THE OHIO STATE UNIVERSITY
COLLEGE OF ENGINEERING

# Transport Phenomena II

## CBE 3521

**Credit Hours:**
4.00 - 4.00

**Course Levels:**
Undergraduate (1000-5000 level)

**Course Components:**
Recitation
Lecture

**Course Description:**
Emphasis on conduction, convective and radiation heat transfer, mass transfer and stagewise operations with applied computational problems.

**Prerequisites and Co-requisites:**
Prereq: 2420 (420), and enrollment in CBE, FABEng, or EngPhysics major; or permission of instructor or Grad standing.

**Course Goals / Objectives:**

- Be familiar with derivation of partial differential equations of heat transfer from First Law of Thermodynamics
- Master solution of steady-state one-dimensional heat transfer problems
- Be familiar with the solution of unsteady-state heat transfer problems in one spatial dimension and the solution of steady-state heat transfer problems in more than one spatial dimension
- Master the solution of simple heat transfer problems involving heat source
- Be familiar with the dimensionless-analysis foundations of correlations for heat transfer coefficients in the presence of fluid motion
- Master aspects of heat exchanger design
- Be familiar with radiation heat transfer problems
- Use a computer tool (e.g., Maple) to calculate and analyze heat transfer problems
- Master the application of the mass, heat, and momentum balances to engineering problems involving mass transfer
- Be familiar with equations describing molecular diffusion through gases, liquids, and solids
- Be familiar with techniques used to estimate diffusivities in binary and multi-component systems
- Be familiar with techniques used to estimate mass transfer coefficients in laminar and turbulent flows
- Understand the analogies between heat, mass, and momentum transfer
- Master the application of computational techniques to solve mass transfer problems
- Be exposed to the general approach for the design of continuous contact and stagewise absorption towers

---

**Course Topics:**

- Introduction to heat transfer, Combined mechanisms of heat transfer
- First law of thermodynamics, Differential equations for heat transfer, One-dimensional, steady-state conduction (walls & radial systems)
- One-dimensional conduction with heat source, Heat transfer from extended surfaces
- Two-dimensional steady-state conduction
- Unsteady-state conduction
- Convective heat transfer/dimensional analysis, Convective heat transfer/boundary layer
- Energy- and momentum-transfer analogies, Reynolds transport theorem
- Natural convection correlations, Forced convection correlations
- Boiling and condensation, Heat exchanger design
- Radiation heat transfer
- Flux equations, Fick’s law, Diffusion coefficient (Diffusivity)
- Steady-state mass transfer
- Diffusion with chemical reaction
- Unsteady-state mass transfer
- Numerical solution – finite difference method
- Convective mass transfer coefficients, Dimensionless numbers
- Analogies and correlations between heat, mass, and momentum transfer
- Equilibrium stages, Continuous gas/liquid contactors
- Absorption in multicomponent systems, Staged columns
- Absorption in multicomponent systems, Packed columns

---

**Designation:**

Elective
Required