THE OHIO STATE UNIVERSITY
COLLEGE OF ENGINEERING

Transport Phenomena II - Heat Transfer

CBE 3421

Credit Hours:
3.00 - 3.00

Course Levels:
Undergraduate (1000-5000 level)

Course Components:
Lecture

Course Description:
The transport of energy, mass and momentum is essential to the function of all non-living and living systems. This course will serve as an introduction to heat transport (i.e., convection and conduction), and will primarily focus on the basic mechanisms of heat transport and its application to the analysis of real world heat transfer problems.

Prerequisites and Co-requisites:
Prereq: 2420, or permission of instructor.

Course Goals / Objectives:
- Describe the three modes of heat transfer and be able to write the empirical laws governing each mode
- Understand the key physical properties governing heat transfer
- Be able to set up shell balances and surface balances for heat transfer problems
- Identify appropriate boundary conditions to solve the governing equations
- Understand and apply the concept of analogies between different transport phenomena
- Apply the finite difference technique to allow numeric solution of heat transfer problems
- Understand the concept and application of key dimensionless numbers in transport
- Identify and apply the appropriate correlation to solve transport problems

Course Topics:

- Vector/tensor algebra
- Addition of two vectors and multiplication of a vector by a number
- The dot product of two vectors; Heat flux and the heat flux vector; Stress vector and stress tensor
- Vector/tensor calculus; The “del” operator; Volume and surface integrals
- The divergence theorem
- The Reynolds transport theorem; Heat transfer with no motion or work
- The first law of thermodynamics (Energy balance); Constitutive relations (Equation of state and Fourier’s “law” of heat conduction)
- Heat transfer from a cylindrical fin; Solutions of 2nd order ODEs (A brief review) (f) Bessel functions
- Unsteady state problems; Solutions of of PDEs (A brief review)
- Numerical solutions (Finite difference method); Heat transfer with motion and work
- Mass, Momentum, and energy balance; Constitutive relations; Remark on forced convection and free convection
- Viscous heating; Macroscopic balance equations; Dimensional analysis
- Heat transfer coefficient in forced convection; The design of heat exchanger; Heat transfer coefficient in free convection

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Designation:
Required