This is to study the transport of thermal energy by a moving fluid. Therefore, this 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.
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:

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.

Final exam and project: The final exams will be open book and notes. It is essential that you concentrate on learning the concepts of the convective heat transfer and basic fluid dynamics. Basically, few equations need to be remembered and most of these are simple enough to require little effort at conscious memorization. To use an equation properly, one must understand its application to specific heat transfer problems. Understanding involves not only knowing what the symbols stand for but also knowing when the equation applies and when it does not apply. Also, in the syllabus, there is one assigned computer project. It is specifically designed to be open ended projects, at publication level. The project emphasizes the role of computer simulation in solving an advanced convective heat transfer problem.

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