Faculty of Engineering & Technology, SRM University, Kattankulathur – 603203

School of Mechanical Engineering

Department of Mechanical Engineering

Course plan

Course Code	:	**ME1021**	Date: 02-Feb-2016
Course title	:	**Heat & Mass Transfer**	
Semester	:	**VI**	
Academic Year	:	**2015-16**	
Semester	:	**FEB-MAY2016**	

Section details:

Sl. No.	Class Room No.	Details of Faculty member				
		Name	Room No.	Intercom No.	e-mail id	Student contact time
1	M14	Dr. P. Chandrasekaran	H102B	1824	chandrasekaran.p@ktr.srmuniv.ac.in	Wednesday 12:30 pm-1:00 pm
2	M12	Mr. S. Malarmannan	MEHA101/A	1834	malarmannan.s@ktr.srmuniv.ac.in	
3	M10	Mr. P.Sundaram	MEHA103/A	1834	Sundaram.p@ktr.srmuniv.ac.in	
4	M11	Mr. E. Kannan	H502	-	Kannan.e@ktr.srmuniv.ac.in	
5	M13	Mr. D.Mohan	MEB208	-	Mohan.d@ktr.srmuniv.ac.in	
6	M15	Mr. Joji Johnson	MED201	-	Jojijohnson@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	26-02-2016	100 minutes
Surprise test	05	Semi Infinite Solid, Infinite solid	Second week of March 2016	10 – 15 min
Cycle test – II	10	Up to radiation	25-03-2016	100 minutes
Model examination	20	Entire Syllabus	28-04-2016	3 hours
End semester examination	50	Entire Syllabus	MAY 2016	3 hours
Attendance	05	N/A		

Syllabus of the course

ME1021 - HEAT AND MASS TRANSFER

PURPOSE

This course provides the knowledge to understand the various modes of heat transfer and the basic concept of mass transfer.

INSTRUCTIONAL OBJECTIVES

1. To understand the concept of conduction.
2. To understand the convection and radiation heat transfer.
3. To analyze the phase change heat transfer and sizing of heat exchanger.
4. To understand the basic concept of mass transfer.

UNIT I - CONDUCTION 15 hours

Basic Concepts – Mechanism of heat transfer – Conduction, convection and radiation – General differential equation of heat conduction – Fourier law of conduction – Cartesian coordinate – One dimensional steady state heat conduction – Conduction through plane wall, cylinders and spherical systems – Composite systems –Critical thickness of insulation– Conduction with internal heat generation – Extended surfaces – Unsteady heat conduction – Lumped analysis – infinite and semi infinite solids.

UNIT II -CONVECTION 12 hours

Hydrodynamic and thermal boundary layer: Principles and governing equations - Dimensional analysis of free and forced convection heat transfer. Forced Convection– External Flow – Flow over plates, cylinders and spheres and bank of tubes –Internal flow –Free convection – Flow over vertical plate, horizontal plate, inclined plate, cylinders and spheres.

UNIT III - RADIATION 12 hours

Basic concepts, laws of radiation – Wien's displacement law – Stefan Boltzman law, Kirchoff law –Black body radiation –Grey body radiation – Shape factor algebra – Electrical analogy – Radiation shields- Solar radiation –Introduction to gas radiation.

UNIT I - PHASE CHANGE HEAT TRANSFER AND HEAT EXCHANGERS 12 hours

Nusselts theory of condensation- Regimes of pool boiling and flow boiling, correlations in boiling and condensation. Heat Exchangers: Types – Overall heat transfer coefficient– Fouling factors– analysis – LMTD Method, ε– NTU method. Introduction to compact heat exchanger.

UNIT V - MASS TRANSFER 9 hours

Basic concepts – Diffusion mass transfer – Fick's law of diffusion – Equimolar counter diffusion – Stefan's law, evaporation in atmosphere, convective mass transfer – Momentum, heat and mass transfer analogy – Convective mass transfer correlations.

TOTAL 60

		L	T	P	C
ME1021	HEAT AND MASS TRANSFER	3	2	0	4
	Prerequisite				
	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. Apply / improve their knowledge in basic sciences for excelling in various disciplines of Mechanical Engineering with the emphasis on Design, Thermal and Manufacturing.	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. tools.	4. Develop skills to work in teams, think intellectually 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
		×		×		×						

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	Genaral		
				X			

4	Course Coordinator	Dr. 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	Basic concepts –Mechanism of heat transfer- conduction, convection and radiation.	T1 -Chapter 1
2	1	General differential heat conduction equation – Fourier law of conduction - Cartesian coordinate, Boundary conditions.	T2 – Chapter 2
3	1	One dimensional steady state conduction in Plane wall, Electrical Analogy, composite system.	T1 – Chapter 2; T2-Chapter 2
4	1	One dimensional steady state conduction in simple and composite cylinders and spherical systems.	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 and hollow sphere–Derivation and problem.	T1 – Chapter 2; T2-Chapter 2
9	1	Critical Thickness of insulation in cylinder and sphere – Derivation and problems.	T1 – Chapter 2; T2-Chapter 2
10	1	Tutorial – Problems on Heat transfer with Heat generation.	T2 – Chapter 2
11	1	Fin -types, differential equation, problems on long , short fin.	T2 – Chapter 4
12	1	Longitudinal fins and circumferential fins – problems.	T2 – Chapter 4
13	1	Newtonian cooling derivation, problems.	T2 – Chapter 6
14	1	Non-Newtonian cooling – Bi, Fn, Geometric parameter, Use of Heisler's chart and Grober's chart, semi infinite body problem.	T2 – Chapter 6
15	1	Tutorial - Infinite plate, cylinder, sphere – problems.	T2 – Chapter 6
		UNIT II CONVECTION	
16	1	Hydrodynamic and thermal boundary layer- Definition, principle and governing equation.	T2 – Chapter 7
17	1	Dimensional analysis – Forced convection - Derivation.	T2 – Chapter 7
18	1	Dimensional analysis – Natural convection – Derivation.	T2 – Chapter 7
19	1	Forced convection – Empirical equations, problems on External flow over plate.	T2 – Chapter 8
20	1	Flow over cylinders, problems.	T2 – Chapter 8
21	1	Sphere and non-circular ducts, problems.	T2 – Chapter 8,
22	1	Internal flow – problems.	T2 – Chapter 9
23	1	Tutorial – Problems on Forced convection.	T2 – Chapter 8, 9
24	1	Natural convection – empirical equations, problems on vertical plate.	T2 – Chapter 10

25	1	Horizontal and inclined plates.	T2 – Chapter 10
26	1	cylinder, sphere – problems.	T2 – Chapter 10
27	1	Tutorial – problems in natural convection.	T2 – Chapter 10
		UNIT III RADIATION	
28	1	Introduction – Electromagnetic spectrum, Wave theory, Absorbtivity, transmissivity, reflectivity, Planks theory, Monochromatic emissive power, Planks, Stefan Boltzman's law. Kirchoff's law, black body	T1 – Chapter 9
29	1	Nature, black, grey body concepts, Radiation shape factor. Problems	T1 – Chapter 9
30	1	Isothermal radiation between two black bodies – derivation.	T1 – Chapter 10
31	1	Radiation Heat transfer between two grey bodies – derivation.	T1 – Chapter 10
32	1	Electrical analogy, problems on Large parallel plates, long cylinder, concentric cylinders, concentric spheres.	T2 – Chapter 13
33	1	Tutorial – Simple problems on radiation heat transfer.	T2 – Chapter 13
34	1	Reradiating surface, Solar radiation, problems.	T2 – Chapter 13
35	1	Tutorial - Radiation shield, problems.	T2 – Chapter 13
36		Radiation Heat exchange between gas volume and enclosure, Radiation emitted by CO_2, problems.	T2 – Chapter 13
37	1	Radiation emitted by H_2O, problem, Radiation emitted by a gas mixture – problem.	T2 – Chapter 13
38	1	Tutorial Problems on radiation between three radiating bodies.	T2 – Chapter 13
39	1	Tutorial – problems on gas radiation.	T2 – Chapter 13
		UNIT IV PHASE CHANGE HEAT TRANSFER AND HEAT EXCHANGERS	
40	1	Nusselts theory of condensation- derivation, types of condensation.	T1 – Chapter 11
41	1	Condensation – Comparison of Film-wise and drop-wise condensation, problems.	T1 – Chapter 11
42	1	Tutorial- problems on condensation.	T1 – Chapter 11
43	1	Boiling Heat transfer, regimes of Boiling, Peak heat flux Nucleate boiling, problem.	T1 – Chapter 11
44	1	Problems on Film boiling.	T1 – Chapter 11
45	1	Tutorial – problems on boiling.	T1 – Chapter 11
46	1	Heat exchangers- Types, Fouling, overall heat transfer coefficient.	T1 – Chapter 12
47	1	LMTD method- parallel flow and counter flow heat exchanger.	T1 – Chapter 12
48	1	Tutorial- problems on LMTD method.	T1 – Chapter 12
49	1	NTU method, significance. Problems.	T1 – Chapter 12
50	1	Compact heat exchanger.	T1 – Chapter 12
51	1	Tutorial – problems on heat exchanger by NTU method	T1 – chapter 12
		UNIT V – MASS TRANSFER	
52	1	Fick's law of diffusion, equimolal counter diffusion, problems.	T1- Chapter 13
53	1	Problems on diffusion through plane wall, cylinder, sphere.	T1 -Chapter 13
54	1	Diffusivity of a Gas A in a mixture of B and C problem.	T1 -Chapter 13

55	1	Stefan's law, Evaporation into atmosphere Derivation, problem.	T1 -Chapter 13
56	1	Tutorial – problems on Diffusion mass transfer.	T1 -Chapter 13
57	1	Non-dimensional numbers in mass transfer, Mass transfer coefficient, Forced convective mass transfer over a plane	T1 -Chapter 14
58	1	Correlations, Problems on convective mass transfer in internal flow of fluid with constant wall mass flux.	T1 -Chapter 14
59	1	Problems on internal flow with uniform concentration difference.	T1 - Chapter 14
60	1	Tutorial – Problems on Convective mass transfer.	T1 - Chapter 14

TEXT BOOKS

1. Sachdeva R C, "Fundamentals of Engineering Heat and Mass Transfer" New Age International, 2009.

2. Kothandaraman C.P "Fundamentals of Heat and Mass Transfer" New Age International, New Delhi, 2006.

DATA BOOKS

1. Kothandaraman. C. P, Subramanyan, S, "Heat and Mass Transfer Data Book", New Age International, 7th edition, 2010.
2. Khurmi. R. S, "Steam Tables", S. Chand Publishers, 2012.

REFERENCES

1. Holman. J. P "Heat and Mass Transfer" Tata McGraw-Hill, 2008.
2. Ozisik. M. N, "Heat Transfer", McGraw-Hill Book Co., 2003.
3. Nag. P. K, "Heat Transfer", Tata McGraw-Hill, New Delhi, 2006.
4. Frank. P, Incropera and D. P. DeWitt, "Fundamentals of Heat and Mass Transfer", John Wiley and Sons, 2001.
5. Yunus. A, Cengel, "Heat and Mass Transfer", Tata McGraw Hill Education, 2007.

Name & Signature of the Faculty:

Section	Name	Signature
	Dr. P. Chandrasekaran	
	Mr. S. Malarmannan	
	Mr.P.Sundaram	
	Mr. E. Kannan	
	Mr. D.Mohan	
	Mr.Joji Johnson	

Professor in charge

III Yr B.Tech Mechanical Engg

2/2/2016