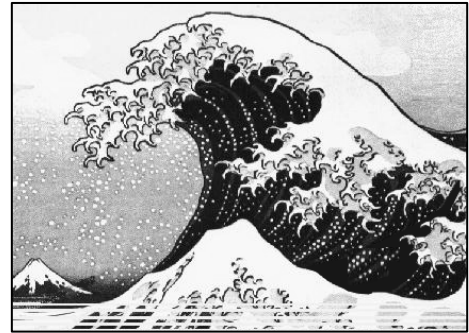


# Fluid Mechanics

(Phys 314)  
**Spring 2009**

**What am I doing here?** The behavior of fluids is critical to a wide variety of everyday applications. To understand why airplanes fly, or propellers push, or curveballs turn, or why the wind blows, we need to first understand the fundamental behaviors of fluids. We'll start by defining "fluid", and contrasting fluids with solids. We'll use Newton's Second Law ( $\Sigma F = ma$ ) to predict the motion of fluids, and we'll use a few ideas from thermodynamics, too. Also, we'll play some clever algebraic tricks with units ("Dimensional Analysis") to help us simplify complicated problems to a more manageable level. By the end of the class, you should be adept at solving problems using the following ideas:



the continuum, fluid fields, streamlines, density, viscosity, control volumes and control masses, pressure, normal and shear stress, buoyancy, conservation principles (Bernoulli's equation, Navier-Stokes), hydraulic jumps, potential flows, dimensional analysis, boundary layers, lift, drag, vorticity, and circulation.

The textbook for this class, *Fluid Mechanics*, by Frank White (6<sup>th</sup> edition, McGraw Hill, 2008) is pretty user-friendly. You may also use earlier editions of the book. Since there are too many subtopics to cover in a single semester, we will not cover all of the topics in the text. Also, we will not cover all of the topics in the exact same order as the text.

**How will I be graded?** Your grade will be determined by:

Weekly Assignments and Quizzes:	30%
Project:	10%
Exams:	<u>60%</u>
	100%

**What's this about a project?** Midway through the semester, you will choose a project idea based on one or more of the topics we've studied. Although I will provide some suggestions for projects, you are permitted to develop your own idea, subject to my approval. Your projects may be theoretically or experimentally based. The projects may be individual or group efforts, and should be open-ended (i.e., you will not be working towards a single "correct" answer).

**When are the tests?** Here is a tentative schedule of exams. Exams are currently scheduled as "in class" exams. If the entire class (including Dr. Pogo) agrees, an exam time, date, or length can be changed (to a two hour evening exam, for example). Such changes will not affect the exam questions.

Exam #1: Thursday, February 19, 2009 (chapters 1 & 2 of *White*)

Exam #2: Thursday, March 26, 2009 (chapters 3 & 6b of *White*)

Exam #3: Thursday, April 9, 2009 (chapters 4 & 8 of *White*)

Final Exam: Friday, May 8, 2009, 12:00pm – 3:00pm (chapters 1 through 8 of *White*)

## Written Homework Rules

The entire point of having written assignments is to help you improve your professionalism. Therefore, unlike the CAPA portion of each weekly assignment, your grade will be based on factors other than whether you get the right answer.

- 1) Use exactly  $8\frac{1}{2} \times 11$  inch paper. I will measure it with a ruler. Do not use spiral ring paper.
- 2) Use only one side of each sheet
- 3) Put your name on the top of every sheet. Put the assignment number on the top of the first page (e.g., “Fluids, Written Assignment #3”).
- 4) **Staple** all your sheets together. Paper-clips and torn corners are not permitted.
- 5) Clearly and systematically indicate what is given, and what is sought.
- 6) Work must progress linearly down the page. If your solution initially meanders around the page, I expect you to **recopy your solutions**.
- 7) Use a pencil. Erase errors instead of blotching them out.
- 8) Draw and use Free Body diagrams as appropriate for all problems. Define and use coordinate systems. Specify your choice of “free body”. Label your forces.
- 9) **Define your symbols, and use subscripts**. Not all velocities can be called “ $V$ ”, not all pressures can be called “ $p$ ”. Every symbol must be unique and clearly defined. Make a list or table of relevant symbols and their values when this will help me to understand your solution.
- 10) Do not even bother to submit nonsensical results (e.g., a negative pressure).
- 11) **Use words** and/or pictures to clarify your method of solution and your symbol definitions.
- 12) Solutions should be symbolic. Include the initial fundamental formulas, but don’t show every step of intermediate algebra. If, for some reason, your solution uses numeric values, show no more than 4 significant figures, and include units.
- 13) **Box** your answers.
- 14) Plots should be professional and no smaller than  $3 \times 5$  inches. Do not use default font sizes, default trendline formatting (where every variable is apparently an  $x$  or a  $y$ ), default line widths, etc.

**Working together is strongly discouraged.** Obviously, this rule is unenforceable. But over the years, I have observed an *extremely* strong correlation between working together and getting bad exam grades. You must arrive at your own answers for each problem. Copying any portion of another student’s work (as from a blackboard) will be considered cheating. When you discuss problems with each other, you should not discuss the details of any solution. If you are stuck, talk to me instead.