com/applied-thermalengineering (Professor Kook is a subject editor of this journal).

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

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 pen and paper based exams. From the student/staff feedback session, it was clear that academic plagirism needs to be avoided through the system. Invisilated exams that are purely pen and paper based are considered the most feasible option and thus we implement it in this course.

Staff Details

Position	Name	Email	Location	Phone	Availability	Equitable Learning Services Contact	Primary Contact
Lecturer	Shawn Kook		402E, Ainsworth Building		Contactable via email and Teams message	Yes	Yes
Head demonstrator	ChengHua Zhang		402, Ainsworth Building		Contactable via email and Teams message	No	No
Demonstrator	Jinxin Yang		402, Ainsworth Building		Contactable via email and Teams message	No	No
	Alastar Heaton		402, Ainsworth Building		Contactable via email and Teams message	No	No
	Chris Zhao		402, Ainsworth Building		Contactable via email and Teams message	No	No
	Harland Rock		402, Ainsworth Building		Contactable via email and Teams message	No	No

Other Useful Information

Academic Information

I. 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, or within 3 working days of, submitting an assessment or sitting an exam.

Please note that UNSW has a Fit to Sit rule, which means that if you sit an exam, 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.

II. Administrative matters and links

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
- Equitable Learning Services

III. Equity and diversity

Those students who have a disability that requires some adjustment in their teaching or learning environment are encouraged to discuss their study needs with the course convener prior to, or at the commencement of, their course, or with the Equity Officer (Disability) in the Equitable Learning Services. Issues to be discussed may include access to materials, signers or note-takers, the provision of services and additional exam and assessment arrangements. Early notification is essential to enable any necessary adjustments to be made.

IV. Professional Outcomes and Program Design

Students are able to review the relevant professional outcomes and program designs for their streams by going to the following link: https://www.unsw.edu.au/engineering/student-life/student-resources/program-design.

Note: This course outline sets out the description of classes at the date the Course Outline is published. The nature of classes may change during the Term after the Course Outline is published. Moodle or your primary learning management system (LMS) should be consulted for the up-to-date class descriptions. If there is any inconsistency in the description of activities between the University timetable and the Course Outline/Moodle/LMS, the description in the Course Outline/Moodle/LMS applies.

Academic Honesty and Plagarism

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.

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 or contract cheating) even suspension from the university. The Student Misconduct Procedures are available here:

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

Submission of Assessment Tasks

Work submitted late without an approved extension by the course coordinator or delegated authority is subject to a late penalty of five percent (5%) 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. This is for all assessments where a penalty applies.

Work submitted after five days (120 hours) will not be 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 will be clearly indicated in the course outline, and such assessments will receive a mark of zero if not completed by the specified date. Examples include:

- Weekly online tests or laboratory work worth a small proportion of the subject mark;
- Exams, peer feedback and team evaluation surveys;
- Online quizzes where answers are released to students on completion;
- Professional assessment tasks, where the intention is to create an authentic assessment that has an absolute submission date; and,
- Pass/Fail assessment tasks.

Faculty-specific Information

Engineering Student Support Services – The Nucleus - enrolment, progression checks, 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

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)

School-specific Information

Short Extensions

Short extensions are not currently applicable to Mechanical and Manufacturing Engineering Courses.

Review of Results

If you believe that there has been a marking error, you can request a review of results. Review of results cannot be used to get feedback.

If you would like feedback for assessments, you are welcome to contact the course convenor directly.

Use of AI

The use of AI is prohibited unless explicitly permitted by the course convenor. Please respect this and be aware that penalties will apply when unauthorised use is detected, such as through Turnitin. If the use of generative AI, such as ChatGPT, is allowed in a specific assessment, they must be properly credited, and your submissions must be substantially your own work.

Final Exam in Exam Period

For courses with a centrally timetabled final exam, students must be available for the entire exam period from Mon-Sat until your exact exam date is confirmed.

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. The School will only be able to refer students on to the relevant team if contacted

Important Links

- Student Wellbeing
- Urgent Mental Health & Support
- Equitable Learning Services
- Faculty Transitional Arrangements for COVID-19
- Moodle
- Lab Access
- Computing Facilities
- Student Resources
- Course Outlines
- Makerspace
- UNSW Timetable
- UNSW Handbook