SUNY Geneseo
Department of Physics and Astronomy
Class: TR 11:00 am; ISC 229
Web: www.geneseo.edu/~pogo

Online Office Hours:
MTW 8:30-10:20; W 2:30-3:20

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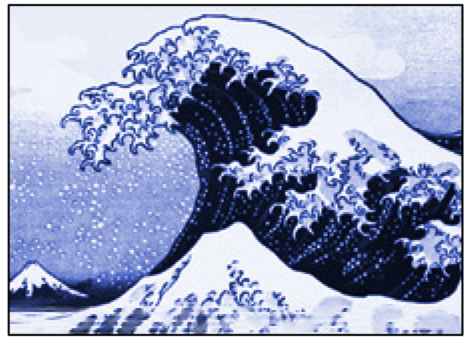
Fluid Mechanics

(Phys 314)

Spring 2025



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 (8th edition, McGraw Hill, 2016) is pretty user-friendly. You may also use earlier or later 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:	60%
	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 number or details of any exam questions.

Exam #1: Thursday, February 13, 2025 (chapters 1 & 2 of *White*)
Exam #2: Thursday, March 13, 2025 (chapters 3 & 6b of *White*)
Exam #3: Thursday, April 10, 2025 (chapters 4 & 8 of *White*)
Final Exam: Monday, May 12, 2025, noon – 2:30 pm (chapters 1 through 9 of *White*)

Schedule of Assignments

	Topic	**Due Date**	**Which Exam?**
Assignment #1	Fluid properties; viscosity	Tue, Jan 28, 2025	1
Assignment #2	Viscosity; hydrostatics	Tue, Feb 4, 2025	1
Assignment #3	Hydrostatics	Tue, Feb 11, 2025	1
Assignment #4	Conservation laws (integral forms)	Thu, Feb 27, 2025	2
Assignment #5	Conservations laws; Bernoulli's equation	Thu, Mar 6, 2025	2
Assignment #6	Conservation laws (differential forms)	Thu, Mar 27, 2025	3
Assignment #7	Differential forms; potential flow	Thu, Apr 3, 2025	3
Assignment #8	Dimensional analysis	Thu, Apr 17, 2025	4
Assignment #9	Internal/external flows (pipes, boundary layers)	Tue, Apr 29, 2025	4
Assignment #10	Compressibility	Fri, May 9, 2025	4

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. Some tips about professionalism are provided on the course homepage… take them seriously! Here are some of the most common issues:

- **Follow Directions**. Do the thing that's asked for!
- **Define your symbols**, and **use subscripts**. Not all velocities can be called "*V*". Make a list or table of relevant symbols and their values.
- **Use words and/or diagrams** to clarify your method of solution and your symbol definitions.
- **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. If a written assignment is based on a CAPA problem for which you were given random numerical values, then those numerical values aren't an important part of your written version of the solution.
- **Under no circumstances may you submit code** (e.g., text imported from Mathematica). Similarly, all "computational" notation ("^", "E", "*", ":=", "Out[8]:=", etc.) is **forbidden**. Solutions must be 100% comprehensible on their own to someone who has never heard of Mathematica. If I can tell what software you used, you've already messed up.
- **Plots should be professional** and no smaller than 3×4 inches. Do not use default font sizes, default trendline formatting (where every variable is apparently an *x* or a *y*), default line widths, etc. All these choices *are* your grade!

What if I have trouble with the homework? Visit me during online office hours (see times listed above) and I'll try to point you in the right direction. Remember that all learning and all skill comes from doing, not seeing. Every part of every problem that you let somebody else do for you is something that you are deciding that you just don't want to learn. You will not have their help on exams!

So for this course, use of online homework solutions (e.g., Chegg) or AI (e.g., ChatGPT) is considered academic dishonesty. Do your own work!

Learning Outcomes:

At the end of this course, students will be adept at solving physical problems involving fluids (e.g., air, water, and oil) using the following techniques:

- Streamlines and streamfunctions
- Control volumes
- Control masses
- Buoyancy and Archimedes' principle
- Conservation of mass and the continuity equation
- Conservation of momentum, including both Bernoulli's equation and the Navier-Stokes equations.
- Potential flow analysis
- Dimensional analysis and similitude

In addition, students will be knowledgeable about the following fluids properties and descriptions:

- The continuum model for describing fluids
- Pressure, normal stress, and shear stress
- Density, viscosity, vorticity, and circulation
- Lift and drag
- Boundary layers
- Hydraulic jumps and fluid instability

College Policies that are not specific to this course:

https://bulletin.geneseo.edu/content.php?catoid=22&navoid=958