THE UNIVERSITY OF MELBOURNE

ENGR30002

Fluid Mechanics

Dr Daniel Heath & Dr Lionel Lam

Departments of Infrastructure & Chemical Engineering

Melbourne School of Engineering

Subject Outline

Semester 1 2021

Essential Administrative Information

Subject Title	Fluid Mechanics
Subject Code	ENGR30002
Subject coordinator	Dr Daniel Heath
Credit	12.5
Handbook website	https://handbook.unimelb.edu.au/view/2021/ENGR30002
Subject website	Available through LMS
Contact hours	Online videos: Several per week (to watch before lectures) Lectures: 2 x 1-hour lecture per week • Wednesday 11:00 – 12:00 pm • Thursday 3:15 – 4:15 pm Tutorial: 1 x 1-hour tutorial per week (starts in week 2) Workshop: 1 x 1-hour workshop per week (starts in week 2) Practical: 2 x 2-hour practical per semester

Important Notices

The Subject Outline (this document) gives you important information about the subject, aims, outcomes, syllabus, and assessment.

Please note the following University of Melbourne Websites:

- Academic Honesty: https://academichonesty.unimelb.edu.au
- Student Rights and Responsibilities: https://students.unimelb.edu.au/admin/rights
- University Policies and Procedures: http://about.unimelb.edu.au/academicboard/policies

You are required to be aware of and fulfil your responsibilities under the University's rules, policies, and procedures, so it is important that you review the content of these in detail.

Teaching Team

Every subject has a person who is responsible for the overall administration of that subject. This person is the Subject Coordinator. For this subject Daniel Heath is the subject coordinator as well as your primary instructor.

Subject Coordinator	Dr Daniel Heath
Email	daniel.heath@unimelb.edu.au
Consultation hour	Fridays 11 – 12pm (week 7-12)

This subject will be co-taught between Dr Heath and Dr Lionel Lam.

Co-teacher	Dr Lionel Lam
Email	lionel.lam@unimelb.edu.au
Consultation hour	Fridays 10 – 11am (week 2-6)

This subject also has a Senior Tutor. The Senior Tutor for this subject is Dan Kim. He is responsible for day-to-day administration of the subject as well as coordinating the tutorials and practicals.

Senior Tutor	Daejung (Dan) Kim
Email	daejungk@student.unimelb.edu.au

Introduction

This subject concerns the fundamental science of fluid flow relevant to a range of engineering applications, and is essential for specializations relating to Chemical, Civil, and Environmental Engineering. You will be introduced to and become familiar with all relevant physical properties and fundamental laws governing the behaviour of fluids and you will learn how to solve a variety of problems of interest to engineers. While there will be a chance for you to put your mathematical skills to use in this subject, the emphasis is on developing a physical understanding of why a fluid behaves the way it does. The aim is to combine your extensive, existing intuition for fluid mechanics with formal analytical methods. Additionally, we will discuss the common types of equipment that, as a practicing engineer, you will encounter when designing fluid flow systems.

Learning outcomes

Upon successful completion of this subject, you will be able to:

- Apply the principles of a force balance in a stationary fluid to solve engineering problems
- Solve the mechanical energy balance in on dimensional pipe flow, scale-up pumps & mixers
- Apply multi-dimensional flow equations to axisymmetric and planar flow problems

Student feedback

We welcome your feedback as a way to keep improving this subject. Later this semester you will be encouraged to give subject feedback through the **SSLC** and **SES (Subject Experience Survey)**.

Textbooks and Resources

You do not have to purchase a textbook for this course. However, you may like to refer to the following texts, as they may be a handy resource for material that you are having difficulty with.

Primary

- Cengel and Cimbala "Fluid Mechanics - Fundamentals and Applications" 2nd edition
- Coulson & Richardson, Chemical Engineering Vol1, Fluid Flow, Heat Transfer & Mass Transfer
- Extra Readings on LMS

Additional

- J. Smits, A Physical Introduction to Fluid Mechanics.
- Frank M. White, Fluid Mechanics

- Massey, Mechanics of Fluids.
- Bird, Stewart, Lightfoot, Transport Phenomena

Copies are available in the library.

Recordings of the lectures, lecture notes, tutorial problems, and prac information will be available on the subject website.

Assessment details

Your course grade will be determined by your performance on the following five pieces of assessment.

Assessment Task	**Worth**
LMS quizzes (5 of them)	10%
Assignment 1	10%
Assignment 2	10%
Practical report 1	10%
Practical report 2	10%
Modelling workshop	10%
End-of-semester exam	40%
Total	**100%**

Hurdle Requirement: The end-of-semester exam is a hurdle. You must pass the exam to pass the course.

Tutorials

There will be weekly tutorials starting the second week of the semester. Your preparation for the exam will involve solving practice problems that the teaching staff will post on the website.

Problems will only be posted when are able to solve them and they will be accompanied by the final answer only. Complete solutions will only be posted two weeks after the topic has finished.

You should bring any issues or difficulties that you are having with these practice problems to the tutorials. The tutorial sessions will enable the tutors to work through

Keeping up to date with these problems is essential for performing well in the course. The tutorials (and the tutors) are a resource that you use as much as necessary.

Assignments

There will be two written assignments throughout the semester. They will consist of several exam-type problems. The exact dates of the assessments are still TBD.

- Approximate due date of first assignment is week 7
- Approximate due date of second assignment is week 12

The assignments can be handwritten. However, they must be scanned in and submitted through the LMS. Hardcopies of the assignments will not be accepted.

Practical

Each student will have to participate in 2 laboratory sessions (practicals) during the semester. Each lab will require a team-based written lab report submitted through the LMS. The reports must be typed. All lab sections will be virtual due to campus restrictions because of the pandemic. The labs will focus on: (1) pipe flow and (2) pump assembly.

Workshops

Each student will have to participate in a weekly modelling workshop. During this workshop, you will work with other students to develop mathematical models of fluid flow systems in MATLAB or learn about computational fluid dynamics. There will be a final modelling project due near the end of the semester.

Penalties

Unfortunately, students have consistently been tardy with submitting assignments/lab reports. As a result, I have been forced to adopt strict penalty policy.

Assignments

- Homework assignment and lab reports will be submitted electronically via the LMS. Homework assignments can be handwritten. Lab reports must be typed.
- Assignments that are submitted late will receive an automatic 10% deduction. An additional 10% will be deducted for each additional day that it is late.
- No assignments will be accepted once the marks for the assignment have been released.
- If your submission is incomplete (e.g., missing pages), the missing content will not be accepted after the due date and time of the assignment.
- Be certain that you receive and keep the submission confirmation email for your assignments.
- If you are having difficulty submitting your document via the LMS, you can email a .pdf of your assignment to the course coordinator before the due date and time of the assignment without penalty. Note, documents submitted this way will still be electronically screened for plagiarism.

- **It is the student's responsibility to ensure timely and complete submission of their assignments.**

Syllabus

A tentative schedule for the semester is provided below. Dates may vary. Blue is Dr Lionel Lam, and pink is Dr Daniel Heath.

Week	**Date**	**Videos** LMS	**Lecture 1** Wed 12–1pm Zoom	**Lecture 2** Thur 3:15–4:15pm Zoom	**Tutorial** Zoom/f2f	**Workshop** Zoom/f2f	**Quiz** LMS	**Practical** Zoom	**Assignments** LMS
Week 1	March 1	Hydrostatics	Hydrostatics	Hydrostatics	No tutorial	No workshop			
Week 2	March 8	Dimensional analysis	Dimensional analysis	Dimensional analysis	Tutorial 1	Workshop 1	Quiz 1		
Week 3	March 15	Conservation laws	Conservation laws	Conservation laws	Tutorial 2	Workshop 2		Prac 1 released	
Week 4	March 22	Pipe flow	Pipe flow	Pipe flow	Tutorial 3	Workshop 3	Quiz 2		
Week 5	March 29	Pipe flow	Pipe flow	Pipe flow	Tutorial 4	Workshop 4		Prac 1 due	Assign 1 released
Non-teaching week (April 5)									
Week 6	April 12	Pumps & mixing tanks	Pumps	Mixing tanks	Tutorial 5	Workshop 5	Quiz 3	Prac 2 released	
Week 7	April 19	Compressible flow	Compressible flow	Open channel flow	Tutorial 6	Workshop 6			Assign 1 due
Week 8	April 26	Open channel flow	Open channel flow	Open channel flow	Tutorial 7	Workshop 7 Assignment released	Quiz 4	Prac 2 due	
Week 9	May 3	Rheology	Rheology	Rheology	Tutorial 8	Workshop 8			Assign 2 released
Week 10	May 10	Fluid flow in 3D	Mass in 3D	Momentum in 3D	Tutorial 9	Workshop 9			
Week 11	May 17	Navier-Stokes Equations	Applications of NSE	Application of NSE	Tutorial 10	Workshop 10 Assignment due	Quiz 5		
Week 12	May 24	Navier-Stokes Equations	Applications of NSE	Applications of NSE	Tutorial 11	Workshop 11			Assign 2 due