155:304 MASS & HEAT TRANSPORT Spring 2012

Department of Chemical & Biochemical Engineering Rutgers U.

***Course Instructor*: Professor Maria Silvina Tomassone**
Course Schedule: Tue, Th: 1:40 PM- 3:00 PM, Wright Rieman Auditorium

Instructor Office Hours: C-234, Thursdays, 3 PM-4 PM
Instructor Contact: silvina@soemail.rutgers.edu

Teaching Assistant: Sen Maitraye Email Address: maitraye@eden.rutgers.edu
TA Office Hours and Location: W, F: 4-6 PM, C-137 .

Course Website: sakai.rutgers.edu

Course Description in Key Words:
Energy and mass transfer in chemical engineering processes. Steady-state and unsteady-state heat conduction and molecular diffusion. Energy and mass transfer in fluids undergoing flow, phase change and/or chemical reaction. Radiant heat transfer, Heat exchangers and mass transfer equipment.

***Course Objectives*:**
Equip the student with necessary analytical understanding and quantitative tools to address the following questions:

- How can physical phenomena be represented mathematically? How does one construct simple mathematical models to capture transport processes?
- What are the various modes of chemical/molecular mass transport and how does one "model" their contributions toward transport dynamics in situations relevant to chemical engineering, broadly defined?
- What are elements of phenomenological/lumped-parameter and mechanistic approaches to describe transport, and when is either applicable?
- What are the basic formulations for solving steady state, quasi-steady state, and unsteady (transient) state mass transfer problems?
- In which problems do diffusive and convective transport interact, and what are the theories to formulate and solve these problems?
- What are the basic modes of heat transfer?
- How can heat exchangers be designed for specific processes?

***Required Book*:** Introduction to Mass and Heat Transfer, Principles of Analysis and Design, by Stanley Middleman

Lecture Schedule: Tuesdays, Thursdays, 1:40 PM- 3:00 PM, Wright Labs Auditorium (will be revised at end of January, 2012)

1.	Jan 17, T	Introduction to Diffusion, Fick's Law, Convection
2.	Jan 19, Th	Examples of Diffusive Transport
3.	Jan 24, T	Generalized Mass Balances
4.	Jan 26, Th	*Quiz 1 Diffusion examples, contd.*
5.	Jan 31, T	Examples of Steady State and Pseudo Steady State Transport
6.	Feb 2, Th	Diffusion in Non-rectilinear Coordinates
7.	Feb 7, T	Diffusion and Convection; Diffusion & Homogenous Reactions
8.	Feb 9, Th	Diffusion and Reactions, continued
9.	Feb 14, T	*Quiz 2*; Diffusion and Higher Order Reactions
10.	Feb 16, Th	Diffusion and Heterogeneous Reactions; Non-rectilinear coordinates
11.	Feb 21, T	Unsteady State Diffusion; Diffusion into semi-infinite media
12.	Feb 23, Th	Unsteady state diffusion, continued
13.	Feb 28, T	Unsteady state diffusion with convection
14.	Mar 1, Th	Examples; Assignment of Research Paper
15.	Mar 6, T	Midterm Review
16.	Mar 8, Th	Midterm Test
	Mar 13, T	Spring Break
	Mar 15, Th	Spring Break
17.	Mar 20, T	Diffusion with Laminar Convection; Mass Transfer Coefficients
18.	Mar 22, Th	Convective Mass Transfer Coefficients, continued; Film and Boundary Layer Theories
19.	Mar 27, T	Mass Transfer in Convective Environments, Continued
20.	Mar 29, Th	*Quiz 3* Introduction to Heat Transfer by Conduction
21.	Apr 3, T	Heat Conduction Problems; Transient Heat Conduction
22.	Apr 5, Th	Convective Heat Transport
23.	Apr 10, T	Design of Heat Exchangers
24.	Apr 12, Th	*Quiz 4;* Design of Heat Exchangers, continued
25.	Apr 17, T	Design of Heat Exchangers, continued.
26.	Apr 19, Th	Design of Heat Exchangers, continued.
27.	Apr 24, T	In class paper presentations I
28.	Apr 26, Th	In class paper presentations II
29.	May 1, T	End Term Review
30.	May xxxx	FINAL EXAM 8 AM- 11 AM, WL Auditorium

Grading Structure:
30% Mid-term, 30% End-term Exams; 20% Quizzes; 10% Homework Solutions; 15% Research Project/Paper and Oral Presentation; and Class Participation

ABET Outcomes and Assessment:

Program outcomes achieved in this course (bolded)

(a) an ability to apply knowledge of mathematics, science and engineering
(b) an ability to design and conduct experiments, as well as to analyze and interpret data
(c) an ability to design a system, component, or process to meet desired needs
(d) an ability to function in multi-disciplinary/multi-functional teams (this can be defined as a mix of biochemical and chemical engineers, or as a group of students working on a different roles of a project)
(e) an ability to identify, formulate, and solve engineering problems
(f) an understanding of professional and ethical responsibilities.
(g) an ability to communicate effectively
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

The achievement of outcomes (a), (c), (e), and (g) will be assessed in this course as follows:
Outcome (a): an ability to apply knowledge of mathematics, science and engineering

(1) Assessment test: 1st day of class – same test at the time of the first exam (after the basics have been revisited).
(2) Exams – Homeworks: Most of the problems test the ability to apply knowledge of mathematics, science and engineering in problem solving

Outcome (c) **) an ability to design a system, component, or process to meet desired needs**

Homework and exam problems that involve the design of mass and heat transfer equipment/process.

Outcome (e): an ability to identify, formulate, and solve engineering problems
Course paper/projects: The project will require the students to identify the engineering approach/problem within the topic identified, and to formulate and review solution strategies.

Outcome (g): an ability to communicate effectively
The project will involve intermediate and final written and oral report. At the intermediate stage feedback will be given from (a) class evaluations (b) instructor evaluations