ME 419
Prerequisite: ME 303, 304
Corequisite: ME 400

BOSTON UNIVERSITY

HEAT TRANSFER

Spring 2012

Instructor: Prof. Aaron Schmidt
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GTF:

Lecture:
Tutoring:
Office Hours:
Textbook *Heat and Mass Transfer* by Çengel and Ghajar, any edition.

Overview

The science of Heat Transfer is concerned with understanding and controlling the rate of thermal energy transfer. It plays a critical role in countless natural processes and engineered systems: The temperature of the earth is maintained by a precise balance of heat transfer from the sun to the earth and the from the earth to the empty blackness of space; heat transfer is essential to design a car radiator or an energy-efficient building; and down at the smallest engineering scales, the performance and durability of semiconductor chips, solar cells, and energy-efficient LED light sources are all limited by the rate at which heat can be transferred from one part of a device to another.

This course will cover the fundamentals of heat transfer, with a strong emphasis on modeling and the use of simplifying approximations to solve commonly encountered engineering problems taken from manufacturing, electronics, consumer products, and energy systems. Topics will include:

1. Steady and unsteady heat conduction in one or more dimensions
2. Numerical simulation of conduction
3. Natural and forced convection heat transfer
4. Heat exchangers
5. Heat transfer during condensation, boiling and evaporation
6. Thermal radiation, black bodies, grey radiation networks
7. Spectral and solar radiation.

Course Details

There are two experimental labs for this course. Sign-up sheets will be posted once the labs have been scheduled. The experiments will be done in groups, but reports are individual. There will also be a numerical design project using the COMSOL software package. We will follow the College of Engineering's Undergraduate Conduct Code; a copy has been placed on the course Blackboard site.

Students are expected to be familiar with fluid dynamics (ME 303 or equivalent), thermodynamics (ME 304 or equivalent) and engineering mathematics with partial differential equations (ME 400 or equivalent).

The GTF will be available for drop-in tutoring two hours each week in the ECL (15 St Mary's rm 125) to help with course material, homework questions, and COMSOL.

Exams and Grading

50% Two mid-terms (15% each) and a comprehensive final exam (20%). Mid-terms are closed book, two pages of notes allowed.

30% Problem sets (12 total, top 10 count). Problem sets are due at the beginning of class.

20% Lab reports & design project

Problems sets will be announced in lecture and posted on the course website. Collaboration with other students is allowed, but each student must write up their own solution. Problem sets turned in after the solution has been discussed in class will not receive credit. The use of solution manuals is forbidden.

Schedule[1]

Date	Topics	Reading	Deadlines
	1: Heat, modes of heat transfer		
	2: The heat equation, steady 1D, thermal circuits		
	3: Fins		Pset 1
	4: Fins		
	5: Unsteady conduction: lumped capacitance		Pset 2
	6: Unsteady conduction: slabs, spheres, cylinders		**Lab 1 starts**
	7: Slabs, spheres, cylinders		Pset 3
	8: Multi-dimensional conduction		
	9: Semi-infinite bodies		Pset 4
	10: Semi-infinite bodies, Exam review		
	Exam 1		
	11: Numerical simulation		**Design project starts**
	12: Intro to convection, boundary layers		
	13: External flow		Pset 5
	14: Internal flow		Pset 6
	15: Heat exchangers (LMTD)		**Lab 1 due**
	16: Heat exchangers (ε-NTU)		
	17: Natural convection		Pset 7, **Lab 2 starts**
	18: Boiling and condensation		
	19: Exam review		Pset 8
	Exam 2		
	20: Blackbody radiation, surface properties		
	21: Radiation view factors		Pset 9
	Thanksgiving		
	22: Gray body networks		
	23: Solar energy, building technology		Pset 10
	In-class prsentations		**Design project & Lab 2 due**
	24: Final exam review		Review problems
	Final Exam (Comprehensive)		

[1]Subject to change. Check the course website for the latest version.