COURSE MODULE OF THE SUBJECT TAUGHT FOR EVEN SEM 2025-26

Heat Transfer
B.E. VI Semester, Mechanical Engineering
[As per Choice Based Credit System]

Course Code	**BME601**	**CIE Marks**	**50**
Number of Lecture/Practical Hours/Week	**03+02**	**SEE Marks**	**50**
Total Number of Lecture Hours	**40 Hours for Theory + 8-10 slots of labs**	**Exam Hours**	**03**

Credits – 04

Course Objectives:

Students will be able to learn,

- Principles of heat transfer.
- Steady and transient heat transfer, obtain the differential equation of heat conduction in various coordinate system.
- Physical mechanism of convection and visualize the development of velocity and thermal boundary layers during flow over a surface.
- Radiation heat transfer mechanism
- The mechanisms of boiling and condensation and understand performance parameters of heat exchangers.

Module - 1

Introductory Concepts and definition: Review of basics of Modes of Heat Transfer

Conduction-Basic Equations: General form of one-dimensional heat conduction equation. Boundary conditions of first, second and third kinds.

One dimensional Steady state conduction with and without heat generation: Steady state conduction in slab, cylinder and sphere with engineering applications.

Steady state conduction: Overall heat transfer coefficient for a composite medium; thermal contact resistance. critical thickness of insulation, Discussion on engineering applications.

Module - 2

Extended surfaces; Steady state conduction in fins of uniform cross section long fin, fin with insulated tip and fin with convection at the tip; fin efficiency & effectiveness, Discussion on engineering applications.

One dimensional Transient conduction: Conduction in solids with negligible internal temperature gradients (lumped system analysis) Use of transient temperature charts (Heisler's charts) for Transient conduction in slab, long cylinder and sphere; concept of semi-infinite solids, Discussion on engineering applications.

Module - 3

Numerical Analysis of Heat Conduction: Introduction, one-dimensional steady conduction and one-Dimensional unsteady conduction, boundary conditions, and solution methods.

Radiation Heat transfer: (Review of basic laws of thermal radiation) Intensity of radiation and solid angle; Concept of thermal radiation resistance, Radiation network, view factor, Radiation heat exchange between two parallel infinite black surfaces, between two parallel infinite gray surfaces; Effect of radiation shield; Discussion on engineering applications.

Module - 4

Concepts and Basic Relations in Boundary layers: Flow over a flat plate -Velocity boundary layer, Thermal boundary layer; Prandtl number; general expression for local heat transfer coefficient; Average heat transfer coefficient.

Forced Convection: Physical significance of Dimensionless numbers. Use of various Correlations for hydro dynamically and thermally developed flows; Use of correlations for flow over a flat plate, cylinder, sphere and flow inside the duct.

Free or Natural Convection: Physical significance of dimensionless numbers. Use of correlations for free convection from or to vertical, horizontal and inclined flat plates, vertical and inclined cylinder.

Module - 5

Boiling and Condensation; Film, dropwise condensation theory, Pool boiling regimes, Use of correlations for film and dropwise condensation on tubes.

Heat Exchangers: Classification of heat exchangers; Overall heat transfer coefficient, Fouling, Scaling factors; LMTD and NTU methods of analysis of heat exchangers, Compact heat exchangers.

Course Outcomes:

Course Outcomes (COs):

At the end of the course the student will be able to:		**RBT**
CO1	**Determine** temperature distribution in SteadyState heat conduction.	L3
CO2	**Analyse** the forced and free convective heat transfer.	L4
CO3	**Analyse** the radiation Heat transfer. **Analyse** the heat transfer through extended surfaces and transient heat conduction.	L4
CO4	**Design** heat exchangers using LMTD, NTU methods and **analyse** boiling and condensation.	L4

TEXT BOOKS:

1 Principals of heat transfer Frank Kreith, Raj M. Manglik, Mark S. Bohn Cengage learning Seventh Edition 2011.

2 Heat transfer, a practical approach Yunus A. Cengel Tata Mc Graw Hill Fifth edition

REFERENCE BOOKS

1. Heat and mass transfer, Kurt C, Rolle, second edition, Cengage learning.
2. Heat Transfer, M. Necati Ozisik, A Basic Approach, McGraw Hill, New York, 2005.
3. Fundamentals of Heat and Mass Transfer, Incropera, F. P. and De Witt, D. P., 5th Edition, John Wiley and Sons, New York, 2006.
4. Heat Transfer, Holman, J. P., 9th Edition, Tata McGraw Hill, New York, 2008.

E-Books/Web references:

1. A Text book of Heat Transfer, John H Lienhard, 4th Edition,
2. NPTEL Heat Transfer course for Mechanical Engineering, http://nptel.ac.in/courses/112101097/
3. Heat Transfer, Chris Long & Naser Sayma, Bookboon.com

PRACTICAL COMPONENT OF IPCC

Experiments:

1 Determination of Thermal Conductivity of a Metal Rod.

2 Determination of Overall Heat Transfer Coefficient of a Composite wall.

3 Determination of Effectiveness on a Metallic fin.

4 Determination of Heat Transfer Coefficient in free Convection

5 Determination of Heat Transfer Coefficient in a Forced Convention

6 Determination of Emissivity of a Surface and Determination of Stefan Boltzmann Constant.

7 Determination of LMDT and Effectiveness in a Parallel Flow and Counter Flow Heat Exchangers.
8 Experiments on Boiling of Liquid and Condensation of Vapour.
9 Experiment on Transient Conduction Heat Transfer.
10/11 Use of CFD for demonstrating heat transfer mechanism considering practical applications , Minimum two exercises
12 Using one dimensional transient conduction, experimentally demonstrate estimation of thermal conductivity and thermal diffusivity

The Correlation of Course Outcomes (CO's) and Program Outcomes (PO's)

List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO-1	3	2	-	-	-	-	-	-	-	-	2
CO-2	3	3	2	2	-	-	-	-	-	-	2
CO-3	3	3	2	2	-	-	-	-	-	-	2
CO-4	3	3	3	2	-	-	-	-	-	-	2

Note: 3 = Strong Contribution 2 = Average Contribution 1 = Weak Contribution ' – '= No Contribution

The Correlation of course Outcomes (CO's) and Program Specific Outcomes (PSO's)

Course outcomes	PSO1	PSO2
CO-1	**2**	-
CO-2	**2**	-
CO-3	**2**	-
CO-4	**2**	-

Note: 3 = Strong Contribution 2 = Average Contribution 1= Weak Contribution '-' = No Contribution