Virginia Tech
The Charles E. Via Jr. Department of Civil and Environmental Engineering

CEE 3304: Fluid Mechanics For Civil And Environmental Engineering (Spring 2016)

Catalog Data: CEE 3304: Fluid Mechanics For Civil And Environmental Engineering Hydrostatics; fluid motion; continuity, momentum, and energy equations; viscous effects; applications to pipe networks and hydraulic systems, including open channel flow. Laboratory experiments and demonstrations. A grade of C- or better in prerequisite ESM 2104. Pre: ESM 2104. (3H,2L,3C)

Instructor: Kyle Strom, Associate Professor
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GTA: Rachel Kuprenas (**Homework**)
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GTA: Eric Muench (**W,R Laboratory**)
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Required Text: *Fundamentals of Fluid Mechanics* (8th ed.), Munson et al. (2016).

Time/Location: Lecture (11616): T, Th 12:30am-1:45am, Patton 207.
Laboratory (19292): Th (R), 4:00pm-5:50pm, Patton 12.
Laboratory (19293): M, 4:00pm-5:50pm, Patton 12.
Laboratory (19294): T, 4:00pm-5:50pm, Patton 12.
Laboratory (19295): W, 4:30pm-6:20pm, Patton 12.

Course Objectives:

Objective 1: Measure fluid properties (e.g. density, viscosity).
Objective 2: Calculate hydrostatic forces on hydraulic structures.
Objective 3: Calculate hydrodynamic forces on hydraulics structures
Objective 4: Calculate flow characteristics (e.g. pressure, discharge, velocity) in pipes and open channels systems.
Objective 5: Determine energy losses in pipe flows.
Objective 6: Conduct hydraulic experiments; analyze and interpret the data.
Objective 7: Develop laboratory report writing skills.

Course Topics:

1. Introduction to Fluids (Chapter 1)
   (a) Units and definitions
   (b) The continuum framework
   (c) Basic fluid properties.
   (d) Classification of fluid flows
2. Fluid Statics (Chapter 2)
   (a) Pressure at a point & manometers
   (b) Pressure forces over submerged surfaces
   (c) Buoyancy & stability
3. Kinematics (Chapter 4)
   (a) Lagrangian and Eulerian reference frames
   (b) Acceleration, angular velocity, and vorticity
4. Governing Equations (Chapter 3 & 5)
   (a) Continuity: Conservation of Mass
   (b) Bernoulli Equation
   (c) Simple applications
   (d) Momentum Equation: Newton's 2^{nd} Law
   (e) Energy Equation: 1^{st} Law of Thermodynamics
5. Pipe Flow (Chapter 8, 12)
   (a) Turbulent and laminar flow interaction with solid boundaries
   (b) Energy losses in pipes
   (c) Pumps
   (d) Simple pipeline systems
6. Open Channel Flow (Chapter 10)
   (a) Uniform open channel flow
   (b) Energy and momentum concepts
7. Dimensional Analysis and Similitude (Chapter 7)
   (a) Concepts and the Buckingham Pi Theorem
   (b) Important scaling considerations for various flows

Laboratory Experiments:

1. Pressure distribution and measurements

2. Hydrostatic pressure force
3. Reynolds number
4. Bernoulli's Theorem
5. Application of the momentum theorem
6. Major head losses in pipe flow
7. Minor head losses in pipe flow

Course Evaluation Tools:

1. **Homework:** Homework will be assigned ≈ once a week.
2. **Laboratory Participation and Reports:** All students are required to participate in the laboratory exercise and turn in a laboratory report.
3. **Examinations:** There will be 2 midterm exams and 1 comprehensive final exam. All exams will be closed book and closed notes.

Homework Requirements:

1. Discussion of homework and collaboration with peers is encouraged. However, each student must submit their own *unique* work for credit. Anything deemed of "suspicious origins" will not be graded, and Honor Code violations will be addressed.
2. Homework is due at the beginning of lecture. *Late work will not be accepted*.
3. Homework submissions must be legible and neat. Any illegible homework will not be graded. Homework solutions should be handwritten or printed on the front side of each piece of paper only, and must conform to the following general framework:
   Given: A brief statement of the problem and the known values.
   Diagram: When applicable, include a sketch of the problem.
   Find: What are the unknowns?
   Solution: Calculations and equations should be placed in this section. Units must be carried through in each step and the answer should be clearly boxed.

Exam Dates:

1st Midterm Exam:	Tues. Feb. 23rd from 7-9pm , 2150 Torgersen Hall
2nd Midterm Exam:	Wed. April. 6th from 7-9pm, 2150 Torgersen Hall
Final Exam:	Sat. May 7, 7:45am-9:45am (Comprehensive)

Grading:

Contributions Towards Final Grade	
Homework Assignments	15%
Laboratory Assignments	15%
1st Midterm Exam	20%
2nd Midterm Exam	20%
Final Exam	30%
Total	100%

Letter Grade	Overall Avg.	Letter Grade	Overall Avg.
A	94-100%	C	73-76%
A-	90-93%	C-	70-72%
B+	87-89%	D+	67-69%
B	83-86%	D	63-66%
B-	80-82%	D-	60-62%
C+	77-79%	F	<60%

Honor Code:

The Virginia Tech Honor Code applies to all work in this class, including homework, laboratory reports, and examinations. When written work is submitted for grading, it is implied that the work is the sole effort of the person, or persons, whose name(s) appears on the paper. You may seek help on the principles and applications involved in the major assignments, and you may talk to each other about these principles and applications, but you are not to simply copy the work of another person or allow another person to work a problem for you. http://honorsystem.vt.edu

Special Accommodations Statement:

If you need adaptations or accommodations because of a disability, if you have emergency medical information to share with me, or if you need special arrangements in case the building must be evacuated, please make an appointment with me within the first two weeks of classes.