Faculty of Engineering and Technology

Bachelor of Technology

Effective from Academic Year: 2018-19

Branch Name:	Mechanical Engineering
Semester/Year:	Semester V / Third Year
Subject Title:	Heat Transfer
Subject Code:	1ET1010501
Pre-requisite:	Engineering Thermodynamics

Course Objectives:

1. To introduce the basic principles of heat transfer.
2. To develop methodologies which facilitate the application of the subject to practical problems.

Teaching Scheme (Hours per week)				Evaluation Scheme (Marks)				
				Theory (Marks)		Practical (Marks)		
Lecture (L)	Tutorial (T)	Practical (P)	Credit	University Assessment	Continuous Assessment	University Assessment	Continuous Assessment	Total (Marks)
04	00	02	05	70	30	30	20	150

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weightage (%)**
1	**Introduction**: Modes of heat transfer, General laws of heat transfer, effect of temperature on thermal conductivity of different solids, liquids and gases, derivation of generalized equation in Cartesian, cylindrical and spherical coordinates and its reduction to specific cases.	6	9
2	**Conduction:** Fourier's law, one dimensional steady state conduction, heat conduction through plane and composite walls, cylinders and spheres, electrical analogy, critical radius of insulation for cylinder and sphere, overall heat transfer coefficient. **Transient heat conduction-** lumped heat capacity analysis, time constant, transient heat conduction in solids with finite conduction and convective resistances. **Heat transfer from extended surface:** Types of fin, heat flow through rectangular fin, infinitely long fin, fin insulated at the tip and fin losing heat at the tip, efficiency and effectiveness of fin, Estimation of error in temperature measurement in a thermometer well.	14	26
3	**Convection:** Newton's law of cooling, Dimensional analysis applied to forced and free convection, dimensionless numbers and their physical significance, empirical correlations for free and forced convection Continuity, momentum and energy equations, thermal and hydrodynamic boundary layer, Blasius solution for laminar boundary layer, General	12	22

	solution of Von-Karman integral momentum equation.		
4	**Radiation:** Absorptivity, reflectivity and transmissivity, black, white and gray body, emissive power and emissivity, laws of radiation – Planck, Stefan-Boltzmann, Wein's displacement, Kirchhoff's law, 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, radiation shield, heat exchange between two grey surfaces, electrical analogy.	10	20
5	**Heat exchanger:** Classification, heat exchanger analysis, LMTD for parallel and counter flow exchanger, condenser and evaporator, overall heat transfer coefficient, fouling factor, correction factors for multi pass arrangement, effectiveness and number of transfer unit for parallel and counter flow heat exchanger, introduction of heat pipe and compact heat exchanger.	8	16
6	**Two-phase heat transfer:** Boiling of liquids, Pool boiling curve, different types of pool boiling, condensation of vapor. Film wise & drop wise condensation.	4	7

Course Outcomes:

The student will be able to

1. Understand basic concept of heat transfer.
2. Able to do basic calculations involving heat transfer as is typical for a mechanical engineer. This includes conduction, convection and radiation heat transfer as well as heat exchanger design.
3. Apply scientific and engineering principles to analyze and design aspects of engineering systems that relate to conduction, convection and radiation heat transfer.

List of Reference Books:

1. Cengel, Yunus. Heat and mass transfer: fundamentals and applications. McGraw-Hill Higher Education.
2. Bergman, Theodore L., and Frank P. Incropera. Fundamentals of heat and mass transfer. John Wiley & Sons.
3. Holman, J. P. "Heat transfer.
4. Dutta, Binay K. Heat transfer: principles and applications. PHI Learning Pvt. Ltd.
5. Rathore, Mahesh M., and R. Kapuno. Engineering heat transfer. Jones & Bartlett Publishers.
6. Nag P.K. Heat and mass transfer, McGraw Hill.
7. R K Rajput, Heat and mass transfer, S. Chand Publication.

List of Practicals:

1. To determine the thermal conductivity of given insulating powder.
2. To determine the thermal conductivity of the given composite walls.
3. To determine Stephan Boltzmann constant experimentally.
4. To determine heat transfer co-efficient by forced convection.
5. To determine heat transfer co-efficient by natural convection.
6. To determine the emissivity of gray body.
7. To study drop & film wise condensation & determine the film co-efficient.
8. To measure convective heat transfer co-efficient and effectiveness of the fin under forced

convection.

9. To measure convective heat transfer co-efficient and effectiveness of the fin under natural convection.
10. To determine heat transfer co-efficient for tube and tube heat exchanger.

E-Resources:

1. nptel.ac.in/courses/103103032