Viscous (and Viscoelastic) Fluids

MW 11:55-1:10PM Elab 327

This is an advanced graduate course in fluid dynamics. Emphasis will be placed on developing a physical understanding of the partial differential equations governing fluid flow. The course will be broken into two parts. The first half of the semester will deal with exact solutions of the Navier Stokes equations for Newtonian fluids, dimensional analysis, lubrication theory, flows at low Reynolds numbers and boundary layer theory. The second half of the semester will deal with a number of more topical issues including non-Newtonian (viscoelastic) fluid dynamics, rheology, microfluidics and surface tension driven flows.

Instructor	Professor Jonathan P. Rothstein Gunness Labs Rm.16 577-0110 rothstein@ecs.umass.edu Office hours: Fridays 12-1PM and 2:30-3:30 PM
Web Page	http://www.ecs.umass.edu/mie/faculty/rothstein/mie707.htm
Course Texts	White, F. M., *Viscous Fluid Flow*, McGraw-Hill, New York, 1991 Morrison, F. A., *Understanding Rheology*, Oxford University Press, New York, 2001. Both of these texts are *recommended, but not required.* There are many other graduate-level fluid dynamics texts which will work equally well. See below.
Grading	The course grade will be based on the following: Homework 50% Midterm Exams 20% Final Exam/Project 30%
Homework	A set of homework problems will be assigned roughly once a week during lectures. You should work through these problems carefully as they are essential for your learning of the material. The problems will be typically collected and graded on Mondays.
Alternate Texts	Leal, L. G., *Laminar Flow and Convective Transport Processes: Scaling Principles and Asymptotic Analysis*, Butterworth-Heinemann, Boston, 1992. Leal, L. G., *Advanced Transport Phenomena*, Cambridge University Press, 2007 Batchelor, G. K., *An Introduction to Fluid Dynamics*, Cambridge Univ. Press, England, 1985. Panton, R. L., *Incompressible flow*, Wiley, New York, 1996. Deen, W. M., *Analysis of Transport Phenomena*, Oxford Univ Press, NYC, 1998.