Winter 04

ENGG*3430: HEAT AND MASS TRANSFER

Instructor:	Dr. Hongde Zhou	Room 1341, ext. 56990, hzhou@uoguelph.ca
	Office hour:	Monday 11:00am to noon or via e-mail
T.A.:	Edgar Quinones:	Room 324, equinone@uoguelp.ca Office hour: Tuesday 2:30 to 3:30pm
	Thair Patros:	Room 317, tpatros@uoguelph.ca Office hour: Thursday 2:30 to 3:30pm

Lectures: Room: C&M 200
Time: Tuesday and Thursday 1:00PM to 2:20PM

Tutorials:	Section 101:	Friday	2:30PM – 3:20PM	MACK 306
	Section 103:			ROZH 107
	Section 102:	Monday	3:30PM – 4:20PM	MACK 227
	Section 104:			MACK 314

Website: http://www.uoguelph.ca/~hzhou/teaching/courses.htm (ID: engg343; pw: hmt)

COURSE OBJECTIVES

This course is to introduce the basic principles of heat and mass transfer with emphasis on their analysis and applications to practical engineering problems. On successful completion of this course, you will be able to:

1) Identify important thermal processes, and derive the basic expressions for heat conduction, convection and radiation based on the First Law of Thermodynamics,
2) Analyze conduction heat transfer using an electrical resistance network analogy,
3) Determine steady state and transient temperature distribution in various solid geometries of practical importance,
4) Understand the physical significance of pertinent dimensionless parameters in convective heat transfer,
5) Select and apply the appropriate correlation for different heat and mass convection processes,
6) Analyze and design a heat exchanger using conventional methods,
7) Determine radiation exchange within an enclosure based on the view factor method, and
8) Analyze mass diffusion in a stationary medium and low rate mass convection based on the analogy between heat and mass transfer.

COURSE SCHEDULE

The following table contains the tentative schedule of lecture topics and reading assignments. You are expected to read the corresponding materials prior to attending the lectures.

Start	Lectures	Topic	Readings
Jan. 6	0.5	**Orientation and course outline**	
Jan. 6 *to* Jan. 8	1.5	**Rate Equations and Conservation Laws** Rate equations of heat transfer Thermal properties of materials Conservation of energy Analogy between heat and mass transfer	 1.1, 1.2 2.2 1.3 to 1.6 14.1.1, 14.1.3
Jan. 13 *to* Jan. 15	2	**1D, Steady-State Conduction** Diffusion equation and boundary conditions Plane wall conduction Radial conduction Conduction with thermal generation	 2.1, 2.3, 2.4 3.1 to 3.2 3.3 to 3.4 3.5
Jan. 20 *to* Jan. 22	2	**2D and 3D Steady-State Conduction** Introduction to analytical solutions Conduction shape factor method	 4.1 to 4.2 4.3
Jan. 27 *to* Jan. 29	2	**Transient Conduction** Lumped capacitance method Introduction to analytical solutions Semi-infinite solid solutions Multi-dimensional solutions	 5.1 to 5.4 5.5 to 5.6 5.7 5.8
Feb. 3 *to* Feb. 5	2	**Numerical Methods in Heat Conduction** Numerical formulation and error control Steady state heat conduction Transient heat conduction	 Notes 4.4 to 4.5 5.9
Feb. 10 *to* Feb. 12	2	**Mass Diffusion** Rate equation and boundary conditions State-state mass diffusion Unsteady-state mass diffusion	 14.1 to 14.3 14.4 to 14.5 14.6
Feb. 24		**MIDTERM**	
Feb. 26 *to* March 14	5	**Heat and Mass Convection** Convection heat transfer and boundary layer Forced convection Free or natural convection	 Chapter 6 Chapters 7 and 8 Chapter 9
March 16 *to* March 18	2	**Heat Exchangers** Introduction to heat exchangers LMTD method Effectiveness-NTU method	 11.1, 11.2, 11.6 11.3 11.4
March 23 *to* March 30	3	**Radiation** Mechanisms and properties of radiation Radiation view factor Heat exchange between black bodies Heat exchange between non-black bodies	 12.1 to 12.7 13.1 13.2 13.3
April 1	1	**Review**	
April 7		**FINAL EXAM (2:30pm to 4:30pm)**	

1. Course topics will be covered by both lectures and tutorials. The main purposes of the tutorials are twofold: 1) provide additional discussion and sample problems in line with the lecture materials, and 2) have a more informal opportunity to explore issues and ask questions about lectures, texts and previously assigned material which require further clarification.

2. A major objective of this course is to prepare students to solve engineering problems that involve heat and mass transfer processes. It is thus important for you to work out each assignment problem by **yourself** to gain the deeper appreciation for the fundamentals of the subject and build your confidence in applying these fundamentals to the solution of engineering problems. Do not deny yourself the joy of self-discovery!

GRADING SYSTEM

Assignments	15 %
Quizzes (2)	15 %
Midterm	30 %
Final Exam	40 %

For each of these tests, you are allowed to bring the textbook and calculator but not the notes and assignment solutions. The quizzes will typically last 30 to 50 minutes and be held one week prior to the announcement. It is suggested that students should clearly understand the involved concepts in order to prepare for any tests rather than simply memorizing the solution schemes.

You must achieve a passing grade combined with the assignments and quiz sections to pass the course. If you fail to it, your final grade will be equal to that failing percentage.

If you miss an assignment or a quiz and have an acceptable, properly written excuse in accordance with University Calendar, the weight of the missed component will be added to the weight of the final exam.

You may appeal any mark within one week after it has been reported to you with the written reasons for remarking.

Late submission of the assignments will be devalued by 50% per day.

Note that the solution to each problem must be neat and in an orderly fashion (see Text 1.4). All equations used must be written in general symbol form before substituting specific numerical values. In some cases, a sketch should be given as a part of the solution. The answers must indicate the appropriate units and be marked clearly.

Please also note that other university policies specified in University Undergraduate Calendar 2003/04 will be followed strictly.

TEXTBOOK

Incropera, F.P. and DeWitt, D.P. (2002). *Fundamentals of Heat and Mass Transfer*, 5th Edition, John Wiley and Sons, New York, NY, 981p.

Notes on pertinent material will be provided throughout the semester.

OTHER REFERENCES

Arpaci, V.S. (1999). Introduction to Heat Transfer. Prentice Hall, 611p.

Gebhart, B. (1993). *Heat Conduction and Mass Diffusion*, McGraw-Hill, 640p.

Holman, J.P. (1997). *Heat Transfer*, 9th edition, McGraw-Hill, 665p.

Kays, W.M. and Crawford, M.E. (1993). *Convective Heat and Mass Transfer*. 3rd ed., McGraw-Hill, 480p.

Kreith, F. and Black, W.Z. (1980). *Basic Heat Transfer*. Harper & Row, 550p.

Mills, A.F. (1999). *Basic Heat and Mass Transfer*. Prentice-Hall, 1000p.

Skelland, A.H.P. (1974). *Diffusional Mass Transfer*. Wiley, 510p.

PREREQUISITES

05-223	Fluid Mechanics
05-326	Thermodynamics
63-227	Applied Differential Equations

Note: If you do not meet this requirement, see your instructor immediately