Autumn, 2003

ChemE 530
Transport I: Emphasis on Fluids

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Theme

To add interest , we will loosely tie the course examples and problems to issues arising in low-intensity acoustic-driven microfluidic devices (hydrodynamic corrals).

Grading

Grades will be determined from the scores on homework (50 pts), two midterms (50 pts each), and a project (100 pts). Due dates for the mid-terms will be around the 4th and 8th week. The project written and oral presentations will be during the final week of class.

Text

The text is *Analysis of Transport Phenomena,* by W.M. Deen.

Course Outline

1. Vectors and Tensors: Appendix A
   Mainly covered in Chem E 512; but a brief review will be provided.

2. Fluxes and Material Properties: Chapter 1
   Constitutive Equations, transport coefficients, and their interpretation.

3. Conservation Equations: §2.1–2.8
   Derivation of equations for the conservation of mass, momentum, and energy, including jump boundary conditions.

4. Scaling and Approximation Techniques: Chapter 3
   Using mathematical methods (*e.g.* singular perturbation) and intuition to determine the essential length and time scaling behavior of transport systems.

5. Solution Methods for Conduction and Diffusion Problems: Mostly avoid Chapter 4.
   Numerical solutions using the Finite Element Method software FEMLab.

6. Fundamentals of Fluids: Chapter 5
   Kinematics, stress, statics and dynamics in fluids.

7. Unidirectional and Lubrication Flows: Chapter 6
   Steady and unsteady unidirectional flows. Lubrication flows.

8. Creeping Flows: §7.1-7.4
   Low Reynolds number flows.

9. Laminar Flow at High Reynolds Numbers: §8.1-8.4
   Invicid, irrotational, and boundary layer flows.