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P.E.S. College of Engineering, Mandya - 571 401

(An Autonomous Institution affiliated to VTU, Belagavi)

Fourth Semester, B.E. - Automobile Engineering

Semester End Examination; July / August - 2022

Heat Transfer

Time: 3 hrs *Max. Marks: 100*

Course Outcomes

The Students will be able to:

CO1: Able to formulate to solve problems in fundamentals of heat transfer modes

CO2: Able to apply basic equations of heat conduction in steady one dimensional problems and design of fins

CO3: Able to formulate, solve transient conduction and forced convection problems

CO4: Able to formulate, solve in free convection problems .design of heat exchangers

CO5: Able to apply the concepts of radiation heat transfer to solve problems

***Note: I) PART - A** is compulsory. **Two** marks for each question.*

***II) PART - B**: Answer any **Two** sub questions (from a, b, c) for a Maximum of **18 marks** from each unit.*

Q. No.	Questions	Marks	BLs	COs	POs
	I:PART - A	**10**			
I a.	State Fourier's law of conduction.	2	L1	CO1	PO1
b.	Write a short note on Critical thickness of Insulation.	2	L1	CO2	PO1
c.	Define steady and unsteady state heat transfer.	2	L1	CO3	PO1
d.	Define Heat exchangers and give any two examples.	2	L1	CO4	PO1
e.	State Stefan Boltzmann law of radiation.	2	L1	CO5	PO1
	II: PART - B	**90**			
	UNIT - I	**18**			
1 a.	Derive an expression for one dimensional general form of heat conduction equation in Cartesian coordinates.	9	L1	CO1	PO1
b.	Derive one dimensional, steady state heat conduction without Heat generation through plan slab.	9	L1	CO1	PO1
c.	A furnace wall consists of 25 cms of fire brick, 15 cms of common brick, 5 cm layer of magnesia insulation and a 3mm thick steel plate on the outside. If the inside surface temperature of the furnace is 1600°C and outside Surface temperature is to be 80°C. Calculate the temperatures between the layers and the heat loss per unit area of furnace wall. Take K for brick = 1028 W/m-K; k for steel = 60.77 W/m-K, k for common brick = 0.814 W/m-K, k for magnesia = 0.0698 W/m-K.	9	L2	CO1	PO2
	UNIT - II	**18**			
2 a.	Derive an expression for critical thickness of insulation of a cylinder and state its importance.	9	L1	CO2	PO1

Contd… 2

b. A steam pipe 100 mm OD is covered with two layers of insulating material each 25 mm thick, one having thermal conductivity thrice the other. Determine the % increase in heat loss when better insulating material is inside than when it is outside. 9

c. Steam flows through a pipe of ID 150 mm and wall thickness 10 mm. The pipe is insulated with two layers. The inner layers of thickness 25 mm with a material having thermal conductivity 0.233 W/m-K and the outer layer has thickness of 40 mm and the material has a conductivity of 0.1163 W/m-K, pipe material has thermal conductivity of 46.51 W/m-k. Determine the heat loss through the pipe per meter length if the inner wall temperature is 200°C and the outer surface temperature is 50°C. Also find the temperature at the surface between insulations. 9

UNIT - III **18**

3 a. Explain the following:
i) Fourier Number
ii) Biot Number 9

b. Derive the expression for lumped system by considering negligible internal resistance. 9

c. A 50×50 cm copper slab 5 mm thickness at a uniform temperature of 300°C. Suddenly has its surface temperature lowered to 30°C. Find the time at which the slab temperature become 90ºC; ρ = 9000 kg/m^3. C = 0.38 kJ/kg-K, K = 370 W/m-K and t = 90 W/m^2-k. 9

UNIT - IV **18**

4 a. Define and write the significance of following non-dimensional numbers:
i) Reynolds number ii) Grastroff Number iii) Nusselt number 9

b. Derive LMTD for paralleler flow heat exchanger. 9

c. Explain the classification of heat exchangers. 9

UNIT - V **18**

5 a. Explain the following:
i) Kichoff's law ii) Plankck's law iii) Weins displacement law 9

b. Define the following:
i) Reflectivity ii) Transmittivity iii) Absorptivity 9

c. A radiation shield is provided between two large parallel iron plates to reduce heat transfer between them by 80 times. If the emissivity of the iron is 0.65. What should be the emissivity of the shield material? 9

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