QPC: RJ18001115 AR - 18 Reg. No.

GIET MAIN CAMPUS AUTONOMOUS GUNUPUR – 765022

B. Tech Degree Examinations, June – 2021

(Sixth Semester)

BMEPC6010 - HEAT TRANSFER

(Mechanical Engineering)

Time: 2 hrs Maximum: 50 Marks

Answer ALL Questions

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.	Thermal diffusivity of a substance is.		1	1
	(i) proportional of thermal conductivity	(ii) inversely proportional to k		
	(iii) inversely proportional to k^2	(iv)) proportional to (2k)		
b.	Thermal conductivity of a material may be defined as the		1	1
	(i) quantity of heat flowing in one second through one cm of material when opposite faces are maintained at a temperature difference of 1^0 C.	(ii) quantity of heat flowing in one second through a slab of the material of area one cm square, thickness 1 cm when its faces differ in temperature by 1^0C		
	(iii)heat conducted in unit time across unit area through unit area through unit thickness when a temperature difference of unity is maintained between opposite faces.	(iv) All of the above		
c.	Heat is transferred by all three modes of transfer viz, conduction, convection and radiation in		1	1
	(i) electric heater	(ii) steam condenser		
	(iii) melting of ice	(iv) boiler		
d.	Critical insulation for a sphereis given by		2	1
	(i) (k/h)	(ii) (k/4h)		
	(iii) (h/2k)	(iv) (2k/h)		
e.	Stanton number is the ratio of Nusselt number to		2	1
	(i) Reynolds number	(ii) Prandtl number		
	(iii) Product of Reynolds and Nusselt number	(iv) None of these		
f.	Prandtl number for liquid metal is generally occurs in the range		2	1
	(i) 0.003 to 0.01	(ii) 0.1 to 1.0		
	(iii) 0.02 to 0.1	(iv) 1 to 10		
g.	In radiative heat transfer, a grey surface is one		3	1
	(i) which appears grey to eye.	(ii) whose emissivity is independent of wave length		
	(iii) which has reflectivity equal to zero.	(iv) which appears equally bright from all directions		
h.	Wavelength for maximum emissive power is given by		3	1

(i) Wein's law (ii) Stefan's law

(iii) Kirchoff's law (iv) Plank's law

i. A perfect black body 4 1

(i) is black in colour (ii) reflect all incident radiation

(iii) absorbs all incident radiation (iv) transmit all incident radiation

j. Automobile radiator is a heat exchanger of 4 1

(i) counter flow type (ii) Parallel flow type

(iii) cross flow type (iv) regenerator type

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

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

a. Differentiate between thermal conductivity and thermal conductance. Mention their units. 1 1

b. What is the dimensionless number which represents the ratio of momentum transport to energy transport? 2 1

c. Explain Reynolds analogy with regard to turbulent fluid flow and heat transfer. 3 1

d. There are two concentric long cylinders having diameters d1 and d2 (d1>d2). What is the view factor of outer cylinder to inner cylinder? 4 1

e. If the ratio of inlet temperature difference to exit temperature difference in a heat exchanger is unit what is the ratio of LMTD to arithmetic mean temperature 4 1

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

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

3. A 50 mm × 50 mm iron bar 0.4 m long is connected to the walls of two heated reservoirs, each at 120 ° C. The ambient air temperature is 35 ° C and the convective heat transfer coefficient is 17.4 W/m^{2}K. Calculate the rate of heat loss from the bar and the temperature of the bar midway between the reservoirs. The thermal conductivity of the iron is 52 W/mK. (6) 1 2

4. A bar of square cross-section connects two metallic structures. One structure is maintained at a temperature 200°C and the other is maintained at 50°C. The bar, 20 mm×20 mm is 100 mm long and is made of mild steel (k = 0.06 kW/m K). The surrounding are at 20°C and the heat transfer coefficient between the bar and surroundings is 0.01 kW/m^{2}K. Derive an expression for temperature distribution along the bar and hence calculate the total heat flow rate from the bar to the surroundings. (6) 1 2

5. For laminar flow over flat plate derive an expression for local Nusselt number from first principle assuming a cubic temperature profile. The thermal boundary layer thickness is given by (6) 2 2

$$\frac{\delta_t(x)}{x} = 4.53\,Re_x^{-\frac{1}{2}}.Pr^{-\frac{1}{3}}$$

6. Air at 2 atm and 200 °C is heated as it flows at a velocity of 12 m/s through a tube with a diameter of 3 cm. A constant heat flux condition is maintained at the wall and the wall temperature is 20°C above the air temperature all along the length (6) 2 2

of the tube. Calculate (a) the heat transfer per unit length of the tube and (b) the increase in bulk temperature of air over a 4 m length of the tube . Properties of air at 200°C arePr = 0.681, $\mu = 2.57 \times 10^{-5}$ kg/ms, k = 0.0386 W/m K and C_p = 1.025 kj/kgK

7.	An enclosure measures 1.5 m x 1.7 m with a height of 2 m. The wall and celling are maintained at 350°C and the floor at 130°C. The walls and celling have an emissivity of 0.82 and the floor 0.7. Determine the net radiation to the floor.	(6)	3	2
8.	Two very large parallel planes with emissivities 0.3 and 0.8 exchange radiative energy. Determine the percentage reduction in radiative energy transfer when a polished aluminium radiation shield ($\varepsilon = 0.04$) is placed between them.	(6)	3	2
9.	A 4 kg/s product steam from a distillation column is to be cooled by a 3 kg/s water steam in a counter-flow heat exchanger. The hot and cold stream inlet temperatures are 400 K and 300 K respectively, and the area of the heat exchanger is 30 m^2. If the overall heat transfer coefficient is estimated to be 820 W/m^2 K, determine the product stream outlet temperature, if its specific heat is 2500 j/kgK .	(6)	4	2
10.	After a long time in service, a counter-flow oil cooler is checked to ascertain if its performance has deteriorated due to fouling. In the test a standard oil flowing at 2.0kg/s is cooled from 420 K to 380 K by a water supply of 1.0 kg/s at 300K. If the heat transfer surface is 3.33 m^2 and the design value of the overall heat transfer coefficient is 930 W/m^2K, how much has it been reduced by fouling? Take C_p of oil as 2330 j/kgK and C_p of water as 4174 j/kgK.	(6)	4	2

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