QPC: RD19BTECH043 AR 19 Reg. No

GIET UNIVERSITY, GUNUPUR – 765022

B. Tech (Third Semester – Regular) Examinations, December – 2020

BPCCH 3020 / BPCPR 3020 – Heat Transfer

(Chemical Engineering & PCPR)

Time: 2 hrs Maximum: 50 Marks

The figures in the right-hand margin indicate marks.

PART – A: (Multiple Choice Questions) (1 x 10 = 10 Marks)

Q.1. Answer ***ALL*** questions		[CO#]	[PO#]
a.	For steady flow of heat and no heat generation, the temperature distribution in a plane wall of constant value of thermal conductivity is i. linear ii. parabolic iii. logarithmic iv. cubic	1	2
b.	Which equation below is used to determine the heat flux for convection? i. $-kA\frac{dT}{dx}$ ii. $h(T_2 - T_1)$ iii. $\varepsilon\sigma T^4$ iv. None of these	1	2
c.	What is the unit of Stefan Boltzman constant? i. $W/m^2.K$ ii. $W/m.K^4$ iii. $W/m^2.K^4$ iv. Unit less	1	2
d.	A steam is covered with two layers of insulating material with better insulating material next to the pipe. If the layers of the insulating materials are interchanged, the conduction heat transfer will i.will decrease ii.will increase iii.will not change iv.may increase or decrease	1	2
e.	Prandtl number is i. Ratio of the momentum and mass diffusivities ii. Ratio of advection to conduction heat transfer rates iii. Ratio of the momentum and thermal diffusivities iv. none of the above	1	2
f.	A fin becomes effective if the Biot number Bi is i.less than one ii.more than one iii.equal to one iv.does not depend on Bi	1	2
g.	The velocity profile of a fluid flowing through a tube depends on i.the velocity of the fluid ii.the diameter of the tube iii.the viscosity of the fluid iv.the Reynolds number	2	2
h.	Planck's law is true for i.real bodies ii.blackbodies only iii.gray bodies iv.white bodies only	3	2
i.	Bodies which reflect more thermal radiation are i.white ii.black iii.gray iv.rough	2	2
j.	The shape factor of a hemispherical body 1 placed on a flat surface 2 with respect to itself is i.Zero ii.0.25 iii.0.5 iv.1.0	2	2

PART – B: (Short Answer Questions) (2 x 5 = 10 Marks)

Q.2. Answer ***ALL*** questions [CO#] [PO#]

a. An ideal gas is heated from 50°C to 80°C (a) at constantvolume and (b) at constant pressure. For which case doyou think the energy required will be greater? Why? 3 2

b. State the conceptual meaning of Forced and Free convection. 2 2

c. What is the physical significance of Fourier's law? 1 1

d. Consider a hot baked potato. Will the potato cool fasteror slower when we blow the warm air coming from our lungson it instead of letting it cool naturally in the cooler air in theroom? Explain 3 2

e. What does the view factor represent? When is the view factor from a surface to itself not zero? 4 1

PART – C: (Long Answer Questions) (6 x 5 = 30 Marks)

Answer ***ANY FIVE*** questions Marks [CO#] [PO#]

3. The walls of a paint drying chamber are built up of a layer of brick (thickness δ = 250 mm and k = 0.7 W/mK). The temperature in the chamber is estimated to be 115 °C. The heat flow from 1 m^2 of the chamber wall is not to exceed 100 W when ambient temperature is 25 °C for which a layer of felt (k = 0.045 W/mK) is to be applied outside the brick layer. Calculate the thickness of the felt if the surface heat transfer coefficients at inner and outer walls are 30 and 20 $W/m^2.°C$, respectively. (6) 3 2

4. A closed container filled with hot coffee is in a room whose air and walls are at a fixed temperature. Identify all heat transfer processes that contribute to the cooling of the coffee. (6) 2 1

5. It was found during a test in which water flowed with a velocity of 2.5 m/s through a tube of 25 mm inside diameter and 6.0 m long, that the head lost due to the friction was 1.53 m of water. Estimate the surface heat transfer coefficient based on the Reynolds analogy. For water ρ= 998 kg/m^3, $\mu=1.0\times10^{-3}$ kg/m.s, Pr=7.02, C_p= 4.187 kJ/kg.K (6)

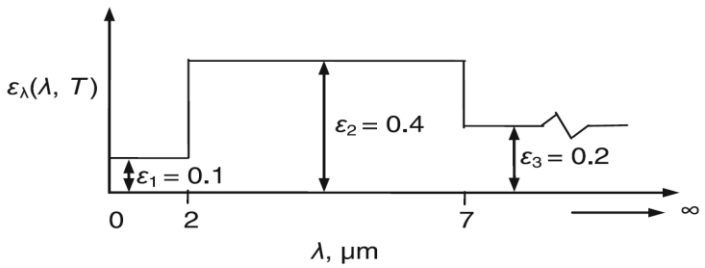
6. Explain the fundamental concept of "Evaporative cooling". (6) 1 1

7. A heat exchanger is to cool liquid metal from 800 to 500 °C. The air used for the cooling enters the exchanger at 300 °C. The flow rate of air is 10 kg/s and that of the liquid metal is 15 kg/s. Overall heat transfer coefficient is estimated to be 300 W/m^2 K. Determine the surface area required for both counter- and parallel-flow arrangements. Average specific heat c_p of the air is 1008 J/kgK and is 950 J/kgK for the liquid metal. (6) 3 2

8. What is the modified latent heat of vaporization? For what purpose it is used? How does it differ from the ordinary latent heat of vaporization? (6) 2 2

9. The hemispherical spectral emissivity $\varepsilon_\lambda(\lambda, T)$ of a surface at temperature T = 1000 K can be approximated as shown in Figure. What are the hemispherical total emissivity and the hemispherical total emissive power of the surface? (6) 3 1

($F_{0\text{-}2000}$=0.06672, $F_{0\text{-}7000}$=0.80806)



10. (i) How does the log mean temperature difference for a heat exchanger differ from the arithmetic mean temperature difference? For specified inlet and outlet temperatures, which one of these two quantities is larger? (6) 3 2

(ii) In the heat transfer relation $Q=UAsF\Delta T_{lm}$ for a heat exchanger, what is the quantity F called? What does it represent? Can F be greater than one?

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