ChE 310
Fall 2013

Process Fluid Mechanics

Instructor: Dr. R. Turton
Office: 433 ESB
Phone: 293-9364
Class: 10:00-10:50 MW 12:00-13:50 Thur MRB-E 205
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Course Goals

1. Students will be able to apply material, energy, force, and mechanical energy balances to pipe flow problems.
2. Students will be able to understand and be able to solve problems in fluid statics.
3. Students will recognize when they need to apply any or all of the balances above simultaneously to solve a fluid flow problem and be able to solve such problems.
4. Students will understand and be able to apply dimensional analysis to fluid flow problems.
5. Students will understand the origin of and be able to solve problems involving frictional losses.
6. Students will understand and be able to solve problems for incompressible and compressible fluids.
7. Students will understand and be able to solve problems involving fluid flow measurement.
8. Students will understand and be able to solve fluid flow problems involving pumps, pump curves, compressors, valves, and complex flow networks.
9. Students will understand and be able to solve problems involving frictional flow around solid objects, packed beds, and fluidized beds.
10. Through working on a design problem, students will:
    a. gain an appreciation for the environmental and safety aspects of fluid mechanics.
    b. be able to use Chemcad to solve the above problems.
    c. be able to apply the above knowledge to the solution of a design problem.
    d. will increase their proficiency in oral and written communication.
    e. will become more proficient at working in groups.

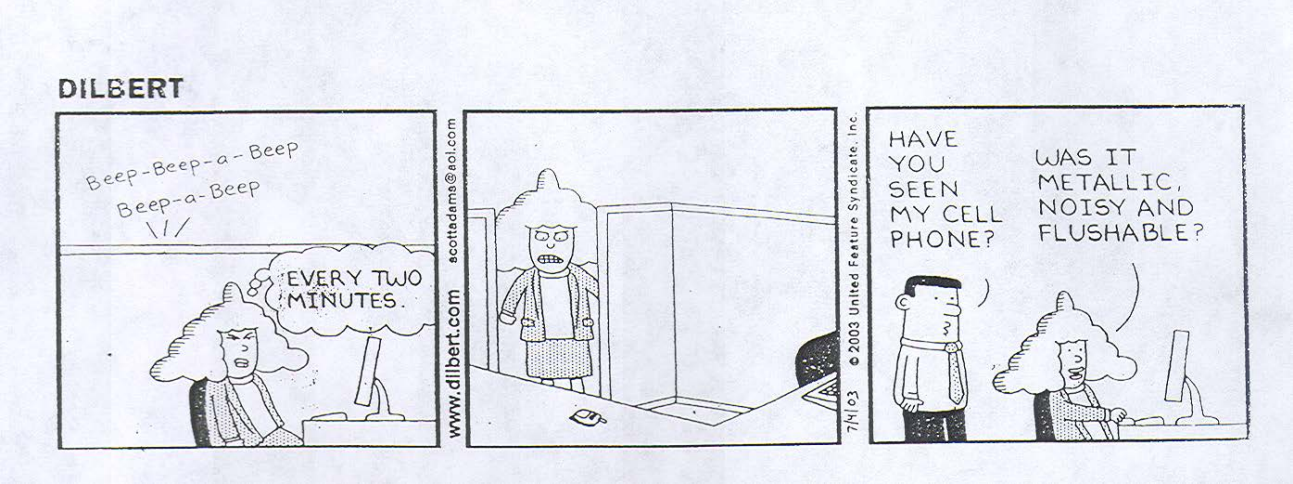
Course Policies (exceptions at discretion of instructor):

1. There are no make-up exams.
2. All problem sets are due at the beginning of class or at the stated time.
3. A late assignment = no assignment.
4. Exam grading appeals **must be submitted in writing on the day** the exam is returned. If you miss that class, you lose the opportunity for regrading. **In addition,**

the instructor reserves the right to regrade all the problems on the test, not just the ones for which the appeal is made.

5. You may (and are encouraged to) work in groups on problem sets. However, what you submit must be your own work. Assignments that are obviously copied will receive no credit.
6. Problem sets and exams should be neat and easy to follow. Each problem should start on a new page. Your answer should be boxed, have units as appropriate, and have the correct number of significant figures. **No credit will be given for answers without work**. Credit will be deducted for missing or incorrect units, sloppy work that is hard to follow, and for the incorrect number of significant figures. You should round off the final answer to the correct number of significant figures.
7. **If you do not participate in the design project** as part of your assigned group, **your grade for the entire course will automatically be an F**, regardless of other grades earned in this class.
8. You must be in the audience for all of the junior design presentations. This means in the classroom, not in the hall or in the computer room. **Failure to do so will result in reduction by one full letter on your design project grade.**
9. **Computers are not allowed in exams or in class. You are not permitted to record the instructor during class, or review sessions**.
10. Most communication in this course will be via eCampus or the equivalent e-system if changed.

Cell Phones



If you have a cell phone, turn it off before coming to class. If your cell phone rings during class, 1 point per call will be deducted from your final grade, if you chose to answer the call, i.e., talk to the caller, an addional 4 points will be deducted per conversation. This means that if your cell phone rings in class and you answer it two times during the semester, you loose 10 points from your final grade!! There are **NO** exceptions to this policy.

Bottom line: Turn the thing OFF!

Grading

Three Exams @ 17.5%	52.5%
Final Exam	20.0%
Problem Sets	10.0%
Design Project	17.5%

grading scale is	≥90%	A
	≥80%	B
	≥70%	C
	≥60%	D
	<60%	F

At the instructor's discretion, this scale may be lowered, but not raised.

Required Texts

Geankoplis, C., *Transport Properties and Unit Operations, 4th ed.*, Prentice Hall, 2003
Do not buy the e-version of this book

Other Reading (Evansdale Library):

Safety, Health, and Loss Prevention in Chemical Processes, Center for Chemical Process Safety of the American Institute of Chemical Engineers, 1990.

Coulson, J. M. and J. F. Richardson, *Chemical Engineering, Volume 1, 5th ed.*, Butterworth, 1996.

Darby, R., *Chemical Engineering Fluid Mechanics*, Dekker, 2001

de Nevers, N., *Fluid Mechanics for Chemical Engineers, 2nd ed.*, Mc Graw-Hill, 1991.

Geankoplis, C., *Transport Properties and Unit Operations, 3rd ed.*, Prentice Hall, 1993.

Levenspiel, O., *Engineering Flow and Heat Transfer*, Plenum Press, 1998

McCabe, W. L., J. C. Smith and P. Harriott, *Unit Operations of Chemical Engineering, 5th ed.*, McGraw-Hill, 1993.

Munson, B. R., D. F. Young and T. H. Okiishi, *Fundamentals of Fluid Mechanics, 3rd ed.*, Wiley, 1998.

Walas, S. M., *Chemical Process Equipment. Selection and Design*, Butterworths, 1988.

Welty, J. R., C. E. Wicks and R. E. Wilson, *Fundamentals of Momentum, Heat and Mass Transfer, 3rd ed.*, Wiley, 1984.

Wilkes, J. O., *Fluid Mechanics for Chemical Engineers*, Prentice Hall, 1999.

Approximate Syllabus (this may change)

Week	Date	Topic	Chapter
		Properties of Fluids	2.3+
1	8/19	Newton's Law of Viscosity	2.4+
		Non-Newtonian Fluids	+
		Measurement of Viscosity	+
2	8/26	Force balance, Fluid statics	2.2+
		Fluid dynamics	2.5+
		Force balance examples	+
3	9/2	(Labor Day 9/1)	
		Conservation of mass	2.6+
		Conservation of Momentum – micro/macro	2.8+
		Conservation of Energy, Examples	2.7+
		More examples on Conservation Equations	
4	9/9	Review	
		Exam 1 (9/12)	
		Dimensional analysis	3.11+
5	9/16*	Dimensional analysis examples	
		Frictional pipe flow (laminar/turbulent flow)	2.10+
		Frictional pipe flow	+
6	9/23	Non-Newtonian pipe flow	+
		Flow measurement	3.2+
		Flow measurement examples	
7	9/30*	Pumps, compressors, and valves	3.3+
		Pump, compressor, and valve examples	+
		Scale-up of existing equipment	+
8	10/7	Review	
		Exam 2 (10/10)	
9	10/14	Mid-Semester Break 10/14-15	
		Complex flow networks – series/parallel flow	+
		Complex flow networks – pump curves and MEB	+
10	10/21	Complex flow network examples	+
		Compressible flow	2.11+
		Compressible flow examples	+

		Flow past submerged objects & External Flows	3.1+
11	10/28	Flow in packed beds and porous media	3.1+
		Submerged object and packed bed examples	
		Design Project	
12	11/04*	Design Project	
		Exam 3 (11/7)	
		Fluidized beds	3.1+
13	11/11	Fluidized bed examples	
14	11/18	Miscellaneous Topics - complex flow networks	+
		Miscellaneous Topics - Pneumatic Transport	+
15	11/25	Thanksgiving Break	
16	12/02	Design Project Presentations (beginning at 10:00 am, 12/02)	
		Written Reports Due (12/02)	
		Design Project Review	
17	12/09	Course Review (Monday 12/09)	
		Final Exam Thursday 12/12 from 3:00 - 5:00 pm	

+Denotes additional handouts/reading material/notes not covered in recommended text will be provided

* During this week, Dr. Turton will be traveling to professional meetings and some rescheduling of classes with other instructors will occur.

Laboratory demonstrations will also be included in this course and timing will depend on availability of unit ops lab and experiments.