CBEMS120B HEAT AND MASS TRANSFER

Catalog Data: **CBEMS120B Heat and Mass Transfer (Credit Units: 4) W.**
Macroscopic and differential energy balances. Heat transfer coefficients, convective and radiative heat transfer, applications to equipment design, macroscopic and differential species balances, mass transfer with and without chemical reactions, mass transfer equipment design. Prerequisite: CBEMS120A. (Design units: 1)

Textbook: Incropera, F. P. and DeWitt, D. P., *Fundamentals of Heat and Mass,* 5th edition, John Wiley & Sons.

References: Welty, J. R., Wicks, C. E., Wilson, R. E., and Rorrer, G., *Fundamentals of Momentum, Heat, and Mass Transfer",* 4th edition, John Wiley & Sons.

Coordinator: Juan Hong

Course Objectives: To design and analyze chemical processes, a chemical engineer must understand how heat is transported and how chemical species diffuse through materials. This is true not only in traditional areas, such as petrochemicals, but also for emerging fields like microelectronics, biotechnology, material processing, and environmental engineering. This course is an introduction to the basic concepts in heat and mass transfer necessary for subsequent courses ranging from separation processes, reactor design, and process control. The course builds on concepts from elementary physics and chemistry, as well as calculus and differential equations.

Course Outcomes: Students will be able to:
Understand the principles of conduction, convection, radiation.
Determine the temperature distributions in heat transfer systems.
Understand the heat transfer with forced convection.
Understand the transient heat transfer.
Understand the principle of interphase heat transfer.
Design a shell and tube heat exchanger.
Understand the principles of diffusion and mass transfer.
Determine concentration distributions in mass transfer systems.
Understand the diffusion with chemical reactions.
Understand the forced convective mass transfer.
Understand the principle of interphase mass transfer.
Design a packed tower absorber.

Prerequisites By Topic: Chemical engineering calculations, Mass and energy balances, Momentum transfer, Differential equations, Computer literacy and basic skills (Fortran, MATLAB, C++, Basic, etc).

Lecture Topics: Steady-state and transient conduction
Temperature Distributions
Composite Walls
Free and Forced Convection
Boiling and condensation

Radiative Heat Transfer
Parallel or Counter-Flow Heat Exchanger
Diffusivity and Mass Transport Mechanism
Models for Diffusion, Concentration Distributions
Diffusion with Chemical Reaction
Forced Convection Mass Transfer
Interphase Transport
Mass Transfer Coefficients
Height of a Packed Tower Absorber

Class Schedule: Each class meets 4 hours per week for 10 weeks.

Computer Usage: Computer literacy and basic skills (Fortran, MATLAB, C++, Basic, etc) are required for designing and analyzing a concentric tube heat exchanger and for solving a partial differential equation for two dimensional heat conduction problem.

Laboratory Projects:

Professional Component: Contributes toward the Chemical Engineering Topics Courses and Major Design experience.

Relationship to Program Outcomes: ChE: This course relates to Program Outcomes 1, 3, 5, 10, 11, and 13 as stated at: http://www.eng.uci.edu/dept/objective_chemical
MSE: This course relates to Program Outcomes 1 and 5 as stated at: http://www.eng.uci.edu/dept/objective_materials_science

Design Content Description

Approach: 2 lectures and a computer project. Two lectures on design and analysis of concentric tube heat exchanger and countercurrent gas absorber.
Lectures: 100%
Laboratory Portion:

Grading Criteria:

Homework:	15%
Quizzes:	15%
Exam #1:	35%
Exam #2:	35%
	100%

To obtain the highest grade (A), all the homework should be attempted and submitted on time. In general, exams cannot be made up and no late homework sets will be accepted.

Estimated ABET Category Content:

Mathematics and Basic Science: 0 credit units or 0%
Engineering Science: 3 credit units or 75%
Engineering Design: 1 credit units or 25%

Prepared by: Juan Hong **Date:** July 2005

CEP Approved: Fall 2001