

**ME 510
Heat Transfer
(3 credit hours)**

Objectives

1. Formulate and apply the balance equations for steady and unsteady (one-dimensional and multidimensional) conduction
2. Learn external and internal forced convection; apply correlations
3. Learn free (natural) convection; apply correlations
4. Analyze and design heat exchangers
5. Understand thermal radiation and determine the enclosure radiation

Prerequisites

ME 501, Thermodynamics I
ME 504, Fluid Dynamics II
or Civil Eng. 413

Before taking this class, the students should specifically know:

1. Ordinary differential equations
2. Partial differential equations
3. Vector calculus
4. Thermodynamics
5. Fluid mechanics

Topics

1. Introduction; Modes of Heat Transfer
2. Steady Heat Conduction
3. Unsteady Heat Conduction
4. Forced and Free Convection
5. Heat Exchangers
6. Thermal Radiation

Basis of Grading

1. Midterms
2. Final
3. Homework

Modes and Steady Conduction

1. Modes of heat transfer
2. Fourier's law
3. 1-D, steady conduction with no heat generation
4. Thermal/electrical analogy; planar, cylindrical, spherical geometries, surface convection
5. 1-D, steady state conduction with heat generation
6. Extended surfaces
7. Conduction in moving media
8. Multidimensional steady conduction and shape factors

Unsteady Conduction

1. 0-D, unsteady heat conduction (Lumped analysis)
2. Distributed (one-dimensional or multidimensional) unsteady conduction, separation of variables
3. Heisler charts

Convection

1. Laminar flow over flat plate, similitude, heat transfer correlations, and Newton's law
2. Correlations for forced convection in external flow
3. Developing and fully developed internal flow, laminar and turbulent flow, and correlations for internal flow
4. Free (natural) convection, similitude, and correlations for free convection

Heat Exchangers

1. Application of balance equations and correlations to heat exchanger design and analysis
2. NTU method

Thermal Radiation

1. Planck's law
2. View factors
3. Enclosure (surface) radiation, electrical analogy, and net radiation