UNSW AUSTRALIA

Course Outline

Semester 1 2016

Never Stand Still | Engineering | Mechanical and Manufacturing Engineering

MECH9761

AUTOMOBILE ENGINE TECHNOLOGY

Contents

1. Staff Contact Details

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

Position	Name	Email	Office	
Lecturer	A/Prof Shawn Kook	s.kook@unsw.edu.au	Room 402E, Ainsworth Building (J17)	
Demonstrator (Head)	Lewis Clark	lewis@unsw.edu.au	Room 402, Ainsworth Building (J17)	
Demonstrator	YiLong Zhang	yilong.zhang@unsw.edu.au		
Demonstrator	Lingzhe Rao	lingzhe.rao@unsw.edu.au		

2. 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

	Week	Day	Time	Location
Lectures	1-5 8-12	Thursday	3pm - 5pm	Electrical Engineering Building (G17) Room G25
Demonstrations	2-5 8-13	Thursday	5pm – 6pm	Electrical Engineering Building (G17) Room G25
Laboratories	6, 7	Thursday	3pm - 6pm	Willis Annexe (J18) Room 116C UG Lab

Summary 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 engine performance test, a demonstration of the engine control unit mapping, and a term project of literature review performed by a group of students.

Aims of the Course

This course aims to improve understanding of the automobile engines 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 such that the basics learned from the course can be used to deal with the real research and engineering challenges.

Student learning outcomes

This course is designed to address the below learning outcomes 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 electricity powered engines.	PE3.2, PE3.4, PE3.6

3. 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 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 students resources.

Weekly demonstrations will be run for the homework problems, lab preparation and review, ECU mapping practice, and term project. Students will take hands-on experiences by solving the homework problems from the engine data and the lab assignment based on the actual data obtained from the lab. Demonstrators will show how the engine control unit mapping is implemented in real-world applications. The term project is for improving student's communication skills and teamwork spirit. A group of students will work together for a technical report on the engine-related topics.

4. Course schedule

Lecture schedule

Week	Topics	Suggested Readings
1	Automobile Industry Why still combustion engines?	
2	Engine classification Thermodynamic Cycle Analysis	Heywood book pp. 7-12, 161-173 Otto & Diesel cycle section of the Thermodynamics text book
3	Engine Performance Parameters	Heywood book pp. 42-54, 383-388, 508-511
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
5	Compression Ignition (CI) Engine	Heywood book pp. 491-493, 517-532, 536-549, 555-561
6	**Lab** for group 1~3, 25 in each group	
7	**Lab** for group 4~6, 25 in each group	
8	Pollutants and After-treatment	Heywood book Chapter 11 An Introduction to Combustion: Chapter 15
9	Combustion and Thermochemistry	Heywood book Chapter 3 An Introduction to Combustion: Chapter 2
10	Fuels and Alternative Fuels Engine	Heywood book pp. 64-68, 470-478, 541-542, 550-552
11	Hybrid/Fuel Cell Engines	
12	Future of Mobility	

Demonstration schedule

Week	Demonstration	Term Project
2	Homework #1 released	Term project outline released
3	Homework #1 due Homework #2 released	Build a team of 5 students Report a selected topic
4	Homework #2 due Homework #3 released	
5	Homework #3 due Background knowledge for the lab	Mid-term report due
6	Lab for group 1~3, 25 in each group	
7	Lab for group 4~6, 25 in each group	
8	The lab review	
9	Lab report due Homework #4 released	
10	ECU mapping practice 1	
11	Homework #4 due ECU mapping practice 2	
12	Consultation	Final report due
13	Consultation ECU mapping report due	

Laboratory schedule

Time: Thu 3-6pm in Week 6 or 7 depending on which group you are in.
One hour session for each group of 25 students to operate and measure two engines: petrol and diesel
Your session will be announced in the Moodle.

Location:
Willis Annexe (J18) Room 116C UG Lab

5. Assessment

Assessment	Length	Weight	Learning outcomes assessed	Assessment criteria	Due date and submission requirements	Marks returned
Homework 1	200 words	5%	1, 4	Data search and compilation, Writing skill	Printed one-pager due by week 3 demo	Week 4 demo
Homework 2	3~4 questions	5%	3	Lecture material from weeks 2-3	Hand written solution due by week 4 demo	Week 5 demo
Homework 3	3~4 questions	5%	3	Lecture material from weeks 3-4	Hand written solution due by week 5 demo	Week 6 demo
Homework 4	2 questions	5%	2, 3	Lecture material from weeks 2, 3, 8, and 9	Hand written solution due by week 11 demo	Two weeks after submission
Lab assignment	Four tasks	Lab attendance 2%, Report 8%	1, 4	Lecture materials from weeks 3-5	Printed results and hand written calculation by week 9 demo	Three weeks after submission
ECU mapping report	Two tasks	5%	2, 3	Lecture materials from weeks 3-5 and the lab	Printed copy of the report due by week 13 demo	Prior to the final exam
Group assignment	5 page report	Mid-term report 5% Final report 10%	1, 4	Literature review and compilation, Writing skill, Team work	Printed copy of the mid-term report by week 5 demo Printed copy of the final report by week 12 demo	Prior to the final exam
Final exam	2 hours	50%	1, 2, 3, 4	All course content from weeks 1-12 inclusive.	Exam period, date TBC	Upon release of final results

Assignments

Presentation

All submissions should follow the instructions provided to each assignment.

All submissions are expected to be neat and clearly set out. Your results are the pinnacle of all your hard work. Presenting them 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. Where an assessment task is worth less than 20% of the total course mark and you have a compelling reason for being unable to submit your work on time, you must seek approval for an extension from the course convenor ***before the due date***. Special consideration for assessment tasks of 20% or greater must be processed through 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.

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 School intranet, and the information on UNSW’s Special Consideration page.

6. Expected resources for students

Lecture notes will be uploaded to the UNSW Moodle prior to the lecture. 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.
http://info.library.unsw.edu.au/web/services/services.html

Additional readings for the up-to-date engine technologies and combustion science can be found in the variety of journals. 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):

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

7. Course evaluation and development

Feedback on the course is gathered periodically using various means, including the Course and Teaching Evaluation and Improvement (CATEI) process, informal discussion during the consultation (week 11 and 12 demons), 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 more hands-on labs and increased practical knowledge of engine design and ECU mapping.

8. 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.

9. Administrative Matters

All students are expected to read and be familiar with School guidelines and polices, 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

Associate Professor Shawn Kook
5 Feb 2016

Appendix A: Engineers Australia (EA) Professional Engineer Competency Standards

	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