COURSE TITLE	**HEAT TRANSFER**
COURSE CODE	**01ME1602**
COURSE CREDITS	**4**

Objective:

1 • To use heat energy for industrial scale operations and to provide energy for industries using electricity and steam to avoid heat loss and to design effective and economical plants.

Course Outcomes: After completion of this course, student will be able to:

1 Use the laws governing conduction, convection, and radiation to interpret heat transfer behavior in different thermal systems.

2 Analyze heat conduction in a steady and transient state for various geometries.

3 Utilize empirical correlations and dimensionless numbers to examine heat transfer characteristics in natural and forced convection.

4 Assess the performance of heat exchangers using LMTD and NTU methods

5 Investigate radiation heat exchange between surfaces and evaluate the influence of emissivity, shape factors, and radiation shields.

Pre-requisite of course: Thermodynamics, Fluid Mechanics

Teaching and Examination Scheme

Theory Hours	Tutorial Hours	Practical Hours	ESE	IA	CSE	Viva	Term Work
3	0	2	50	30	20	25	25

Contents : Unit	Topics	Contact Hours
1	**Introduction to Heat Transfer** Basic concepts and laws of Conduction, Convection and Radiation, Difference between Thermodynamics and Heat Transfer , Thermal conductivity and Thermal diffusivity, General heat conduction equation in Rectangular coordinates and its reduction to specific cases, General heat conduction equation in Cylindrical & Spherical coordinates and its reduction to specific cases, General heat conduction equation in Spherical coordinates and its reduction to specific cases	6
2	**Conduction** Heat conduction in plane wall including thermal resistance concepts, composite wall including thermal resistance concepts, Heat conduction in multilayered cylinders and spheres, electrical analogy, Contact resistance, Overall heat transfer coefficient, Critical radius of insulation for cylinder and sphere	8

Contents : Unit	Topics	Contact Hours
3	**Extended Surfaces** Types and applications of fins, Heat flow through uniform cross-section of fin, infinitely long fin, fin insulated at the tip and fin losing heat at the tip, Fin efficiency, Fin effectiveness	5
4	**Transient Heat Conduction** Transient heat conduction in solids having infinite thermal conductivity, Significance of Biot and Fourier number, Time constant, transient heat conduction in solids with finite conduction and convective resistances	4
5	**Convection** Introduction to dimensionless number, Physical significance of dimensionless number, Dimensional analysis applied to natural and forced convection, Empirical correlations applied to natural and forced convection problems	5
6	**Heat Exchanger** Types of heat exchanger, Analysis of heat exchanger, Log Mean Temperature Difference for parallel flow heat exchanger, Log Mean Temperature Difference for counter flow heat exchanger, condenser and evaporator, overall heat transfer coefficient, Fouling factor, Correction factors for multi pass arrangement, Effectiveness and NTU method for parallel flow heat exchanger, Effectiveness and NTU method for counter flow heat exchanger	7
7	**Radiation** Radiation properties, blackbody radiation, Different laws of radiation, Intensity of radiation and solid angle, Lambert's cosine law, Radiation heat exchange between black bodies, Shape factor, heat exchange between non-black bodies-infinite parallel planes and infinite long concentric cylinders by electrical analogy, Radiation shield, Heat exchange between two grey surfaces	5
8	**Boiling and condensation** Boiling regimes, Film wise & drop wise condensation, laminar film condensation on vertical plate	2
Total Hours		**42**

Suggested List of Experiments:

Contents : Unit	Topics	Contact Hours
1	**To analyze the conduction heat transfer in plane wall using ANSYS** To analyze the conduction heat transfer in plane wall using ANSYS	2
2	**To analyze the conduction heat transfer in composite wall using ANSYS** To analyze the conduction heat transfer in composite wall using ANSYS	2

Suggested List of Experiments:

Contents : Unit	Topics	Contact Hours
3	**To analyze the conduction heat transfer in hollow cylinder using ANSYS** To analyze the conduction heat transfer in hollow cylinder using ANSYS	2
4	**To determine the thermal conductivity of the given composite walls** To determine the thermal conductivity of the given composite walls	2
5	**To determine heat transfer co-efficient by natural convection** To determine heat transfer co-efficient by natural convection	2
6	**To determine heat transfer co-efficient by forced convection** To determine heat transfer co-efficient by forced convection	2
7	**To determine Stephan Boltzmann constant experimentally** To determine Stephan Boltzmann constant experimentally	2
8	**To determine the emissivity of the test plate** To determine the emissivity of the test plate	2
9	**To determine heat transfer co-efficient for transient heat transfer apparatus** To determine heat transfer co-efficient for transient heat transfer apparatus	2
10	**To determine the overall heat transfer co-efficient of tube and tube type heat exchangers** To determine the overall heat transfer co-efficient of tube and tube type heat exchangers	2
11	**To determine the overall heat transfer co-efficient of shell and tube type heat exchangers** To determine the overall heat transfer co-efficient of shell and tube type heat exchangers	2
12	**To determine convective heat transfer co-efficient of the fin under free convection** To determine convective heat transfer co-efficient of the fin under free convection	2
Total Hours		**24**

Textbook :

1 Heat & Mass Transfer, P.K. Nag, McGraw Hill, 2015

2 Heat and Mass Transfer: Fundamentals and Application, Yunus Cengel, McGraw Hill , 2018

References:

1 Fundamental of Heat and Mass Transfer, Fundamental of Heat and Mass Transfer, Incropera and Dewitt, Wiley Publication , 2011

2 Heat Transfer, Heat Transfer, Mills and Ganesan, Pearson Education, 2013

3 Heat Transfer, Heat Transfer, J P Holman, McGraw Hill, 2012

References:

4 Heat & Mass Transfer, Heat & Mass Transfer, Arora & Domkundwar, Dhanpat rai and Co, 2014

5 Engineering Heat & Mass Transfer, Engineering Heat & Mass Transfer, M.M. Rathore, Laxmi Prakshan, 2015

Suggested Theory Distribution:

The suggested theory distribution as per Bloom's taxonomy is as follows. This distribution serves as guidelines for teachers and students to achieve effective teaching-learning process

Distribution of Theory for course delivery and evaluation					
Remember / Knowledge	**Understand**	**Apply**	**Analyze**	**Evaluate**	**Higher order Thinking / Creative**
0.00	0.00	45.00	35.00	20.00	

Instructional Method:

1 The subject will be tought using ppt, and videos etc

Supplementary Resources:

1 nptel.ac.in