Subject Code: 01ME0602
Subject Name: Heat and Mass Transfer

B.Tech. III Year – (Sem-6) Automobile Engineering

Type of course: Science

Prerequisite: Thermodynamics, Fluid Mechanics

Rationale: The course is prepared to provide the detailed understating of heat and mass transfer principles.

Course Outcome

Students will be able to

1. Understand the modes and phenomenological origin of laws for the different modes of heat and mass transfer
2. Analysis of heat conduction in a steady and transient state for various geometrics
3. Apply empirical correlation for analyzing free and forced convection problem
4. Evaluate the performance of heat exchangers by using the method of heat exchanger effectiveness
5. To analyze radiation heat exchange between surfaces and in diffuse, gray enclosure

Teaching and Examination Scheme:

TeachingScheme(			Credits	Evaluation Scheme					Total Marks
				TheoryMarks			PracticalMarks		
Theory	Tutorial	Practical		ESE (E)	IA	CSE	Viva (V)	Term Work (TW)	
3	2	0	4	50	30	20	25	25	150

Sr no	Contents	Duration	Weightage
1	**Introduction to Heat Transfer** Basic concepts and laws of Conduction, Convection and Radiation, Difference between Thermodynamics and Heat Transfer, Thermal conductivity, Thermal diffusivity, General heat conduction equation in Rectangular, Cylindrical and Spherical coordinates and its reduction to specific cases.	3	7
2	**Conduction** Heat conduction in plane and composite wall including thermal resistance concepts, Heat conduction in multilayeredcylinders and spheres, electrical analogy, Contact resistance, Overall heat transfer	5	11

	coefficient, Critical radius of insulation for cylinder and sphere, Overall heat transfer coefficient.		
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, Estimation of error in temperature measurement in a thermometer well	5	12
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	9
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, Conservation of mass, momentum and energy equations, Hydrodynamic and thermal boundary layer, General solution of Von-Karman integral momentum equation	5	11
6	**Heat exchanger** Types of heat exchanger, Analysis of heat exchanger, Log Mean Temperature Difference for parallel and 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 and counter flow heat exchanger	7	16
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, Radiation shield,Heat exchange between two grey surfaces, electrical analogy	7	16
8	**Boiling and Condensation** Boiling regimes, Film wise & drop wise condensation, laminar film condensation on vertical plate, turbulent film condensation, film condensation on tubes.	4	9
9	**Mass Transfer** Modes of mass transfer, concentrations, velocities and fluxes, Fick's law, general equation of mass diffusion in stationary media, steady state diffusion through a plain membrane, steady state equimolar counter diffusion, isothermal evaporation of water into air from a surface, mass transfer coefficient, convective mass transfer.	4	9

R Level	U Level	A Level	N Level	E Level
15	20	25	25	15

Legends: R: Remembrance**; U:** Understanding**; A:** Application, **N:** Analyze**, and E:** Evaluate

Reference Books:

1. Heat & Mass Transfer by P.K. Nag, McGraw Hill
2. Heat and Mass Transfer: Fundamentals and Application by YunusCengel, McGraw Hill
3. Fundamental of Heat and Mass Transfer by Incropera and Dewitt, Wiley Publication
4. Heat Transfer by Mills and Ganesan, Pearson Education
5. Heat Transfer by J P Holman , McGraw Hill
6. Heat & Mass Transfer by Arora &Domkundwar, Dhanpatrai and Co., NewDelhi
7. Engineering Heat & Mass Transfer by M.M. Rathore, LaxmiPrakshan
8. Heat & mass transfer by by D.S. Kumar, S.K. Kataria& Sons
9. Heat & Mass Transfer by R.K. Rajput, S. Chand & Co. New Delhi.

List of experiments

1. To determine the thermal conductivity of the given composite walls.
2. To determine Stephan Boltzmann constant experimentally.
3. To determine heat transfer co-efficient by natural convection.
4. To determine the effective thermal conductivity of the composite cylinders.
5. To determine heat transfer co-efficient by forced convection.
6. To determine the overall heat transfer co-efficient of shell and tube type heat exchangers.
7. To determine the emissivity of gray body.
8. To study drop & film wise condensation & determine the film co-efficient
9. To determine convective heat transfer co-efficient of the fin under free and forced convection.
10. To determine heat transfer co-efficient for transient heat transfer apparatus.

List of Open Source Software/learning website:

1. nptel.ac.in
2. www.learnerstv.com
3. cosmolearning.org