GIET UNIVERSITY, GUNUPUR – 765022

B. Tech (Sixth Semester Regular) Examinations, May – 2024

21BMEPC36001 – Heat Transfer

(Mechanical)

Time: 3 hrs Maximum: 70 Marks

(The figures in the right hand margin indicate marks)

PART – A **(2 x 5 = 10 Marks)**

Q.1. Answer ***ALL*** questions

		CO #	Blooms Level
a.	State Fourier law of heat conduction.	CO1	K1
b.	Define lumped heat capacity body.	CO1	K1
c.	State Newton's cooling law.	CO2	K1
d.	Express the conditions at which effectiveness of counter flow heat exchanger can be one.	CO4	K2
e.	Explain about absorptivity, reflectivity and transmissivity.	CO3	K2

PART – B **(15 x 4=60 Marks)**

Answer ***ALL*** questions

		Marks	CO #	Blooms Level
2. a.	Define contact resistance and state the methods to avoid it.	5	CO1	K1
b.	A furnace wall consists of 200 mm layer of refractory brick, 60 mm layer of steel plate, 100 mm layer of insulation brick. The maximum temperature of the wall is 1150 ^oC and minimum temperature is 40^oC on the outer side of the wall. Thermal conductivities of layer are 1.52 w/mK, 45 w/mK, 0.138 w/mK. Estimate the heat flux and inner temperature of refractory brick.	10	CO1	K3
	(OR)			
c.	A plane wall is 150 mm thick with wall area of 4.5 m^2. If it's conductivity is 935 w/m ^oC and surface temperatures are 150 ^oC and 45 ^oC then find out rate of heat transfer and the temperature gradient.	5	CO1	K3
d.	A wire of 6.5 mm diameter at a temperature of 60 ^oC is to be insulated by a material having K= 0.174 watt/mk. Convection heat transfer coefficient h_0=8.722 w/m^2k. The ambient temperature is 20 ^oC. For maximum heat loss calculate critical thickness of insulation and also calculate maximum heat lost with consideration of critical thickness.	10	CO1	K4
3.a.	Explain hydrodynamic and thermal boundary layer.	5	CO2	K2
b.	Air at atmospheric pressure and 200^oC flows over plate with a velocity of 5 m/s. The plate is 15 mm wide and is maintained at a temperature of 120^oC. Calculate the thickness of hydrodynamic and thermal boundary layers and the local heat transfer coefficient at a distance of 0.5m from the leading edge. Assume that flow is on one side of the plate. [Properties of air, ρ = 0.815 kg/m3, k=0.0364 W/mK , μ = 24.5× 10-6 Ns/m2, Cp=1.005 kJ/kgK, Pr=0.7, $\delta^{th} = {}^{\delta}/_{Pr^{1/3}}$].	10	CO2	K4
	(OR)			

c.	Explain the importance of Reynolds number and Grashof number in convection.	5	CO2	K2
d.	Air is flowing over a plate 5m long and 2.5m wide with velocity of 4m/s at 15 ^oC . If $\rho = 1.208$ kg/m^3 and $\upsilon = 1.47\times$ 10-5 m^2/s, calculate: i. Length of the plate over which the boundary layer is laminar, and thickness of the boundary layer (laminar). ii. Shear stress at the location where boundary layer to be laminar. iii. Total drag force on the both sides on that portion of plate, where boundary layer is laminar.	10	CO2	K4
4.a.	Explain the following - i. Wilson plot ii. fouling factor	5	CO3	K2
b.	A thin walled concentric tube heat exchanger is used to cool engine oil from 160 ^oC to 60 ^oC and water, which is available at 25 ^oC acts as coolant. The oil and water flow rates are each 2 kg/s and diameter of the inner tube is 0.5 m and corresponding value of overall heat transfer coefficient is 250 w/m^{2}K. How long must be the heat exchanger be to accomplish the desired cooling. C_p of engine oil= 2.035 kJ/kgK.	10	CO3	K3
	(OR)			
c.	Explain different types of heat exchanger with suitable diagrams.	5	CO3	K2
d.	A counter flow heat exchanger is employed to cool 0.55 kg/s (Cp=2.45kL/kg ^oC0 of oil from 115 ^oC to 40 ^oC by the use of water. The inlet and outlet temperature of cooling water are 15 ^oC and 75 ^oC respectively. The overall heat transfer coefficient is expected to be 1450w/m ^oC. Using NTU method, calculate the following i. The mass flow rate of water ii. The effectiveness of the heat exchanger iii. The surface area required	10	CO3	K4
5.a.	Estimate the shape factor of a hemispherical body placed on a flat surface with respect to itself?	5	CO4	K2
b.	Two very large parallel planes with emissivity 0.3 and 0.8 exchange radiative energy. Determine the % reduction in radiative energy transfer when a polished copper radiation shield (ε=0.04) is placed between them.	10	CO4	K4
	(OR)			
c.	Sketch the boiling curve of water and explain different regimes.	5	CO4	K3
d.	Develop the LMTD equation for parallel flow heat exchanger.	10	CO4	K3

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