SHAHEED BHAGAT SINGH STATE TECHNICAL CAMPUS, FEROZEPUR

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B.Tech. -ChE/ 4th Sem

Heat Transfer

Subject Code: BTCH-402A/403 (RG/RP)

Paper ID: M/18

(2011 batch onwards)

Time allowed: 3 Hrs **Max Marks:60**

Important Instructions:

- **All questions are compulsory**
- **Assume any missing data**

PART A (2×10)

Q. 1. Answer in brief:

(a) Enumerate the various modes of heat transfer. Give their governing equations.

(b) What are super insulators?

(c) Define overall heat transfer coefficient, emissivity, Nusselt number and Prandtl number.

(d) What is meant by shape factors? For a body, how are the shape factors related?

(e) What is Wein's displacement law?

(f) What do you understand by capacity and economy of an evaporator?

(g) Define Fourier Law of conduction.

(h) Differentiate between a black body and a grey body.

(i) Make a neat sketch of 1-2 Shell and tube heat exchanger.

(j) What are Heisler Charts? How are these charts used?

PART B (5×8marks)

Q. 2. A steam pipe with inside diameter 10 cm has an inside surface temperature of 200 °C and has a wall thickness of 5.5mm. It is surrounded by 8 cm thick insulation layer having k= 0.5 W/m °C followed by 4 cm layer of insulation having k = 0.2 W/m °C. The outside temperature of the outside surface of insulation is 20 °C. Calculate the heat lost per meter length of pipe. k for pipe material = 50 W/m°C. Also calculate the interface temperatures. CO1, CO2

OR

What is meant by Fin efficiency and fin effectiveness? Under what condition fins are useful? Derive the expression for fin effectiveness for the case of a straight finite fin with insulated tip. State all the assumptions. CO1, CO2

Q. 3. a) What is meant by heat transfer analogy? Discuss any one of the analogies. CO1, CO3
b) What is the difference between forced convection and natural convection? Discuss about the heat transfer in enclosed spaces.

OR

Air at 3.5Mpa and 38°C, flows across a tube bank consisting of 400 tubes of 1.25cm o.d. arranged in a staggered arrangement. The arrangement is 20 rows high, Sp=3.75cm, Sn=2.5cm. The incoming flow velocity is 9m/s and the tube wall is maintained constant at 20°C by condensing vapours on the inside of the tubes. The length of tube is 1.5m. Estimate the exit air temperature as it leaves the tube bank. CO1, CO3

Data : Sn/d=3, Sp/d=2, C=0.488, n=0.562

For air (0-100°C) k=0.027W/m°C, Cp=1007 J/kg °C, $\mu=1.89 \times 10^{-2}$cP

Q. 4. Three infinite parallel plates are arranged vertically, plate 2 being in between plates 1 and 3. Plate 1 is maintained at 1200 K ad plate 3 at 300K. Plate 2 does not receive energy from any other external source. Find the temperature of the second plate. $\varepsilon_1 = 0.2$, $\varepsilon_2 = 0.5$ ad $\varepsilon_3 = 0.8$ CO1, CO4

OR

a) Show that the introduction of one radiation shield reduces the heat transfer between two parallel plates to half if the emissivity of the plates and shield is the same. CO1, CO4
b) Discuss about the shape factors.

Q. 5. What is meant by log mean temperature difference? Derive a relation for LMTD. What is the requirement of correction in LMTD and how is it done? CO3

OR

A 2-4 shell and tube heat exchanger operates such that ethylene glycol is cooled from 140°C to 80°C at a flow rate of 4500kg/hr on the shell side. Cooling water flows through the tubes and enters at 35°C and leaves at 85°C. The overall heat transfer coefficient is 850 W/m^2 °C. Calculate the flow rate of water and the area of the heat exchanger. Assume temperature correction factor of 0.8. CO3

Q. 6. a) How do you classify evaporators? Draw a neat sketch for forward feed and backward feed evaporator system. CO5
b) Discuss about fouling factors. How is the overall heat transfer coefficient affected by fouling?

OR

a) Describe the boiling curve for pool boiling. CO5
b) Differentiate between film wise and dropwise condensation. What is the effect of presence of non condensables on condensation heat transfer?