ENVE 3120 Fluid Mechanics, Spring Semester, 2018

Department of Civil and Environmental Engineering
University of Connecticut

Lecture Time/Place: MWF 11:15 am - 12:05 pm, CAST 212
Discussion/Lab Time/Place: Tu or Th 11:00-12:15 or 12:30-1:45, Castleman 114 (117 for Lab #4)

Instructor: Dr. Zoi Dokou
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Recitation/Lab Instructor: Dr. Ross Bagtzoglou
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Teaching Assistants: Grad TAs: Mohsen Kheirabadi / mohsen.kheirabadi@uconn.edu
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Text: Munson, Young, and Okiishi's *Fundamentals of Fluid Mechanics*, 8th edition, by Gerhart, Gerhart, and Hochstein, John Wiley and Sons, ISBN 978-1-118-84713-8

[The previous edition: *Fundamentals of Fluid Mechanics*, 7th edition, by Munson, Okiishi, Huebsch, and Rothmeyer, John Wiley and Sons, ISBN 978-1-11811613-5 is also acceptable]

Office Hours: Dr. Dokou MWF ~12:05-1:15 pm or by appointment or anytime via e-mail
Dr. Bagtzoglou and TA/UA TBA (will be announced)

Overview of Learning Objectives:

Upon completion of this course, you will be able to:

1. Understand what a fluid is and how to distinguish fluids from solids. Define their properties and describe their fundamental fluid behaviors.
2. Calculate the forces that fluids at rest exert on objects.
3. Understand what causes fluids to move. Learn and apply the methods used to measure fluid flow. Calculate how much force moving fluids exert on objects.
4. Characterize fluid flow and distinguish between Lagrangian and Eulerian flow descriptions
5. Understand and apply the continuity, energy and linear momentum equations. Learn about pumps/turbines and perform relevant calculations in pipe systems using the energy equation.
6. Predict flow behavior in pipes – Understand and calculate energy losses
7. Design pipe systems and solve multiple reservoir problems.
8. Predict flow in open channels. Categorize flows as subcritical or supercritical, gradually varying or rapidly varying. Understand and apply the concepts of specific energy, hydraulic jump, steps in channels and other design considerations in open channel flow.

Course expectations:

The students will:
- work assigned problems and hand them in when due
- fully participate in laboratory assignments and write group lab reports
- notify the professor BEFORE missing any exams, or get a ZERO on the exam

The instructors will:
- assign challenging and pertinent homework problems and lab exercises
- oversee homework and lab report grading / critically and fairly grade exams
- provide feedback on student's performance in a timely fashion

Grading:

Two Midterm Exams:	40%,	Final Exam:	20%,
Homework:	15%,	Quizzes:	5%
Labs:	20%		

Students are required to take all mid-term exams and the final exam. Homework will be assigned every Wednesday (on HuskyCT) - except on exam weeks - and will be due 1 week after it is assigned, unless otherwise noted. Homework will be collected at the beginning of class on the due date. No late homework can be accepted.

Final Grade Scale:

Grade Scale							
A	= 92 – 100%	**B**	= 82 –86%	**C**	= 72 – 76%	**D**	= 62 – 66%
A-	= 89 – 92%	**B-**	= 79 – 82%	**C-**	= 69 – 72%	**D-**	= 59– 62%
B+	= 86 – 89%	**C+**	= 76 –79%	**D+**	= 66 – 69%	**F**	= 0 – 59%

This grade scale is guaranteed. The instructor reserves the right to bump students up to the next-higher grade when deemed appropriate (as determined by the instructor). PLEASE NOTE: There will be no extra assignments to improve students' perceived grade deficiencies.

Homework Format:
- always use approved engineering paper
- new page for each problem (or reasonable spacing between problem solutions)
- name on each page
- staple pages together and turn in flat (do not fold)

Quizzes:
- there will be a short in-class Quiz after each Chapter (a total of 6 Quizzes). The dates can be found below.

Exam Policies:
- closed book and notes
- you are allowed one sheet (8.5x11 inch letter size or engineering paper) of your own notes for the mid-terms and two sheets for the Final exam.
- "crib sheet" may be front and back and contain formulas and any information you consider useful
- refer only to your "crib sheet" during the exam
- all work to be graded will be submitted on the exam papers, using backs of pages if necessary

Code of Conduct and Collaboration Policy:
Students who come to the class must respect other students' right to learn. No distracting behavior will be tolerated. Distracting behaviors may lead to point deductions from the final grade. Students are encouraged to discuss homework assignments in the interest of gaining better understanding of the material. However, direct copying is discouraged and may result in point deductions for all involved parties. Collaborating on exams will result in a ZERO exam grade for all parties involved.

Detailed Learning Objectives

Unit 1: Fundamentals, Statics, and Idealized Fluid Motion

Chapter 1. Fluid Properties. At the end of this topic, you will be able to:
- Understand what a fluid is and how to distinguish fluids from solids
- Learn about the primary unit systems. Perform unit conversions
- Define fluid properties. Look up fluid properties from tables in the text
- Define and apply Newton's law of viscosity

Quiz 1: January 31st

Chapter 2. Fluid Statics. After successful completion of this topic, you will be able to:
- Understand how pressure is generated in fluids at rest. Define static pressure
- Understand and apply the "manometer rule" to measure differences in pressure
- Calculate the magnitude and direction of hydrostatic forces on planar surfaces
- Calculate the magnitude and direction of hydrostatic forces on curved surfaces
- Calculate the buoyant force and determine the stability of floating and submerged objects

Quiz 2: February 16th

Chapter 3. Idealized Fluid Motion. At the end of this topical section you will be able to:
- Understand what causes fluids to move
- Understand and apply Bernoulli's equation for flow without losses along a streamline
- Compute the static, dynamic, and total (stagnation) pressure in a moving fluid at a point using Bernoulli's equation
- Use Bernoulli's equation to solve for flow through openings in tanks
- Learn and apply the methods for measuring fluid flow based on the Bernoulli's equation
- Learn about, compute and draw the hydraulic grade line (HGL) and energy line (EL).

Quiz 3: February 26th

1st Mid-Term Exam (Fluid Properties, Statics, Idealized Fluid Motion) - Friday, March 2nd

Unit 2: Fluid Dynamics and Pipe Flow

Chapter 4. Fluid Kinematics. When you finish this topic, you will be able to:
- Distinguish between the Lagrangian and Eulerian flow descriptions
- Categorize flows as steady or unsteady
- State Reynolds Transport Theorem for flow through a control volume. Apply a control volume to a flow situation

Chapter 5. Finite Control Volume Analysis. After successful completion of this topic, you will be able to:

- Understand and apply the conservation of mass – continuity equation
- Understand and apply the conservation of energy equation
- Learn about pumps/turbines and perform relevant calculations in pipe systems using the energy equation. Understand the cavitation phenomenon
- Understand and apply the conservation of linear momentum equation

Quiz 4: March 26th (Chapters 4 and 5)

Chapter 8. Viscous Flow in Pipes. At the end of this topic, you will be able to:

- Understand velocity profiles for laminar and turbulent flow in a circular pipe
- Identify entrance regions and fully-developed pipe flow
- Use the Darcy-Weisbach equation for calculating head losses in pipes. Use the Moody diagram to obtain the friction factor f for a given flow. Identify major and calculate major and minor head losses
- Solve for head losses in laminar and turbulent pipe flow
- Solve for discharge or pipe diameter in turbulent flow problems

Quiz 5: April 2nd

2nd Mid-Term Exam (Fluid Kinematics, Finite Control Volume Analysis, Viscous Flow) - Friday, April 6th

Chapter 8.5.2. Multiple Pipe Systems. At the end of this topic, you will be able to:

- Solve three reservoir, multiple pipe problems
- Understand and apply the Hardy Cross method to simple pipe networks

Unit 3: Open Channel Flow

Chapter 10. Open Channel Flow. In this topic area, you will learn to:

- Understand the characteristics of open channel flow. Categorize flows as subcritical or supercritical, gradually varying or rapidly varying
- Apply the Bernoulli equation in open channel flow. Calculate the specific energy and draw a Specific Energy Diagram
- Understand and categorize hydraulic jumps. Compute related values
- Calculate the velocity and volumetric flow rate in open channels using Manning's Equation
- Explore flow over steps in open channels

Quiz 6: April 20th (Chapters 8.5.2 and 10)

Final Exam (Comprehensive) - TBD

Final Exam: The Final exam (Schedule TBA) will be comprehensive and will cover all topics, including material covered after the 2nd Mid-Term Exam. Students are required to be available for their exam during the stated time. If you think that your situation warrants permission to reschedule, please give the professor plenty of notice and, if necessary, contact the Office of Student Services and Advocacy with any questions. Thank you in advance for your cooperation.

ENVE 3120: Tentative Course Schedule			
Semester Week	**Dates**	**Topic**	**Chapter**
1	Jan 17-19	Introduction / Fluid Properties ***No Discussion Session***	Chapter 1
2	Jan 22-26	Fluid Properties / Viscosity **Discussion Session: LAB Introduction**	Chapter 1
3	Jan 29-Feb 2	Fluid Statics **Discussion Session: LAB #1: Viscosity**	Chapter 2
4	Feb 5-9	Fluid Statics ***No Discussion Session***	Chapter 2
5	Feb 12-16	Idealized Fluid Motion / Bernoulli Applications ***No Discussion Session***	Chap. 2, 3
6	Feb 19-23	Fluid Kinematics **Discussion Session: LAB #2: Flow Measurements**	Chapter 3
7	Feb 26-Mar 2	Finite Control Volume Analysis **Discussion Session: EXAM REVIEW RECITATIONS** **EXAM 1 (Chapters 1-3) Friday, March 2nd**	Chapter 4
8	Mar 5-9	Conservation of Mass, Momentum, and Energy **Discussion Session: LAB #3: Impact of Jet**	Chapter 5
9	Mar 12-16	**SPRING BREAK**	
10	Mar 19-23	Conservation of Mass, Momentum, and Energy ***No Discussion Session***	Chapter 5
11	Mar 26-30	Viscous Flow **Discussion Session: EXAM REVIEW RECITATIONS**	Chapter 8
12	Apr 2-6	Multiple Pipe Systems **Discussion Session: LAB #4 Pipe Network Analysis** **EXAM 2 (Chapters 4, 5, 8) Friday, April 6th**	Chapter 8.5.2
13	Apr 9-13	Open Channel Flow / Hydraulic Jump and Specific Energy **Discussion Session: LAB #5: Hydraulic Jump and Specific Energy**	Chapter 10
14	Apr 16-20	Open Channel Flow /Manning's Equation and Steps **Discussion Session: EXAM REVIEW RECITATIONS**	Chapter 10
15	Apr 23-27	Comprehensive Course Review: Units 1 / 2 / 3 **Discussion Session: EXAM REVIEW RECITATIONS**	
	TBD	**FINAL EXAM (Comprehensive)**	