Michigan State University

DEPARTMENT OF CHEMICAL ENGINEERING AND MATERIALS SCIENCE

CHE 210: Modeling and Analysis of Transport Phenomena Spring 2011

Course Outline

Week	Topic(s)	Reading[1]
1 – Jan. 10	Course structure and policies; Review of steady state balances; Transient mass and energy balances	Felder & Rousseau, Ch. 4,7 Felder & Rousseau, Ch. 11
2 – Jan. 17	Note: No class on September 17 (*Martin Luther King Day*) Transient mass and energy balances (contd.) Solution methods for first order ODEs	Hawley Ch. 1, 2[2]
3 – Jan. 24	Solution methods for first order ODEs (contd.) Solution methods for second order ODEs	Hawley Ch. 2
4 – Jan. 31	Numerical methods for first/second order differential equations; MATLAB applications	Hawley Ch. 2 Thomson Appendix B
5 – Feb. 7	Introduction to transport phenomena: diffusive and convective fluxes; analogy between mass, energy, and momentum transport **EXAM I (*Coverage through Feb. 4*)**[3]	Thomson Ch. 2
6 – Feb. 14	Introduction to vectors and tensors Shell balances: molecular momentum, mass and energy transport	Thomson Ch. 2
7 – Feb. 21	Shell balances (contd.) Note: No class on February 25, but all students are ***required*** to attend ***Symposium Day***	Thomson Ch. 3.1-3.3, 4.1-4.5 Thomson Ch. 5.1-5.4
8 – Feb. 28	In-Class Exercises on shell balances – large groups	
Mar. 7-11	***Spring break – no classes***	
9 – Mar. 14	In-Class Exercises on shell balances – small groups	
10 – Mar. 21	Transport properties – viscosity, thermal conductivity, diffusivity **EXAM II (*Coverage through March 18*)**	Thomson Ch. 6
11 – Mar. 28	The generalized equations of change and application to transport phenomena	Thomson Appendix A Thomson Ch. 8
12 – Apr. 4	Dimensional analysis and dimensionless equations Transient molecular transport in semi-infinite media	Thomson Ch. 7
13 – Apr. 11	Transient molecular transport in finite media Convective transport coefficients (f, h, k_c)	Thomson Ch. 10
14 – Apr. 18	Transport across interfaces; film theory **EXAM III (*Coverage through April 15*)**	
15 – Apr. 25	Numerical solutions, MATLAB applications	
Mon., May 2	**FINAL EXAMINATION: 12:45-2:45 P.M.,** 115 Center for Intl Programs	

[1] You are responsible for all assigned reading, even if that particular topic is not specifically discussed in class.
[2] This reference is available on ANGEL
[3] Each semester examination will be on Friday of the specified week.

Course Structure and Policies

Instructor Professor Robert Y. Ofoli, Room 1248 EB, 432-1575, ofoli@egr.msu.edu

Office Hours Mondays 3-4:30 PM; Wednesdays 10:30-12 noon

TA Rui Lin, linrui@egr.msu.edu

Office Hours Mondays 11-12 noon; Tuesdays 1-3 PM. Location: Engineering Library

Schedule Lecture M W F 12:40-1:30 115 Center for Intl Programs

Textbook Thomson, W.J. *Introduction to Transport Phenomena*, Prentice-Hall PTR, Upper Saddle River, NJ, 2000.

Books on Reserve (Engineering Library)

Felder, R. M. and R. W. Rousseau, Elementary Principles of Chemical Processes, 3rd Edition, John Wiley & Sons, New York, 2000.

Chapra, S. C., Applied Numerical Methods with MATLAB for Engineering and Science, McGraw-Hill, New York, 2004.

Sticklen, J. and M. T. Eskil, An Introduction to Technical Problem Solving with MATLAB® v.7, 2nd Edition, Great Lakes Press, St. Louis, MO, 2006.

Catalog description Steady and unsteady state material and energy balances. Fluxes and rate processes. Shell balances. Balance equations for mass, heat, and momentum transport. Analogies among mass, heat, and momentum transport. Analytical and numerical solutions. Application of computational methods to problem solutions.

Course objective To place mathematics in a chemical engineering context, and provide students with a foundation for upper level ChE courses (in particular, CHE 311, 312 and 431).

Expected outcomes This course will enable each student to:

a. Derive and verify governing equations on transport processes using basic principles;
b. Solve such equations analytically or numerically based on process information;
c. Improve his/her problem solving, critical thinking, and analytical skills;
d. Improve his/her ability to work as an effective member of a group of peers.

Class Attendance Class attendance is required. Students who miss three (3) or fewer class sessions will earn 50 points (5% of the total number of points). Students who miss more than three (3) class sessions will earn no points. Missing roll call is equivalent to being absent.

Homework Groups of up to three (3) students may work together on homework solutions; however, each student must turn in his/her OWN solution on lined paper. ***Homework must be turned in before class begins on the due date. Late homework will NOT be accepted.***

Quizzes: Several quizzes will be given during the semester. There will be no make-ups for quizzes under any circumstances; however, the lowest quiz grade will be dropped.

Mid-term exams Examinations are ***closed-book and closed notes***. However, students will be allowed to use handwritten notes on both sides of one 8.5x11 sheet for each exam. Make-up examinations will NOT be given, unless arrangements are made at least 24 hours ahead of time or in cases where there is a DEMONSTRABLE emergency.

Grading

Course component	**Point Value**	Percentage
Class attendance	50	5
Homework	100	10
Quizzes	100	10
3 mid-semester examinations	400	40
Group project	100	10
Final examination (comprehensive)	250	25
Total	**1,000**	**100%**

Performance incentive Students who score 90% or better on the final exam will earn a ***minimum*** course grade of 3.0, no matter what their grades were before the final. This is intended to reward students who struggle early, but remain persistent in learning and understanding the material.