University of Massachusetts
Mechanical and Industrial Engineering 707
Spring 2013

Viscous and Viscoelastic Fluids
Course Syllabus

Topics	**Reading**

Introduction [W1, M1]

Derivation of Governing Equations [W1&2, M2&3]

Exact Solutions to the Newtonian Navier-Stokes Equations [W3]
- → Steady and unsteady flow in ducts and tubes
- → Stokes 1st and 2nd problems

Approximate Solutions to the Newtonian Navier-Stokes Equations [W3]
- → Lubrication theory
  - ▪ Bearings and thin films
- → Stokes flow (low Reynolds number flows)
  - ▪ Flow past spheres and into corners
  - ▪ Symmetry of low Reynolds number flows

Surface Tension [Leal]
- → Contact angles
- → Motion of bubbles and drops
- → Surfactants and Marangoni flows

Microfluidics [Assorted Papers]
- → Fabrication of microfluidic devices
- → Electroosmotic flows

Introduction to Non-Newtonian Fluid Dynamics [M1]
- → Viscoelastic effects including rod climbing

Material Properties/Functions and their Measurement [M4,5&6]
- → Cone-and-plate rheometer
- → Steady and unsteady shear flows
- → Time-temperature superposition
- → Elongational flows

Constitutive Models [M7&8]
- → Generalized Newtonian Fluid
- → Maxwell Model
- → FENE-P Model

Boundary Layer Theory [W4]
- → High Reynolds number flow past a flat plate