EML 4142 - HEAT TRANSFER
Common Course Syllabus

Catalog Data: 3 Credits. Modes of heat transfer, one and two-dimensional steady state heat conduction, unsteady heat conduction, numerical methods, computer program projects, empirical relations for forced and free convection, radiation properties, shape factors, radiation heat exchange between gray bodies.

Goals: This course introduces the three basic modes of heat transfer to the students. It also demonstrates the methods of analysis of dealing with each type of heat transfer process.

Prerequisites:
1. EML 3701 – Fluid Mechanics

Topics: (The number of sessions merely provides guidelines, and is subjected to change by individual instructor)
1. Introduction
   Modes of heat transfer: conduction, convection and radiation (2 hours).
2. Conduction – Basic Equations
   One-dimensional heat-conduction equations, three-dimensional heat conduction equation, boundary conditions (3 hours).
3. One-dimensional Steady-State Heat Conduction
   The slab, composite medium, the cylinder, critical thickness of insulation, heat sources, finned surfaces (6 hours).
4. Transient Conduction and Use of Temperature Charts
   Lumped-System Analysis, charts for slab, cylinder and sphere (3 hours).
5. Finite-Difference Methods for Solving Heat Conduction Problems
   One-dimensional unsteady problem, design project, two-dimensional steady problem, computer project (4 hours).
6. Convection – Concepts and Basic Relations
   Flow inside a duct, flow over a body, dimensional analysis, empirical relations for flows over a cylinder and flows inside ducts (6 hours).
7. Free Convection
   Empirical relations for free convection on vertical and horizontal plates and cylinders (3 hours).
8. Radiation – Basic Concepts
   Plank and Stefan – Boltzman Laws, intensity of radiation, radiation from real surfaces, view factors, radiosity, radiosity matrix method for radiation exchange in an enclosure (6 hours).
9. An introduction to Heat Exchangers
   LMTD method, theoretical determination of the overall heat transfer coefficient (3 hours).

Course Outcomes: (numbers in parentheses indicate correlation of the outcome with the appropriate ABET program outcomes 1-7)

1. The students will be well aware of the steady and transient heat conduction, the underlying principles, solution approaches and applications. (1,2,6)
2. The students will be familiar with both forced and natural convection, the underlying mechanism, empirical relationships and applications. (1,2,6)
3. The students will learn basic radiation heat transfer, understand view factors and use them in radiation heat transfer calculations. (1,2,6)
4. The students will know simple schemes of numerical computations for heat conduction problems. (1,2,6)

Design Content: There is a design project for this course that will count between 15% and 20% of the course grade.

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