Winter 07
ENGG*3430: HEAT AND MASS TRANSFER

Instructor:	Dr. Lambert Otten	Room 211 (old bldg), ext. 53070 lotten@uoguelph.ca
	Office hour:	Monday 11:00 am to noon or make appointment via e-mail
T.A.:	Moonhee Lee:	Room 307, moonhee@uoguelph.ca Office hour:
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Lectures:	Location:	War Memorial
	Time:	Tuesday and Thursday 1:00PM to 2:20PM

Tutorials:	Section 101:	Monday	1130AM – 12:20PM	MACK 304
	Section 103:			MACK 306
	Section 102:	Wednesday	2:20PM – 3:20PM	MACK 311
	Section 104:			MACK 312

Website: http://www.uoguelph.ca/otten/teaching/courses.htm (ID: engg3430; pw: hmt2007)

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 should 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/mass 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. It is suggested that you scan the reading materials prior to the lectures.

Start	Lectures	Topic	Reading
Jan. 9	0.5	**Orientation and course outline**	

Jan. 9, 11	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. 16	2	**1D Steady-State Conduction** Diffusion equation and boundary conditions	 2.1, 2.3, 2.4
Jan. 18	1	**Temperature Measurements Videos**	
Jan. 23		**1D Steady-State Conduction** Plane wall conduction Radial conduction Conduction with thermal generation	3.1 to 3.2 3.3 to 3.4 3.5
Jan. 25, 30	2	**2D and 3D Steady-State Conduction** Introduction to analytical solutions Conduction shape factor method	 4.1 to 4.2 4.3
Feb. 1, 6, 8	3	**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. 13, 15	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. 20, 22		**WINTER BREAK**	
Feb. 27	1	**MIDTERM**	
Mar. 1, 6	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
Mar. 8, 13,15, 20	4	**Heat and Mass Convection** Convection heat transfer and boundary layer Forced convection Free or natural convection	 Chapter 6 Chapters 7 and 8 Chapter 9
Mar. 22, 27	2	**Heat Exchangers** Introduction to heat exchangers LMTD method Effectiveness-NTU method	 11.1, 11.2, 11.6 11.3 11.4
Mar.29, April 3, 5	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
Apr. 5		**Classes conclude**	
Apr. 14		**FINAL EXAM (7:00 to 9:00 pm)**	

1. Course topics are covered by both lectures and tutorials. The main purposes of the tutorials are twofold: 1) to allow an opportunity to explore issues and ask questions about lectures, texts and previously assigned material that requires further clarification; 2) to write a short quiz dealing with the problems recommended for that particular week.

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!

3. Please note that to be successful in the course it is imperative that you keep up with the material on a weekly basis regardless of the pressure imposed by other courses or circumstances. Experience has shown that once a person falls behind in the course there is little chance of catching up later. Similarly, if you have unresolved difficulties with the material, see one of the teaching assistants or myself immediately – **DO NOT WAIT UNTIL THE MIDTERM OR FINAL TO RESOLVE YOUR DIFFICULTIES.**

SUGGESTED PRACTICE PROBLEMS

The following table provides a number of problems selected as practice problems. The problems are not graded. Instead, the solutions are discussed at the start of the tutorials on the dates shown in the first column. At the end of the tutorials a short quiz will be given to evaluate your understanding of the material relevant to the problems. Solutions to the problems will be made available on the web after each tutorial.

Please note that the course is primarily analytical and the more problems that are attempted, the better. If you decide to do additional problems, the TAs are pleased to review them.

Tutorial Dates	**Problems**	**Tutorial Dates**	**Problems**
Jan 15, 17	1.2, 1.12, 1.17, 1.28, 1.36, 1.72 (g)	Mar. 5, 7	
Jan 22, 24	2.14, 2.24, 2.26, 2.47	Mar. 12, 14	12.6, 14.18, 14.21, 14.40, 14.43
Jan 29, 31	3.2, 3.11, 3.68, 3.74(a), 3.154	Mar. 19, 21	6.58, 6.65, 7.20, 7.56, 8.22, 8.31, 9.27, 9.97
Feb. 5, 7	4.8, 4.22, 4.29		
Feb. 12, 14	5.12, 5.15, 5.41, 5.47, 5.68, 5.74	Mar. 26, 28	11.25, 11.34, 11.55
Feb. 26	4.35, 4.40, 4.49, 5.96, 5.98	April 2, 4	12.44, 12.120, 12.141, 13.1, 13.78 13.93

GRADING SCHEME

Quizzes (weekly)	20 %
Midterm	30 %
Final Exam	50 %

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 10 minutes and will be held during the weekly tutorials. Students should clearly understand concepts in order to prepare for any tests rather than simply memorizing the solution schemes.

You must achieve a passing grade in the combined midterm and final grades to pass the course. If not, you will be assigned the failing grade.

If you miss a quiz for acceptable reasons, it will not be counted in determining the overall quiz grade. If you miss the midterm and have an acceptable, properly written reason in accordance with University Calendar, the weight of the midterm will be added to the weight of the final exam.

You may appeal any mark with the written reasons for remarking **within one week** of receipt.

Please also note that other university policies specified in University Undergraduate Calendar 2004/05 will be followed strictly.

TEXTBOOK

Incropera, F.P., DeWitt, D.P., Bergman, T.L. and Lavine A.S. (2007). *Fundamentals of Heat and Mass Transfer*, 6th 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.

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

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

PREREQUISITES

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

Note: If you do not meet this requirement, you must have the instructor's approval to stay in the course.