MECH 375: Heat Transfer

3 credits

Instructor: **Prof. W. K. Bushe**
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Lectures: Mon., Wed., Fri. 13:00–14:00
DMP 310

Tutorials: Wed. 10:00–11:00
IBLC 182

Office Hours: Mon. 13:00–14:00
Fri. 10:00-11:00

Textbook: A Heat Transfer Textbook, 5th ed
Lienhard & Lienhard
(online for free at https://ahtt.mit.edu/)

Grading:

Quizzes:	20%
Midterm:	30%
Final:	50%

Course Synopsis

In this course we will study basic heat transfer. We will start by reviewing partial differential equations—the heat equation in particular. We will cover steady-state conduction in one dimension, then in two and three dimensions. We will cover transient conduction, then move on to convection. We will briefly discuss the influence turbulence has on increasing the rate of heat transfer and then explain how this is treated in practical cases. We will then discuss the effects of phase changes on convection. We will discuss radiation and wrap up by talking about common devices used in engineering that involve heat transfer.

Problem sets will be assigned as detailed on the reverse, however they will be neither collected nor marked; rather, there will be five quizzes held at the end of the tutorials based on the material in the assigned problems. Only the top four quiz grades will be included in the final grade calculation. Students must pass the final exam in order to receive credit for the midterm and quizzes.

Approximate Course Outline by Week

Week	**Topic**
Jan. 6	Introduction: PDEs and the Heat Equation
Jan. 13	Steady-State Conduction: 1D
Jan. 20	Steady-State Conduction: 1D (cont.)
Jan. 27	Steady-State Conduction: 2D/3D
Feb. 3	Unsteady Conduction
Feb. 10	Convection: Fundamentals
Feb. 17–21	"Reading" break
	Midterm: February 26
Feb. 24	Convection (cont.)
Mar. 2	Forced Convection
Mar. 9	Natural Convection
Mar. 16	Boiling and Condensation
Mar. 23	Heat exchangers
Mar. 30	Radiation

Expanded Outline by Tutorial/Assignment

Date	**Topic**	**Assignment covered**[1]
Jan. 8	Review of PDEs	None
Jan. 15*	1D Steady Conduction	2.9, 2.17, 2.20, 2.30, 2.46
Jan. 22*	1D Steady Conduction	4.14, 4.20, 4.26, 4.37, 4.43
Jan. 29	2D/3D Steady Conduction	5.18, 5.26, 5.30, 5.43, 5.44
Feb. 5*	Unsteady Conduction	5.24, 5.27, 5.34, 5.47, 5.49
Feb. 12	Conduction:	Bring your own questions!
Feb. 26	Review for Midterm	
Mar. 4	Review of Midterm	
Mar. 11	Convection	6.15, 6.39, 7.4, 7.29, 7.46
Mar. 18*	Convection	8.17, 8.31, 8.36, 8.49, 8.53
Mar. 25	Convection:	Bring your own questions!
Apr. 1*	Boiling/Condensation/	9.3, 9.11, 9.27
	Heat exchangers	3,12, 3.17, 3.34
Apr. 8	Radiation	10.3, 10.15, 10.24, 10.30, 10.42

* Dates of quizzes.

Expanded Outline by Lecture

Date	Topic
Jan. 6	Introduction
Jan. 8	PDEs
Jan. 10	Steady Conduction I
Jan. 13	Steady Conduction II
Jan. 15	Steady Conduction III
Jan. 17	Fins I
Jan. 20	Fins II
Jan. 22	Worked Problems: Steady 1D Conduction
Jan. 24	Conduction in 2/3D
Jan. 27	Shape Factors
Jan. 29	Shape Factors: examples
Jan. 31	Unsteady Conduction I
Feb. 3	Unsteady Conduction II
Feb. 5	Unsteady Conduction III
Feb. 7	Numerical Methods
Feb. 10	Convection: Basics
Feb. 12	Convection in Laminar Flow
Feb. 14	Turbulence and Convection
Feb. 17–21	"Reading" break
Feb. 24	Modelling Turbulent Convection
Feb. 26	Mid-term
Feb. 28	Models for Turbulent Convection
Mar. 2	Convection: examples
Mar. 4	Forced Convection
Mar. 6	Forced Convection: examples
Mar. 9	Natural Convection
Mar. 11	Natural Convection: example
Mar. 13	Boiling
Mar. 16	Condensation
Mar. 18	Boiling/Condensation: examples
Mar. 20	Heat Exchangers I
Mar. 23	Heat Exchangers II
Mar. 25	Worked Problems: Heat Exchangers
Mar. 27	Radiation I
Mar. 30	Radiation II
Apr. 1	Radiation II
Apr. 3	Rediation examples
Apr. 6	Review