UNIVERSITY OF ARIZONA
DEPARTMENT OF CHEMICAL AND ENVIRONMENTAL ENGINEERING
CHEE 505 - Advanced Transport Phenomena
FALL 20xx

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Office hours: open-door policy or by email appointment

Textbook Class Notes posted on the course web page (D2L)

Objective

Study of the fundamental principles and governing equations used in the analysis of transport phenomena. The knowledge obtained will be used to formulate and solve transport phenomena problems.

Outline

1. Introduction
The continuum hypothesis. Vector algebra – index notation. Description of motion in continua – kinematics. Dilatation. The transport theorem.

2. Conservation of mass and momentum
Mass conservation. The macroscopic mass balance. Linear momentum conservation. Stress. Tensor analysis. The stress tensor. The stress equations of motion. Angular momentum conservation. Hydrostatics. Viscous stresses. Kinematics of deformation and rotation. The Newtonian fluid. The Navier-Stokes equations.

3. Incompressible flows
Solutions of the Navier-Stokes equations in one-dimensional flows. Fluid mechanics of phase interfaces. Stream function and vorticity. Inertial and viscous effects. Creeping flows. Inviscid flows. Boundary layer theory. Turbulence.

4. Energy transport
Energy conservation. Viscous dissipation and expansion/compression energy effects. Thermal boundary layers. Natural convection.

5. Mass transport
Mass conservation for a chemical species in a mixture. Diffusion with chemical reaction. Concentration boundary layers. Hydrodynamic dispersion.

Selected References

R. Aris, *Vectors, Tensors and the Basic Equations of Fluid Mechanics*, Prentice Hall, 1962.
R.B. Bird, W.E. Stewart, E.N. Lightfoot, *Transport Phenomena*, John Wiley, 2002.
W.M. Deen, *Analysis of Transport Phenomena*, Oxford University Press, 1998.
L.G. Leal, *Advanced Transport Phenomena*, Cambridge University Press, 2007.
A.E. Sáez, J.C. Baygents, *Environmental Transport Phenomena*, CRC Press, 2014.
J.C. Slattery, *Advanced Transport Phenomena*, Cambridge University Press, 1999.

Course Evaluation

Homeworks

There will be individual homework assignments approximately every week. The final homework average will correspond to 25% of the final grade.

Tests

There will be three tests. Each test will correspond to 25% of the final grade. All tests will be open book and notes. Test dates and times TBD