QPC: RJ20MTECH043 AR 19 Reg. No

GIET UNIVERSITY, GUNUPUR – 765022

M. Tech (First Semester – Regular) Examinations, June – 2021

MPCCH1030 – Advanced Heat Transfer

(Chemical Engineering)

Time: 2 hrs Maximum: 50 Marks

The figures in the right hand margin indicate marks.

PART – A **(2 x 10 = 20 Marks)**

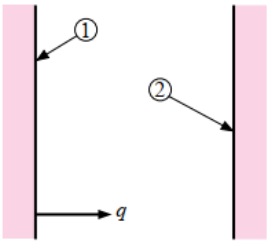
Q.1. Answer ***ALL*** questions

a. A solid spherical copper ball is to be heated from 100 °C to 150 °C in 30 minutes. Given average density and specific heat of water to be 8950 kg/m^3 and 0.395 kJ/kg. °C respectively. Determine total heat transferred to the copper ball.

b. Shape factor for two dimensional system is given by q=kS$\Delta T_{overall}$, where S is the shape factor. Compute the shape factor for plane wall.

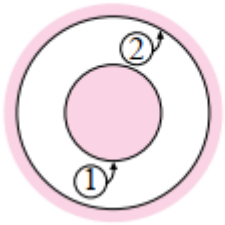
c. Shape factor for two dimensional system is given by q=kS$\Delta T_{overall}$, where S is the shape factor. Compute the shape factor for hollow cylinder.

d. Infinite parallel planes



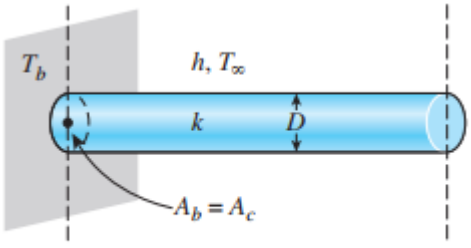
Find the radiation exchange between two infinite parallel planes.

e. Concentric spheres



Find the radiation exchange between two concentric spheres.

f. Draw the temperature profile of very long fin attached to a base temperature as shown in the figure. Temperature vs length of the fin from the base.



($p = \pi D$, $A_c = \pi D^2/4$ for a cylindrical fin)

g. Calculate the efficiency of the cylindrical fin shown in above figure.

h. Calculate the efficiency of the rectangular fin shown in above figure.

i. Suppose we have two parallel concentric disks of$d1$ = 10 cm, $d2$ = 5 cm and are spaced 10 cm apart. Determine $F12$ and $F21$.

j. Distinguish between laminar and turbulent flow in a physical sense.

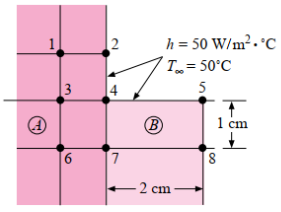
PART – B **(6 x 5 = 30 Marks)**

Answer ***ANY FIVE*** questions Marks

2. A copper sphere of 4cm in diameter have uniform temperature of 200◦C. Itis suddenly kept to a convection environment at 30◦C with h = 20 W/m2 ·◦C. Calculate the time taken for the center of the sphere to achieve a temperature of 80◦C. (6)

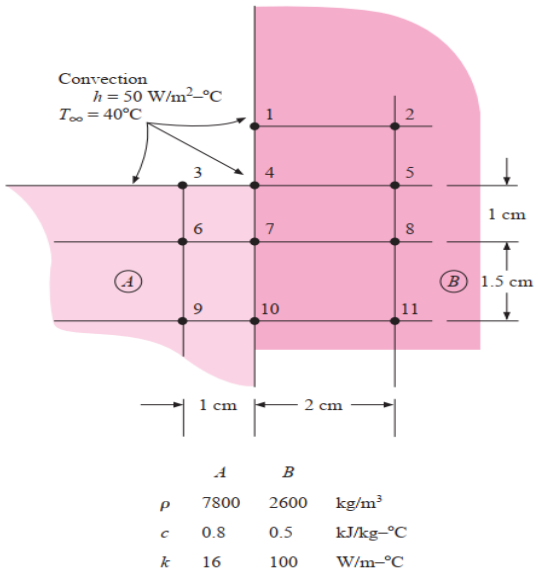
3. The initial temperature of a large slab of copper is found to be 300◦C. The surface temperature is suddenly lowered to 35◦C. What is the temperature at a depth of 7.5 cm, 4 min after the surface temperature is changed? (6)

4. For the nodes shown in Figure, calculate the maximum allowed time increment for node 4 in a transient numerical atmosphere. (6)



	A	B	
k	20	2	W/m · °C
ρ	7800	1600	kg/m³
c	0.5	0.8	kJ/kg · °C

5. Write the transient nodal equation for node 7 in Figure. Physical and thermal properties of materials *A* and *B*are shown in the figure. (6)



	A	B	
ρ	7800	2600	kg/m³
c	0.8	0.5	kJ/kg–°C
k	16	100	W/m–°C

6. Nitrogen at 2 atm and 500 K flows across a 40-cm-square plate at a velocity of 25 m/s. Calculate the cooling required to maintain the plate surface at a constant temperature of 300 K. (6)

7. Air enters a small duct having a cross section of an equilateral triangle, 3.0 mm on aside. The entering temperature is 27◦C and the exit temperature is 77◦C. If the flowrate is 5 × 10^{-5}kg/s and the tube length is 30 cm, calculate the tube wall temperature necessary to effect the heat transfer. (6)

8. It is desired to transmit energy from one spaceship to another. A1.5-m-square plate is available on each ship to accomplish this. The ships are guided so that the plates are parallel and 30 cm apart. One plate is maintained at 800◦C and the other at 280◦C. The emissivities are 0.5 and 0.8, respectively. Find (*a*) the net heat transferred between the spaceships in watts. (6)

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