CE 3120 Fluid Mechanics, Fall Semester, 2009
Dept. of Civil and Environmental Engineering
University of Connecticut

(This syllabus is available at the HuskyCT site, and will continue to be updated.)

Instructor: Professor Guiling Wang, Ph.D.
Contact: FLC 313/ Phone: 486-5648 / gwang@engr.uconn.edu
Lecture Time/Place: MWF 10-10:50, UTEB 175
Lab: Castleman 114
Teaching Assistants: Leah Torres
Feyera Hirpa
Rui Mei

Text: Fundamentals of Fluid Mechanics, by B. R. Munson, D. F. Young, and T. H. Okiishi, John Wiley and Sons, 5th edition or later
Office Hours: (All office hours except for Thursday are in Castleman 301)
Leah, Monday 1-3pm
Feyera, Tuesday 4-6pm and Friday 1-3pm
Rui Mei, Wednesday 3-5pm
Guiling Wang, Thursday 2-4pm

<u>This course will give you insight to the following questions:</u>
What is a fluid?
How are fluids different from solids?
What properties do fluids have?
How do fluids at rest exert forces on objects?
What causes fluids to move?
What methods are used to calculate how fluids move?
How much force do moving fluids exert on objects?
How do we measure fluid flow?
Are there any fundamental fluid behaviors that are common to all fluids?
How do we predict flow behavior in pipes?
How do we predict the flow of liquids in open channels?
Why do airplanes fly (or not)?
Why do boats float (or not)?

COURSE EXPECTATIONS and GRADING

The student will:

- actively seek answers to questions
- participate during in-class discussions
- participate during in-class group learning exercises
- seek help from the professor whenever needed
- work assigned problems and hand them in when due

- ask questions in class, and attend office hours for further insight
- notify the professor BEFORE missing any exams, or get a 0.0 on the exam
- allocate sufficient time during the week to complete assigned work
- be honest, ethical, and adhere to UConn standards of academic conduct

The professor will:

- present ideas
- derive basic principles
- answer any question with respect
- lead classroom discussions
- show examples on the board
- discuss simplifying assumptions
- provide insight to you at any reasonable hour
- assign challenging and pertinent homework problems
- grade exams critically and fairly
- provide feedback on your performance in a timely fashion
- evaluate your performance using exams, on-line quiz, and team discussions.
- provide a final grade based on your performance using the following criteria: *A*-excellent, *B*-good, *C*-not good, marginally acceptable, could have done significantly better, *D*-did not perform well, most work lacking in some key way, insufficient effort put forth, *F*-failed to demonstrate any notable understanding.

Grading:

Three Midterm Exams	60%
Final Exam	30%
Homework	10%
Optional Weekly Quiz	extra 5%
Optional Group Discussion	extra 5%

Students are required to take all mid-term exams and the final exam. If a student's final exam score is better than the lowest score of the midterm exams, the final exam score will be used to replace the lowest midterm exam score.

Homework will be collected and checked, but will NOT be graded based on performance. No late homework can be accepted.

While students are expected to come to class, attendance is not mandatory.

Code of Conduct:

Students who come to the class must respect other students' right to learn. No distracting behavior will be tolerated. Distracting behaviors will lead to a deduction of up to 20 points from the final grade.

Collaboration Policy:

This course has a lot of homework because Fluid Mechanics is as fundamental as statics, with lots of variations on each theme. Students are encouraged to discuss homework assignments in the interest of gaining better understanding of the material. However, any evidence of direct copying will result in a zero homework grade for all involved parties. Copying from solutions manuals will also result in a zero homework grade. Collaborating on exams will result in an F for the course for all parties involved.

Regular postings at the HuskyCT site

1. Reading quizzes for each topic *(**Optional.** Do not turn in. Will not be graded. These are for your self-evaluation: did you read and understand the textbook materials?)*
2. Homework Assignment *(**Required**. Will be checked and grading is based on effort.)*
3. Online quizzes *(**Optional**. Will be automatically graded, and will be added as extra points to your final grade)*
4. “Topic of the Week” Group Discussion Topic *(**Optional**. See instructions below)*

"Topic of the Week" Discussion

Students are strongly encouraged to form study groups. One group can have 4-8 members. There will be weekly assignment on “Topic of the Week” discussion. In addition to discussing homework problems, group members carry out discussions on "Topic of the Week" and hand in a half to one page report. In order to be accounted for credit, the report has to be signed by all members of the group and handed in on Friday by 11am (by the end of class), and must include the following elements:

Topic of the Week:
Group ID:
Name of Report Writer(s)/Discussion Leader(s):

[Text Body]

Name of Group Members followed by signature

CE 3120 Instructional Objectives

The instructional objectives are given below in the order that the topics are introduced in this course. Use these objectives to judge your understanding, see what I expect of you, and to study for exams.

Topic 1. Fluid Properties, Chapter 1. At the end of this topic, you will be able to:

- define the density, specific gravity, viscosity, surface tension, vapor pressure, bulk modulus of elasticity, ratio of specific heats, and specific gas constant
- describe why liquids cavitate at low pressure
- look up fluid properties from tables in the text
- determine the specific weight of a fluid
- solve for the capillary rise of a liquid in a cylindrical tube
- calculate fluid compressibility and the speed of sound in a fluid (liquid or gas)
- define and apply Newton's law of viscosity
- explain and write the partial derivative of a multiple variable equation

Topic 2. Fluid Statics, Chapter 2. After successful completion of this topic, you will be able to:

- explain how pressure is generated in fluids at rest under the action of gravity
- define static pressure
- apply the "manometer rule" to measure differences in pressure
- calculate the magnitude and direction of hydrostatic forces on planar surfaces
- determine the magnitude and direction of a hydrostatic forces on curved surfaces
- solve for the effects of bulk acceleration on a hydrostatic pressure field

1st Mid-Term Exam (Fluid Statics)

Topic 3. Idealized Fluid Motion, Chapter 3. At the end of this topical section you will be able to:

- define a streamline
- apply Bernoulli's equation for flow without losses along any streamline
- compute the static, dynamic, and total (stagnation) pressure in a moving fluid at a point using Bernoulli's equation
- explain what are the hydraulic grade line and energy grade line
- apply a Pitot tube and manometer to calculate total pressure
- determine flow velocity using a Pitot-static tube and manometer
- use Bernoulli's equation to solve for flow through openings in tanks
- calculate flow through pipes using venturi meters and orifices using Bernoulli's equation and pressure measurements

Topic 4. Flows of Real Fluids, Chapter 8. At the end of this topic, you will be able to:

- predict the velocity profile for laminar flow in a circular pipe
- solve for the losses in laminar pipe flow
- explain the derivation of the Darcy-Weisbach equation for calculating losses in pipes
- write the Darcy-Weisbach equation from memory
- use the Moody diagram to obtain the value of the friction factor *f* for a given flow
- solve for head loss in turbulent pipe flow

2nd Mid-Term Exam (Elementary Fluid Dynamics)

Topic 5. Description of Fluid Motion, Chapter 4. and Sections 5.1, 5.2. When you finish this topic, you will be able to:

- define the dimensionality of a velocity field
- categorize flows as steady or unsteady, uniform or non-uniform, laminar or turbulent
- calculate the equations for the streamline, streakline, and pathline for steady, two-dimensional velocity fields
- distinguish between the Lagrangian and Eulerian flow descriptions
- take the material derivative of the flow velocity
- apply a control volume to a flow situation
- write Reynold's Tranport Theorem (RTT) a.k.a. "The Theory of Where Stuff Goes"
- use RTT to solve for the integral form of the conservation of mass equation
- write the equation of conservation of linear momentum using RTT

Topic 6. Differential Flow Analysis, Chapter 6., Sections 6.1 through 6.4.4. In this topical area, you will learn to:

- derive the differential form of the equation of mass conservation
- explain the potential (lossless) flow concept
- explain the terms of the material derivative
- calculate whether a velocity field is irrotational or rotational

Topic 7. Open Channel Flow, Chapter 10, Section 10.1 through 10.6.1. 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
- Calculate open channel flow rate
- Determine water depth before or after a hydraulic jump

3rd Mid-Term Exam

Final Exam: Final exam is necessarily comprehensive, and will cover all topics