Course Syllabus CHE 310 Fluid Mechanics

Days/Times: Monday Wednesday 10:00-10:50 414 EVC Crossing Thurs 12-1:50 G05 Bennet Tower
Instructor: Paul T. Daniell, Ph.D.
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Office Hours: MWF 1-3, T/Thurs 9-11 Other times come on by, I’m happy to help.

Goals and Objectives

This class should achieve the following

Make the student comfortable with any fluid mechanics problem on the FE exam.

Make the student proficient with buoyancy, and forces on complex submerged surfaces.

Make the student proficient with velocity profiles in laminar and turbulent flow

Make the student proficient in analyzing various combinations of flow or velocity measuring devices including feedback control schemes

The student will apply the Bernoulli equation for flow situations including frictional and minor losses, and pumps.

The student will understand pump sizing, pump design curves and tube and piping selection.

Make the student proficient in analyzing forces due to fluids in motion

Provide the student with a foundation in dimensionless analysis for use in scale up.


My lecture material comes from a variety of sources. In order to enhance the subject matter beyond the textbook, I use additional resources including:

Several FE training manuals

Personal experience and notes (both academic and industrial)


Google I find it efficient to look up conversions, definitions, and sample problems on Google. It’s part of our world, no reason not to use it.

Prerequisites
This course is packed with algebra, trigonometry, geometry and calculus. The student is expected to be fluent in these subjects. Due to the large amount of material, I will not take time to review these subjects except to explain carefully more complex derivations involving calculus. If you are falling behind due to a poor command of math, it is up to you to get caught up.

Teaching Philosophy
Since I once took a similar class (many years ago), I have a perspective on what I believe to be most valuable for the student. I strongly believe the most efficient technique for you to learn is to be active. I’m not going to lecture for the entire class. I will have “Lecture bursts” followed by working problems and interactions. We will do this as follows.

I will spend a certain amount of time introducing a topic, adding my best insight for you. This may be 5 to 10 minutes.

I will then give you a few minutes to do a simple problem or two (not graded) as practice.

Do the problem yourself and if you stumble, review it quickly with a student next to you. Working with a “buddy” helps resolve any minor issues you might have and helps move things along. It’s important that you first try it yourself, because this is the true test of whether you get it. These classroom practice exercises are excellent pre work for quizzes and exams.

I may then add a more complex examples and review it for the class in order to reinforce the topic.

As your instructor, I do not see much use in reciting the textbook, or writing complex derivations on the board without reference to real application. Since this is a course in “applied fluid mechanics” my teaching style is help you understand the meaning of the subject and how it relates to real life problems. As the semester progresses, you will acquire critical thinking skills, that allow you to relate the physical understanding of a situation to the underlying theory and equations of fluid mechanics.

There are many concepts in fluid mechanics which are not addressed adequately by your textbook. I intend to add these to our classes and compliment this with additional material
that is important to your career as engineers. My wish is that you will reach a point where you realize the following about fluid mechanics; “When you get a deep understanding of the Bernoulli equation and the laws of conservation of mass and momentum you are well on your way to tackle most any problem”.

At first, the sight of a very complicated process or diagram can be intimidating. One of the goals of this class is to calmly break it down, recognize the proper approach and using your understanding of the physical significance of the system, apply the correct equations to solve the problem. The class will allow you to assemble a toolbox and a deep understanding of how to use these tools for any problem.

You will find me friendly and approachable. I am happy to help with questions/issues during office hours. I don’t mind questions in class, just try to use some restraint in order to keep things moving. If I have totally lost you, it’s not a problem to raise your hand. But a minor issue may be best left for you to ask me after class or ask a classmate.

**Course Outline**

There is a tremendous amount of material to cover in this class. Each section has additional sub sections with multiple example problems. Students will work additional problems in class for each section. Expect a couple of quizzes on each section.

1. **Fluid Properties**
   Units, dimensions, basic fluid mechanics definitions

2. **Viscosity**
   Newtonian, Non Newtonian, Viscosity models, Application

3. **Pressure Measurement**
   Pascal’s Law
   U tubes, columns, manometers
   Hydraulic lift

   Quiz 1

4. **Forces on submerged objects**
   Linear and curved surface
   Buoyancy and stability

5. **Bernoulli’s Equation and Continuity**
   Steady State versus non steady state
   The open flow equation and general energy equation
   Losses and pumps

   Quiz 2
6. Flow regimes
   Reynolds numbers
   Laminar versus turbulent
   Frictional losses
   EXAM 1

7. Minor losses
   Enlargement
   Contraction
   Valves and fittings
   Quiz 3

8. Velocity Profiles
   Circular and non-circular
   Laminar versus turbulent
   Navier Stokes and Hagen Poiseuille *

9. Pressure drop and flow measurement systems
   Pump selection
   Quiz 4

10. Flow measurement
    Pitot, static, orifice DP cell, Venturi, PID control *

   EXAM 2

11. Similitude *
   Quiz 5

12. Pump Selection

13. Forces due to fluids in motion

14. Fluidization and flow through packed bed. *
    Quiz 6

Final

• Denotes material from sources outside the text

Attendance

Although attendance is not part of your grade, by missing class you may miss quizzes, homework assignments and additional material I may introduce. I will post some examples online, but not all class notes. If you miss a quiz or exam, I will only allow a
makeup with an excused absence such as illness with a note, a college or department sponsored function. A calculator and notepad should be brought to class. If you prefer to take notes using an electronic device such as an IPAD or PC, this is fine. I will require all cell phones, etc. to be turned off as a courtesy to the class. We will not have an official “Bio” break, but if nature calls, please quietly leave the room. Treat this as a job, be on time, be courteous, and don’t be a distraction by talking except when we have open class discussion. I understand people are occasionally late due to traffic or other issues and will not be nasty about it as long as it is not a habit. However, I will be quite strict about phones, texting etc. I will have to excuse you.

Inclusivity Statement

The West Virginia University community is committed to creating and fostering a positive learning and working environment based on open communication, mutual respect, and inclusion. If you are a person with a disability and anticipate needing any type of accommodation in order to participate in this class, please advise me and make appropriate arrangements with the Office of Accessibility Services (293-6700). For more information on West Virginia University's Diversity, Equity, and Inclusion initiatives, please see http://diversity.wvu.edu.

Exams and Quizzes

Quizzes will be given in class and will be less than 15 minutes to conserve time. Homework practice problems will be given for you to prepare for the quizzes and exams, but will not be graded. If you do not attend class and do the homework, you will have a very hard time on quizzes and tests. **For all exams and quizzes, you will be allowed only a single 8 1/2” by 11” sheet of paper (crib sheet), your textbook and a calculator.** You will not be allowed to use any electronic devices on exams and quizzes except a basic calculator. Your grade will be calculated as follows

- 2 exams 20% each,
- 6 quizzes 35%,
- Design Project 10%,
- Final 15%,

Dishonesty

Dishonesty within the academic community is a very serious matter, because it destroys the basic trust necessary for a healthy educational environment. Academic dishonesty is any treatment or representation of work as if one were fully responsible for it, when it is in fact the work of another person. Academic dishonesty includes cheating, plagiarism, theft, or improper manipulation of laboratory research data or theft of other services. A substantiated case of academic dishonesty may result in disciplinary action, including a failing grade on the project, a failing grade in the course, or expulsion from the University.
If I sense **Wandering Eyeballs** during an exam or quiz, I will speak to you and give you a warning and your will be reseated far away from another student. This is something I do not wish to ever encounter, so please DO NOT TEST me. A repeated offense will result in failure and disciplinary action.