SCHOOL OF ENGINEERING, UNIVERSITY OF GUELPH
ENGG*3430: HEAT AND MASS TRANSFER, W'2011

Instructor: Dr. Gauri S. Mittal, Room 2433, ext. 52431, gmittal@uoguelph.ca
Office hour: Thursdays 2:30 to 4:00 pm or by appointment via e-mail

T.A.: *Emily Austin* *Room ?* *eaustin@uoguelph.ca, Wed 3-5 pm*
Cameron Farrow *Room 312* *cfarrow@uoguelph.ca Tue 2-4 pm*

***Lectures**:* *Tuesdays & Thursdays @ 11:30 to 12:50; LA 204*

Tutorials: *Start the week of January 10th*
Section 0102: Thursdays @ 10:30-11:20 am, MACK 238
Section 0103: Thursdays @ 4:00-4:50 pm, MACK 238
Section 0104: Mondays @ 1:00-1:50 pm, MACK 316
Section 0105: Wednesdays @ 2:30-3:20 pm, MACK 314

Students are not allowed to change their tutorial sections without the approval of the instructor.

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 dimensionless parameters in convective heat/mass transfer,
5) Select and apply the appropriate correlation for different convective heat and mass convection processes,
6) Analyze and perform the thermal design of heat exchangers 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 strongly suggested that you scan the reading materials prior to the lectures.**

Date	# of Lectures	Topic	Text
Jan. 11	1	**Orientation and course outline** **Introduction** Rate equations of heat transfer	 1.1, 1.2
Jan. 13	1	**Rate Equations and Conservation Laws** Thermal properties of materials Conservation of energy	 2.2 1.3 to 1.6

Jan. 18, 20	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 except 3.1.4 3.3 to 3.4 3.5
Jan. 25	1	**2D and 3D Steady-State Conduction** Introduction to analytical solutions Conduction shape factor method	 4.1 and 4.2 4.3
Jan. 27, Feb. 1, 3	3	**Transient Conduction** Lumped capacitance method Introduction to analytical solutions Semi-infinite solid solutions	 5.1, 5.2, 5.4 5.5 to 5.6 5.7
Feb. 8, 10	2	**Numerical Methods in Heat Conduction** Numerical formulation Steady state heat conduction Transient heat conduction	 Notes 4.4 to 4.5 5.9
Feb. 15, 17, Mar 1	3	**Heat Convection** Convection heat transfer and boundary layer Forced convection Free or natural convection	 6.1-6.6, 6.7.3, 6.8 7.1-7.6,8.1-8.5 9.1-9.6
Feb. 21-25		**WINTER BREAK**	
Mar 3	1	**REVIEW CLASS**	
Mar 4	7-9 PM	**MIDTERM**	MACN 105
Mar. 8, 10, 15, 17	4	**Radiation** Mechanisms and properties of radiation Radiation view factor Heat exchange between black bodies	 12.1 to 12.7 13.1 13.2
Mar. 22, 24, 29	3	**Mass Transfer** Rate equation and boundary conditions State-state mass diffusion Unsteady-state mass diffusion Convective mass transfer	 14.1 to 14.3 14.4 14.6
Mar 31, Apr. 5	2	**Heat Exchangers** Introduction to heat exchangers Effectiveness-NTU method	 11.1, 11.2, 11.4
Apr. 7	1	**REVIEW CLASS**	
Apr. 11		**CLASSES CONCLUDE**	
Apr. 14		**FINAL EXAM (8:30 to 10:30 am)**	

1. Course topics are covered by both lectures and tutorials. The main purposes of the tutorials are two-fold: i) to allow an opportunity to explore issues and ask questions about the material covered in the lectures, text and previously assigned material that requires further clarification; and ii) 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 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 schedule of problem sets to be completed prior to the dates shown. The problems are not graded. Instead, the solutions are discussed at the start of the tutorials on and after the dates shown in the second 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 the last tutorial of the week.

Please note that the course is primarily analytical in nature and the more problems that are attempted, the better. The suggested problems should be regarded as a minimum effort. If you have difficulties with them, you need to attempt additional problems. A list of suitable problems is found on the Courselink course site. This list contains the problems and the corresponding solutions are also provided on the Courselink site. If you decide to do additional problems for which you have no solutions, the TAs are pleased to review them.

Problem Set	**Complete before**	**Problem Set**	**Complete before**
P1	Jan. 21	P6	Mar. 4
P2	Jan. 28	P7	Mar. 25
P3	Feb. 4	P8	Apr. 1
P4	Feb. 11	P9	Apr. 8
P5	Feb. 25		

GRADING SCHEME

Quizzes (weekly, total 5-7) (Open or Closed book)	20 %
Midterm (Open book)	30 %
Final Exam (Open book)	50 %

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

Open Book means that you are allowed to bring the textbook but not your notes and assignment solutions (If you copy solutions to the problem sets into your textbook, you will not be allowed to use it during the various tests). You are also allowed to use a **non-programmable** calculator during the tests and exams.

MISSED QUIZZES AND MIDTERM

If you **miss a quiz** due to illness, please inform your TA. The quiz 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.

Please note that all other university policies specified in the Undergraduate Calendar 2010/11 will be followed. In particular, you may wish to review the section on academic misconduct.

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 not found in the text will be provided throughout the semester.

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.

CAUTION: The Heat and mass Transfer course requires a working knowledge of the prerequisite courses. Generally, a grade <70% in a prerequisite does not reflect a working knowledge and you need to review the material important to this course. If you have a grade between 50 and 60% in one or more of the prerequisite course, especially in Applied Differential Equations and Thermodynamics, you can expect the course to be difficult and require considerable time and effort.