Syllabus
for ME 5317,
Spring 2015

The course begins by reviewing the equations of motion for viscous fluids. Then, the energy equation that governs the heat flux across a fluid layer is introduced. A discussion of forced and free convection solutions is an integral part of this course.

Course Outline

1. Review of fluid mechanics
   - continuity equation
   - momentum equation
2. Derivation of energy equation.
3. Boundary layer equations.
4. Flow over flat plate:
   - Similarity solutions
   - Blasius equation
   - Natural convection
5. High-speed flow over a flat plate.
6. Momentum and energy integral equations:
   - Flow over a flat plate
   - Flow in the presence of a pressure gradient
   - Flow in porous media
7. Turbulent flow:
   - The Reynolds stresses
   - The Boussinesq approximation
   - The von Karman turbulence model
   - Universal velocity profile
   - The Deisler model
8. Condensation and flow over a vertical plate.
9. Internal flow:
   - Flow in circular ducts
   - Flow in noncircular ducts
   - Flow through porous passages

Exams: 1 Mid-semester (50%) and 1 final (50%)

Textbook: None, see the Blackboard on the Web for a set of class notes.
Most of the materials in this course are also obtainable from the references below.

References:

1. *Mathematical Principles of Classical Fluid Mechanics*, by J. Serrin, in Handbüch der Physik Bd. Vol VIII/1, 1959.

2. *Vector, Tensor, and the Basic Equations of Fluid Mechanics,* by R. Aris, Prentice Hall, 1962.
3. *Convective Heat Transfer,* by L. C. Burmeister, Wiley
4. *Convective Heat and Mass Transfer,* by W. W. Kays and M. E. Crawford, McGraw-Hill.
5. *Boundary Layer Theory*, by H. Schlichting, McGraw-Hill.
6. *Convection in Porous Media*, 3rd edition, by D. A. Nield and A.Bejan, Springer-Verlog, New York, 1999.

Objective: The course objective is to discuss the fundamentals of convective heat transfer that includes derivation of governing equations, effects of different boundary conditions, and equations for external flow and internal flow. Related physical problems such as forced convection, free convection, condensation, boiling, and heat transfer in compressible flow will receive considerations. Additionally, the goal of this course is to familiarize students with fundamentals of fluid mechanics and mathematical/numerical techniques needed to handle advanced convective heat transfer problems in engineering applications and advanced heat transfer research.

Instructor: A. Haji-Sheikh
Office: Room 300C Woolf Hall
Tel.: 817-272-2010
Fax: 817-272-2952
Email <haji@uta.edu>

Office Hours: Tuesday and Thursday 11:00-12:00.