22510

21222

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

15 minutes extra for each hour

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

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

(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. Attempt any FIVE of following: **10**

a) State the effect of temperature on thermal conductivity.

b) Give the types of convection with one example each.

c) Differentiate between Drop-wise and Film-wise condensation. (any two)

d) Define

i) Absorptivity

ii) Reflectivity

e) Name any four heat exchange equipments.

f) List out four properties of solution that influences evaporation.

g) Write the expression for Prandtl number and state its significance.

Marks

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

a) Derive a expression to find out rate of heat flow by conduction through a plane wall.

b) Write the Sieder-Tate and Dittus Bolter equation for turbulent and laminar flow.

c) Explain the working of long tube vertical evaporator with a neat sketch.

d) State Kirchoff's law of radiation and derive its expression.

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

a) Calculate the loss of heat by radiation from a steel tube of diameter 70 mm and 3 m long at a temperature of 500 k, if the tube is located in a square brick conduit 0.3 m side at 300 k. Assume e for steel as 0.79 and for brick conduit as 0.93.

b) Describe with a neat diagram the construction of plate type heat exchanger.

c) Suggest the pass of fluid for the following situation with justification :

i) Viscous fluid

ii) Corrosive fluid in case of shell and tube heat exchanger.

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

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

a) Explain the term

i) Emissive power

ii) Mono-chromatic Emissivity

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 $W/(m^2.k)$
Outside diameter of tube = 30 mm
Inside diameter of tube = 20 mm
Thermal conductivity of metal wall = 46.52 W/(m.k)

Marks

c) Give any four characteristics of insulating materials. Explain the concept of optimum thickness of insulation.

d) Describe regimes of boiling with the help of boiling curve.

e) Explain the working of forced circulation evaporator with sketch.

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

a) Derive the relation between overall and individual heat transfer coefficients.

b) Explain the construction and working of 'U' tube heat exchanger with a neat sketch.

c) A solution containing 10% solids is to be concentrated to a level of 50% solids. Steam is available at a pressure of 0.20 MPa (Saturation temperature of 393k). Feed rate to the evaporator is 30000 kg/h. The evaporator is working at reduced pressure such that boiling point is 323k. The overall heat transfer coefficient is 2.9 kw/cm^{2}k. Estimate the steam economy and heat transfer surface for feed introduced at 308k. [Data : specific heat of feed = 3.98 kJ/kg.k ; Latent heat of condensation of steam at 0.20 MPa = 2202 kJ/kg ; Latent heat of vaporisation of water at 323 k = 2383 kJ/kg].

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

a) A steam pipeline, 150/160 mm in diameter is covered with a layer of insulating material of thickness 50 mm. The temperature inside the pipeline is 393 K and that of the outside surface of insulation is 313 K. Calculate the rate of heat loss per 1m length of pipeline. Data : K for pipe is 50 W/(m.k) and K for insulating material is 0.08 W/(m.k).

Marks

b) Determine the heat transfer coefficient for water flowing in a tube of 16 mm diameter at a velocity of 3 m/s. The temperature of the tube is 297 K and the water enters at 353 K and leaves at 309 K. Using (i) Dittus-Bolter equation and (ii) Sider-Tate equation. [Data :Properties of water at 331 K i.e. at arithmetic mean-bulk temp. are : ρ = 984.1 kg/m^3, Cp = 4187 J/(kg.k), μ = 485 $\times$ 10^{-6} pa.s, K = 0.657 W/(m.k) viscosity of water at 297 K (μw) = 920 $\times$ 10^{-6} pa.s.]

c) In a double pipe counter current flow heat exchanger 10,000 kg/h of an oil having a specific heat 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 as 4180 J/(kg.k).

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