UNSW SYDNEY | Australia's Global University

Mechanical and Manufacturing Engineering

Course Outline

Term 3 2019

ENGG2500

FLUID MECHANICS

Contents

1. Staff contact details

Contact details and consultation times for course convenor

Name: Dr Shaun Chan
Office location: Room 402D, Building J17
Email: qing.chan@unsw.edu.au
Research: https://research.unsw.edu.au/projects/advanced-combustion-diagnostics-laboratory

For questions regarding demonstration/example problems, the demonstrators in your demonstration will be the first contact. Administrative enquiries that are personal and confidential in respect of an individual student can be made to the course convenor (Dr Shaun Chan), if the circumstances require it.

Head demonstrator (contact for online assignment and laboratory etc.)

Name: Mr Paul Yip (Online assignment)
Email: h.l.yip@unsw.edu.au

Name: Mr Mark Zhai (Lab)
Email: g.zhai@unsw.edu.au

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

Please see the course Moodle.

2. Important links

- Moodle
- Lab Access
- Computing Facilities
- Student Resources
- Course Outlines
- Engineering Student Support Services Centre
- Makerspace
- UNSW Timetable
- UNSW Handbook
- UNSW Mechanical and Manufacturing Engineering

3. Course details

Credit points

This is a 6 unit-of-credit (UoC) course and involves ~5 hours per week (h/w) of face-to-face contact.

The normal workload expectations of a student are approximately 25 hours per term for each UOC, including class contact hours, other learning activities, preparation and time spent on all assessable work.

You should aim to spend about 10 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

The class contact will include the following sessions:

	Day	**Time**	**Location**
Lectures	Wednesday	1400-1600	Ainsworth G03 (K-J17-G03)
	Thursday	1700-1800	Ainsworth G03 (K-J17-G03)
(Web stream)	Any	Any	Moodle
Mid-session test	Thursday (Week 7)	1900-2000	Mathews Theatre A (K-D23-201)
Lab	Refer to Section 5, Course outline	Refer to Section 5, Course outline	UTL

Please refer to your class timetable for the learning activities you are enrolled in and attend only those classes.

Laboratory periods

You will have 3 compulsory two-hour laboratories to attend, commencing in Week 2. At the time of enrolment, you selected one of the 16 possible laboratory timeslots. Please refer to your class timetable for the laboratory you are enrolled in, and attend only that section.

Online assignments

You will have 5 online assignments. Each assignment will cover the topics that were taught in the prior weeks, with work due at 23.59 on Saturdays at the end of Weeks 3, 5, 7, 9, and 11.

Consultation sessions

There will be 1 two-hour non-compulsory drop-in consultation session (held in Week 10) at the UTL, during the two-hour laboratory time. The consultation session is intended for you to seek face-to-face contact with the academic staff and selected demonstrators in order to consult on issues related specifically to the lecture content, online assignment questions or past examination questions that you have attempted in the weeks prior. You are encouraged to prepare a list of the questions that you have before attending the consultation session, for maximum benefit.

Summary and Aims of the course

This course introduces the student to the terminology, principles and methods used in engineering fluid mechanics. Fluid mechanics is a subject which deals with both fluid statics (fluids at rest) and fluid dynamics (fluids in motion). Fluid flow has a broad application area ranging from car/airplane aerodynamics, heat exchangers, combustion systems, micro-fluidics, and flows in artificial hearts. The knowledge of fluid mechanics gained in this course is a spring board for many other courses studied in the mechanical engineering degree programmes, including, advanced thermofluids (heat transfer and advanced thermodynamics), computational fluid dynamics (CFD), automobile engine technology, and aerodynamics and propulsion, as well as other disciplines, particularly renewable energy.

In this course the topics covered include: fluid properties, fluid statics and buoyancy, Bernoulli's equation and its use/limitations, linear momentum, dimensional analysis, laminar and turbulent flow, flow in pipes and pipe networks including pressure drop calculations, boundary layer in external flow, drag or immersed bodies, turbines, fans and pumps and analysis of turbo-machines.

This course will familiarise you with the terminology associated with fluid mechanics and the use of fluid properties in solving problems. At first, you will develop an intuitive understanding of fluid mechanics by emphasis of the physics and physical arguments. Then you will be given insight into the basic principles of fluid mechanics and you will learn how to measure fluid systems and be given the tools to design fluid systems. Also, you will be given an understanding of the workings of hydraulic systems, e.g. turbines.

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.	Be familiar with the terminology associated with fluid mechanics	PE1.1
2.	Be able to use fluid properties correctly to solve problems	PE2.1, 2.2
3.	Understand the principals of flow rates and velocity measurement	PE1.1
4.	Be able to determine pressure drops for pipe systems and choose appropriate pumps and turbines depending on the application	PE2.3, 2.4

4. Teaching strategies

Lectures

Lectures in the course are designed to cover the terminology and core concepts and theories in fluid mechanics. They do not simply reiterate the texts, but build upon the lecture topics using practical examples to show how the theory is applied in real engineering problems and the details of when, where and how it should be applied. The lectures are recorded and are made available on the Moodle course page.

Lab classes

Student learning will be encouraged during practical lab classes, where the students are required to perform lab experiments that are based upon fluid flow concepts. The lab classes are designed to encourage group work and self-directed learning.

Moodle course page

The Moodle course page provides a discussion forum to enable students to interact with the course staff, course demonstrators and receive help from peers. Links to video recordings, course materials and assignments are also available.

Online assignments

Online assignments with automated feedback are provided in parallel to the lecture content on Moodle. The online assignments are designed to allow students to practice the questions as many times as they like, while receiving feedback on their attempt. This is to ensure that they can investigate problem areas in greater depth, understand the application and avoid making the same mistake.

5. Course schedule

Class schedule

Week	Day	Time	Topic	Chapter, Cengel book	Lecture room	Lab
01	Wed Thurs	1400-1600 1700-1800	Introduction, physical properties of fluids, fluids in static equilibrium, pressure measurements, manometer.	1.1-1.7, 2.1-2.7	K-J17-G03 K-J17-G03	
02	Wed Thurs	1400-1600 1700-1800	Forces on submerged plane surfaces, buoyancy and stability of floating objects, pressures in accelerating fluid systems.	3.1-3.7	K-J17-G03 K-J17-G03	Hydrostat
03	Wed Thurs	1400-1600 1700-1800	Fluid flow (Langrangian and Eulerian descriptions), continuity equation, flow visualisation, Euler's equation of motion, steady flow energy equation.	4.1-4.2, 5.1-5.3	K-J17-G03 K-J17-G04	Hydrostat
04	Wed Thurs	1400-1600 1700-1800	Bernoulli equation, hydraullic and energy grade line, energy transfer and general energy equation.	5.4-5.5	K-J17-G03 K-J17-G05	No lab class
05	Wed Thurs	1400-1600 1700-1800	Linear momentum equation (Newton's law), forces caused by deflection of jets, forces on nozzles, linear momentum + Bernoulli/Energy equations.	6.1-6.4	K-J17-G03 K-J17-G06	Flow measurement
06	Wed Thurs	1400-1600 1700-1800	Dimensional analysis and similarity. Introduction to laminar and turbulent flow in ducts, Reynolds number, entrance region.	7.1-7.5, 8.1-8.3	K-J17-G03 K-J17-G07	Flow measurement
07	Wed Thurs	1400-1600 1700-1800	Laminar and turbulent flow in pipes, analytical solutions, Moody chart and Darcy friction factor.	8.1-8.5	K-J17-G03 K-J17-G08	Pipe
07	Thurs	1900-2000	**Mid-sesssion test**		K-D23-201	
08	Wed Thurs	1400-1600 1700-1800	Pipe friction, minor loss, pipe network.	8.6-8.7	K-J17-G03 K-J17-G10	Pipe
09	Wed Thurs	1400-1600 1700-1800	External flow boundary layers, characteristics of laminar, transition and turbulent zones. Drag of immersed bodies, skin friction, form drag, variation of drag coefficient with Reynold's number.	11.1-11.6	K-J17-G03 K-J17-G11	
10	Wed Thurs	1400-1600 1700-1800	Compressor, pump and pipeline characteristics. Turbines, centrifugal and axial flow, velocity diagrams for moving blades.	14.1-14.4	K-J17-G03 K-J17-G12	In-lab consultation

Laboratory schedule

Willis Annex 116A UG Laboratory (K-J18-116A)

Laboratory time slots

M09A	Mon	0900 – 1100	UTL
M09B	Mon	0900 – 1100	UTL
M11A	Mon	1100 – 1300	UTL
M11B	Mon	1100 – 1300	UTL
W09A	Wed	0900 – 1100	UTL
W09B	Wed	0900 – 1100	UTL
W11A	Wed	1100 – 1300	UTL
W11B	Wed	1100 – 1300	UTL
F11A	Fri	1100 – 1300	UTL
F11B	Fri	1100 – 1300	UTL
F13A	Fri	1300 – 1500	UTL
F13B	Fri	1300 – 1500	UTL
F15A	Fri	1500 – 1700	UTL
F15B	Fri	1500 – 1700	UTL
F17A	Fri	1700 – 1900	UTL
F17B	Fri	1700 – 1900	UTL

Due to the large number of students, there will be 16 possible lab sessions over 2 weeks, for each lab topic. The laboratory timeslots that you are required to attend, is dependent on the session that you have selected at the time of your enrolment (please refer to your class timetable). For example, if you have selected to enroll in M09A, you will have to attend the lab on Mon 0900 – 1100 in Weeks 2, 6, and 8. If you are enrolled to M09B, your lab will be on Mon 0900 – 1100 in Weeks 3, 5 and 7.

Please note that:

- There is no lab session scheduled in Week 4 (or the automatic public holiday resequenced class in Week 11) because of logistical reasons.
- We will be running non-compulsory drop-in consultation sessions (in Week 10) in the lab, during the typical two-hour laboratory time.

	Week of Semester								
Group	2	3	4	5	6	7	8	9	10
A	Lab 1		No lab		Lab 2		Lab 3		Consult
B		Lab1	No lab	Lab 2		Lab 3			Consult

Laboratory topic

Lab 1	Flow measurement
Lab 2	Hydrostatics
Lab 3	Pipe friction
Consult	Drop-in consultation sessions

***There will be no waiver of labs for repeating students.**

6. Assessment

Assessment overview

Assessment	Group Project?	Length	Weight	Learning outcomes assessed	Assessment criteria	Due date and submission requirements	Deadline for absolute fail	Marks returned
5 x Online assignments	No	2 hours per assignment	12.5%	1, 2, 3, 4	Lecture materials from Weeks 1-2, 3-4, 5-6, 7-8, and 9-10	23.59 on Saturdays at the end of Weeks 3, 5, 7, 9, and 11.	N/A	Online
3 x Laboratories	No	2 hours per lab session	12.5%	1, 2, 3, 4	Lab materials	During each allocated lab class	N/A	In lab
1 x Mid-session test	No	1 hour	15%	1, 2, 3, 4	Lecture materials from Weeks 1-6	Week 7	N/A	In class, during Week 8
1 x Final exam	No	2 hours	60%	1, 2, 3, 4	All course content from Weeks 1-10 inclusive	TBC, during UNSW exam period	N/A	Upon release of final results

Assignments

Online Assignments

You will have 5 online assignments. Each assignment will cover the topics that were taught in the prior weeks, with work due at 23.59 on Saturdays at the end of Weeks 3, 5, 7, 9 and 11. The online assignments are an integral part of this course. In recognition of this, they will contribute 12.5% of your final grade. Each online assignment mark has a total mark out of 2.5.

Note:

- Your work on these must be your own work, but you are encouraged to discuss the methods required with other students.
- Each version of an online assignment will be slightly different.
- The online assignments are available from the beginning of the semester so that you have an extended period to complete them.
- No deadline extensions will be granted. You should attempt these assignments with sufficient remaining time to allow for unplanned service interruptions.

Lab Assignments

There will be 3 laboratory experiments held as outlined in the “Laboratory Timetable”.

You are required to obtain a bound laboratory book (alternate lined and graph pages) to record results of each experiment and analysis carried out whilst in the laboratory.

The laboratory demonstrators will mark your preliminary work at the start of the laboratory period and mark your data collection and analysis at the end of the laboratory period. Ensure that your work is marked before you leave the laboratory, that your mark is entered in the class record and that your laboratory book is initialled by the demonstrator.

You will not be admitted to the laboratory unless you are appropriately dressed for safe working, have a laboratory book, a calculator and present the assigned preliminary work.

The laboratory demonstrators will give instructions on how to operate the equipment and will explain what is required of you. If in doubt, ask. It is important that you fully understand the experiment at the time it is being carried out, when instruction is available. In some experiments, you are only required to take readings at intervals, use the intermediate time to ask questions and find out what other members of your group are doing. Little is learned merely by sitting and waiting to make a measurement - much is learned by inquiry and discussion.

Attendance at all laboratory experiments to which you are assigned is compulsory and a register is taken. If you are unable to attend due to illness, it is important that you inform the Head Demonstrator as soon as possible so that you may be reassigned to that experiment at a later date. You might be asked to present a medical certificate later.

Transfer from other groups. The laboratory groups are large, so transfers between groups are granted only for the circumstances that are unexpected and beyond your control. The transfers must be arranged through the Head Demonstrator. Please note that according to the university's rule for special consideration, "Students are expected to give priority to their University study commitments and work commitments are not normally considered a justification."

Lab report marks will be allocated for completion of preliminary analysis, results obtained and calculations made during the laboratory period (2 marks for preliminary work, 2 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 preliminary work which is not your own, or copying during the laboratory period, will result in a mark of zero for the laboratory.**

Presentation

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

Work submitted late without an approved extension by the course coordinator or delegated authority is subject to a late penalty of 20 percent (20%) 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.

Work submitted after the 'deadline for absolute fail' is not 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 are clearly indicated in the course outline, and such assessments receive a mark of zero if not completed by the specified date. Examples include:

a. Weekly online tests or laboratory work worth a small proportion of the subject mark, or
b. Online quizzes where answers are released to students on completion, or
c. Professional assessment tasks, where the intention is to create an authentic assessment that has an absolute submission date, or

d. Pass/Fail assessment tasks.

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

There will be 1 two-hour examination at the end of the session for everything learned from this course.

You must be available for all tests and examinations. Final examinations for each course are held during the University examination periods: February for Summer Term, May for T1, August for T2, and November/December for T3.

Please visit myUNSW for Provisional Examination timetable publish dates.

For further information on exams, please see the Exams webpage.

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 available 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 Engineering Student Supper Services Centre prior to the examination. Calculators not bearing an "Approved" sticker will not be allowed into the examination room.

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 submitting an assessment or sitting an exam.

Please note that UNSW now has a Fit to Sit / Submit rule, which means that if you sit an exam or submit a piece of assessment, 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.

7. Expected resources for students

Textbook

Cengel and Cimbala, Fluid Mechanics Fundamentals and Applications, 2nd Ed in SI unit.

The textbook is available from the UNSW Bookshop and the UNSW Library.

UNSW Library website: https://www.library.unsw.edu.au/
Moodle: https://moodle.telt.unsw.edu.au/login/index.php

8. 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 incorporating more blended learning modules into the course.

9. 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, 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.

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

10. 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
- Computing Facilities
- Special Consideration
- Exams
- Approved Calculators
- Academic Honesty and Plagiarism
- Disability Support Services
- Health and Safety
- Lab Access

Appendix A: Engineers Australia (EA) Competencies

Stage 1 Competencies for Professional Engineers

	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