FLUID MECHANICS – AE 204

CHAPTER 0

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Course Objectives and Syllabus

by
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Instructor

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Lecture webpage:

http://www1.gantep.edu.tr/~emrekara/index.php/ae204/

Course Information

Lectures: Mon – 09:25-12:00 (A03)

Wed – 13:30-15:10 (Fluid Mechanics Laboratory)

Instructor's Office Hour:

Mon – 15:30-16:30 (Z04)

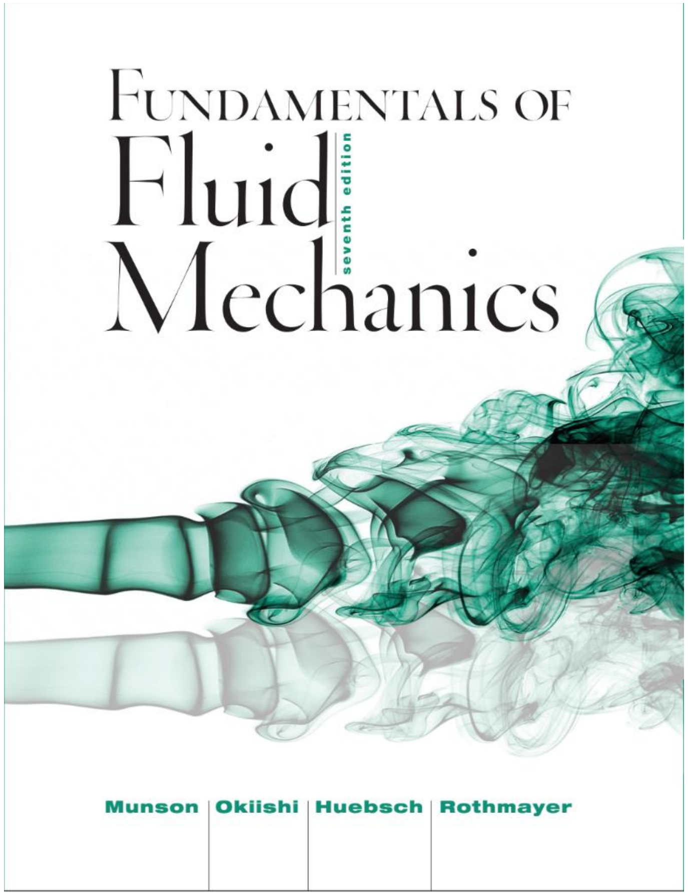
Teaching Assistant:

Ahmet Şumnu: ahmetsumnu@gantep.edu.tr

Teaching Assistant Office Hours: Talk to him.

Compulsory Textbook

1. Fundamentals of Fluid Mechanics, 7th Edition (2013) or newer



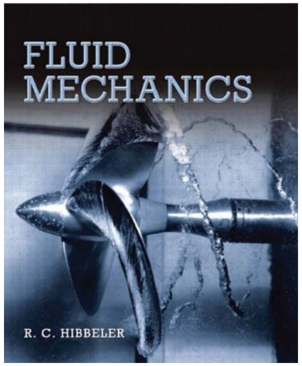
Bruce R. Munson
Department of Aerospace Engineering
Iowa State University
Ames, Iowa

Theodore H. Okiishi
Department of Mechanical Engineering
Iowa State University
Ames, Iowa

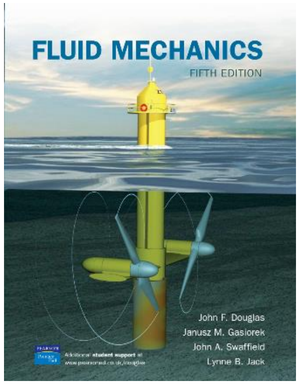
Wade W. Huebsch
Department of Mechanical and Aerospace Engineering
West Virginia University
Morgantown, West Virginia

Alric P. Rothmayer
Department of Aerospace Engineering
Iowa State University
Ames, Iowa

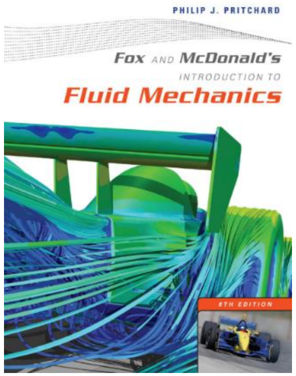
Recommended Textbooks



- Fluid Mechanics, Hibbeler, 2015.



- Fluid Mechanics, Douglas et al., 2006.



- Fox and McDonald's Introduction to Fluid Mechanics, Pritchard, 2011.

Course Objectives

This course deals with the fundamentals of “Fluid Mechanics” and the students completing this course in good standing will be able to:

- Understand the basic principles of fluid mechanics
- Identify various types of flows
- Interpret and apply the “inviscid” approximation and the “Bernoulli” relationships to analysis of fluid systems
- Be familiar with differential analysis concepts (including approximations such as creeping flow, potential flow, and boundary layers), and external flows (lift and drag)

Expected Learning Outcomes

After successful completion of this course the students will:

- understand basic fluid mechanics, including fluid properties, fluid statics, the origin of conservation of mass, energy and momentum equations and their application to a range of internal and external flow problems, and laminar and turbulent flow conditions.
- acquire an introductory knowledge of open-channel flow, and flow through porous media.
- gain experience and skills in with experimentation and data analysis for fluidic systems and creating simple designs for fluidic components and systems.

Assessment (LOOK OUT !)

- Labs
- Attendance
- Examinations
- Final Grades

Assessment (LOOK OUT !)

- Labs:

Regular attendance to lab works is **strictly required (at least 80 %).**

There will be ten labs during this class (mentioned at the end of these slides, in the schedule) and prior to lab, there will be a 5 minutes long quiz. Student should be in lab session on time.

LAB RULES:

- Each group should submit one report.
- Each group should write each parts by their own and get together with their group members to merge all of them.
- Reports are due to next day. They must be submitted to the corresponding assistant **till 17:00** on the next day.
- Students must sign the data sheet from the lab assistant at the end of each experiment and the signed sheet must be attached with the report. Reports without the signed data sheet will not be graded.
- Students are advised to read the detail of each experiment sheet before coming to the corresponding lab class.

LAB REPORT FORMAT (HANDWRITTEN EXCEPT COVER PAGE, TABLES AND PLOTS):

The lab report (no longer than 15 pages – all included –) should include the followings (unless otherwise specified):

1. Objective
2. Theory
3. Procedure
4. Results
5. Sample calculation
6. Necessary plots
7. Discussion on results, errors and graphs
8. Conclusion

Assessment (LOOK OUT !)

- Attendance:

Regular attendance to class works is **strictly required (at least 70 %).**

The discussions during the class can be beyond the schedule of the lecture. Thus, course attendance is strongly encouraged for better understanding of this lecture and better grades of yours.

In case you have to miss a class, **you are responsible for keeping up** with the class work and being informed of all announcements made in the class concerning quizzes, labs, midterm date changes, etc.

If you encounter difficulties of any kind, feel free to come and see me in my office.

Assessment (LOOK OUT !)

- Examinations:

Two term tests are scheduled. A final comprehensive examination will be given according to the school schedules based on the same format as the term tests.

You must bring one A4 page (both sides of the page can be filled) of formula sheet (HANDWRITTEN BY YOUR OWN) for each midterm exam. You can bring 2 A4 pages of formula sheet to the final. Necessary graphs (such as Moody Diagram) will be supplied during the exam.

They will consist of a section on concepts, definitions, and short exercises plus section with numerical problems. **They will be closed-book, closed-notes**.

Make-up exams may be given for legitimate excuses if you contact the instructor as soon as you return to the school.

Assessment (LOOK OUT !)

- Final Grades:

Lab Reports and Quizzes	20%
Midterm 1	20%
Midterm 2	20%
Final Exam	40%
Total	100%

Assessment (LOOK OUT !)

- Final Grades:

Lab Reports and Quizzes	20%
Midterm 1	20%
Midterm 2	20%
Final Exam	40%
Total	100%

For the ultimate success in this lecture

1. **After the class, read and try to understand all the examples of the presented chapters.**
2. **Solve all the problems given at the end of each chapter, during the class. ALSO, SOLVE EXTRA PROBLEMS.**
3. **Participate in all the labs actively.**
4. **ASK QUESTIONS DURING LABS, TRY TO LEARN THE PHYSICAL MEANINGS OF THE PHENOMENA DESCRIBED IN LAB SESSIONS.**

Tentative Schedule (Title numbering from the textbook)

CHAPTER 0 – Course Objectives and Syllabus:

Week 1 **-** Instructor Information
Course Information
Compulsory Textbook
Recommended Textbooks
Course Objectives
Expected Learning Outcomes
Assessment (LOOK OUT !)
Tentative Schedule (Title numbering from the textbook) (3 hour Lecture)

- LAB DEMONSTRATION (HANDOUTS WILL UPLOADED DURING CLASS) (2 hour Lecture)

CHAPTER 1 – INTRODUCTION:

Week 2 **-** 1.1 Some Characteristics of Fluids
1.2 Dimensions, Dimensional Homogeneity, and Units
1.3 Analysis of Fluid Behavior
1.4 Measures of Fluid Mass and Weight
1.5 Ideal Gas Law (3 hour Lecture)
1.6 Viscosity

- LAB 1 – Viscosimeter Experiment (2 hour Lecture)

Tentative Schedule (Title numbering from the textbook)

Week 3 **-** 1.7 Compressibility of Fluids
1.8 Vapor Pressure and Cavitation
1.9 Surface Tension

CHAPTER 2 – FLUID STATICS:

2.1 Pressure at a Point
2.2 Basic Equation for Pressure Field
2.3 Pressure Variation in a Fluid at Rest (3 hour Lecture)

- LAB 2 – Cavitation Experiment (2 hour Lecture)

Week 4 **-** 2.4 Standard Atmosphere
2.5 Measurement of Pressure
2.6 Manometry
2.7 Mechanical and Electronic Pressure Measuring Devices
2.8 Hydrostatic Force on a Plane Surface
2.10 Hydrostatic Force on a Curved Surface
2.11 Buoyancy, Flotation, and Stability
2.12 Pressure Variation in a Fluid with Rigid-Body Motion (3 hour Lecture)

- LAB 3 – Vortex Experiment (2 hour Lecture)

CHAPTER 3 – ELEMENTARY FLUID DYNAMICS:

Week 5 **-** 3.1 Newton's Second Law
3.2 F = *ma* along a Streamline
3.3 F = *ma* Normal to a Streamline
3.4 Physical Interpretation
3.5 Static, Stagnation, Dynamic, and Total Pressure
3.6 Examples of Use of the Bernoulli Equation (3 hour Lecture)

- LAB 4 – Bernoulli Experiment (2 hour Lecture)

Tentative Schedule (Title numbering from the textbook)

CHAPTER 4 – FLUID KINEMATICS:

Week 6 **-** 4.1 The Velocity Field
4.2 The Acceleration Field (3 hour Lecture)
4.3 Control Volume and System Representations

Problem Solving Session (2 hour Lecture)

Week 7 **-** MIDTERM 1 23 March 2020 (Mon) 9:25-12:00 (A03) (3 hour Lecture)

- LAB 5 – Centrifugal Pump Experiment (2 hour Lecture)

Week 8 **-** 4.4 The Reynolds Transport Theorem

CHAPTER 5 – GOVERNING INTEGRAL EQUATIONS:

5.1 Conservation of Mass—The Continuity Equation (3 hour Lecture)
5.2 Newton's Second Law—
The Linear Momentum and Moment-of Momentum Equations

- LAB 6 – Striking Jet Experiment (2 hour Lecture)

Week 9 **-** 5.3 First Law of Thermodynamics—The Energy Equation

CHAPTER 6 – GOVERNING DIFFERENTIAL EQUATIONS:

6.1 Fluid Element Kinematics
6.2 Conservation of Mass
6.3 Conservation of Linear Momentum
6.4 Inviscid Flow (3 hour Lecture)

- LAB 7 – Pelton Turbine Experiment (2 hour Lecture)

Tentative Schedule (Title numbering from the textbook)

Week 10	**-**	6.8 Viscous Flow 6.9 Some Simple Solutions for Viscous, Incompressible Fluids	
CHAPTER 8 – VISCOUS FLOW IN PIPES:			
		8.1 General Characteristics of Pipe Flow 8.2 Fully Developed Laminar Flow 8.3 Fully Developed Turbulent Flow	(3 hour Lecture)
	•	LAB 8 – Reynolds Dye Experiment	(2 hour Lecture)
Week 11	**-**	8.4 Dimensional Analysis of Pipe Flow 8.5 Pipe Flow Examples	(3 hour Lecture)
		Problem Solving Session	(2 hour Lecture)
Week 12	**-**	MIDTERM 2 27 April 2020 (Mon) 9:25-12:00 (A03)	(3 hour Lecture)
	•	LAB 9 – Pipe Loss Experiment	(2 hour Lecture)
CHAPTER 9 – FLOW OVER IMMERSED BOUNDARIES:			
Week 13	**-**	9.1 General External Flow Characteristics 9.3 Drag	(3 hour Lecture)
	•	LAB 10 – Francis Turbine Experiment	(2 hour Lecture)
Week 14	**-**	9.4 Lift	(3 hour Lecture)
		LAB REVIEW (Possible makeup for **ONLY ONE** LAB SESSION)	(2 hour Lecture)
Week 15	**-**	LECTURE REVIEW	(3 hour Lecture)
		FINAL Problem Solving Session	(2 hour Lecture)