University of Tennessee Space Institute

Heat Transfer

AE 344 | **Course Outline** | **Fall Semester 2002**

Lecturer: Joseph Majdalani, Ph.D.

Section No.: 1002.

Lecture Times: 1:00–1:50 p.m., MWF.

Lecture Location: EN160.

Course Call No.: 61910.

Office Hours: 4:00-5:00 p.m., MWF, Haggerty Hall, Rm. 251.

Contacts: (1) email: maji@mu.edu; (2) office: 288-6877; (3) Mailbox 42, Rm 201.

Grader: D. Fang.

Textbook: Yunus A. Çengel, Heat Transfer –A Practical Approach, McGraw-Hill, 1998.

References:
1. Frank P. Incropera, and David P. DeWitt, Introduction to Heat Transfer, Third Edition, John Wiley & Sons, Inc., 1996.
2. Frank Kreith, and Mark S. Bohn, Principles of Heat Transfer, Fifth Edition, PWS Publishing Company, ITP Inc., 1997.
3. Claus Borgnakke, and Richard Sonntag, Tables of Thermodynamics and Transport Properties, , John Wiley & Sons, Inc., 1996.
4. Alan J. Chapman, Heat Transfer, Fourth Edition, Prentice Hall, Inc., 1984.
5. J.P. Holman, Heat Transfer, Eigth Edition, McGraw-Hill, Inc., 1997.

Prerequisites: Differential Equations and Energy Engineering Thermodynamics .

Objectives: This course teaches basic problem-solving skills in heat transfer. Students should become aware of what can be readily done analytically as well as when one must resort to numerical methods or to experimental correlations. Increased proficiency with differential equations is expected. Modeling of heat-transfer systems is introduced.

Scope: Thermodynamic systems are amongst the most complicated systems engineers encounter in practice. Their complexity derives from the coupling that exists between the thermal and mechanical aspects of system behavior. Since the thermal and mechanical aspects of system behavior cannot be separated, more independent parameters are necessary to describe these systems with a concomitant increase in the number of relevant physical phenomena that must be taken into account. For a variety of reasons, these systems utilize fluids as the working medium with energy and entropy transfers between the fluid and surrounding environment occurring by both work transfer and heat transfer processes. In the traditional mechanical engineering curriculum, the study of thermodynamic systems is compartmentalized into three separate subject areas: (1) thermodynamics in which we study the basic laws that govern energy and entropy transfers and the ways in which these interactions manifest themselves in system behavior; (2) fluid mechanics in which we study the complex dynamic behavior of the working fluids that are used as the media to transport energy from one part of the system to another; and (3) heat transfer in which we study the complex physical processes involved in the transport of energy and entropy in these systems. This course will be dedicated to the third subject area.

Topics:
1. One-dimensional, steady-state conduction (analytical, numerical)
2. Two-dimensional, steady-state conduction (shape factors, numerical)
3. Lumped-parameter transients (analytical, numerical)
4. One- and two-dimensional transients (numerical)
5. External free and forced convection (nondimensional groups, experimental correlations)
6. Internal forced convection (experimental correlations)
7. Radiation (basic)
8. Heat exchanger analysis (LMTD, e-NTU)

Catalog Data: Overview of principal mechanisms of heat transfer: conduction, convection, and thermal radiation. Application of conduction and forced convection to heat exchangers and thermal system design. Discussion of theory and applications of conduction, forced and natural convection, and thermal radiation.

Grading and Exams: Based on the best score earned under any one of the following:

Option 1	**Option 2**	**Option 3**	**Option 4**
Homework: 15%.	Homework: 15%.	Notebook: 10%.	Notebook: 10%.
Design Proj: 10%.	Design Proj: 10%.	Design Proj: 10%.	Design Proj: 10%.
Exam I: 15%.	Best 2 Exams: 30%.	Homework: 15%.	Homework: 15%.
Exam II: 15%.	Final: 45%.	3 Exams: 45%.	Best 2 Exams: 30%.
Exam III: 15%.		Final: 20%.	Final: 35%.
Final: 30%.			

Heat Transfer

Lecture		Date	Topics		Text
1	August	26	Basic Concepts		1.1-1.3
2		28	Basic Concepts	*Week 1*	1.4-1.5
3		30	Basic Concepts		1.6-1.7
4	September	4	Heat Conduction Equation	*Week 2*	2.1-2.2
5		6	Heat Conduction Equation		2.2-2.3
6		9	Heat Conduction Equation		2.4-2.5
7		11	Heat Conduction Equation	*Week 3*	2.6-2.7
8		13	Heat Conduction Equation		2.8-2.9
9		16	Steady Heat Conduction		3.1-3.2
10		18	Steady Heat Conduction	*Week 4*	3.3-3.4
11		20	Steady Heat Conduction		3.5-3.6
12		23	Steady Heat Conduction		3.7-3.8
13		25	Steady Heat Conduction	*Week 5*	3.9
14		27	Transient Heat Conduction		4.1-4.2
15		30	Transient Heat Conduction		4.3
16	October	2	EXAM I	*Week 6*	
17		4	Transient Heat Conduction		4.4-4.5
18		7	Numerical Methods		5.1-5.2
19		9	Numerical Methods	*Week 7*	5.3-5.4
20		11	Numerical Methods		5.5-5.6
21		14	Numerical Methods	*Week 8*	5.7-5.8
22		16	Forced Convection		6.1-6.2
23		21	Forced Convection		6.3
24		23	Forced Convection	*Week 9*	6.4-6.5
25		25	Forced Convection		6.6-6.7
26		28	EXAM II		
27		30	Forced Convection	*Week 10*	6.6-6.7
28	November	1	Natural Convection		7.1
29		4	Natural Convection		7.1
30		6	Natural Convection	*Week 11*	7.2
31		8	Natural Convection		7.3
32		11	Heat Exchangers		10.1-10.2
33		13	Heat Exchangers	*Week 12*	10.3-10.4
34		15	Heat Exchangers		10.5-10.6
35		18	Heat Exchangers		10.7
36		20	Exam III	*Week 13*	
37		22	Special Topics		
38		25	Special Topics	*Week 14*	
39	December	2	Review	*Week 15*	
40		4	Review		
	Tuesday	10	FINAL EXAM 1:00-3:00 p.m.		EN160