Department of Mechanical & Aerospace Engineering

Carleton UNIVERSITY
Canada's Capital University

MECH 4406: Heat Transfer

(FALL 2012)

COURSE OUTLINE

Instructor:

Prof. Matthew Johnson
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Office hours: Tuesday 9:00-9:45am; 11:30-12:00
Thursday 9:00-9:45am; 11:30-12:00

Course Description

Heat transfer is one of the most fascinating topics in core mechanical engineering curriculum covering a range of fundamental and practical applications of unique physical phenomena. The science of heat transfer incorporates aspects of thermodynamics, fluid mechanics, and even quantum physics and deals with the transfer and exchange of energy due to temperature differences. In this course, the three classical modes of heat transfer (conduction, convection, and radiation) will be discussed in detail. Our goals will include developing and understanding the underlying theory as well as applying this knowledge to practical engineering problems. Understanding the mechanisms of heat transfer is fundamental to the practice of engineering and a few of the many applications include design analysis of buildings, vehicles, power plants, electronic components, refrigerators, medical devices, etc.

Specific Objectives

After completing this course you should be able to:

1. Identify heat transfer modes and understand the physical mechanisms they represent;
2. Understand the complementary nature of heat transfer and fluid dynamics and thermodynamics;
3. Correctly apply theory to calculate heat transfer rates and coefficients;
4. Design mechanical engineering heat transfer components including heat exchangers, cooling fins, etc.; and
5. Design, analyze, and evaluate heat transfer processes including heating and cooling of buildings.

Prerequisites:

MAAE 2400: Thermodynamics & Heat Transfer
MAAE 3300: Fluid Mechanics II **OR** MECH 3310: Biofluid Mechnics

Required Text:

T.L. Bergman, A.S. Lavine, F.P. Incropera, D.P. Dewitt, Fundamentals of Heat and Mass Transfer, 7th Ed., Wiley, 2011. (ISBN: 978-0470-50197-9)

Grading

There will be a mid-term examination and a 3-hour final examination. The final grade for the course will be derived as follows:

Mid-term examination:	25%
Final examination:	75%

The final examination is for evaluation purposes only and answer booklets will not be returned to the students. **You must pass the final exam to pass the course.**

Course Schedule

Lectures:

Wednesday & Friday
11:35am – 12:55pm
Mackenzie Building, Room 3275

Midterm Exam:

The midterm exam is scheduled for Wednesday, October 24, 2012 starting at 11:35am. Further details will be provided in class.

Assignments:

Problem assignments relating to the lecture materials will be regularly posted on WebCT. The study of heat transfer involves a number of concepts and ideas that are unique within the engineering curricula. Diligent practice in problem solving is essential for success.

Course web site:

Additional course material including assignments and materials shown in class, as well as midterm grades, will be posted using WebCT.

Brief Outline of Lectures

Major Topics	Book Chapters	Approx. # of Lectures
I. INTRODUCTION TO HEAT TRANSFER AND HEAT TRANSFER MODES	1	1
II. CONDUCTION		
Introduction; thermal resistance concept	2	2
Steady state conduction, 1D & 2D; Fins	3,4	4
Transient conduction; Lumped capacitance, semi-infinite solids	5	3
III. CONVECTION		
Introduction to convection; boundary layers; convection coefficients	6	2
Convection in external flows; flat plate boundary layer	7	3
Convection in internal flows; Nusselt number relationships	8	2
Free / natural convection	9	2
IV. HEAT EXCHANGERS		
Log-mean temperature difference (LMTD) method	11	1
NTU-Effectiveness method	11	1
V. RADIATION		
Introduction to radiation	12 , 13	2
Viewfactors, gray bodies	13	2

Academic Accommodations for Students with Disabilities

The Paul Menton Centre for Students with Disabilities (PMC) provides services to students with Learning Disabilities (LD), psychiatric/mental health disabilities, Attention Deficit Hyperactivity Disorder (ADHD), Autism Spectrum Disorders (ASD), chronic medical conditions, and impairments in mobility, hearing, and vision. If you have a disability requiring academic accommodations in this course, please contact PMC at 613-520-6608 or pmc@carleton.ca for a formal evaluation. If you are already registered with the PMC, contact your PMC coordinator to send me your Letter of Accommodation at the beginning of the term, and no later than two weeks before the first in-class scheduled test or exam requiring accommodation (if applicable). After requesting accommodation from PMC, meet with me to ensure accommodation arrangements are made. Please consult the PMC website for the deadline to request accommodations for the formally-scheduled exam (if applicable).