MECH 314 Fluid Mechanics — February 1, 2016
American University of Beirut, Spring 2016 — Handout # Syllabus

Syllabus

Course Administration

	Section 3
Lecturer:	Issam Lakkis
Office	Bechtel 410
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Office hours	Wednesday 10 AM - 2 PM
Lectures	Tuesdays and Thursdays 11 AM – 12 PM
	Bechtel 539
Problem Solving Session	TBD
Teaching Assistant	TBD

Welcome to MECH 314!

Fluid mechanics is an important area of study that spans a diverse range of disciplines from astrophysics to life sciences and climate studies. As engineers, we use fluid mechanics in the service design, whether designing air conditioners, respiratory drug delivery devices, tennis balls, high performance swim suits, artificial hearts, air filters or airplane wings, to name a few examples. Fluid mechanics can be thought of as one side of a thermal-fluid sciences triangle, the other two sides being heat/mass transport and thermodynamics. We expect this course to help you better engage the world around you by honing your understanding, knowledge, and problem solving abilities in this branch of the thermal-fluid sciences.

Educational objectives

The objectives of this course are to

1. learn the fundamentals of fluid mechanics and its applications in various engineering disciplines.
2. acquire problem solving skills and modeling techniques for fluid mechanics problems occurring in engineering applications.
3. have a clear overview of the various flow regimes and their particular aspects.

4. develop the proper analytical mindset for tackling fluid mechanics problems of more advanced nature.

Textbook

The suggested text is *Fluid Mechanics* by Frank M. White, Seventh Edition (McGraw Hill).

Moodle

We expect to use Moodle for course announcements. Students are expected to check for updates on Moodle on a daily basis. In addition to announcements, Course handouts, Problem Set solutions, Exams solutions and additional material will be available in "pdf" formats form Moodle in a timely fashion.

Problem Sets

Problem sets will assigned on a weekly basis on average. The assigned problems along with the due date will be posted on Moodle. Not all problems in all problem sets will be corrected. Randomly selected problems from each problem set will be corrected and the problem sets grades will count towards the course final grade. It is observed over the years that there is a strong correlation between solving the problem sets and performance in exams. Solutions to selected problems will be posted on Moodle after the due date.

Problem Solving Sessions

Announcements for holding problem solving sessions will be placed on Moodle ahead of time.

Exams and grading

The final grade in the course will be based upon drop quizzes, two quizzes, and a final exam as follows:

- 20 % Quiz 1: 90 minutes. Closed book.
- 31 % Quiz 2: 90 minutes. Closed book.
- 39 % Final: 180 minutes. Closed book.
- 10 % Pop up quizzes and occasional assignments.

Office Hours

Your are encouraged (and even expected) to come by and see us during office hours to ask any questions you have. Please be advised that we will not be able to answer or discuss course related questions outside the office hours.

Collaboration and honesty rules

- No collaboration or cheating is allowed in the exams.
- Do not copy problems sets. Even though problem sets are optional, both parties involved in cheating will be sent to the student affairs committee.

Approach

The course will be presented as a series of lectures accompanied by visual aids (images and movies) when convenient. Reading material is assigned mainly from the textbook. Example problems will be solved in class. Separate problem solving sessions will be held when necessary. The Problem Sets are an essential part of the course and the students is therefore strongly required to spend enough time in solving the problems. In addition to the Problem Sets, solving additional problems from the textbook is recommended.

From experience, students who do not spend enough time on the Problem Sets end up not doing well in the class.

Course outline

1. The concept of a fluid. The continuum viewpoint. Thermodynamics properties of a fluid. Transport properties of a fluid. Flow description: Eulerian vs. Lagrangian approaches, streamlines, streaklines, pathlines. Classification of forces (body force, surface force, line force.) Surface tension. Reading: Chapter 1.
2. Conservation of mass: integral and differential forms. Reading: Chapter 3.
3. Conservations of momentum : fluid statics. Forces acting on a body of fluid at rest. Pressure. Buoyancy and stability. Reading: Chapter 2.
4. Conservation of momentum and energy: integral form. Reading: Chapter 3.

5. Inviscid (frictionless) flows. The Bernoulli equation. Reading: Chapter 3 and chapter 4.

6. Differential form of the conservation laws for mass, momentum and energy and the corresponding boundary conditions. Reading: Chapter 4.

7. Incompressible flow. Irrotational flow and vorticity. Potential flow. Chapter 4.

8. Dimensional analysis, similarity, and scaling. Chapter 5.

9. Internal flows: viscous flow in ducts. Chapter 6.

10. External flows: flow past immersed bodies. Chapter 7.

References

1. Introduction to Fluid Mechanics by Robert W. Fox, Philip J. Pritchard, and Alan T. McDonald, John Wiley and Sons Inc. 2009.

2. Tritton, D. J. 1988. Physical Fluid Dynamics, 2nd ed., Oxford University Press.

3. Batchelor, G. K. 1973. An Introduction to Fluid Mechanics, Cambridge.

4. James A. Fay. 1994. Introduction to Fluid Mechanics, The MIT Press.