GOVERNMENT OF GUJARAT

LUKHDHIRJI ENGINEERING COLLEGE, MORBI

Mechanical Engineering Department

Course Teaching-Learning-Evaluation Strategy

Subject: Heat Transfer (3151909) Academic Year: 2022-23 (odd)
Class: 5th Semester (Div:A&B)
Type of course: Professional Core Course
Faculties: Dr NMBhatt, Prof.R.N.Makadia, Dr. C.A.Maradiya
Prerequisite: Nil

Course Outcomes (COs)

CO	CO statement	Weightage (Marks %)
1.	Student should be able to apply the principles of steady and unsteady state conduction to determine conduction heat transfer for simple geometries.	32
2.	Student should be able to calculate heat transfer coefficients for natural convection and forced convection in inside as well as exterior surfaces.	22
3.	Student should be able to apply various laws of radiation heat transfer to determine the radiation heat transfer between black and grey surfaces of simple Mechanical systems	20
4.	Student should be able to classify the heat exchangers, practice heat exchanger analysis method and evaluate design parameters of simple heat exchange device	16
5.	Student should be able to identify types of boiling and condensation heat transfer process and to use the same to calculate heat transfer coefficient for simple cases.	10

Teaching and Examination Scheme:

Teaching Scheme			credits	Examination Marks				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE(E)	PA(M)	ESE(V)	PA(I)	
4	0	2	5	70	30	30	20	150

Distribution of marks weightage for cognitive level

Bloom's Taxonomy for Cognitive Domain	Recall	Understanding	Application	Analysis	Evaluate	Create
Marks% weightage	10	20	60	10	0	0
70 marks	7	14	42	7		
30 marks	3	6	18	3		

Course Evaluation Plan

	Direct Assessment				
	Internal Evaluation			External(Uni.) Evaluation	
	Mid Sem Exam (Continue evaluation) (Theory)	Assignment/ Quiz	Lab. Work	Practical/ Viva	Uni. Exam (Theory)
Max. Marks	30	20	20	30	70
Weightage	30%			70%	
CO1	10	4	10		
CO2	10	4	0		
CO3	10	4	4		
CO4	0	4	4		
CO5	0	4	2		

Course Content with lecture plan:

Sr. No.	Chapter	Course outcome(s)	Lecture(s) require	Faculty
1	**Conduction:** Fourier's law, effect of temperature on thermal conductivity of different solids, liquids and gases, generalized equation in Cartesian, cylindrical and spherical coordinates and its reduction to specific cases, One dimensional steady state conduction, heat conduction through plane and composite walls, cylinders and spheres, electrical analogy, critical radius of insulation for cylinder and sphere, overall heat transfer coefficient Heat transfer from extended surface: Types of fin, heat flow through uniform cross-sectional area fin for various cases like infinitely long fin, fin insulated at the tip and fin losing heat at the tip, efficiency and effectiveness of fin, Estimation of error in temperature measurement in a thermometer well Transient heat conduction: lumped capacitance method for bodies of infinite thermal conductivity, time constant, one dimensional transient heat conduction in plane wall with finiteconduction and convective resistances	CO1	18	NMB
2	**Convection:** Newton's law of cooling, dimensional analysis applied to forced and free convection, dimensionless numbers and their physical significance, empirical correlations for free and forced convection, Continuity, momentum and energy equations, thermal and hydrodynamic boundary layer, Blasius solution for laminar boundary layer, General solution for Von-Karman integral momentum equation	CO2	12	CAM
3	**Radiation:** Absorptivity, reflectivity and transmissivity, black, white and grey body, emissive power, emissivity, Kirchhoff's law, Planck's law, Rayleigh-Jeans' law, Wien's law, Wien's displacement law, Stefan-Boltzmann law, intensity of radiation, radiation heat exchange between black bodies, shape factor, electrical analogy, radiation heat exchange between gray bodies, radiosity, irradiation, radiation shields	CO3	12	RNM

4	**Heat exchanger:** Classification, heat exchanger analysis, LMTD for parallel and counter flow exchanger, condenser and evaporator, overall heat transfer coefficient, fouling factor, correction factors for multi pass arrangement, effectiveness-NTU method for parallel and counter flow heat exchanger, introduction of heat pipe and compact heat exchanger	CO4	8	NMB
5	**Two-phase heat transfer:** Boiling of liquids, Pool boiling curve, modes of pool boiling, correlation for pool boiling, condensation of vapor, film wise and drop wise condensation, condensation on flat surfaces and horizontal tubes	CO5	6	RNM, CAM

Reference Books:

1. Heat and 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 and Mass Transfer by R K Rajput, S.Chand Publication

Course articulation matrix correlation

CO No.	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3				1		1	2					
CO2	3	3				1								
CO3	3	3				1		1	2					
CO4	3	3	2	2		1		1	2					
CO5	3	2				1		1	2					

Justification(s) of correlation between CO and POs/PSOs

Mapping	Justification(s)
3151909-1 WITH PO1, PO2,PO6,PO8,PO9	3151909-1 mapped with PO1 (3), PO2 (3),PO6 (1) PO8 (1) and PO9 (2) because through 3151909-1, students show ability to evaluate conduction heat transfer problemthrough analytical and experimental methods in a teamby following good engineering practices in laboratoryand calculate conduction heat loss for design of energy efficient systemsto mitigate global warming.
3151909-2 WITH PO1, PO2,PO6	3151909-2 mapped with PO1 (3), PO2 (3) and PO6 (1) because through 3151909-2, students show ability to make calculation and analysis of simple convection heat transfer problems by following good engineering practices.
3151909-3 WITH PO1, PO2,PO6,PO8,PO9	3151909-3 mapped with PO1 (3), PO2 (3), PO6 (1) PO8 (1) and PO9 (2) because through 3151909-3, students show ability to determine radiation heat transfer between black and non-blacksurfaces and calculate emissivity of a surface through analytical and experimental methods in a team by following good engineering practices in laboratoryand alsoestimate radiation heat loss for design of energy efficient systems to mitigate global warming.
3151909-4 WITH PO1, PO2, PO3, PO4,PO6,PO8,PO9	3151909-4 mapped with PO1 (3), PO2 (3), PO3 (2), PO4 (2) PO6 (1) PO8 (1) and PO9 (2) because through 3151909-4,students show ability to classify and analyze the heat exchangers,perform the experiment on heat exchanger set up

	in a team by following good engineering practices in laboratory and evaluate the design parameters of heat exchangers for energy efficient system design.
3151909-5 WITH PO1, PO2, PO6,PO8,PO9	3151909-5 mapped with PO1 (3), PO2 (2), PO6 (1) PO8 (1) and PO9 (2) because through 3151909-5, students show ability to identify types of boiling and condensation heat transfer process, calculate heat transfer coefficient for simple cases and determine the critical heat flux through experimental method in a team by following good engineering practices in laboratory.

Tagging of COs with POs, PSOs, Cognitive Level (R-Remember, U-Understand, Ap- Apply, An-Analyze, E-Evaluate and C-Create), Knowledge Categories (F—Factual, C—Conceptual, P—Procedural and M—Metacognitive).

CO No.	Statement	POs	PSOs	Cognitive Level	Knowledge Categories
CO1	Student should be able to apply the principles of steady and unsteady state conduction to determine conduction heat transfer for simple geometries.	1,2	-	R,U,A	C,P
CO2	Student should be able to calculate heat transfer coefficients for natural convection and forced convection in inside as well as exterior surfaces.	1,2	-	R,U,A	C, P
CO3	Student should be able to apply various laws of radiation heat transfer to determine the radiation heat transfer between black and grey surfaces of simple Mechanical systems	1,2,	-	R,U,A	C, P
CO4	Student should be able to classify the heat exchangers, practice heat exchanger analysis method and evaluate design parameters of simple heat exchange device	1,2,3 ,4	-	R,U,A,N	C, P
CO5	Student should be able to identify types of boiling and condensation heat transfer process and to use the same to calculate heat transfer coefficient for simple cases.	1,2	-	R,U,A	C, P

List of Experiments:

Sr. No.	Title	COs	POs	PSOs	Marks
1	To find thermal conductivity and total thermal resistance of composite wall	CO1	PO1,PO2,PO6,PO8,PO9	--	2
2	To measure thermal conductivity of insulating powder.	CO1	PO1,PO2,PO6,PO8,PO9	--	2
3	To calculate the thermal conductivity of the lagged pipe	CO1	PO1,PO2,PO6,PO8,PO9	--	2
4	To calculate the critical radius of insulation for a cylinder	CO1	PO1,PO2,PO6,PO8,PO9	--	2
5	To determine heat transfer of unsteady state heat	CO1	PO1,PO2,PO6,PO8,PO9	--	2

	conduction				
6	To measure heat transfer coefficient in Natural Convection heat transfer. **(VLAB)**	CO2	PO1,PO2,PO6	--	0
7	To measure emissivity of a given test plate.	CO3	PO1,PO2,PO6,PO8,PO9	--	2
8	To measure the value of Stefan Boltzmann constant on Stefan Boltzmann apparatus	CO3	PO1,PO2,PO6,PO8,PO9	--	2
9	To determine effectiveness of concentric tube heat exchanger	CO4	PO1, PO2, PO3, PO4,PO6,PO8,PO9	--	2
10	To perform experiment on Heat pipe demonstrator	CO4	PO1, PO2,PO3, PO4,PO6,PO8,PO9	--	2
11	To find out critical heat flux	CO5	PO1,PO2,PO6,PO8,PO9	--	2

Online Links:

1. https://nptel.ac.in/courses/112/101/112101097/
2. https://nptel.ac.in/courses/103/103/103103032/
3. http://vlabs.iitb.ac.in/vlab/labsps.html
4. https://www.youtube.com/watch?v=j3RUEgKig0I&list=PLQyZnNpd6tVhlE3hmgUWt4gzVWMX4Vy5o

Software:

1. NIL

Journals referred:

1. https://asmedigitalcollection.asme.org/heattransfer
2. https://asmedigitalcollection.asme.org/thermalscienceapplication?searchresult=1