UNSW AUSTRALIA

Course Outline

Semester 1, 2015

Never Stand Still | Faculty of Engineering | School of Mechanical and Manufacturing Engineering

MECH9761

AUTOMOBILE ENGINE TECHNOLOGY

Contents

MECH9761: Automobile Engine Technology

Course Outline

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	Dr Shawn Kook	s.kook@unsw.edu.au	EE room 464P	
Demonstrator (Head)	Lewis Clark	lewis@unsw.edu.au	Library office	Demo/Lab
Demonstrator	YiLong Zhang	yilong.zhang@unsw.edu.au	Library office	Demo/Lab
Demonstrator	Bryan Woo	changhwan.woo@unsw.edu.au	Library office	Lab

2. COURSE DETAILS

Credit Points:

This is a 6 unit-of-credit (UoC) course, and involves 6 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.”

For a standard 24 UoC in the semester, this means 600 hours, spread over an effective 15 weeks of the semester (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

you understand the lecture material, completing the set assignments, further reading about the course material, and revising and learning for the examination.

Summary of the Course

This course introduces the fundamentals of how the design and operation of automobile engines affect their performance and environmental impact. 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: conventional petrol, diesel engines, and the next-generation combustion engines including spark-ignition direct-injection (SIDI), common rail diesel, homogeneous-charge compression-ignition (HCCI) 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 and a term project of literature review and presentation performed by 5 students as a project team.

3. 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.

4. STUDENT LEARNING OUTCOMES

At the conclusion of this course the student will be able to:

1. identify advantages and disadvantages of the operation and efficiency of automobile engines of all types;
2. describe the key pollutants associated with combustion in engines and understand their significance with respect to health and the environment;
3. describe basics of the combustion and pollutant formation processes;
4. perform basic calculations relating to the performance and emissions of automobile engines.

5. GRADUATE ATTRIBUTES

UNSW's graduate attributes are shown at
https://my.unsw.edu.au/student/atoz/GraduateAttributes.html

UNSW aspires to develop graduates who are rigorous scholars, capable of leadership and professional practice in a global community. The university has, thus, articulated the following Graduate Attributes as desired learning outcomes for ALL UNSW students.

UNSW graduates will be

1. Scholars who are:
   - (a) understanding of their discipline in its interdisciplinary context ✓
   - (b) capable of independent and collaborative enquiry ✓
   - (c) rigorous in their analysis, critique, and reflection ✓
   - (d) able to apply their knowledge and skills to solving problems ✓
   - (e) ethical practitioners
   - (f) capable of effective communication ✓
   - (g) information literate ✓
   - (h) digitally literate ✓

2. Leaders who are:
   - (a) enterprising, innovative and creative ✓
   - (b) capable of initiating as well as embracing change
   - (c) collaborative team workers ✓

3. Professionals who are:
   - (a) capable of independent, self-directed practice
   - (b) capable of lifelong learning
   - (c) capable of operating within an agreed Code of Practice

4. Global Citizens who are:
   - (a) capable of applying their discipline in local, national and international contexts
   - (b) culturally aware and capable of respecting diversity and acting in socially just/responsible ways ✓
   - (c) capable of environmental responsibility ✓

   ✓ = Developed in this course

Among other UNSW's Graduate Attributes, the students will develop the following Graduate Attributes by undertaking the lecture, homework, and the term project in

this course. These attributes will be assessed within the prescribed assessment tasks, as shown in the assessment table in the section 8.

6. RATIONALE FOR THE INCLUSION OF CONTENT AND TEACHING APPROACH

Designed for senior undergraduate and postgraduate students, it is learning rather than a teaching course. The contents in this course stretch from the basic engine components to the most up-to-date engine technologies. This will benefit students in a wide spectrum of their goals, namely, from simply taking some experience in the practical engineering problem to developing career in the automobile industry.

Students will be challenged by the homework problems from the actual engine data that are different from the textbook examples. This approach is to improve student's ability in dealing with real research and engineering issues. The term project of reporting and presenting the literature review of the selected engine technology is intended to develop communications skills and teamwork manner that are essential in the real engineering.

7. 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 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 (why don't you try to search the lecturer's publications?). Weekly demonstrations will be run for the homework problems and the term project. Students will take hands-on experiences by solving the homework problems from the engine data that is obtained from the lab demonstration. The term project is for improving student's communication skills and teamwork spirit. A group of 5 students will work together for a technical report on the engine-related topics. They will present the results in front of the classmates during the demonstrations. Both the quality of report and the presentation skill will be assessed.

8. ASSESSMENT

The homework problems, lab report, term project, and final examination will be marked for the assessment.

Four homework problems will be released. These are simple substitution type problems that can be solved easily once students comprehend which formula applies

to where. Homework questions will be weighted differently as shown below the breakdown table. In week 6 and 7, students will attend a lab demonstration to obtain experimental data from engine rigs prepared for this course. Students will process the data to assess performance parameters learned from the lectures (10% weight). The term project will be a literature review that requires a reporting skill (10%) and an effective presentation skill (10%). The final exam will consist of 4~5 problems and is weighted at 50%.

Assessment task	**Weight**			
Homework (20%)	#1	#2	#3	#4
	6%	3%	3%	8%
Lab (10%)	Attendance		Report	
	2%		8%	
Term Project (20%)	Report		Presentation	
	10%		10%	
Examination (50%)	50%			

Submission of assessment tasks

The homework problems are released and collected during the weekly demonstration. The release and due dates are given in the course schedule (section 10). The due time is the end of the demonstration. Late submission will be penalised 30% plus 10% per day that the work is late, to a maximum penalty of 100%, except in highly exceptional and verifiable cases. Once the solutions are presented, the maximum penalty will apply.

The term project is run at the demonstration. See the course schedule for the details.

Examinations

You must be available for all tests and examinations. Final examinations for each course are held during the University examination periods.

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 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 “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 Administrative Matters, available on the School website and on Moodle, and the information on UNSW's Special Consideration page.

9. 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: https://my.unsw.edu.au/student/academiclife/Plagiarism.pdf

There is a range of resources to support students to avoid 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. Information is available on the dedicated website Plagiarism and Academic Integrity website: http://www.lc.unsw.edu.au/plagiarism/index.html

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 a 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, available on the School website.

10. COURSE SCHEDULE

Lecture schedule

Time: Thu 3-5pm Location: Electrical Engineering (G17) Room G25

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

Time: Thu 3-5pm Location: Electrical Engineering (G17) Room G25

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	Term project presentation schedule released
5	Homework #3 due Background knowledge for the lab	
6	**Lab** for group 1~3, 25 in each group	
7	**Lab** for group 4~6, 25 in each group	
8	The lab review	Term Project Report due Term Project Presentation Team 1 ~ 5
9	**Lab report due** Homework #4 released	Term Project Presentation Team 6 ~ 10
10		Term Project Presentation Team 11 ~ 15
11	Homework #4 due	Term Project Presentation Team 16 ~ 20
12		Term Project Presentation Team 21 ~ 25
13		Term Project Presentation Team 26 ~ 30

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:
To be announced (Willis Annexe 116D UG Lab is still under construction!)

11. EXPECTED RESOURCES FOR STUDENTS

Lecture notes will be uploaded in the UNSW Moodle prior to the lecture. Text book reading is suggested for further detail of engine technology and combustion. 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

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

12. 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 in the final demonstration 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.

Since semester 2 of 2009, the lecturer has reformatted this course by infusing up-to-date engine technologies and more fundamentals in combustion. In semester 1, 2012, the course was renamed from Internal Combustion Engine 1 to Automobile Engine Technology. This is the first semester that we introduce new engine rigs for more hands-on lab. Feedback on the new format will be gathered periodically using

various means, including the Course and Teaching Evaluation and Improvement (CATEI) process, informal discussion in the final demonstration 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.

13. OTHER INFORMATION TO BE INCLUDED

Find the information for the special consideration for the assessment in the following link: https://student.unsw.edu.au/special-consideration

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 Student Equity and Disabilities Unit (SEADU) by phone on 9385 4734, email: seadu@unsw.edu.au or via the website

Further information for students with disabilities is available at www.studentequity.unsw.edu.au

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.

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 safety, and student equity and diversity.

Shawn Kook
February 2015