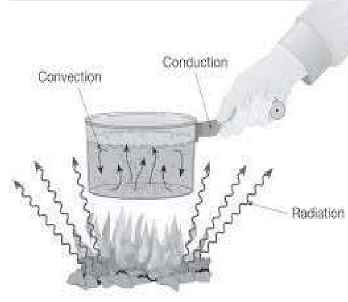
19ME311 HEAT AND MASS TRANSFER



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Hours Per Week :

L	T	P	C
3	-	2	4

Total Hours :

L	T	P	WA/RA	SSH/HSH	CS	SA	S	BS
45	-	30	14	30	-	-	-	-

PRE-REQUISITE COURSE: Engineering Thermodynamics

COURSE DESCRIPTION AND OBJECTIVES:

This course is designed to understand basic modes of heat transfer such as conduction, convection and radiation and its various real time applications. The objective of this course is to apply analytical and empirical techniques for solving heat transfer problems.

COURSE OUTCOMES:

Upon completion of the course, the student will be able to achieve the following outcomes:

COs	Course Outcomes	POs
1	Understand the basic modes and mechanisms of heat and mass transfer.	1,2,3,4,5
2	Formulate temperature distribution equations in steady-state and unsteady-state heat conduction.	1,2,3,4,5,9,10
3	Evaluate heat transfer through extended surfaces.	1,2,3,4,5,9,10
4	Interpret and analyze forced and free convection heat transfer for a given application.	1,2,3,5,12
5	Estimate the performance of heat exchangers devices for a given application.	1,2,3,4,5

SKILLS:

- ✓ *Ability to calculate heat transfer rate in steady state systems.*
- ✓ *Estimate heat transfer in complex systems involving several heat transfer mechanisms.*
- ✓ *Examine the performance of heat exchanger using LMTD or Effectiveness-NTU method.*
- ✓ *Apply mass transfer analogy equations for various applications.*

UNIT- I **L-9**

INTRODUCTION: Modes and mechanisms of heat transfer, Basic laws of heat transfer, General discussion about applications of heat transfer, Fourier's law, General heat conduction equation in Cartesian, cylindrical and spherical coordinates.

ONE DIMENSIONAL STEADY STATE CONDUCTION HEAT TRANSFER: Homogeneous slabs, Hollow cylinders and Spheres - overall heat transfer coefficient, electrical analogy, critical radius of insulation.

UNIT- II **L-9**

FINS: Heat transfer through extended surfaces - rectangular fins.

ONE DIMENSIONAL TRANSIENT CONDUCTION HEAT TRANSFER: Systems with negligible internal resistance, Significance of Biot and Fourier Numbers, Chart solutions of transient conduction systems.

UNIT- III **L-9**

CONVECTIVE HEAT TRANSFER: Concepts about Continuity, Momentum and Energy Equations, Concepts about hydrodynamic and thermal boundary layer, Significance of non-dimensional numbers, Use of empirical correlations for forced and natural convective heat transfer, Flat plates and Cylinders.

HEAT EXCHANGERS: Classification of heat exchangers, Overall heat transfer Coefficient and fouling factor, Concepts of LMTD and NTU methods, Heat Exchanger design using LMTD and NTU methods.

UNIT- IV **L-9**

BOILING AND CONDENSATION: Pool boiling - Regimes; Calculations on Nucleate boiling, Critical Heat flux and Film boiling, Film wise and drop wise condensation, Nusselt's Theory of Condensation on a vertical plate.

RADIATION HEAT TRANSFER: Emission characteristics and laws of black-body radiation heat exchange between two black bodies, Concepts of shape factor, Emissivity, Heat exchange between grey bodies, Radiation shields, Electrical analogy for radiation networks.

UNIT- V **L-9**

MASS TRANSFER: Diffusion Mass Transfer, Fick's Law of Diffusion, Steady state molecular diffusion, Convective mass transfer, Momentum, Heat and Mass Transfer Analogy, Convective mass transfer correlations.

LABORATORY EXPERIMENTS

LIST OF EXPERIMENTS **TOTAL HOURS: 30**

1. Determine thermal conductivity of a given metal rod.
2. Determine Overall heat transfer coefficient for a composite slab.
3. Calculate heat transfer through lagged pipe.
4. Experiment to determine heat transfer through a concentric sphere.
5. Simulation of Heat transfer through a pin-fin.
6. Determine Forced convection heat transfer coefficient for a given test plate.
7. Determine natural convection heat transfer coefficient for a hollow tube.
8. Simulation of heat transfer Parallel and counter flow heat exchanger.
9. Experiment to determine Emissivity for a given test plate.
10. Determine Stefan-Boltzmann constant for a given test disc.

TEXT BOOKS:

1. Sachdeva R. C., "Fundamentals of Engineering Heat and Mass Transfer", 4th edition Wiley Eastern Limited, 2010.
2. J. P. Holman, "Heat Transfer", 9th edition, McGraw-Hill, 2004.

REFERENCE BOOKS :

1. Frank P. Incropera and David P. De Witt, "Fundamentals of Heat Transfer", 7th edition, Wiley, Eastern, reprint, 2012.
2. Sukhatme S. P., "A text book on Heat Transfer", 3rd edition, Orient Longmans Ltd., New Delhi,1989.