FLUID MECHANICS I
0901-341
FALL 2005
Lecture: 9:25 –10:40 Monday
Labs: 8:00 – 10:40 Thursday / Friday

This is an introduction to the basic phenomena and principles of fluid flow. We discuss fluid properties, fluid statics, conservation of mass, momentum and energy. Emphasis is on quantitative analysis of velocities, pressures, shear stresses, and flow forces. The application of basic fluid mechanics concepts to the analysis of pipe flow, and flow over or around objects is stressed in homework assignments and exams. Flow phenomena are illustrated in CD-ROM tutorials and laboratory demonstrations. Measurement of fluid properties, pressures, velocities, and flow forces are performed in laboratory sessions. The course audience is primarily 2nd and 3rd year engineering students with knowledge of statics, deformable body mechanics and calculus. The course is a prerequisite for courses such as water resources engineering, water and wastewater treatment, geotechnical engineering, heat and mass transfer, and chemical process courses. *Prerequisite courses: Physics I (1902.200), Math for Engineering Analysis II (1701.236).*

Upon completion of this course, students will be able to:

- Determine pressures and forces on submerged bodies
- Analyze flow rates, velocities, energy losses, and momentum fluxes for fluid systems
- Measure and describe fluid flow phenomena
- Analyze, design, and evaluate pumping systems and pipeline components
- Communicate effectively with written reports and engineering graphics

INSTRUCTOR: Dr. Joe Orlins, 234 Rowan Hall, (856) 256-5328, orlins@rowan.edu

TEXT: ***A Brief Introduction to Fluid Mechanics****, 3rd Edition,*
by Young, Munson, & Okiishi
ISBN (hard cover): 0471457574
ISBN (soft cover): 0471660779

OFFICE HOURS: Mondays, 3:30 – 5:00; any time my door is open; or by appointment
WEB PAGE: http://engineering.rowan.edu/~orlins/fm/

GRADING:

Homework	100 points	(10%)
Quizzes	100 points	(10%)
Labs	200 points	(20%)
Design Project	100 points	(10%)
Mid-Term Exam 1	200 points	(20%)
Final Exam	250 points	(25%)
Professional Conduct	50 points	(5%)
TOTAL	1000 points	

A grade of C- or better is required in this course to proceed to subsequent courses in the Civil Engineering curriculum at Rowan University.

Explanation of Grading System:

Homework (10%): Puzzle and problem-solving skills are the hallmark of a successful engineer. You will be expected to complete homework puzzles before the next class period. You may work on the home problems with your colleagues, **but the work you turn in must be your own**. You will be expected to follow the College of Engineering Homework Format guidelines for all work done for this course; neatness and clarity are essential to conveying technical information to others. Solutions to home puzzles and problems will be posted outside the instructor's office after the assignment is due.

Late homework will not be accepted without prior arrangement with the instructor.

Quizzes (10%): You are expected to have completed home puzzle assignments and read the assigned material before the start of class. Short quizzes may be given at the beginning of any class period to ensure you are ready to learn!

Self-Study Quizzes (no grade): You are strongly encouraged to make use of web-based self-study quizzes before each class period. These will be announced in class, and links posted from the course web page.

Laboratory Exercises (20%): Fluid mechanics is largely an experimental science. You will be expected to actively participate in all laboratory activities, and to turn in well-written laboratory reports presented in a professional manner. You may work on the lab data analysis with your colleagues, but the work you turn in must be your own.

Design Project (10%): One of the great things about engineering is being able to design, build, and test a machine. In this course, we will design and build positive displacement pumps, and compete against the Mechanical Engineers in the annual Golden Piston Competition!

Midterm Exam (20%): The midterm exam will be conducted in two parts. The first part will be an individual exam, open notes, open book. The second part will be a group exam, where you will work with other students to solve problems similar to those in the first part. The second part will also be open notes, open book.

Final Exam (25%): The final exam will be cumulative. It will be conducted in two parts, similar to the Midterm Exam.

Professional Conduct (5%)

You will be graded on your professionalism in this course. Many people including your fellow employees, community and family rely on your professional decisions and actions. Your work should place the highest value on safety. In addition, engineers are expected to consider the ethical and environmental consequences of their actions. In seeking internships and fulltime employment, employers will ask professors their opinion of not only your excellence in engineering, but also your ability to make engineering decisions that are safe, ethical and environmentally responsible. The practice of professionalism will be divided into the three areas of safety, attendance, and ethics.

Safety

Safety is of critical importance; it will be discussed numerous times throughout this course. Failure to follow safe laboratory practices can lead to accidents that can endanger you and other students. Your grade will be reduced if you fail to follow proper safety procedures.

Attendance Policy

Attendance is required. Attendance will count toward your final grade. An indirect grade of attendance will be given in all teamwork exercises. It is to your advantage to attend this class, since a substantial amount of material is presented for which no texts are available and many of the laboratories and in-class exercises will be conducted in teams. In addition to classes, you are expected to attend all scheduled team meetings.

Although arriving late for class can occur, a habitual practice of this is not professional. You will only be given credit for attendance in class if you are present within 5 minutes of the start of the start of the class period. If you know that you will be absent from class for a valid reason, obtain approval from your instructor 24 hours before the class period. The only exception to this rule is a medical emergency.

Academic and Work Conduct

Your ability to work effectively with your coworkers (classmates) and team leaders and managers is important for your success as an engineer. If you contribute creatively and effectively to the workload of your team in homework and laboratory assignments, and studying for quizzes and the final exam, then industry will actively seek you as an employee. If you are careless in your work, no company will want to hire you.

The policy in this class in matters of academic misconduct will follow that stated in "Rowan University Student Handbook." **While consultation between students on homework and laboratory assignments is encouraged, plagiarism is not.** ***Any student cheating in this class will receive a grade of F for the course***. If another student is involved in the offense knowingly, he or she will receive the same penalty.

As an engineering professional, it is extremely important that you treat your manager and your colleagues with respect and consideration. It is expected, therefore, that you will maintain good professional conduct throughout this course, in all your interactions with your peers and the instructor. You will earn points for having good professional conduct, and you may lose points for exhibiting poor behavior.

Course Outline:

PART I: Building a Fluid Mechanics Vocabulary

- Fluid Properties
- Fluid Statics
- Pressure Measurement
- Fluid Forces

PART II: Fluids in Motion

- Conservation of Mass: Continuity Equation
- Conservation of Energy, Part I: Bernoulli's Equation
- Conservation of Momentum: Momentum Equation
- Conservation of Energy, Part II: Energy Equation

PART III: Application of the Basic Principles

- Hydraulic Modeling
- Flow in Pipes
- Energy Losses

SOME OBSERVABLE FLOW PHENOMENA

At your earliest opportunity observe the following and be prepared to give a written discussion of the physics of the phenomena during one or more of the scheduled examinations or quizzes.

- Describe the movement of the engine exhaust fluid from a stationary car when the engine is idling. How does it differ from the situation when the car is moving?

- Observe the movement of fluid from a tall smokestack or chimney. What causes the fluid to move the way it does? Describe the fluid movement at different distances from the top of the chimney.

- On a windy day, determine how much protection you seem to get from the wind by standing different distances from a wooden telephone pole or electric power line pole.

- Why does a cloth flag flap in the wind and not stay at a fixed position?

- Why do equal sized tree branches at different elevations from the ground move at different speeds when it is windy?

- Next time it rains sufficiently for water to pond and move across paved surfaces, determine how the water moves on relatively flat and steeper slopes. Examine flow some distance from a gutter and in the gutter. How would you measure the flow velocity and volumetric flow rate in a gutter?

- How does soil "dry out" between storms? If you dig a hole in the ground and reach a depth at which standing water occurs, why is the soil wet but not saturated above that level?

- When you turn on the faucet in a standard kitchen sink what happens to the water when it strikes the sink? Observe the situation for various flow rates for now water initially contained in the sink (with and without a drain plug) and for the situation when there are about three inches of water in the sink.

- What happens to the flow from the fountain in the pond outside Rowan Hall? Observe the jet just as it leaves the fountain nozzles, at the peak of its motion, and as the flow enters the pond again. What factors affect the size of the droplets that are formed?

- How does a beach "migrate?" The next time you are at the shore, walk along the surf zone and examine how sand grains are moved by the waves. How many different types of motion can you identify? What are the causes of each of the types of motion?

- Observe the nature of materials on a streambed. Where do you find larger sized and where do you find finer-grained materials? Why? A stroll along the creek on campus on a pleasant day will be enjoyable and provide many opportunities to examine this situation.

Keep looking! There are many fascinating fluid phenomena to observe!

COURSE SCHEDULE
FLUID MECHANICS I – FALL 2005

Week #	Monday	Thursday / Friday	Reading	HW
1	8/29 No Class	9/1-2 Introduction Fluid Properties	Chapter 1	HW 0 (handout) 10 Probs. From Ch. 1
2	9/4 Labor Day - No Class	9/8-9 Lab 1: Fluid Properties		Lab report
3	9/12 Fluid Statics – Pressure at a point	9/15-16 Pressure variations, Project Intro	Chapter 2	5 Probs. From Ch. 2 Pump calculations
4	9/19 Fluid Statics	9/22-23 Fluid Forces		6 Probs. From Ch. 2
5	9/26 Manometers, Pressure Meas.	9/29-30 Lab 2: Forces on Submerged bodies		Mini-lab report, Motor selection
6	10/3 Fluids in Motion	10/6-7 Control Volumes	Chapters 3, 4	9 Probs. From Ch. 3.
7	10/10 Continuity	10/13-14 Project		2 Probs. From Ch. 4
8	10/17 Project	10/20-21 Project		Pump Project Report
9	10/24 Energy (simple) Bernoulli Demo	10/27-28 Pump Competition		Project Peer Evaluation
10	10/31 Review	11/3-4 Midterm (Chapters 1-4, pumps)		No HW !
11	11/7 Momentum	11/10-11 Lab 3: Momentum	Chapter 5	Lab report
12	11/14 Momentum	11/17-18 Energy (full)		10 Probs. from Ch. 5
13	11/21 Energy (full)	11/24-25 Thanksgiving Holiday (no class)		
14	11/28 Energy Grade Lines	12/1-2 Lab 4: Friction Losses	Chapter 8	Lab report
15	12/5 Friction Losses	12/8-9 Pipe Flow		8 Probs. From Ch. 8
16	12/12 Pipe Flow (last class)	12/15-16 Finals Week		
Final Exam	Monday, December 19 10:15 am – 12:15 pm			