17560

11819

3 Hours / 100 Marks Seat No. | | | | | | | | |

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

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

(3) Figures to the right indicate full marks.

(4) Assume suitable data, if necessary.

(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. a) **Attempt any THREE of the following:** **12**

(i) Why it is necessary to study the different modes of heat transfer? Give three modes of heat transfer with example.

(ii) State and explain Kirchoff's law of radiation.

(iii) Define thermal conductivity. Give its S.I.unit. How it is related with temperature?

(iv) Give the difference between single pass and multi pass shell and tube heat exchanger (any four)

b) **Attempt any ONE of the following:** **6**

(i) Derive an expression to find out rate of heat transfer through a composite wall of three materials of different thickness having different thermal conductivity.

(ii) Give the construction and working of short tube evaporator.

Marks

2. Attempt any FOUR of the following: **16**

a) Define sensible heat and latent heat. Give the mathematical equation to calculate them.

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 of the brick may be taken as 0.7 w/(m.k)

c) List different types of finned tube heat exchangers? State one application of each.

d) Draw a labelled diagram of double pipe heat exchanger.

e) Define absorptivity, reflectivity and transmissivity. Name the material for which $\alpha + \varsigma = 1$

3. Attempt any TWO of the following: **16**

a) In a double pipe counter current flow heat exchanger, 10000 kg/h of an oil having a specific heat of 2095 J/(kg.k) is cooled from 353 k to 323 k by 8000 kg/h of water entering at 298 k. Calculate the heat exchanger area for an overall heat transfer coefficient of 300 w/(m^2-k). Take Cp for water at 4180 J/(kg.k)

b) Calculate the overall heat transfer coefficient from the following data

Inside heat transfer coefficient = 5800 w/(m^2.k)

Outside heat transfer coefficient = 1750 $\frac{w}{(m^2 k)}$

Outside diameter of tube = 30 mm

Inside diameter of tube = 20 mm

Thermal conductivity of metal wall = 46.52 w/(m.k)

c) Derive the relationship between individual and overall heat transfer coefficients.

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

(i) Calculate the heat loss by radiation from an unlagged horizontal steam pipe, 50 mm. o.d at 377 k to air at 283 k

(ii) List out different heat-transfer equipments with their applications (any four)

Marks

(iii) Define capacity and economy of evaporator.

(iv) In case of heat transfer in solids, what are the different factors on which rate of heat transfer depends. Give the relation.

b) **Attempt any ONE of the following:** **6**

(i) Derive an expression to find out rate of heat transfer through a sphere

(ii) Give the advantages and disadvantages of short tube evaporator.

5. Attempt any TWO of the following: **16**

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

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

Data: Cp for thermic fluid = 2.72 $\frac{KJ}{(Kg\ K)}$

Cp for water = 4.187 $\frac{KJ}{(Kg\ K)}$

c) Calculate the inside heat transfer coefficient for a fluid flowing at a rate of 300 cm^3/s through a 20 mm inside diameter tube of heat exchanger

Data: Viscosity of the flowing

Fluid = 0.8 (N.S) $/m^2$

Density of flowing fluid = 1.1 g/cm^3

Specific heat of fluid = 1.26 KJ/(kg.k)

Thermal conductivity of fluid : 0.384 $\frac{w}{(m.k)}$

Viscosity at wall temperature = 1 $N.S/m^2$

length of heat exchanger = 5m

Marks

6. Attempt any TWO of the following: **16**

a) An evaporator is operating at atmospheric pressure. It is desired to concentrate a feed from 5% solute to 20% solute (by weight) at a rate of 5000 kg/h. Dry saturated steam at a pressure corresponding to the saturation temperature of 399 k is used. The feed is at 298 k and the boiling point rise is 5 k. The overall heat transfer coefficient is 2350 w/(m^2.k).
Calculate the economy of the evaporator and the area of heat transfer to be provided
Data - Treating the solution as a pure water and neglecting the B.P.R. the latent heat of condensation of steam at 399 k is 2185 KJ/kg.
latent heat of vapourisation of water at 101.325 kpa and 373k = 2259 KJ/kg sp. heat of feed = 4.187 KJ/(kg.k)

b) Derive the relation

$$\Delta T_{lm} = \frac{\Delta T_2 - \Delta T_1}{ln\left(\Delta T_2 / \Delta T_1\right)}$$

c) Give the mechanism of heat transfer to boiling liquid.