Instructor: John H. Thomas  phone: 275-4083  
Hopeman 223  e-mail: thomas@me.rochester.edu  
Office hours:  T 3:00-5:00 pm, Th 4:00-5:00 pm, or by appointment  

Meeting times:  MWF 9:00-9:50 am, B&L 106, T 2:00-3:15 pm, Dewey 1-101  

There will be no “recitation” session. Each of the four weekly class periods will be in the same format and will typically include presentation of new material, worked examples, and discussion of homework problems. The Tuesday class session will end at 2:50, except for the Tuesdays on which there are examinations when we will use the full seventy-five minutes. You are expected to attend all of the class sessions!

Teaching assistants:  
Sam Butler (e-mail: sbutler4@u.rochester.edu)  
Jonathan Cyganik (email: cyganik@u.rochester.edu)  
Andrew Keene (e-mail: akeene@u.rochester.edu)  
Joseph Ricci (email: jricci2@u.rochester.edu)  

Prerequisites: Math 163 (or 165), 164; ME 120, 123.


Course Outline: You will be responsible for all of the material in the text in the sections listed below, as well as all of the material covered in the lectures and in the problem sets. The lectures will cover most, but not all, of the assigned material in the text and will include examples and applications. The lectures will occasionally cover some additional material that is not in the text, including a few more advanced subjects, and in general the lectures will be at a higher level than the text. You should read ahead in the text to prepare yourself for the lectures. Topics to be covered are the following:

Chapter 1 (all)  Introduction: dimensions and units of physical quantities, the continuum hypothesis, pressure and temperature scales, fluid properties.

Chapter 2 (all)  Fluid Statics: the pressure field, pressure gradients; the hydrostatic equation; manometry; hydrostatic forces on surfaces; buoyancy and flotation.
Chapter 3 (all) **Elementary Fluid Dynamics – The Bernoulli Equation:** Newton's second law for a fluid element; streamline coordinates; the Bernoulli equation and its applications.

Chapter 4 (all) **Fluid Kinematics:** Eulerian and Lagrangian descriptions; the velocity and acceleration fields, the material derivative; control volume representations; the Reynolds transport theorem.

Chapter 5 (sections 5.1-5.2) **Finite Control Volume Analysis:** Integral forms of the continuity, momentum, and moment of momentum equations; applications using control-volume analysis.

Chapter 6 (all) **Differential Analysis of Fluid Flow:** kinematics of fluid elements; conservation of mass, the continuity equation; the stream function; differential momentum equation; inviscid flow, the Euler equation; plane potential flows; viscous flow, the Navier-Stokes equation; laminar viscous flows.

Chapter 7 (all) **Similitude, Dimensional Analysis, and Modeling:** dimensional analysis, the Buckingham Pi-Theorem, applications; common dimensionless numbers in fluid mechanics; modeling and similitude.

Chapter 8 (sections 8.1–8.5) **Viscous Flow in Pipes:** laminar pipe flow; turbulent pipe flow; empirical analysis of pipe flow, the Moody diagram, applications.

Chapter 9 (all) **Flow Over Immersed Bodies:** lift and drag; boundary layers, boundary layer on a flat plate; effect of pressure gradient, flow separation; lift and drag coefficients, empirical results.

**References:** The references listed below, along with the textbook cited above, are on reserve in the Carlson Library.

Munson, B. R., Young, D. F., and Okiishi, T. H., *Fundamentals of Fluid Mechanics*, 5th ed., Wiley, 2006. An expanded version of our text, with additional chapters on more specialized topics. This text contains some examples not found in our text.


Also on reserve is the Schaum Outline on Fluid Mechanics, with many worked examples.

**Homework:** To achieve a good understanding of fluid dynamics you will need to work out several example problems. There will be a set of problems from the text assigned each week (except for exam weeks), and a representative sample of these problems will be graded. Beyond that, I encourage you to read some of the other problems in the text and think about how you would go about solving them. Although you may discuss homework problems with me, the teaching assistants, or your classmates, I expect each student to work out all of the assigned problems independently.

**Examinations:** There will be three regular examinations during the semester and a three-hour final examination during the scheduled time period in the final exam week (Sunday, December 22, 8:30-11:30 am). The regular exams will be given during the longer Tuesday class sessions (seventy-five minutes). The regular exams are scheduled for the following dates:

- October 1 (Tuesday)
- October 29 (Tuesday)
- December 3 (Tuesday)

All of the examinations (regular and final) will be closed book, but as an aid to your memory you may bring in one sheet of standard-size paper on which you have written any notes, formulas, equations, etc. that you think are important.

**Class attendance:** Class attendance is required, although it won’t be formally recorded. I will be presenting a good deal of material that is not in the textbook, for which you will be responsible on the examinations.

**Classroom etiquette:** Please try to arrive on time for each class: late arrivals are distracting. If you do arrive late, please enter quietly and take a seat near the back of the room. Please do not converse with your classmates during the class session. All electronic devices (cell phones, iPods, iPads, laptop computers, etc.) must be turned off (or asleep) and stowed.

**Grading:** In determining your final grade, the weighting will be as follows: each of the three regular exams will count as 100 points, the final exam will count as 200 points, and the homework will count collectively as 100 points, for a total of 600 points. In computing your average homework score, I will drop your lowest homework grade. Your grade will be based primarily on your total point score, but other appropriate factors, such as improvement over the course of the semester, will also be taken into account.
ME 225 Introduction to Fluid Dynamics
Fall 2013

Problem Sets

(Note that odd-numbered problems are available on the textbook’s web site.)

Due Wednesday, September 11:  1.5, 1.16, 1.19, 1.37, 1.40, 1.49, 1.52, 2.5, 2.17
Due Wednesday, September 18:  2.24, 2.40, 2.43, 2.55, 2.59, 2.64, 2.73, 3.1
Due Wednesday, September 25:  3.8, 3.16, 3.29, 3.42, 3.47, 3.58, 3.69, 3.73
Due Wednesday, October 2:  (exam week – no problem set)
Due Wednesday, October 9:  4.3, 4.15, 4.25, 4.36, 5.3, 5.13, 5.27, 5.28, 5.48
Due Wednesday, October 16:  6.7, 6.13, 6.19, 6.21, 6.25, 6.31, 6.33
Due Wednesday, October 23:  6.34, 6.38, 6.40, 6.42, 6.51, 6.54
Due Wednesday, October 30:  (exam week – no problem set)
Due Wednesday, November 6:  6.58, 6.67, 6.71, 6.77
Due Wednesday, November 13:  7.6, 7.11, 7.15, 7.18, 7.37, 7.38, 7.42
Due Wednesday, November 20:  8.3, 8.14, 8.18, 8.32, 8.38, 8.57, 8.61
Due Wednesday, November 27:  8.76, 8.86, 8.89, 9.1, 9.10, 9.17, 9.20
Due Wednesday, December 4:  (exam week – no problem set)
Due Wednesday, December 11:  9.31, 9.40, 9.43, 9.52, 9.65, 9.69

Solutions to the problems will be posted after each due date on the ME 225 Web site, at: www.me.rochester.edu/courses/ME225/
A user ID and password are needed to access the solutions (and the practice exams): these will be given in class.