22510

11920

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

(6) 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) Define steady state heat transfer.

b) Define film heat transfer coefficient.

c) Give the unit of overall heat transfer coefficient in SI and MKS.

d) Define radiation and give one example.

e) Name any four types of shell and tube heat exchanger.

f) Define capacity and economy of evaporator.

g) Give expression for the following and explain the terms involved.

(i) Nusselt number

(ii) Prandtl number

Marks

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

a) Explain the concept of optimum thickness of insulation.

b) Draw temperature - length curve for parallel and counter current flow and give the expression for ΔT_{LM} in both cases.

c) Explain the properties of solution that influences evaporation.

d) Define the following terms :

(i) absorptivity

(ii) reflectivity

(iii) transmissivity

(iv) emissivity

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

a) Calculate the rate of heat transfer by radiation from an unlagged steam pipe, 50 mm o.d. at 393 K to air at 293 K emissivity e = 0.9.

b) Draw a neat labelled diagram of 1-2 shell and tube heat exchanger.

c) Thermic fluid flowing at a rate of 5000 kg/hr is to be cooled from 423 k to 363 k by circulating water at a rate of 15000 kg/hr. If the water is available at 303 K, find the outlet temperature of water.

Cp for thermic fluid = 2.72 kJ/kg K

Cp for water = 4.187 kJ / kg K.

d) With a neat diagram explain the construction of calendria type evaporator.

Marks

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

a) Explain Kirchhoff's Law with its mathematical expression in detail.

b) Explain Wilson plot.

c) 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. K for brick is 0.7 W/mK.

d) A hot fluid enters a double pipe heat exchanger at a temperature of 423 K and is to be cooled to 367 K by a cold fluid entering at 311 K and heated to 339 K. Shall they be directed in parallel or counter current flow?

e) Explain the type of multiple effect evaporator feed arrangement used for handling viscous liquid.

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

a) Derive the expression $Q = UA\Delta T_{LM}$ where terms have usual meaning.

b) With neat sketch explain the construction and working of heat exchanger used for handling corrosive liquid.

c) An evaporator is operating at atmospheric pressure. It is desired to concentrate the feed from 5% solute to 20% solute by weight at a rate of 5000 kg/hr. Dry saturated steam at a pressure corresponding to saturation temperature of 399 K is used. The feed is at 298 K and boiling point elevation is 5 K. Calculate economy of evaporator.
latent heat of condensation of steam at 399 K = 2185 kJ/kg
latent heat of vaporisation of water at 373 K = 2257 kJ/kg.

Marks

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

a) A pipe 65 mm OD is lagged with 50 mm layer of asbestose (K = 0.14 w/mk) and a 40 mm layer of cork (K = 0.035 w/mk). If the temperature of the outer surface of the pipe is 423 K and the temperature of the outer surface of the cork is 308 K, calculate the heat loss per meter of pipe.

b) Calculate overall heat transfer coefficient (ω) from the following data.

d_o = 130 mm di = 20 mm

K of metal wall = 46.52 w/mK.

c) Explain with reason through which side of shell and tube heat exchanges, the following liquids are directed.

(i) viscous liquid

(ii) high pressure liquid

(iii) corrosive liquid