ChBE 6200 Fall 2016 Course Outline

1. Review of basic fluid mechanics principles and math

Setting up balances (differential and macroscopic) and concepts of transport. Introduction to tensor and vector calculus; index notation. Fluid Statics.

Readings: Lecture Notes: pages 1-39,
BSL (reserve): Chapter 2.1-2.5, Chapter 6.1-6.3, Appendix A
Middleman (reserve): 2.1-2.2, 3.1-3.3, 3.5
Deen: Chapter 1.1-1.4, 1.6, 2.1-2.4. 2.7, 5.5, Appendix A.

2. General conservation equations

Kinematic time derivatives, spatial derivatives, transport theorem. Conservation laws in a continuous fluid. Constitutive relationships and boundary conditions.

Readings: Lecture Notes: pages 46-88,
BSL (reserve): Chapter 3.1 – 3.5, 9.1
Deen: Chapter 5.1 – 5.4, 5.7, 5.10

3. Steady-unsteady Parallel (unidirectional) transport

Readings: Lecture Notes: pages 89-111,
BSL (reserve):
Deen: Chapter 6.1 – 6.5, 4.1-4.3, 4.5, 4.7, 4.8, 3.1-3.2, 3.5

4. Nearly unidirectional transport

Readings: Lecture Notes: pages 112-150,
BSL (reserve):
Deen: Chapter 6.6

5. Boundary Layer (High Re) Theory

Scaling principles. Approximate solution for thermal and momentum B.L. Numerical solution of B.L. equations.

Readings: Lecture Notes: pages 163-186
BSL (reserve):
Deen: Chapter 8.1, 8.2, 8.4

6. Stokes (Re << 1) Flow

Scaling of equations of motion; discussion of properties and physical meaning. Solution of Stokes equations using spherical harmonics; 3D and 2D examples.

Readings: Lecture Notes: pages 187-209, 222-231
BSL (reserve):
Deen (reserve): Chapter 7.1, 7.2, 7.3

7. Computational Methods for solving Transport Phenomena

The Finite Volume Method: application to solving heat transfer problems. Solution of coupled heat-mass-momentum transfer problems using the Semi-Implicit-Method for Pressure-Linked Equations (SIMPLE).

Readings: Lecture Notes: pages 246-260, 265-271
Patankar: Chapters 5, 6