QP Code:RD22BTECH047 Reg. No | | | | | | | | | | AY 22

GIET UNIVERSITY, GUNUPUR – 765022

B. Tech (Third Semester Regular) Examinations, December – 2023

22BCMPC23001– Heat Transfer

(Chemical)

Time: 3 hrs Maximum: 70 Marks

Answer all questions

(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.	Write conductive resistance in a cylindrical pipe whose thermal conductivity is K and length is L and d_i and d_o are the inside and outside diameters.	CO2	K2
b.	Define fin effectiveness and efficiency.	CO2	K2
c.	What are the dimensionless numbers which may classify the convection heat transfer process?	CO3	K1
d.	What is TEMA?	CO3	K2
e.	Write the mathematical form of Stefan Boltzman fourth power law for a perfect blackbody.	CO1	K1

PART – B **(15 x 4 = 60 Marks)**

Answer ***ALL*** questions		Marks	CO #	Blooms Level
2. a.	A concrete highway may reach a temperature of 550C on a hot summer's day. Suppose that a stream of water is directed on the highway so that the surface temperature is suddenly lowered to 35OC. How long will it take to cool the concrete to 45OC at a depth of 50mm from the surface? For concrete take thermal diffusivity as 1.77×10-3 m2/hr. [Data: erf (0.46)=0.4847, erf (0.48)=0.5027, erf (0.50)=0.5205, erf (0.55)=0.5633]	15	CO2	2
	(OR)			
b.	A furnace wall consists of 200 mm layer of refractory bricks, 6 mm layer of steel plate and 100 mm layer of insulation bricks. The maximum temperature of the wall is 11500C on the furnace side and the minimum temperature is 400C on the outermost side of the wall. An accurate energy balance over the furnace shows that the heat loss from the wall is 400 W/m^2. It is known that there is a thin layer of air between the layer of refractory brick and steel plate. Thermal conductivities of three layers are 1.52, 45 and 0.138 W/m0C respectively. Find i) How many mm of insulation brick is the air equivalent?	15	CO2	2

	ii) The temperature of outer layer surface of the steel plate.			
3.a.	Derive Nusselt equation by Dimensional analysis for free convection heat transfer.	15	CO2	1
	(OR)			
b.	Derive an expression for local heat transfer coefficient for film wise condensation over a vertical flat plate.	15	CO2	1
4.a.	A tubular heat exchanger is to be designed for cooling oil from a temperature of 80°C to 30°C by a large of stagnant water which may be assumed to remain constant at a temperature of 20°C. The heat transfer surface consists of 30 m long straight tube of 20 mm inside diameter. The oil (specific heat= 2.5 kj/kg k and specific gravity = 0.8) flows through the cylindrical tube with an average velocity of 50 cm/s Calculate the overall heat transfer coefficient for the oil cooler .	8	CO3	2
b.	In a certain double pipe heat exchanger, hot water flows at a rate of 14kg/s and gets cooled from 95OC to 65OC. At the same time 14kg/s of cooling water at 30OC enters the heat exchanger. The flow conditions are such that overall heat transfer coefficient remains constant at 2270W/m^2K. Determine the heat transfer area required, effectiveness, assuming the streams are in parallel flow. Assume for both the streams Cp = 4.2kJ/kgK	7	CO4	2
	(OR)			
c.	Derive the LMTD formula for counter flow Heat Exchanger.	8	CO3	2
d.	A counter flow heat exchanger is employed to cool 0.55 Kg/sec (Cp = 2.45 KJ/Kg°C) of oil from 115°C to 40°C by the use of water. The inlet and outlet temperatures of cooling water are 15°C and 75°C, respectively. The overall heat transfer coefficient is expected to be 1450 W/m^2°C. Using NTU method calculate the following: (i) Effectiveness of heat exchanger (ii) The surface area required (iii)The mass flow rate of water	7	CO4	2
5.a.	Differentiate between black and grey body.	8	CO4	1
b.	A furnace radiation at 2000K. Treating it as a black body radiation, calculate the (i)Monochromatic radiant flux density at 1 μm wavelength. (ii)Wavelength at which emission is maximum and the corresponding radiant flux density (iii)Total emissive power and (iv)Wavelength λ such that emission from 0 to λ is equal to the emission from λ to ∞.	7	CO3	2
	(OR)			
c.	A sphere of radius 10 mm at a temperature of 600 K is dipped into the liquid at 300 Kelvin with a convective coefficient of 100 w/m.k. find the time required to become temperature of the sphere equals to 500 K The sphere has, c = 375 J/Kg.K ρ = 8700 Kg/m^3 K = 360 w/m.K	8	CO4	1
d.	Derive the expression for the rate of heat transfer by radiation within infinite long parallel plates.	7	CO3	2

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