CBE:5115 Transport Phenomena I
Syllabus
Fall 2016

Instructor: David Rethwisch; 4138 SC; 335-1413; email: david-rethwisch@uiowa.edu
Class: 11:00 am-12:15 pm TTh (3321 SC)

Textbook: Bird, Stewart, and Lightfoot, *Transport Phenomena*, 2nd ed. revised, Wiley, 2007.

Course Description:

Transport Phenomena I provides a unified treatment of momentum, mass, and energy transport in chemical engineering problems. Vector and tensor notations and mathematics will be used in expressing equations of continuity, motion, energy. The chief objective of this course is to further develop the foundations of transport phenomena and to apply this knowledge to the solution of problems of interest to the engineer. The objective of this course is for the student to gain an enhanced understanding of transport phenomena and to gain confidence in their ability to use transport phenomena as a tool.

There will be two two-hour exams and a final. They will be held in the evening (starting at 7 p.m.) and will typically comprise three problems based on the indicated material. The final exam will be comprehensive, covering the whole course with particular emphasis placed on the material since the second exam. However, each exam will build on previous material.

Course objectives The objectives of this course are for students to learn to:

- setup shell balances for conservation of momentum, energy, and mass;
- understand and apply flux laws in balances;
- understand and apply interphase transport relationships;
- employ shell balance equations to obtain desired profiles for velocity, temperature and concentration;
- reduce and solve the appropriate equations of change to obtain desired profiles for velocity, temperature and concentration;
- reduce and solve appropriate macroscopic balances for conservation of momentum, energy and mass;
- utilize information obtained from solutions of the balance equations to obtain engineering quantities of interest;
- recognize and apply analogies among momentum, heat and mass transfer;
- appreciate relevance of transport principles in diverse applications of chemical, biological, and materials science and engineering.

Topics covered

- Mass, momentum and energy transport mechanisms
- Calculation of transport coefficients
- Dimensional analysis
- Momentum, energy and mass interphase transport
- Microscopic and macroscopic balances
- Solution to problems in viscous flow, energy and mass transport

- Elementary applications

Grading: The distribution of points for grading is indicated below.

Exam I	250
Exam II	250
Final Exam	250
Homework	250
TOTAL	1000

Homework: Homework will be due at the beginning of class on the due date. Late homework will not be accepted.

Email: Each of you has an email account at name@engineering.uiowa.edu and you are responsible for reading email sent to this account. It's fine to use hotmail, or aol, etc., but it is your responsibility to go into the CSS web site and configure your engineering account to forward mail to your preferred address.

Special Accommodations: Special academic arrangements for students with disabilities are handled with the cooperation of Student Disability Services (SDS), 133 Burge Hall, phone 335-1462. Students who feel they need special accommodations for any aspect of the course are encouraged to contact SDS and to speak with the instructor early in the semester.

Non-Engineering Students: This course is given by the College of Engineering. This means that class policies on matters such as requirements, grading, and sanctions for academic dishonesty are governed by the College of Engineering. Students wishing to add or drop this course after the official deadline must receive the approval of the Dean of the College of Engineering. Details of the University policy of cross enrollments may be found at: http://www.uiowa.edu/~provost/deos/crossenroll.doc

Collaboration Policy: Discussion of homework problems with other students in the class and/or working in groups is not only acceptable, but encouraged. Engineers in industry are generally expected to work as a team. This is a good way to develop that team concept, and to learn from each other, thereby putting in fewer hours on homework. Feel free to work together; however, direct copying of an assignment in part or in total is not allowed. A zero will be given in all homework assignments if this policy is violated. Cheating on hourly or final exams will result in an "F" in the course.

CBE:5115 Transport Phenomena I
Fall 2016 – Tentative Lecture Schedule

		Date	**Topic(s)**	**Sections**		**Suggested Problems**
			Part I: Momentum Transport			
1	T	Aug 23	Introduction; Momentum Balances; Newton's Law of Viscosity;	Preface; 1.1, 2.1		
2	R	Aug 25	Falling Film; Laminar Flow in Tube and Annulus	2.1-2.4		
3	T	Aug 30	Vector and Tensor Notation	A.1-A.6		Set 1 (Ch. 2)
4	R	Sept 1	Equations of Continuity and Motion	3.0-3.2		
5	T	Sept 6	Solution of Isothermal Flow Problems	3.3-3.6		
6	R	Sept 8	Dimensional Analysis	3.7		Set 2 (Ch. 3)
7	T	Sept 13	Turbulent Flow	5.1-5.4		
8	R	Sept 15	Friction Factors	6.1-6.3		Set 3 (Ch. 3 & 5)
9	T	Sept 20	Friction Factors; Dimensional Analysis			
10	R	Sept 22	Macroscopic Balances	7.1-7.5		Set 4 (Ch. 6)
11	T	Sept 27	No lecture	7.6		
		TBD	**Exam 1 evening 7:00 pm**	Chpts. 1-6		
12	R	Sept 29	Solution of Steady and Unsteady Flow Problems	7.6-7.7		
13	T	Oct 4	Isothermal Macroscopic Balances			Set 5 (Ch. 7)
			Part II: Energy Transport			
14	R	Oct 6	Heat Conduction; Fourier's Law	9.1-9.5		
15	T	Oct 11	Shell Energy Balances; Analogies	10.1-10.2		Set 6 (Ch. 8 & 9)
16	R	Oct 13	Heat Conduction with Sources; Forced Convection	10.3-10.5, 10.8		
17	T	Oct 18	Equations of Energy	11.1-11.2		Set 7 (Ch. 10)
18	R	Oct 20	Solutions of Nonisothermal Problems	11.3-11.5		

19	T	Oct 25	Dimensional Analysis	11.6		
20	R	Oct 27	Heat Transfer Coefficients	14.1-14.6		Set 8 (Ch. 11)
21	T	Nov 1	Radiative Equilibrium and Transfer	16.1-16.5		
22	R	Nov 3	Non-Isothermal Macroscopic Balances	15.1-15.4		Set 9 (Ch. 14)
23	T	Nov 8	Solution of Non-Isothermal Problems	15.5-15.6		
		TBD	**Exam 2**	Up to Ch. 14		
			Part III: Mass Transport			
24	R	Nov 10	Ordinary Diffusion, Fick's Law	17.1-17.4		
25	T	Nov 15	Shell Mass Balances; Stagnant Film	18.1-18.2		Set 10 (Ch. 15)
26	R	Nov 17	Diffusion with Chemical Reaction; Absorption in Falling Liquid Film	18.3-18.5		
		Nov 20-27	**Thanksgiving Break**			
27	T	Nov 29	Equations of Change for Mixtures	19.1-19.3		
28	R	Dec 1	Mass Transfer Coefficients	22.1-22.4		Set 11 (Ch. 17,18)
29	T	Dec 6	Multicomponent Macroscopic Balances	23.1-23.4		
30	R	Dec 8	Solution of Multicomponent Problems	23.5-23.6		Set 12 (Ch. 18, 19)
		TBD	**Final Exam TBD**			