JAIPUR ENGINEERING COLLEGE AND RESEARCH CENTRE, JAIPUR

MECHANICAL ENGINEERING

Name of Subject: Heat Transfer

Subject Code: 5ME4-02

Year: 3rd Year 5th Semester

Name of Faculty: 1) Dr.Bhuvnesh Bhardwaj

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RAJASTHAN TECHNICAL UNIVERSITY, KOTA

Syllabus

3rd Year - V Semester: B.Tech. : Mechanical Engineering

5ME4-02: HEAT TRANSFER

Credit: 3 **Max. Marks: 150(IA:30, ETE:120)**

3L+0T+0P **End Term Exam: 3 Hours**

SN	CONTENTS	HOURS
1	Introduction: Objective, scope and outcome of the course.	1
2	Introduction: Heat transfer processes, conduction and radiation. Fourier's law of heat conduction, thermal conductivity, thermal conductivity of solids, liquids and gases, effect of temperature on thermal conductivity. Newton's law of cooling, definition of overall heat transfer coefficient. General parameters influence the value of heat transfer coefficient.	4
	Conduction: General 3-Dimensoinal conduction equation in Cartesian, cylindrical and spherical coordinates; different kinds of boundary conditions; nature of differential equations; one dimensional heat conduction with and without heat generation; electrical analogy; heat conduction through composite walls; critical thickness of insulation	3
3	Heat transfer from extended surfaces: Governing differential equation of fin, fin efficiency and effectiveness for different boundary conditions.	3
	Unsteady state heat conduction for slab, cylinder and sphere, Heisler chart.	2
	Convection: Review of Navier – Stokes and energy equation, hydrodynamic and thermal boundary layers; laminar boundary layer equations; forced convection appropriate non dimensional members; effect of Prandtl number; empirical relations for flow over a flat plate and flow through pipes.	4
4	Natural convection: Dimensional analysis, Grashoff number, boundary layers in external flows (flow over a flat plate only), boundary layer equations and their solutions, heat transfer correlations.	4
	Heat transfer with change of phase: Nature of vaporization phenomena; different regimes of boiling heat transfer; correlations for saturated liquid vaporization; condensation on flat plates; correlation of experimental results, drop wise condensation.	4
5	Heat exchanger: Types of heat exchangers, arithmetic and logarithmic mean temperature differences, heat transfer coefficient for parallel, counter and cross flow type heat exchanger; effectiveness of heat exchanger, N.T.U. method, fouling factor. Constructional and manufacturing aspects of Heat Exchangers.	8
6	Thermal Radiation: Plank distribution law, Krichoff's law; radiation properties, diffuse radiations; Lambert's law. Radiation intensity, heat exchange between two black bodies heat exchanger between gray bodies. Shape factor; electrical analogy; reradiating surfaces heat transfer in presence of reradiating surfaces.	8
	TOTAL	41

Course Outcome

CO1	To understand the basic concept of mode of heat transfer.
CO2	To apply non-dimensional numbers to evaluate and validate heat transfer parameters.
CO3	To analyze the complex problems of heat transfer with proper boundary conditions.
CO4	To discuss the radiation phenomenona and impact on global environment.

Mapping of CO –PO

Subject: Heat Transfer **Code: 5ME4-02**

Subject Code	COs	Program Outcomes (POs)											
		PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
5ME4-02	CO-1	3	2	1	2	0	1	1	0	0	1	0	2
	CO-2	3	2	1	2	0	1	1	0	0	1	0	3
	CO-3	3	2	2	2	1	1	2	1	0	1	2	3
	CO-4	3	1	2	1	0	2	2	1	1	2	2	3

COURSE PLAN

Course Plan

Subject-Heat transfer	**Subject Code: 5ME4-02**

Vision and Mission of Institute:

Vision: To become a renowned center of outcome based learning, and work towards academic, professional, cultural and social enrichment of the lives of individuals and communities.

Mission:

M1: Focus on evaluation of learning outcomes and motivate students to inculcate research aptitude by project based learning.

M2: Identify, based on informed perception of Indian, regional and global needs, areas of focus and provide platform to gain knowledge and solutions.

M3: Offer opportunities for interaction between academia and industry.

M4: Develop human potential to its fullest extent so that intellectually capable and imaginatively gifted leaders can emerge in a range of professions.

Vision and Mission of Department:

Vision: The Mechanical Engineering Department strives to be recognized globally for excellent technical knowledge and to produce quality human resource, who can manage the advance technologies and contribute to society through entrepreneurship and leadership.

Mission:

M1: To impart highest quality technical knowledge to the learners to make them globally competitive mechanical engineers.

M2: To provide the learners ethical guidelines along with excellent academic environment for a long productive career.

M3: To promote industry-institute linkage.

Course outcomes

CO-1	To understand the basic concept of mode of heat transfer.
CO-2	To apply non-dimensional numbers to evaluate and validate heat transfer parameters.
CO-3	To analyze the complex problems of heat transfer with proper boundary conditions.
CO-4	To discuss the radiation phenomenona and impact on global environment.

S. No.	Lect. No.	Topics to be discussed	Relevant CO	Objective of unit	Outcome of Lecture (After completion of this lecture students will be able to)	Book reffered	Fom page to
1	1	Introduction to Heat Transfer Processes, Modes of Heat Transfer	CO-1	To understand basics heat transfer mechanisms i.e. conduction, convection and radiation with more emphasis on conduction mode of heat transfer.	differentiate thermodynamics and heat transfer	T1	T1(1-5), T1(9-13)
2	2	Thermal conductivity, Thermal conductivity of solids, liquids and gases, effect of temperature on thermal conductivity	CO-1		understand the effect of thermal conductivity on heat transfer	T1	T1(5-8)
3	3	Newton's law of cooling, definition of overall heat transfer coefficient	CO-1		understand the convection phenomenon	T1, T2	T1(23-33), T2(25-27)
4	4	General parameters influence the value of heat transfer coefficient	CO-1		understand the variation of heat transfer coefficient with parameters	T1	T2(25-27)
5	5	Conduction: General 3 Dimensional conduction equation in Cartesian coordinates and cylindrical coordinates	CO-1		identify the generalized conduction equation of different coordinates	T2	T2(74-75)
6	6	General 3 Dimensional conduction equation in spherical coordinates, different kinds of boundary conditions; nature of differential equations	CO-1		understand the boundary conditions in conduction	T2	T2(75-76)
7	7	One dimensional heat conduction with and without heat generation; electrical analogy; heat conduction through composite walls;	CO-1		identify the similarity between electrical & heat flow with analogy	T2	T2(128-155)
8	8	critical thickness of insulation	CO-1		understand the concept of critical thickness of insulation	T1	T1(56-65)
9	9	Multiple Dimensions Conduction (*BC1)	CO-1		understand the concept of multi dimension conduction	T1	T1(69-113)
10	10	Heat transfer from extended surfaces	CO-1	To understand heat transfer	understand the effect of extended surface on heat transfer rate	T2	T2(156-157)
11	11	Governing differential equation of fin	CO-1		understand the differential equation associated with fin	T2	T2(157-160)

12	12	Fin efficiency and effectiveness for different boundary conditions	CO-1	from extended surfaces, phenomenon of unsteady state and forced convection heat transfer.	understand the effect of fin on heat transfer under different condition	T2	T2(160-163)
13	13	Unsteady state heat conduction for slab, cylinder and sphere	CO-1		identify the difference between steady & unsteady state conduction	T1	T1(131-136)
14	14	Heisler chart	CO-2		understand the use of Heisler chart in heat transfer	T1	T1(137-143)
15	15	Convection: Review of Navier – Stokes and energy equation	CO-2		understand the differential equation associated with convection	T2	T2(334-338)
16	16	Hydrodynamic and thermal boundary layers; laminar boundary layer equations	CO-2		understand the concept of boundary layer	T2	T2(339-342)
17	17	Forced convection appropriate non dimensional members; effect of Prandtl number	CO-2		understand the differential numbers associated with convection	T2	T2(345-360)
18	18	Empirical relations for flow over a flat plate and flow through pipes	CO-2		understand the empirical relations in forced convection heat transfer	T1	T1(267-283)
19	19	Natural convection, Dimensional analysis	CO-2	To understand phenomenon of natural convection and the mechanism of heat transfer	understand the concept of Natural convection	T1	T1(316-320)
20	20	Grashoff number, boundary layers in external flows (flow over a flat plate only)	CO-2		understand the differential numbers associated with free convection	T1	T1(321-322)
21	21	Boundary layer equations and their solutions	CO-2		understand the concept of boundary layer in free convection	T1	T1(214-223)
22	22	Heat transfer correlations	CO-2		identify the different heat transfer correlations	T1	T1(348-352)
23	23	Heat transfer with change of phase: Nature of vaporization phenomena	CO-2		understand the concept of vaporization	T2	T2(516-517)
24	24	Different regimes of boiling heat transfer; correlations for saturated liquid vaporization	CO-2		identify the different regimes of boiling heat transfer	T2	T2(518-531)

25	25	Condensation on flat plates	CO-2	with change of phase .	understand the concept of condensation	T2	T2(532-535)
26	26	Correlation of experimental results, drop wise condensation	CO-2		understand the phenomenon of drop wise condensation	T2	T2(536-545)
27	27	Heat exchanger: Introduction and Types of heat exchangers	CO-3	To analyze heat transfer performance and to understand construction and manufacturing aspects of heat exchangers.	understand the functioning of heat exchanger	T1	T1(514-519)
28	28	Arithmetic and logarithmic mean temperature differences	CO-3		understand the concept of LMTD in heat exchanger	T1	T1(525-524)
29	29	Heat transfer coefficient for parallel flow type heat exchanger	CO-3		calculate the heat transfer coefficient for parallel flow using LMTD	T1	T1(524-526)
30	30	Heat transfer coefficient for counter and cross flow type heat exchanger	CO-3		calculate the heat transfer coefficient for counter and cross flow	T1	T1(527-534)
31	31	Effectiveness of heat exchanger	CO-3		calculate the effectiveness of different heat exchangers	T1	T1(535-536)
32	32	N.T.U. method	CO-3		understand the concept of NTU	T1	T1(537-552)
33	33	Fouling factor and effect in heat transfer	CO-3		understand the effect of fouling factor in heat transfer	T1	T1(520-521)
34	34	Constructional and manufacturing aspects of Heat Exchangers	CO-3		identify the different aspects of heat exchangers construction	T1	T1(562-563)
35	35	Mass Transfer (*BC2)	CO-3		understand the concept of mass transfer	T1	T1(578-588)
36	36	Thermal Radiation: Plank distribution law	CO-4	To understand the various laws of radiation and to calculat	understand the concept of radiation	T1	T1(367-338)
37	37	Radiation properties, diffuse radiations	CO-4		understand the different properties of radiation	T1	T1(369-372)
38	38	Lambert's law. Radiation intensity	CO-4		understand the different law's associated with radiation	T1	T1(363-377)
39	39	Heat exchange between two black & gray bodies	CO-4		calculate the heat exchange between two bodies	T1	T1(394-405)

40	40	Shape factor, Electrical analogy,	CO-4	e radiation heat transfer between black body surfaces.	identify the relation between shape factors	T1	T1(377-393)
41	41	Reradiating surfaces	CO-4		understand the concept of reradiating	T1	T1(412-418)
42	42	Heat transfer in presence of reradiating surfaces	CO-4		calculate the heat transfer in presence of reradiating surfaces	T1	T1(419-430)
