

CE 251 Fluid Mechanics, Fall 2017

When & Where: MWF 9:00 – 9:50, AEC 327

Instructor:

Dr. David Brandes, Professor of Civil & Environmental Engineering
Office: AEC 320 Office Hours: MW 2:00-4:00 and by appt
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Overview:

Considering that we breathe fluids, drink fluids, and are largely made up of fluids, fluid mechanics is a topic of fundamental importance to many fields, including civil engineering. CE 251 is an engineering fundamentals course emphasizing the application of basic principles of physics to engineering problems with fluids, especially water. In this sense it is similar to ES courses like Statics or Strength of Materials, except that we are working with fluids rather than solids. The course is particularly important for those students interested in careers in water resources or environmental science & engineering, and fluid mechanics is a major component of the Fundamentals of Engineering (FE) exam. The broad objective of the course is for you to learn how to formulate and solve engineering problems involving fluids by applying fundamental principles from engineering, science and mathematics.

Text:

Engineering Fluid Mechanics, 11th Edition, Wiley, 2016. ISBN: 978-1-118-88068-5
D.F. Elger, B.A. Lebet, C.T. Crowe, and J.A. Roberson

Course Webpage:

<http://sites.lafayette.edu/brandesd/courses/ce-251/>
Check here for updates to the weekly schedule, homework assignments, etc.

Course Outcomes:

- Students will understand fluid properties and how they impact fluid behavior
- Students will use hydrostatics to solve a variety of problems with forces on submerged surfaces, such as gates and dams
- Students will understand the control volume principle and will apply the continuity equation to fluid flow problems
- Students will apply Bernoulli's equation to determine fluid pressures and velocities
- Students will apply the Momentum equation to determine the forces exerted by flowing fluids
- Students will understand the terms of the Energy equation and will apply it to solve pipeflow problems including frictional and local head losses and head of pumps and turbines

- Students will understand the concepts of Hydraulic Grade Line and Energy Grade Line and will be able to accurately sketch them for a single pipe system
- Students will apply the concept of dimensional analysis to determine the form of unknown equations relating fluid properties, and will use similitude (dynamic scaling) for designing appropriately scaled physical models
- Students will understand basic boundary layer concepts and will determine frictional and pressure drag on two- and three-dimensional objects

Grading:

Distribution of points

- Two mid-terms and final exam: 100 pts each (75%)*
- Homework: 80 pts (20%)
- Attendance, participation, and effort (APE): 20 pts (5%)

* "bad-day rule" may apply - if one of your exam scores is 15 pts or more lower than the other two, when calculating your final course grade I will weigh the three exam scores by 20/40/40 rather than 33.33/33.33/33.33

Exams

The two mid-term exams will be given in the evening during the semester, typically from 7-9 pm. All exams are closed book and notes, but I will allow you to bring a sheet of equations and definition of their variables (but not concepts nor example problems nor anything else). All necessary fluid properties and conversion factors will be provided. The exam problems will generally be very similar to your homework problems, but exams may also include a few qualitative/conceptual questions. Each exam covers the course material since the previous exam; however, topics from earlier parts of the course provide the basis for topics covered later in the semester, and in that sense, the exams are comprehensive.

Homework

Keeping up with the homework is a key to success in this course. Homework assignments will be given each week (see "Weekly Schedule" link on webpage) and will be due Wednesday in class except during exam weeks. You are strongly urged to start the homework by Monday, so that you can make effective use of my office hours. Late work will be accepted with full credit only if you have made prior arrangements with me – otherwise a 10% grade reduction will be applied each day the assignment is late.

Homework solutions must be done in a neat, professional manner, on engineering paper or computer output, with intermediate steps shown and answers clearly designated (see Division of Engineering Guidelines for Engineering Homework). A labeled drawing of problems involving forces, pressures, and flow vectors is *essential* – use a sharp pencil and a straight edge! You may earn an extra 10% by submitting exceptionally neat, well-presented work, and you may *lose* 10% each time you submit exceptionally sloppy, unprofessional-looking work. Make sure that units are included with all numerical answers and that assumptions (if needed) are clearly stated. Homework will be graded based on completeness and your solutions to three or

four problems selected at random. Solutions will be available in my office for your review after the homework is returned to your mailbox.

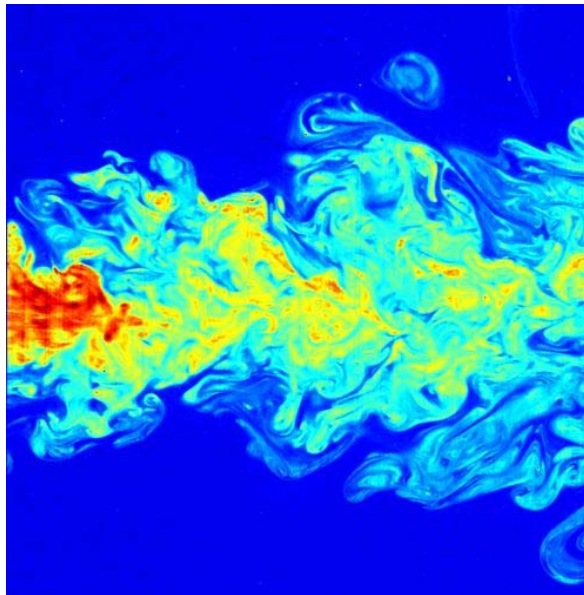
Attendance, participation, and effort

At a small liberal arts college like Lafayette, we expect students to be engaged in the learning process. This means attending class (obviously), participating and asking questions in class, visiting office hours for help on homework, etc. More than two unexcused absences will likely reduce your final grade. As part of this effort, as well as to satisfy federal requirements for credit hours, I may require you to attend a few seminars/events outside of normal class hours that relate to fluid mechanics.

I am a strong believer in learning by doing (termed “experiential learning” in the parlance of our times). Although CE 251 is not a laboratory course, I will occasionally use some hands-on demonstrations/experiments in class to illustrate concepts and hopefully help you better understand the course topics. You are expected to participate in these demos/experiments by recording and analyzing the data as appropriate.

Extra Credit:

Fluid dynamics is somewhat infamous for being difficult and complex, but this complexity also results in exceptional beauty – see figure below:



To celebrate the artistic side of fluid mechanics (yes, we are a liberal arts college!), you can earn extra homework points by submitting original creative or artistic work (a photo, a short clip, a poem, etc) related to the science and/or natural beauty of fluids. I will then share it in class, and will post it on the course website under the link “Fluids are Cool Gallery”. You can check out some entries from previous students on the course website.

Image of a submerged jet of fluid: reds, yellows = high velocity, blue = low velocity
(from <http://commons.wikimedia.org/wiki/File:Jet.jpg>)

Policy on Personal Communications Devices

It is great to live in the digital information age, but it is a fact that the human brain is not so good at multi-tasking. In order to promote you getting the most for your tuition dollars and to prevent disruption of other students' learning environment, cell phones/smart phones/wireless devices *must be turned off* during class. If you routinely disregard this policy, your grade for attendance, participation, and effort will be adjusted downward.

A Note on Intellectual Honesty

This is college and you are here to learn. Getting a good grade may be important but its never as important as maintaining your integrity. Furthermore the College has clear written policies on intellectual honesty (see the on-line Student Handbook, pages 9-10), and we are encouraged to report suspected cases of dishonesty to the Dean. You are encouraged to work together to solve the homework problems, but don't just copy a classmate's answers, make sure you understand the solution yourself. In the past some students have copied answers from the solutions manual, which is out there in some unscrupulous bit of cyberspace - I have been teaching from various editions of the text for about 15 years and I will probably notice if you copy answers unless you are very clever at disguising them as your own.

Some **Quotations of Interest**

"If there is magic on this planet, it is contained in water"

- Loren Eiseley (anthropologist and writer about science and nature)

"Water is H₂O, hydrogen two parts, oxygen one, but there is also a third thing that makes it water and nobody knows what it is"

- D.H. Lawrence (British writer and poet)

Calvin and Hobbes by Bill Watterson

