Academic Course Description

BHARATH UNIVERSITY
Faculty of Engineering and Technology
Department of Mechanical Engineering

BME603- HEAT AND MASS TRANSFER
SIXTH SEMESTER, 2015-16 (Even Semester)

Course (catalog) Description

To understand the mechanisms of heat transfer under steady and transient conditions.

To understand the concepts of heat transfer through extended surfaces.

To learn the thermal analysis and sizing of heat exchangers and to understand the basic concept of mass transfer. (Use of standard HMT data book permitted)

Compulsory/Elective course : Compulsory

Credit & contact hours : 4 &60

Course Coordinator : MR.D.Ravi

Instructors :

Name of the instructor	Class handling	Office location	Office phone	Email (domain:@ bharathuniv.ac.in	Consultation
Dr.Shanmuganandham	III Year A,B	SR001,2		shanmuganandham.mech @ bharathuniv.ac.in	11.40 to 12.30 pm
Mr.D.Ravi	III Year C,E	SR003,4		ravid.mech@bharathuniv.ac.in	2.20 to 3.10 pm
Mr.J.Manikandan	III Year D	SR005		Manikandanj.mech@bharathuniv.ac.in	10.50 to 11.30 am

Relationship to other courses:

Pre –requisites : THERMAL ENGINEERING-II

Assumed knowledge : Basic Knowledge on conduction, convection & Radiation
Following courses :

Syllabus Contents

UNIT I STEADY STATE HEAT CONDUCTION **12 HOURS**

Fourier law of conduction, general equation in Cartesian, cylindrical and spherical co-ordinates, One dimensional steady state conduction across plane wall-Composite wall -composite cylinder-composite sphere with convection boundaries, Overall heat transfer co-efficients, critical thickness of insulation, conduction with generation, conduction and convection systems-fins with direct boundary conditions(Derivations not included)

UNIT II UNSTEADY STATE HEAT CONDUCTION **12 HOURS**

Unsteady state conduction-Lumped capacity systems, semi-infinite solids, infinite solids and multi dimensional systems, Numerical solution of 2-dimensional steady and unsteady condition

UNIT III CONVECTION **12 HOURS**

Principles and governing equations, Natural convection from vertical, inclined and horizontal surface, Forced convection-Heat transfer from a flat plate, flow through pipes, condensation and boiling processes-Heat exchangers-Type of heat exchangers-Overall heat transfer co-efficient, LMTD & NTU methods, Fouling factor

UNIT IV RADIATION **12 HOURS**

Black body concept, Grey body, Radiation shape factor, relation between shape factors, radiation heat transfer between two surfaces, Radiation shields, Gas radiation, Solar radiation

UNIT V MASS TRANSFER **12 HOURS**

Fick's law of diffusion, Stefan's law, Mass transfer co-efficient, Non-dimensional number used in mass transfer, evaporation process in the atmosphere.

Total: 60 HOURS

Text book(s) and/or required materials

TEXT BOOKS

1.Sachdeva.r.c-Fundamentals of Heat & Mass Transfer-New Age international (p)Ltd, 2003

REFERENCES

1. OzisikN.M-heat transfer-McGraw hill Book Company, 1985

2. Holman.J.P-heat transfer –McGraw hill Book Company, 2002

3. Dr.D.S.Kumar,Heat and Mass Transfer,S.K.Kataria& sons,2003

4. P.K.Nag, Heat transfer, McGraw Hill Book Company,2002.

5. **book**boon.com/en/momentum-**heat-and-mass**-**transfer**-**eBook**

Computer usage: Nil

Professional component

General	-	0%
Basic Sciences	-	0%
Engineering sciences & Technical arts	-	0%
Professional subject	-	100%

Broad area: MECHANICAL

TEST SCHEDULE

S. No.	Test	Tentative Date	Portions	Duration
1	Cycle Test-1	February 2nd week	Session 1 to 14	2 Periods
2	Cycle Test-2	March 2nd week	Session 15 to 28	2 Periods
3	Model Test	April 3rd week	Session 1 to 45	3 Hrs
5	University Examination	TBA	All sessions / Units	3 Hrs.

Mapping Of Instructional Objectives with Program Outcome

		Correlates to program outcome		
		H	**M**	**L**
CO1	Learn steady state state of systems	a	b,g,j	
CO2	Learn unsteady state of systems	a	j	h
CO3	Understand the principles of convection	a	j	h,l
CO4	Understand the principles of radiation			k
CO5	Learn the design concepts in mass transfer		g	
CO6	Learn evaporation process in atmosphere		e	l

H: high correlation, M: medium correlation, L: low correlation

Draft Lecture Schedule

S.NO	Topics	Problem solving (Yes/No)	Text / Chapter
SESSIONS	**UNIT-1-STEDY STATE HEAT CONDUCTION**		
1.	Introduction	NO	[T1] chapter - 2, [R3] chapter -1
2.	Fourier law of conduction, general equation in Cartesian, cylindrical and spherical co-ordinates	NO	
3.	Fourier law of conduction, general equation in Cartesian, cylindrical and spherical co-ordinates	YES	
4.	One dimensional steady state conduction across plane wall-Composite wall	NO	
5.	One dimensional steady state conduction across plane wall-Composite wall	YES	
6.	Composite cylinder-composite sphere with convection boundaries, Overall heat transfer co-efficient	NO	
7.	Composite cylinder-composite sphere with convection boundaries, Overall heat transfer co-efficient	YES	
8.	Critical thickness of insulation	NO	
9.	Critical thickness of insulation	YES	
10.	Conduction with generation, Conduction and convection systems	NO	
11.	Conduction with generation, Conduction and convection systems	YES	
12.	Fins with direct boundary conditions	NO	
UNIT-2-UNSTEADY STATE HEAT CONDUCTION			
13.	Introduction	NO	[T1] chapter - 6, [T3] chapter - 4
14.	Unsteady state conduction-Lumped capacity systems	NO	
15.	Unsteady state conduction-Lumped capacity systems	YES	
16.	Semi-infinite solids, infinite solids	NO	
17.	Semi-infinite solids, infinite solids	YES	
18.	Multi dimensional systems	NO	
19.	Multi dimensional systems	YES	
20.	Multi dimensional systems	YES	
21.	Numerical solution of 2-dimensional steady condition	NO	
22.	Numerical solution of 2-dimensional steady condition	YES	

23.	Numerical solution of 2-dimensional unsteady condition	NO	
24.	Numerical solution of 2-dimensional unsteady condition	YES	
UNIT-3-CONVECTION			
25.	Introduction	NO	[T1] chapter - 10, [R2] chapter - 6
26.	Principles and governing equations	NO	
27.	Natural convection from vertical, inclined and horizontal surface	NO	
28.	Natural convection from vertical, inclined and horizontal surface	YES	
29.	Forced convection-Heat transfer from a flat plate, flow through pipes	NO	
30.	Forced convection-Heat transfer from a flat plate, flow through pipes	YES	
31.	Condensation and boiling processes	NO	
32.	Processes-Heat exchangers	NO	
33.	Type of heat exchangers	NO	
34.	Overall heat transfer co-efficient	YES	
35.	LMTD & NTU methods, Fouling factor	NO	
36.	LMTD & NTU methods, Fouling factor	YES	
UNIT-4-RADIATION			
37.	Introduction	NO	[T1] chapter - 10, [R2] chapter - 6
38.	Black body concept, Grey body	NO	
39.	Radiation shape factor, relation between shape factors	NO	
40.	Radiation shape factor, relation between shape factors	YES	
41.	Radiation heat transfer between two surfaces	NO	
42.	Radiation heat transfer between two surfaces	YES	
43.	Radiation shields	NO	

44.	Radiation shields	YES	
45.	Gas radiation	NO	
46.	Gas radiation	YES	
47.	Solar radiation	NO	
48.	Solar radiation	YES	
UNIT-5-MASS TRANSFER			
49.	Introduction	NO	[T1] chapter - 12, [R2] chapter - 9
50.	Fick's law of diffusion	NO	
51.	Fick's law of diffusion	YES	
52.	Stefan's law,	NO	
53.	Stefan's law,	YES	
54.	Mass transfer co-efficient	NO	
55.	Mass transfer co-efficient	YES	
56.	Non-dimensional number used in mass transfer	NO	
57.	Non-dimensional number used in mass transfer	YES	
58.	Evaporation process in the atmosphere.	NO	
59.	Evaporation process in the atmosphere.	YES	
60	Evaporation process in the atmosphere.	YES	

Teaching Strategies

The teaching in this course aims at establishing a good fundamental understanding of the areas covered using:

- Formal face-to-face lectures
- Tutorials, which allow for exercises in problem solving and allow time for students to resolve problems in understanding of lecture material.
- Laboratory sessions, which support the formal lecture material and also provide the student with practical construction, measurement and debugging skills.
- Small periodic quizzes, to enable you to assess your understanding of the concepts.

Evaluation Strategies

Cycle Test – I	-	5%
Cycle Test – II	-	5%
Model Test	-	10%
Assignment / Seminar / Online Test / Quiz	-	5%
Attendance	-	5%
Final exam	-	70%

Prepared by MR.R.SHARAVANAN

Addendum

ABET Outcomes expected of graduates of B.Tech / MECH / program by the time that they graduate:

a) The ability to apply knowledge of mathematics, science, and engineering fundamentals.

b) The ability to identify, formulate and solve engineering problems.

c) The ability to design a system, component, or process to meet the desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.

d) The ability to design and conduct experiments, as well as to analyze and interpret data

e) The ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

f) The ability to apply reasoning informed by the knowledge of contemporary issues.

g) The ability to broaden the education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context.

h) The ability to understand professional and ethical responsibility and apply them in engineering practices.

i) The ability to function on multidisciplinary teams.

j) The ability to communicate effectively with the engineering community and with society at large.

k) The ability in understanding of the engineering and management principles and apply them in project and finance management as a leader and a member in a team.

l) The ability to recognize the need for, and an ability to engage in life-long learning.

Program Educational Objectives

PEO1: PREPARATION:
Mechanical Engineering graduatesare enthusiastic to provide strong foundation in mathematical, scientific and engineering fundamentals necessary to analyze, formulate and solve engineering problems in the field of Mechanical Engineering.

PEO2: CORE COMPETENCE:
Mechanical Engineering graduates have competence to enhance the skills and experience in defining problems in the field of Mechanical Engineering and Technology design and implement, analyzing the experimental evaluations, and finally making appropriate decisions.

PEO3: PROFESSIONALISM:
Mechanical Engineering graduates made competence to enhance their skills and embrace new thrust areas through self-directed professional development and post-graduate training or education.

PEO4: PROFICIENCY:
Mechanical Engineering graduates became skilled to afford training for developing soft skills such as proficiency in many languages, technical communication, verbal, logical, analytical, comprehension, team building, inter personal relationship, group discussion and leadership skill to become a better professional.

PEO5: ETHICS:
Mechanical Engineering graduates are morally merged to apply the ethical and social aspects of modern Engineering and Technology innovations to the design, development, and usage of new products, machines, gadgets, devices, etc.

Course Teacher	Signature
Dr.Shanmuganandham	
Mr.D.Ravi Mr.J.Manikandan	

Course Coordinator **HOD/MECH**
MR.D.Ravi