ME/CEE 2342 – FLUID MECHANICS

May-term Syllabus

Course Description

An introduction to the concept of a fluid and how to apply the laws of motion to both static and moving fluids. Topics include static forces on submerged surfaces, Bernoulli's equation, fluid motion in control volumes, differential equations of fluid motion, irrotational flow, similitude and dimensional analysis, flow in conduits (pipes), boundary layer theory, lift and drag.

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Instructor Bio

Prof. Krueger has degrees in Mechanical Engineering (BS) and Aeronautics (MS and PhD) from the University of California at Berkeley and Caltech, respectively. He has been teaching fluid mechanics and related topics at SMU since 2002. Outside of the classroom, Prof. Krueger has an active research program investigating various fluid flow phenomena, including aquatic jet propulsion as can be observed in squid locomotion. Prof. Krueger frequently uses simple in-class demonstrations based on his research to illustrate fluid flow concepts.

Course Benefits

This course will introduce and develop the basic math and physics to answer the following questions (and more!):

- Why do container ships stay upright even though most of their mass is out of the water?
- How does your pool cleaner suck up trash from the bottom of the pool?
- Why do engineers use such small models to test the aerodynamics of their airplane and car designs?
- Why should we use large pipes for water mains if they are so much more expensive than smaller pipes?
- Why do golf balls have dimples and airplane wings do not?

Lectures: Location TBD

Website: TBD (probably through Blackboard (courses.smu.edu))

Prereqs: ME 2310 (Statics), Math 2339 (Calc III), Phys 1303 (Introductory Mechanics) [ME 2320 (Dynamics) is highly encouraged], Math 2343 (Differential Equations)

Required Textbook: Cengel and Cimbala, Fluid Mechanics: Fundamentals and Applications, 3rd Ed., McGraw Hill, 2014.

Grading:

Class Participation	10%
Exams (4)	22.5% each

Homework and Exam Policies:

Homework will be assigned at the end of each day (except the last day). The homework is provided as an exercise for the students, but will not be graded. Homework and additional exercises will be discussed in class and in groups. Participation in the group discussions will be weighted heavily in the class participation grade.

Four exams will be given during the May-Term (May 18, 21, 27, and 29). The exams comprise the majority of the grade for the course.

Lecture Policies:

Class attendance is mandatory. The class time will be divided between lecture, homework/exercise discussion groups, and exams. A typical daily schedule will be as follows:

8 – 9:20	Lecture
9:20 – 9:30	*Break (10 min)*
9:30 – 11:00	Lecture or Exam. Exams will be held on May 18, 21, and 27 during this period. The exam on May 29 will begin at 10:30.
11:00 – 12:00	Homework and in-class exercise discussion group

Some Recommended References:

1. White, Fluid Mechanics, McGraw-Hill.
2. Fox and McDonald, Introduction to Fluid Mechanics, John Wiley and Sons.
3. Munson, Young, and Okiishi, Fundamentals of Fluid Mechanics, John Wiley and Sons.

Notices:

University Honor Code: The SMU Honor Code applies to all work performed in this class (see http://smu.edu/studentlife/PCL_05_HC.asp). Giving or receiving dishonest aid on homework or exams, or toleration of such action, constitutes an Honor Code violation. An example of an Honor Code violation is submitting for evaluation a homework assignment that was completed with the aid of a solution set or was directly copied from a classmate (solutions from two different students should not look the same!). Honor code violations will be dealt with by the instructor and referred to the Honor Council if necessary.

Disability Accommodations: Students needing academic accommodations for a disability must first be registered with Disability Accommodations & Success Strategies (DASS) to verify the disability and to establish eligibility for

accommodations. Students may call 214-768-1470 or visit http://www.smu.edu/alec/dass to begin the process. Once registered, students should then schedule an appointment with the professor to make appropriate arrangements.

Religious Observance: Religiously observant students wishing to be absent on holidays that require missing class should notify their professors in writing at the beginning of the semester, and should discuss with them, in advance, acceptable ways of making up any work missed because of the absence. (See University Policy No. 1.9.)

Excused Absences for University Extracurricular Activities: Students participating in an officially sanctioned, scheduled University extracurricular activity should be given the opportunity to make up class assignments or other graded assignments missed as a result of their participation. It is the responsibility of the student to make arrangements with the instructor prior to any missed scheduled examination or other missed assignment for making up the work. (University Undergraduate Catalogue)

Course Outcomes:

A. An ability to apply knowledge of mathematics, science, and engineering.
E. An Ability to identify, formulate, and solve engineering problems.
K. An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Lecture Schedule

ME/CEE 2342 – Fluid Mechanics, May-Term 2015

Date (Day)	Topics	Reading	Homework
5/14 (Th)	Introduction; Definitions and Properties Fluid Statics – Pressure; Pressure measurement (Manometers) Fluid Statics – Forces on flat, submerged surfaces	Syllabus; 1-1 – 1-10, 2-1 – 2-6, 3-1 – 3-4	1-26, 2-13, **2-81**, 3-38, **3-49**, 3-51, **3-77E**, 3-86
5/15 (F)	Fluid Statics – Forces on curved submerged surfaces, buoyancy Fluid Kinematics Control Volume Analysis (CVA) – Conservation of Mass; Reynolds Transport Theorem	3-5 – 3-6, 4-1 – 4-3, 4-6; 5-1 – 5-2	**3-79,** 3-99, **3-169, 4-17**, **4-35**, **4-47E**, **5-15**, 5-17, 5-100
5/18 (M)	CVA – General Energy Equation **EXAM 1 (9:30 A.M.)**	5-3, 5-5 – 5-6	5-83, **5-95, 5-97**
5/19 (Tu)	Bernoulli's Equation – Theory Bernoulli's Equation – Examples CVA – Newton's 2nd Law (Momentum An.)	5-4, 6-1 – 6-4	5-30C, **5-38C,** 5-43, **5-50E,** 5-60, 6-37E
5/20 (W)	Newton's 2nd Law Examples Dimensional Analysis – Pi Theorem; Dimensional Analysis – Common dimensionless groups; Theory of Models	6-4, 7-1 – 7-5	**6-29E**, 6-38, **6-80,** 7-4, 7-49, **7-51**, **7-37**, **7-39**, 7-83
5/21 (Th)	Pipe Flow – Laminar **EXAM 2 (9:30 A.M.)**	8-1 – 8-4	8-10C, **8-23C, 8-50,**
5/22 (F)	Pipe Flow – Turbulent (Moody Chart) Pipe Flow – Minor losses, Open Channel Flow Differential Analysis (DA) – Conservation of Mass; Stream Function;	8-5 – 8-6 (8-7, 8-8); 9-1 – 9-3	8-39, **8-154**, **8-132**, 8-66, **8-78E**, **8-91**, **9-30**, **9-35**, **9-64E**
5/26 (Tu) [No class on 5/25]	DA –Newton's 2nd Law; N-S Equations DA – Basic solutions Inviscid Flow (Potential Flow) – ϕ, ψ, and Bernoulli	9-5 – 9-6, 4-5, 10-4, 10-5,	9-86, **9-88**, 10-58,10-60, 4-99
5/27 (W)	Inviscid Flow (Potential Flow) – Composite solutions, cylinder flow; **EXAM 3 (9:30 A.M.)**	10-5	**10-71**
5/28 (Th)	Boundary Layers – Reynolds No. Behavior; Basic Equations; Flat Plate BL BLs – δ, δ^* and θ; Turbulent boundary layers Drag (BL Separation, C_D, Flat Plates)	10-6, 11-1 – 11-6	**10-73C**, 10-87, **10-90E**, 11-15C, **11-55E**, 11-57, 11-29, **11-35**, **11-69** For material covered on Friday: **11-91**, **11-95**
5/29 (F)	Lift Review **EXAM 4 (10:30 A.M.)**	11-7	

Disclaimer: The lecture schedule is tentative and subject to change.

Note: It is highly recommended that students purchase the text book and read at least the first four (4) chapters BEFORE class begins on May 14.