315309

12526

3 Hours / 70 Marks Seat No. | | | | | | | | |

Instructions – (1) All Questions are *Compulsory.*

(2) Answer each next main Question on a new page.

(3) Illustrate your answers with neat sketches wherever necessary.

(4) Figures to the right indicate full marks.

(5) Assume suitable data, if necessary.

(6) Use of Non-programmable Electronic Pocket Calculator is permissible.

(7) Mobile Phone, Pager and any other Electronic Communication devices are not permissible in Examination Hall.

Marks

1. Attempt any FIVE of the following : **10**

a) State Fourier's law of heat conduction.

b) State Kirchoff's law of Radiation.

c) Define capacity and economy of an evaporator.

d) Differentiate between natural and forced convection. (Two points)

e) Name (any four) types of heat transfer equipments.

f) Define film heat transfer coefficient and write its SI unit.

g) Enlist the parts of shell and tube heat exchanger. (Any four)

Marks

2. Attempt any THREE of the following : **12**

a) Draw a neat labelled diagram of calendria type evaporator.

b) Find the inside individual heat transfer coefficient using Sieder - Tate equation for turbulent flow.

Data : Inside Diameter of tube = 20 mm

Reynolds Number (N_{Re}) = 15745

Viscosity of fluid at mean bulk temperature = 550×10^{-6} Pa.S

Viscosity of fluid at average wall temperature = 900×10^{-6} Pa.S

Prandtl Number (N_{Pr}) = 36

Thermal conductivity of fluid = K = 0.25 W/(mK)

c) Draw neat labelled diagram of 1–2 shell and tube heat exchanger.

d) Give any four characteristics of insulating materials.

3. Attempt any THREE of the following : **12**

a) Define Absorptivity, Reflectivity and Transmissivity of a body. Give example for material whose transmissivity = 1.

b) Estimate the heat loss per m^2 of the surface through a brick wall 0.5 m thick when the inner surface is at 400 K and the outside surface is at 310 K. Thermal conductivity (K) for brick is 0.7 $\frac{W}{(M \cdot K)}$

c) Write the significance of baffles in heat exchanging equipments. (Any four)

d) Compare filmwise condensation with dropwise condensation (Any four)

Marks

4. Attempt any THREE of the following : **12**

a) Calculate the rate of heat transfer by radiation from an unlagged steam pipe, 50 mm outside diameter of 393 K to air at 293 K. emissivity e = 0.9 & $\sim = 5.67 \times 10^{-8} \frac{W}{(M^2 \cdot K^4)}$

b) Draw temperature length curve for the co-current and counter current flow arrangements.

c) Explain modes of heat transfer with suitable examples.

d) Enlist the methods to improve economy of an evaporator and explain any one in detail.

e) Give mathematical expression for the following and explain the terms involved.

i) Nusselt Number

ii) Prandtl number

5. Attempt any TWO of the following : **12**

a) Describe any two methods of feeding a multiple effect evaporation system.

b) With a neat diagram explain construction and working of plate type heat exchanger.

c) Derive the expression to calculate rate of heat transfer by conduction through thick wall hollow cylinder.

6. Attempt any TWO of the following : **12**

a) Water enters a two fluid heat exchanger at 328 K and leaves at 358 K. Hot gases enters at 578 K and leave at 433 K. If the total heat transfer area is 500 m^2 and the overall heat transfer coefficient is 700 W/(m^2.K). Calculate the total heat transferred for –

i) Co-current and

ii) Countercurrent flow of the two fluids.

Marks

b) A solution containing 10% solids is to be concentrated to a level of 50% solids. Steam is available at a pressure of 0.2 MPa (Saturation temperature of 393 K). Feed rate to the evaporator is 3000 Kg/h. The evaporator is working at reduced pressure such that boiling point is 323 K. If feed enters at 308 K, Calculate.

i) Stem economy and

ii) Area of heat transfer

Overall heat transfer coefficient = 2.9 KW/m^2·K

Specific heat of feed = 3.98 KJ/(Kg.K), Latent heat of condensation of steam at 0.2 MPa = 2202 KJ/Kg, Latent heat of vaporisation of water at 323 K = 2383 KJ/Kg.

c) Differentiate between single pass and multipass shell and tube heat exchanger. (six points)

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