

Faculty of Engineering & Technology, SRM University, Kattankulathur – 603203
School of Mechanical Engineering
Department of Mechanical Engineering
Course plan

Course Code : ME0305 Date : 02-July-2013
 Course title : Heat & Mass Transfer
 Semester : V
 Academic Year : 2013-14
 Semester : July – December 2013

Section details:

Section	Class Room No.	Details of Faculty member				Student contact time
		Name	Room No.	Inte rco m No.	e-mail id	
A	MEA301	Mr.P.Chandrasekaran	H102B	1824	chandrasekaran.p@ktr.srmuniv.ac.in	Wednesday 12:15 pm-1:00 pm
B	MEA302	Mr.V.Mathanraj	MEB305	1805	mathanraj.v@ktr.srmuniv.ac.in	
C	MEA303	Mr.D.Premnath	H102A	1824	premnath.d@ ktr.srmuniv.ac.in	
D	MEA304	Mr.R.Yuvaraj	H102B	1824	yuvaraj.r@ktr.srmuniv.ac.in	
E	MEA401	Mr.S.Malarmannan	H502A	-	malarmannan.s@ktr.srmuniv.ac.in	
F	MEA402	Mr.K.Sathiyamoorthy	H502	-	sathiyamoorthy.k@ktr.srmuniv.ac.in	
G	MEA403	Mr.P.Udhayakumar	H502	-	udhayakumar.p@ktr.srmuniv.ac.in	
H	MEA404	Mr.K.Karunamurthy	H102B	-	karunamurthy.k@ktr.srmuniv.ac.in	

Direct assessment details:

Name of assessment	Marks	Topics	Tentative date	Duration
Cycle test - I	10	Up to lumped system in conduction-II	30-07-2013	100 minutes
Surprise test	05	Critical thickness	Second Week of August	10 – 15 min
Cycle test - II	10	Up to heat exchanger in convection heat transfer	30-08-2013	100 minutes
Model examination	20	Entire syllabus	15-10-2013	3 hours
End semester examination	50	Entire syllabus	November 2013	3 hours
Attendance	05	N/A		

PURPOSE

This course provides the necessary background for an engineer to under take the thermal design and analysis of different types of heat exchange equipment

INSTRUCTIONAL OBJECTIVES

To familiarize the students with

1. Conduction, convection and radiation heat transfer.
2. Applications of heat transfer in Heat exchangers, insulations etc.
3. Mass Transfer.

CONDUCTION

12

Fourier's Law of Conduction – General equation in Cartesian, cylindrical and spherical co-ordinates - One dimensional steady state conduction in plane wall, composite wall, composite cylinder, composite sphere with convection boundaries - Conduction with heat generation - Thermal contact resistance - Overall heat transfer coefficients - Critical thickness of insulation.

CONDUCTION II

12

Fins or Extended surfaces: Pin fins, annular fins, longitudinal fins - Unsteady state conduction - Lumped heat capacity system - Biot number, Fourier number - Semi infinite, infinite solids – Multi - Dimensional systems, Conduction shape factor - Numerical solutions of two dimensional steady and unsteady state conduction.

CONVECTION

12

Hydrodynamic and thermal boundary layer: Principles and governing equations - Dimensional analysis of free and forced convection heat transfer.

Forced convection: External flow over a flat plate, cylinder, sphere and non-circular ducts, Internal flow through pipe, annular spaces and non-circular conduits. **Natural convection:** vertical, horizontal, inclined surfaces. **Heat exchangers:** Types, fouling factor, log mean temperature difference and number of transfer units method – Simple problems on double pipe heat exchanger.

RADIATION

12

Electromagnetic spectrum - Black body emission, emissive power, laws of radiation - Nature, black, grey bodies, concepts, radiation shape factor - Thermal resistance and electrical analogy - Radiation heat transfer between two surfaces - Reradiating surface - Radiation shield - Solar radiation - Radiation properties of gases and vapors.

HEAT TRANSFER WITH PHASE CHANGE AND MASS TRANSFER

12

Film wise and drop wise condensation. Film wise condensation outside vertical and horizontal tubes. Boiling heat transfer, regimes of boiling - Nucleate boiling, film boiling - Peak heat flux. Fick's law of diffusion, Equimolar counter diffusion, Stefan's law, Evaporation in atmosphere- problem, Non-dimensional numbers in mass transfer - Mass transfer coefficients - Forced convective mass transfer - Introduction to Energy conservation.

TOTAL 60**TEXT BOOKS**

1. Sachdeva, R.C., *Fundamentals of Heat and Mass Transfer*, 2nd Edition, New Age International (P) Ltd., New Delhi, 1998.
2. Kothadaraman, C. P., *Fundamentals of Heat and Mass Transfer*, 4th Edition, New Age International (P) Ltd., New Delhi, 1998.

REFERENCE BOOKS

1. Franker, P. and David, P., *Introduction to Heat Transfer*, 4th edition, John Wiley, New York, 2002.
2. Holman, J. P., *Heat Transfer*, 4th Edition, McGraw Hill book Company, New York, 1989.
3. Nag, P.K., *Heat Transfer and Mass Transfer*, Tata McGraw Hill, 2nd Edition, New Delhi, 2006.
4. Ozisik, M., *Heat Transfer*, McGraw Hill book Company, New York, 1998.

ME0305	HEAT AND MASS TRANSFER	L	T	P	C
	Prerequisite	3	2	0	4
	Nil				

Student outcomes	Program Educational Objectives				
	The main objective of the B.Tech in Mechanical Engineering Program is to provide a periodically-updated curriculum so that, following the completion of the program and with a few years of experience, our alumni will have the expertise to:				
	1. Practice mechanical engineering in different disciplines towards system design, realization,	2. Enhance professional practice to meet the global standards with ethical and social responsibility.	3. Solve industrial, social, and environmental problems with appropriate techniques and tools.	4. Work in large cross-functional teams and pursue life-long learning.	
(a) an ability to apply knowledge of mathematics, science, and engineering	X		X		
(c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability	X	X	X		
(e) an ability to identify, formulate, and solve engineering problems	X		X		

Course designed by		Department of Mechanical Engineering										
1	Student outcome	a	b	c	d	e	f	g	h	i	j	k
		x		x		x						
2	Category	GENERAL (G)			BASIC SCIENCES (B)			ENGINEERING SCIENCES AND TECHNICAL ART (E)			PROFESSIONAL SUBJECTS (P)	
											X	
3	Broad area (for professional courses only, i.e 'under P' category)	Manufacturing			Design		Thermal		General			
							X					
4	Course Coordinator	Mr.P.Chandrasekaran										

SESSION PLAN

Lecture No	No. Of Hours	Title / Details of the chapter	References (Code of the Text / Reference Book)
UNIT I CONDUCTION			
1	1	Introduction, Fourier's law of conduction, Thermal conductivity, General Heat conduction equation in Cartesian coordinates –	T1 -chapter1
2	1	One dimensional Steady state conduction in Plane wall, Electrical Analogy, composite wall, problems	T2 – chapter 2
3	1	General conduction equation in Cylindrical coordinates, simple and composite cylinder problems	T1 – chapter 2; T2- chapter 2
4	1	General conduction equation in spherical coordinates, simple and composite sphere, problems	T1 – chapter 2; T2- chapter 2
5	1	Thermal contact resistance, Overall heat transfer coefficient,	T1 – chapter 2
6	1	Tutorial – Problem on Plane wall, cylinder and sphere	T2 – chapter 2
7	1	Conduction with heat generation in plane wall having same surface temperatures only - Derivation and Problem	T1 – chapter 2; T2- chapter 2
8	1	Conduction with heat generation in hollow cylinder –Derivation and problem	T1 – chapter 2; T2- chapter 2
9	1	Conduction with heat generation in hollow sphere – Derivation and problem	T1 – chapter 2; T2- chapter 2
10	1	Critical Thickness of insulation in cylinder and sphere – Derivation and problems	T1 – chapter 2; T2- chapter 2
11	1	Tutorial – Problems on Heat transfer with Heat generation and	T2 – chapter 2
12	1	Tutorial – Discussion of Assignment problems	T2 – chapter 2
UNIT II CONDUCTION			
13	1	Fins – types, differential equation, problems on long fin	T2 – chapter 4
14	1	Short fin with end insulated and un-insulated - problems	T2 – chapter 4
15	1	Longitudinal fins and circumferential fins - problems	T2 – chapter 4
16	1	Newtonian cooling derivation, problems	T2 – chapter 6
17	1	Non-Newtonian cooling – Bi, Fn, Geometric parameter, Use of Heisler's chart and Grober's chart, Semi infinite body problem	T2 – chapter 6
18	1	Tutorial – Problems on Fins, Newtonian cooling	T2 – chapter 6
19	1	Infinite plate, cylinder, sphere – problems	T2 – chapter 6
20	1	Finite solids – multidimensional system of heating or cooling –	T2 – chapter 6
21	1	Conduction shape factor- Definition, problems on buried cylinders, spheres and long parallel pipes, problems on 2	T2 – chapter 6
22	1	Unsteady state – Numerical methods: Determining the temperature at an interior node Gauss Siedel method- problem	T2 – chapter 6

23	1	Determining the Temperature of an exterior node exposed to convection – problem	T2 – chapter 6
24	1	Tutorial – problems on Numerical methods and discussion of Class Test I questions	T2 – chapter 6
UNIT III CONVECTION			
25	1	Hydrodynamic and thermal boundary layer- Definition, principle and governing equation,	T2 – chapter 7
26	1	Dimensional analysis – Forced convection - Derivation	T2 – chapter 7
27	1	Dimensional analysis – Natural convection - Derivation	T2 – chapter 7
28	1	Forced convection – Empirical equations, problems on External flow over plate & cylinder	T2 – chapter 8
29	1	sphere and non-circular ducts, Internal flow – problems	T2 – chapter 8, 9
30	1	Tutorial – Problems on Forced convection	T2 – chapter 8, 9
31	1	Natural convection – empirical equations, problems on Vertical, horizontal and inclined plates.	T2 – chapter 10
32	1	cylinder, sphere – problems	T2 – chapter 10
33	1	Heat Exchangers – Types, fouling factor, LMTD method – problems on Parallel flow and counter flow Heat exchangers	T1 – chapter 12
34	1	NTU method – problems	T2 – chapter 12
35	1	Tutorial – problems on Natural convection and Heat Exchanger	T2 – chapter 10,12
36	1	Tutorial – Discussion of Assignment problems	T2 – chapter 10,12
UNIT IV RADIATION			
37	1	Introduction – Electromagnetic spectrum, Wave theory, Absorbitivity, transmissivity, reflectivity, Planks theory, Monochromatic emissive power, Planks law, Stefan Boltzman's	T1 – chapter 9
38	1	Nature, black, grey bodies concepts, Radiation shape factor,	T1 – chapter 9
39	1	Isothermal radiation between two black bodies – derivation	T1 – chapter 10
40	1	Radiation Heat transfer between two grey bodies – derivation,	T1 – chapter 10
41	1	Electrical analogy, problems on Large parallel plates, long cylinder, concentric cylinders, concentric spheres	T2 – chapter 13
42	1	Tutorial – Simple problems on Radiation Heat transfer	T2 – chapter 13
43	1	Reradiating surface, Solar radiation, problems	T2 – chapter 13
44	1	Radiation shield, problems	T2 – chapter 13
45		Radiation Heat exchange between gas volume and enclosure, Radiation emitted by CO ₂ , problems	T2 – chapter 13
46	1	Radiation emitted by H ₂ O, problem, Radiation emitted by a gas mixture – problem	T2 – chapter 13
47	1	Tutorial – Problems on Radiation between three radiating	T2 – chapter 13
48	1	Tutorial – discussion of Assignment problems and Class Test II	T2 – chapter 13
UNIT V			
49	1	Condensation – Comparison of Film-wise and drop-wise condensation, problems	T1 – chapter 11
50	1	Boiling Heat transfer, regimes of Boiling, Nucleate boiling, Film boiling, Peak heat flux	T1 – chapter 11

51	1	Fick's law of diffusion, equimolar counter diffusion, problems	T1 chapter 13
52	1	Problems on diffusion through plane wall, cylinder, sphere	T1 chapter 13
53	1	Diffusivity of a Gas A in a mixture of B and C problem	T1 chapter 13
54	1	Stefan's law, Evaporation into atmosphere Derivation, problem	T1 chapter 13
55	1	Tutorial – problems on Diffusion mass transfer	T1 chapter 13
56	1	Non-dimensional numbers in mass transfer, Mass transfer coefficient, Forced convective mass transfer over a plane surface	T1 chapter 14
57	1	Problems on convective mass transfer in internal flow of fluid with constant wall mass flux	T1 chapter 14
58	1	Problems on internal flow with uniform concentration difference	T1 chapter 14
59	1	Tutorial – Problems on Convective mass transfer	T1 chapter 14
60	1	Tutorial – Discussion of Assignment problems	T1 chapter 13,14

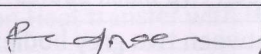

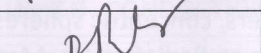
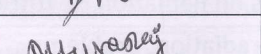
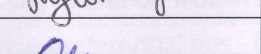
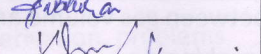
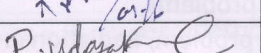
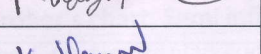
TEXT BOOKS

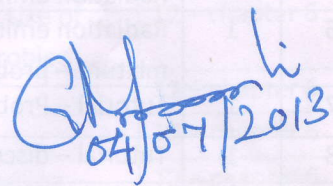
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Name & Signature of the Faculty:

Section	Name	Signature
A	Mr.P.Chandrasekaran	
B	Mr.V.Mathanraj	
C	Mr.D.Premnath	
D	Mr.R.Yuvaraj	
E	Mr.S.Malarmannan	
F	Mr.K.Sathiyamoorthy	
G	Mr.P.Udhayakumar	
H	Mr.K.Karunamurthy	


04/07/2013

for Dean/Mechanical