Department of Mechanical & Aerospace Engineering

Carleton UNIVERSITY
Canada's Capital University

MAAE 2300: Fluid Mechanics I

(SECTIONS C and D – Winter 2018)

COURSE OUTLINE

Instructors

	Section C	**Section D**
Instructor	Dr. Fidel Khouli	Dr. Houman Hanachi
Office	3246 ME	3105 CB
Phone	613 520 2600 ext. 5783	
Email	Fidel.Khouli@carleton.ca	Houman.Hanachi@carleton.ca
Office Hrs.	Monday & Wednesday 11:00am to 12:00pm or by appointment	Tuesday & Thursday 9:00am to 10:00am or by appointment

Course Schedule

Lectures

Section C (Khouli)	Mon. & Wed.	13:05 to 14:25	5050 MC (Minto)
Section D (Hanachi)	Tue. & Thu.	11:35 to 12:55	C164 LA (Loeb)

Problem Analysis (PA) Sessions / Laboratory Sessions

Section L01	Friday	08:35 to 11:25	ME 3356
Section L02	Tuesday	14:35 to 17:25	ME 4342
Section L03	Thursday	14:35 to 17:25	ME 4332
Section L04	Monday	14:35 to 17:25	CB 2202
Section L05	Friday	11:35 to 14:25	ME 3190
Section L06	Friday	14:35 to 17:25	ME 3190
Section L07	Thursday	08:35 to 11:25	ME 3190
Section L08	Wednesday	14:35 to 17:25	ME 3174

Please note: *All laboratory work will take place in Mackenzie Building as outlined in the course manual. Laboratory group sign-up and schedule will be posted on cuLearn after the first class have occurred. Because of equipment access and space restrictions, you can only sign-up for laboratory in the section in which you are registered. However, you are free (and encouraged) to attend any or all of the tutorial sessions listed above.*

Teaching Assistants

To be announced later.

Course Description

Fluid Mechanics is one of the most interesting and widely applicable subject areas in all of engineering. Familiar examples and applications include diverse topics such as aerodynamics (e.g. flight, lift, and drag); weather; biology (circulation, breathing, etc.); transportation (combustion, vehicle design); water transport; hydroelectric power, wind-turbines, pollutant dispersion, along with numerous other fascinating and important areas. In this course, we will first introduce basic concepts of fluids and fluid mechanics. We will consider fluids at rest and in motion and we will develop powerful governing equations using the control volume approach. We will give particular attention to developing useful forms of linear momentum and energy equations to study fundamental and practical applications of fluid mechanics in engineering problems. Laboratory experiments will also provide "hands-on" examples and experience to complement the lecture material.

Prerequisites

MATH1005: Differential Equations and Infinite Series for Engineering Students
MATH1104: Linear Algebra for Engineering and Computer Science Students
ECOR 1101: Mechanics I

Textbook

The course is assigned the following textbook, which is available in the bookstore:

Frank M. White, "Fluid Mechanics", Eighth Edition, McGraw-Hill, 2016 (ISBN 978-0-07-339827-3) **(On Reserve in Library)**

Older versions of this book can also be used; however, the section numbers, figures, diagrams and problems would be cited based on the Eighth Edition.

Other Books

There are several good texts on undergraduate fluid mechanics. Three good textbooks are selected for those looking for additional learning resources. These books are not considered our official references for the course. The first two textbooks are on reserve in the library.

C.T. Crowe, D.F. Elger, and J.A. Roberson, "Engineering Fluid Mechanics", 9th Ed., John Wiley & Sons, 2008 (ISBN 978-0470259771).

- An introductory text aimed at both 2nd and 3rd year students. Coverage and explanations of introductory concepts and material is generally very good and examples tend to focus on problem solving. Although, it may not be as useful as White as a long-term reference, it might be better as a first introduction to fluid mechanics **(On Reserve in Library)**.

R.W. Fox, A.T. McDonald, and P.J. Pritchard, "Introduction to Fluid Mechanics", 7th Ed., John Wiley & Sons, 2008 (ISBN 978-0471742996).

- Another widely used introductory text. The content is similar to that of White, and there is an emphasis on problem solving in the text **(On Reserve in Library)**.

R. C. Hibbeler, "Fluid Mechanics", 2nd Ed. Pearson, 2018, (ISBN-10: 0134676610).

- This book has a thorough coverage on the topics of fluid mechanics at undergraduate level. Particular attention is given to application of the principles in different disciplines. It supports the students' problem-solving skills through a large variety of problems with different levels of difficulty.

Grading

The final grade for the course will be derived as follows

Laboratory experiments:	15%
Assignments:	10%
One Mid-term test:	20%
Final examination:	55%

The final examination is for evaluation purposes only and answer booklets will not be returned to the students. **You must pass the final exam to pass the course**.

Please note that successful completion of laboratory work is an important requirement of professionally accredited engineering programs. **Failure to submit any laboratory report or to receive an overall passing grade for the reports will result in a grade of FND (failure no deferred) for the course**.

Midterm Exam

The midterm is a problem oriented exam. It covers all parts of the course taught by the midterm time. It will be held in the lecture halls according to the following:

Section C (Khouli)	Mon., Feb. 26, 2018,	from 13:00 to 14:25	5050 MC (Minto)
Section D (Hanachi)	Tue., Feb. 27, 2018,	from 11:30 to 12:55	C164 LA (Loeb)

Course Website

Additional course material, laboratory sign-up sheets, problems, and term grades will be posted using cuLearn.

Laboratory Experiments

All students will be required to perform three laboratory experiments, as described in the course manual. The experiments will be conducted near the middle of the term. The precise scheduling of the laboratory sessions will be announced in lectures. The late start to the laboratory exercises is to enable most of the theory needed in the laboratory to have been covered in lectures. Students will be required to personally submit their laboratory reports to the large drop box outside the Mechanical and Aerospace Engineering Office (3135 Mackenzie Bldg.) or to the Teaching Assistant (TA) responsible for that lab, one week after performing the laboratory exercise. Students **must include the name of the TA, names of their lab partners, and date the experiment was performed on the cover sheet**. See the section on Laboratory Exercises in the course manual for details on laboratory report preparation.

Students who have successfully completed the laboratory work during a previous registration in the course may NOT request an exemption from the laboratory work.

Assignments

There are up to ten assignments for this course. The assignments will be posted on cuLearn on Friday evening every week. The assignment will reflect mainly the material covered during the week. However, problems that reflect material that was previously covered during the course may be assigned to emphasize certain concepts. Each assignment will include six to ten problems to solve. The assignment will be addressed during the Problem Analysis sessions of the week that follows its posting, where the TA will pick two problems to solve on the board. The students have to submit their solutions of all assigned problems in the drop box outside the Mechanical and Aerospace Engineering Office at 4:00pm on the Monday that follows the week of the Problem Analysis session that addressed the assignment. Therefore, the students have ten days to tackle the assignment from the day of its posting. **Depending on available TA resources, one or two problems that were not solved by the TA will be picked randomly from the assignment problems for marking.** While collaborative work is acceptable, each student must submit their own solution set and identify any collaboration in writing to avoid plagiarism. Students are encouraged to solve all problems to prevent the risk of losing marks for a single missed solution. The assignments will be returned in the next problem analysis session by the TA.

Problem Sessions with TAs

Problem solving proficiency will be essential in order to succeed in the course. We will focus on developing problem solving skills in the problem sessions. However, the range of possible problems in fluid mechanics is enormous. Possible problems cannot be categorized into few "standard" types. To develop the necessary understanding and proficiency in solving problems, it is essential to do a substantial number of problems and to do them relatively independently. In addition to the assignment problems, practice problems will be posted on a weekly basis. These problems will neither be marked nor tackled directly in the Problem Analysis sessions; however, they are meant to provide additional practice for the midterm and the final exams. You are encouraged to discuss the solutions with your TA once you are finished with your assignment problems.

Brief Outline of Lectures

Date	Book Section	Topic
Week 1 Jan.08	1.1 to 1.7	Introduction, concept of fluid, dimensions and units, different properties and viscosity
Week 2 Jan.15	2.1 to 2.4	Pressure, equilibrium in fluid, pressure distribution, manometry
Week 3 Jan.22	2.5, 2.6	Hydrostatic forces on plane and curved surfaces
Week 4 Jan.29	2.8	Buoyancy and stability of submerged and floating bodies
Week 5 Feb.05	2.9, 2.10	Pressure distribution in gravity fields, pressure measurement
Week 6 Feb.12	1.9, 3.1 to 3.3	Flow patterns, basic laws of fluid mechanics, Reynolds transport theorem, continuity
Week 7 Feb.19		Study week
Week 8 Feb.26		Midterm exam
	3.4	Linear momentum equation
Week 9 Mar.05	3.4	Linear momentum equation and application to steady flows
Week 10 Mar.12	3.6	Angular momentum equation and application to steady flows
Week 11 Mar.19	3.5, 3.7	Bernoulli's equation and energy equation, applications in pumps and turbines, efficiency
Week 12 Mar.26	6.1, 6.3, 6.4	Reynolds number and flow regimes, friction and head loss, laminar flow
Week 13 Apr.02	6.6, 6.7, 6.9	Turbulent pipe flow and Moody chart, types of pipe flow problems, minor losses in pipe systems
Week 14 Apr.09		Review

Accommodations

You may need special arrangements to meet your academic obligations during the term because of disability, pregnancy or religious obligations. Please review the course outline promptly and write to me with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist.

Students with disabilities requiring academic accommodations in this course must register with the Paul Menton Centre for Students with Disabilities for a formal evaluation of disability-related needs. Registered PMC students are required to contact the Centre, 613-520-6608, every term to ensure that course instructors receive your Letter of Accommodation, no later than two weeks before the first assignment is due or the first in-class test/midterm requiring accommodations. If you require accommodation for your formally scheduled exam(s) in this course, please submit your request for accommodation to PMC. See the Paul Menton Centre website https://carleton.ca/pmc/ for additional information.

You can visit the Equity Services website to view the policies and to obtain more detailed information on academic accommodation at http://carleton.ca/equity/accommodation