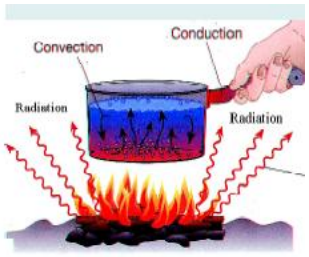
16ME307 HEAT TRANSFER



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	3	4	-	-

Course Description and Objective:

This course offers basic knowledge on various modes of heat transfer such as conduction, convection and radiation with their applications. The objective of this course is to cover analytical, empirical and numerical techniques for solving heat transfer problems.

Course Outcomes:

The student will be able to:

- understand the basic laws and modes of heat transfer.
- analyze problems involving steady state heat conduction in simple geometries.
- develop solutions for transient heat conduction in simple geometries.
- obtain numerical solutions for conduction and radiation heat transfer problems.
- understand the fundamentals of convective heat transfer processes.
- evaluate heat transfer coefficients for natural and forced convection problems.
- analyze heat exchanger performance using LMTD and NTU methods.
- calculate radiation heat transfer between black and gray body surfaces.

SKILLS:

- ✓ *Derive governing equations for heat conduction problems.*
- ✓ *Analyze heat generation in solids.*
- ✓ *Determine performance of fins under different boundary conditions.*
- ✓ *Formulate transient heat conduction problems*
- ✓ *Identify basic mechanisms and applications of convective heat transfer.*
- ✓ *Calculate net radiative heat exchange of black and gray surfaces.*

ACTIVITIES:

- *Demonstr - ation of basic modes of heat transfer and its applications.*
- *Demonstration of electric resistance heater.*
- *Calculating efficiency and effectiveness of fins.*
- *Calculating time required for heating and cooling of bodies.*
- *Calculating heat transfer coefficients for different geometries and flow conditions*
- *Evaluate performance of heat exchangers.*

UNIT - 1 **L-9**

INTRODUCTION: Modes and mechanisms of heat transfer - Basic laws of heat transfer - General discussion about applications of heat transfer.
CONDUCTION HEAT TRANSFER: Fourier's law - General heat conduction equation in Cartesian; Cylindrical and Spherical coordinates.

UNIT - 2 **L-9**

ONE DIMENSIONAL STEADY STATE CONDUCTION HEAT TRANSFER: Homogeneous slabs; hollow cylinders and spheres - overall heat transfer coefficient; electrical analogy - Critical radius of insulation. systems with heat sources or Heat generation. Heat transfer through extended surfaces – rectangular fins.

UNIT - 3 **L-9**

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

UNIT - 4 **L-9**

CONVECTIVE HEAT TRANSFER: Concepts about Continuity; Momentum and Energy Equations. Concepts about hydrodynamic and thermal boundary layer and use of empirical correlations for 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 - 5 **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.

LABORATORY EXPERIMENTS

LIST OF EXPERIMENTS: Total hours: 30

1. Overall heat transfer co-efficient of a composite slab apparatus.
2. Heat transfer through lagged pipe.
3. Heat transfer through a concentric sphere.
4. Thermal conductivity of given metal rod.
5. Heat transfer through pin-fin
6. Transient heat conduction.
7. Forced convection apparatus.
8. Natural convection.
9. Parallel and counter flow heat exchanger.
10. Emissivity apparatus.
11. Stefan Boltzman apparatus.
12. Heat transfer in drop and film wise condensation.
13. Critical heat flux apparatus.
14. Shell and tube heat exchanger.

TEXT BOOKS:

1. Frank P. Incropera and David P. DeWitt, "Fundamentals of Heat and Mass Transfer", 7th edition, Wiley Publications, 2011.
2. Holman J.P., "Heat transfer" 10th edition, McGraw Hill, London, 2009.

DATA BOOK:

1. C. P. Kothandaraman, "Heat and Mass Transfer Data Book", 6th edition, New Age International Publishers, 2007.

REFERENCE BOOKS:

1. R.K.Rajput,"Heat and Mass Transfer", 4th edition, S.Chand and Co, New Delhi, 2008.
2. R.C.Sachdeva, "Fundamentals of Engineering Heat and Mass Transfer", 4th edition, New Age International Publishers, 2009.
3. Sukhatme S.P, "Heat Transfer",4th edition, University Press India, 2006.
4. R.Yadav, "Heat Transfer", 6th edition, McGraw Hill Publications, 2004.