UNSW SYDNEY | Australia's Global University

Mechanical and Manufacturing Engineering

Course Outline

Semester 2 2017

MMAN2600

FLUID MECHANICS

Contents

1. Staff contact details

Contact details and consultation times for course convenor

Course convener and lecturer:
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

Guest lecturer:
Name: Dr Jeoffrey Fisher
Office location: Room 408, Building J17
Email: jeoffrey.fischer@unsw.edu.au

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 Samuel Olgers (Online assignment)
Email: s.olgers@unsw.edu.au

Name: Mr Harsh Goyal (Lab)
Email: harsh.goyal@unsw.edu.au

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

Please see the course Moodle.

2. Important links

- Moodle
- UNSW Mechanical and Manufacturing Engineering
- Course Outlines
- Student intranet
- UNSW Mechanical and Manufacturing Engineering Facebook
- UNSW Handbook

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 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

The class contact will include the following sessions:

Lecture periods

Monday	1600 to 1800	Law Theatre G04 (K-F8-G04)
Friday	1000 to 1100	Central Lecture Block 8 (K-E19-105)

Mid-session tests

Weeks 5 and **9** will take place in the Friday:

Friday	1700 to 1900	Central Lecture Block 7 (K-E19-104)

Laboratory periods

You will have 5 compulsory 2-hour laboratories to attend, commencing in week 3. At the time of enrolment you selected one of 7 possible laboratory timeslots.

Online assignments

You will have 6 online assignments. Each assignment will cover the topics that were taught in the prior weeks, with work due at 23.59 on Fridays at the end of weeks 3, 5, 7, 9, 11 and 13.

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.

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.

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.

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.

This course uses the mathematical and physical concepts which you learned in MATH1131 or MATH1141 and PHYS1121 or PHYS1131. It lays the groundwork for the procedure which you will use in undertaking more complex fluid dynamics problems in courses such as AERO3630 or MECH9620 as well as thermal engineering problems in courses such as MECH3610 and MECH9761.

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 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 on 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.

Demonstrations are designed to provide you with feedback and discussion on the example problems, and to investigate problem areas in greater depth to ensure that you understand the application and can avoid making the same mistake again.

5. Course schedule

Week	Day	Time	Activity	Chapter, Cengel Book	Lecturer	Lab
01	Mon Fri	16-18 10-11	Introduction, physical properties of fluids, fluids in static equilibrium, pressure measurements, manometer	1.1-1.7 2.1-2.7	SC	
02	Mon Fri	16-18 10-11	Forces on submerged plane surfaces, buoyancy and stability of floating objects, pressures in accelerating fluid systems.	3.1-3.7	SC	
03	Mon Fri	16-18 10-11	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	JF	Flow mea
04	Mon Fri	16-18 10-11	Bernoulli equation, hydraullic and energy grade line, energy transfer and general energy equation.	5.4-5.5	JF	Flow mea
05	Mon Fri	16-18 10-11 17-19	Introduction to CFD **No lecture.** **Mid-session test 1**	CFD Week 1-4	JF	Hydrostat
06	Mon Fri	16-18 10-11	Linear momentum equation (Newton's law) Forces caused by deflection of jets, forces on nozzles, linear momentum+Bernoulli/Energy equations	6.1-6.2 6.3-6.4	SC	Hydrostat
07	Mon Fri	16-18 10-11	Dimensional analysis and similarity, introduction to laminar and turbulent flow in ducts, Reynolds number, entrance region.	7.1-7.5 8.1-8.3	SC	Pipe
08	Mon Fri	16-18 10-11	Laminar and turbulent flow in pipes, analytical solutions, Moody chart and Darcy friction factor.	8.1-8.5	SC	Pipe
09	Mon Fri	16-18 10-11 17-19	Pipe friction, minor loss, pipe network **No lecture.** **Mid-session test 2**	8.6-8.7 Week 5-8	SC	CFD
Break		-	-		-	-
10	Mon Fri	16-18 10-11	External flow boundary layers, characteristics of laminar, transition and turbulent zones. Grag of immersed bodies, skin friction, form drag, variation of drag coefficient with Reynold's number.	11.1-11.6	SC	**No lab**
11	Mon Fri	16-18 10-11	Compressor, pump and pipeline characteristics.	14.1-14.2	SC	CFD
12	Mon Fri	16-18 10-11	Turbines, centrifugal and axial flow, velocity diagrams for moving blades.	14.4	SC	Pelton
13	Mon Fri	16-18 10-11	**No lecture.**			Pelton

LABORATORY TIMETABLE

Undergraduate Teaching Laboratory (UTL), J18 Willis Annexe

Laboratory Time Slots

M10A	Mon	1000 – 1200	UTL
T10A	Tue	1000 – 1200	UTL
T12A	Tue	1200 – 1400	UTL
W16A	Wed	1600 – 1800	UTL
H14A	Thu	1400 – 1600	UTL
F12A	Fri	1200 – 1400	UTL
F14A	Fri	1400 – 1600	UTL

Due to the large number of students, each of these timeslots will further be broken into 2 groups. You will be notified of which group, Archimedes or Bernoulli, you are in before the lab commences in week 3. For example, if you are enrolled to M10A and are selected for group Bernoulli, you will attend the lab on Mon 10:00-12:00 in week 4, 6, 8, 11 and 13. If you are enrolled to H14A and are selected for group Archimedes, your lab will be on Thurs 14:00-16:00 in week 3, 5, 7, 9 and12.

	Week of Semester										
Group	3	4	5	6	7	8	9	10	11	12	13
Archimedes	Lab 1		Lab 2		Lab 3		CFD	**No lab**		Lab 4	
Bernoulli		Lab 1		Lab 2		Lab 3		**No lab**	CFD		Lab 4

Laboratory Topic

Lab 1 Flow measurement
Lab 2 Hydrostatics
Lab 3 Pipe friction
CFD CFD laboratory, conducted in the computer labs
Lab 4 Pelton wheel

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

6. Assessment

Assessment overview

Assessment	Length	Weight	Learning outcomes assessed	Assessment criteria	Due date and submission requirements	Deadline for absolute fail	Marks returned
6 x Online assignments	2 hours per assignment	20%	1, 2, 3, 4	Lecture material from weeks 1-2, 3-4, 5-6, 7-8, 9-10 and 11-12	23.59 on Fridays at the end of weeks 3, 5, 7, 9, 11 and 13.	N/A	Online
5 x Laboratories	2 hours per lab session	20%	1, 2, 3, 4	Lab materials	During each allocated lab class	N/A	In lab
2 x Mid-session tests	1 hour per test	20%	1, 2, 3, 4	.Lecture material from weeks 1-4 and 5-8	Week 5 and 9	N/A	In class, during Week 7 and 11 lectures
1 x Final exam	2 hours	40%	1, 2, 3, 4	All course content from weeks 1-12 inclusive	TBC, during UNSW exam period	N/A	Upon release of final results

Online Assignments

You will have 6 online assignments. Each assignment will cover the topics that were taught in the prior weeks, with work due at 23.59 on Fridays at the end of weeks 3, 5, 7, 9, 11 and 13. The online assignments are an integral part of this course. In recognition of this, they will contribute 20% of your final grade. Each online assignment mark has a total mark out of 5. The best 5 of the 6 online assignments will then be summed to give the online assignment component of your final grade.

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 5 laboratory experiments held as outlined in the “Laboratory Timetable”, including 1 computer-lab based CFD experiment.

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 0 for the laboratory.**

Presentation

All non-electric submissions should have a standard School cover sheet which is available from this course's Moodle page.

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

Late submissions will be penalised 5 marks per calendar day (including weekends). An extension may only be granted in exceptional circumstances. Special consideration for assessment tasks 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.

Where there is no special consideration granted, the 'deadline for absolute fail' in the table above indicates the time after which a submitted assignment will not be marked, and will achieve a score of zero for the purpose of determining overall grade in the course.

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.

Examination

There will be one 2-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, 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.

Mid-session Tests

There will be two one-hour mid-session tests (held in weeks 5 and 9). For each test, there will be questions from week 1~4 lectures (Test 1) and week 5~8 lectures (Test 2).

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.

7. Attendance

You are required to attend a minimum of 80% of all classes, including lectures, labs and seminars. It is possible to fail the course if your total absences equal to more than 20% of the required attendance. Please see the School intranet and the UNSW attendance page for more information.

8. 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

9. 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 incorporation of blended learning modules into the course.

10. 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.

11. Administrative matters and links

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

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