ENGG2500

Fluid Mechanics for Engineers

Term Three // 2020

School of Mechanical and Manufacturing Engineering // UNSW Engineering

Course Overview

Staff Contact Details

Convenors

Name	Email	Availability	Location	Phone
Shaun Chan	qing.chan@unsw.edu.au		J17 402D	

Lecturers

Name	Email	Availability	Location	Phone
Cheng Wang	c.wang@unsw.edu.au			

Demonstrators

Name	Email	Availability	Location	Phone
Paul Yip	h.l.yip@unsw.edu.au			
Mark Zhai	g.zhai@unsw.edu.au			

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

Course Details

Credit Points 6

Summary 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 program, including, advanced thermofluids (heat transfer and advanced thermodynamics), computational fluid dynamics (CFD), automobile engine technology, and aerodynamics and propulsion, as well as other disciplines.

Course Aims

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.

This course will familiarize 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. You will then 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.

Course Learning Outcomes

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, PE2.2
3. Understand the principles of flow rates and velocity measurement.	PE1.1
4. Be able to determine pressure drops for pipe systems depending on the application.	PE2.3, PE2.4

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. For this term, the lectures will be delivered live using Microsoft Teams.

- **Moodle course page:** The Moodle course page provides a discussion forum to enable students to interact with one another, the course demonstrators and staff. 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. The online assignments are designed to ensure students can investigate problem areas in greater depth, understand the application and avoid making the same mistake.
- **Lab assignments:** 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. Both in-person and online delivery mode are available for selection. The lab classes are designed to encourage group work and self-directed learning.

Additional Course Information

Please post questions regarding demonstration/example problems on Moodle forums. When communicating via forum, you are expected to follow the same etiquette as you would in a classroom situation, please (1) be respectful of your peers, demonstrators and course staff; (2) value the opinions of others; and (3) do not attack others personally. Administrative inquiries that are personal and confidential with respect of an individual student can be made to the course convenor, when circumstance requires.

Assessment

Assessment Tasks

Assessment task	Weight	Due Date	Student Learning Outcomes Assessed
Online assignments	15%	End of Weeks 3, 5, 7, 9 and 11 of the term.	1, 2, 3, 4
Lab assignments	15%	End of Weeks 6, 8 and 10.	1, 2, 3, 4
Mid-term test	15%	Week 7	1, 2, 3, 4
Final examination	55%	Refer to university examination period.	1, 2, 3, 4

Assessment Details

Assessment 1: Online assignments

Start date: Start of term.

Length: 2 hours per assignment (unlimited attempts, see Moodle instructions)

Details:

You will have 5 online assignments. Each assignment will cover the topics 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 15% 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 extension will be granted. You should attempt these assignments with sufficient remaining time to allow for unplanned service interruptions.

Turnitin setting: This is not a Turnitin assignment

Assessment 2: Lab assignments

Start date: Start of term.

Details:

There will be 3 laboratory experiments, as outlined in the “schedule”, with work due at 23.55 on

Saturdays, at the end of Weeks 6, 8 and 10. The lab assignments will contribute 15% of your final grade. Each online assignment mark has a total mark of 5.

Note:

- You must review the relevant video and lab report template, which are made available on Moodle since the start of semester, before attending each lab session.
- If you are enrolled in an in-person lab class, it is recommended that you bring an electronic or physical lab report template to class, as it contains information that will help you complete your experiment. You will not be admitted to the laboratory unless you are appropriately dressed for safe working.
- If you are enrolled in an online lab class, your demonstrator will provide you with the relevant experimental data at the start of each online lab session. Your demonstrator will work with you to form your lab group at the start of each online session. Your demonstrator will also remain online to answer any question that you may have, during the online lab session.

Additional details:

To accommodate the large cohort of students, there will be at least 18 possible lab sessions each week, for each lab experiment type. The laboratory session that you are required to attend depends on your selection at the time of enrollment (refer to your class timetable). For example, if you are enrolled in M13A (UTL), you will have to attend the in-person lab session on Mon 1300-1400 in Weeks 5, 7, and 9. Alternatively, if you are enrolled in M10A (online), you will need to attend the online lab session on Mon 1600-1700 in Weeks 5, 7, and 9.

Note:

- If you are unable to attend any of your allocated lab session, because of circumstances that are beyond your control, you must write to inform the head lab demonstrator and to discuss alternative arrangement. The reason that you provide, must be consistent with the circumstances that are considered valid for special consideration applications (https://student.unsw.edu.au/special-consideration).

For both in-person and online lab classes, you will be asked to work with your group members to submit a group lab report. Only 1 person from the group will need to submit the group report, using the online submission portal on Moodle, before the due date. You will need to identify all group members (maximum 5 members) on the cover sheet of the lab report. You will need special permission from your head lab demonstrator to submit individually. No deadline extension will be granted. You and your group members must plan to allow for unplanned service interruptions.

For in-person lab classes, the laboratory demonstrators will give general instructions on how to operate the equipment safely 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 Lab Demonstrator as soon as possible so that you may be reassigned to another class. You will need to present a medical certificate.

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."

Timely arrival and completion of laboratory experiment. We require you to arrive punctual to the lab class you enrolled in. We strongly recommend that you arrive 5 minutes before the scheduled time to make yourself known to your other group members, if you have chosen to enroll in the in-person lab class.

We will need to strictly adhere to the time, because of the back-to-back nature of the classes, as well as the large number of students that are anticipated to arrive and leave the labs. The following **penalties** will therefore be applied for late arrival to your scheduled online/in-person lab class:

- If you arrive between 5 and 10 minutes late, you will receive an individual penalty of 1 out of 5 mark for the respective lab;
- if you arrive more than 10 minutes late, you will not be allowed to participate in the lab class and will receive 0 marks for the lab assignment.

Turnitin setting: This is not a Turnitin assignment

Assessment 3: Mid-term test

Start date: Week 7

Details:

There will be one 1-hour mid-term test (Week 7). The test will cover lecture materials from Weeks 1 to 5. The mid-term test is an integral part of this course and will contribute 15% of your final grade.

The test question booklet will be made available for download from Moodle, on the planned date and time. You will need to submit your answer sheet through Moodle, within the allocated time period. Your invigilators will be online to answer any question that you may have, during the period, as well as to remind you of the submission time.

Turnitin setting: This is not a Turnitin assignment

Assessment 4: Final examination

Start date: Refer to university examination period.

Details:

There will be one 2-hour examination at the end of the session for everything learned from this course.

The exam will be delivered online, in a similar manner to that of the mid-semester test.

Attendance Requirements

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

Course Schedule

View class timetable

Timetable

Date	Type	Content
Week 1: 14 September - 18 September	Lecture	Introduction, physical properties of fluids, fluids in static equilibrium, pressure measurements, manometer. (Chapters 1.1-1.7, 2.1-2.7)
Week 2: 21 September - 25 September	Lecture	Forces on submerged plane surfaces, buoyancy and stability of floating objects, pressures in accelerating fluid systems. (Chapters 3.1-3.7)
Week 3: 28 September - 2 October	Lecture	Fluid flow (Langrangian and Eulerian descriptions), continuity equation, flow visualisation, Euler's equation of motion, steady flow energy equation. (Chapters 4.1-4.2, 5.1-5.3)
Week 4: 5 October - 9 October	Lecture	Bernoulli equation, hydraulic and energy grade line, energy transfer and general energy equation. (Chapters 5.4-5.5)
Week 5: 12 October - 16 October	Lecture	Linear momentum equation (Newton's law), forces caused by deflection of jets, forces on nozzles, linear momentum + Bernoulli/Energy equations. (Chapters 6.1-6.4)
	Group Work	Hydrostat lab experiment.
Week 6: 19 October - 23 October		Flexibility week.
Week 7: 26 October - 30 October	Lecture	Dimensional analysis and similarity. Introduction to laminar and turbulent flow in ducts, Reynolds number, entrance region. (Chapters 7.1-7.5, 8.1-8.3)
	Group Work	Flow measurement lab experiment.
	Assessment	Mid-term test.
Week 8: 2 November - 6 November	Lecture	Laminar and turbulent flow in pipes, analytical solutions, Moody chart and Darcy friction factor. (Chapters 8.1-8.5)
Week 9: 9 November - 13 November	Lecture	Pipe friction, minor loss, pipe network. Rotational Motion and Angular Momentum. (Chapters 8.6-8.7, 6.5-6.6)
	Group Work	Pipe flow lab experiment.
Week 10: 16 November - 20 November	Lecture	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. (Chapters 11.1-11.6)

Resources

Prescribed Resources

Not available

Recommended Resources

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

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, following students' feedback, we have incorporated more problem examples and solutions into the teaching of the course.

Submission of Assessment Tasks

Assessment submission and marking criteria

Should the course have any non-electronic assessment submission, these should have a standard School cover sheet.

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.

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.

Late policy

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:

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

Examinations

You must be available for all quizzes, tests and examinations. For courses that have final examinations, these 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.

Special Consideration

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.

UNSW now has a Fit to Sit / Submit rule, which means that if you attempt 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.

Please note that students will **not** be required to provide **any** documentary evidence to support absences from any classes missed **because of COVID-19 public health measures such as isolation**. UNSW will **not** be insisting on medical certificates from anyone deemed to be a positive case, or when they have recovered. Such certificates are difficult to obtain and put an unnecessary strain on students and medical staff.

Applications for special consideration **will** be required for assessment and participation absences – but no documentary evidence **for COVID 19 illness or isolation** will be required in T3.

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

Academic Information

Credit points

Course credit is calculated in Units-Of-Credit (UOC). The normal workload expectation for one UOC is approximately 25 hours per term. This includes class contact hours, private study, other learning activities, preparation and time spent on all assessable work.

Most coursework courses at UNSW are 6 UOC and involve an estimated 150 hours to complete. Each course includes a prescribed number of hours per week (h/w) of scheduled face-to-face and/or online contact. Any additional time beyond the prescribed contact hours should be spent in making sure that you understand the lecture material, completing the set assignments, further reading, and revising for any examinations.

On-campus class attendance

Public distancing conditions must be followed for all T3 face-to-face classes. To ensure this, only students enrolled in those classes will be allowed in the room. Class rosters will be attached to corresponding rooms and circulated among lab demonstrators. No over-enrolment is allowed in face-to-face class. Students enrolled in online classes can swap their enrolment from online to other additional, **but limited**, number of on-campus classes by Sunday, Week 1. Please refer to your course's Microsoft Teams and Moodle sites for more information about class attendance for in-person and online class sections/activities.

Your health and the health of those in your class is critically important. You must stay at home if you are sick or have been advised to self-isolate by NSW health or government authorities. Current alerts and a list of hotspots can be found here. **You will not be penalised for missing a face-to-face activity due to illness or a requirement to self-isolate.** We will work with you to ensure continuity of learning during your isolation and have plans in place for you to catch up on any content or learning activities you may miss. Where this might not be possible, an application for fee remission may be discussed. Further information is available on any course Moodle or Teams site.

In certain classroom and laboratory situations where 1.5 metres physical distancing cannot be maintained or there is a high risk that it cannot be maintained, face masks will be considered **mandatory PPE** for students and staff.

For more information, please refer to the
FAQs: https://www.covid-19.unsw.edu.au/safe-return-campus-faqs

Guidelines

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

Important Links

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

Image Credit

Synergies in Sound 2016

CRICOS

CRICOS Provider Code: 00098G

Acknowledgement of Country

We acknowledge the Bedegal people who are the traditional custodians of the lands on which UNSW Kensington campus is located.

Appendix: Engineers Australia (EA) Professional Engineer Competency Standard

Program Intended Learning Outcomes	
Knowledge and skill base	
PE1.1 Comprehensive, theory based understanding of the underpinning natural and physical sciences and the engineering fundamentals applicable to the engineering discipline	✓
PE1.2 Conceptual understanding of the mathematics, numerical analysis, statistics, and computer and information sciences which underpin the engineering discipline	
PE1.3 In-depth understanding of specialist bodies of knowledge within the engineering discipline	
PE1.4 Discernment of knowledge development and research directions within the engineering discipline	
PE1.5 Knowledge of engineering design practice and contextual factors impacting the engineering discipline	
PE1.6 Understanding of the scope, principles, norms, accountabilities and bounds of sustainable engineering practice in the specific discipline	
Engineering application ability	
PE2.1 Application of established engineering methods to complex engineering 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	✓
Professional and personal attributes	
PE3.1 Ethical conduct and professional accountability	
PE3.2 Effective oral and written communication in 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	