22510

24225

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 answer 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) Write the SI unit of Thermal Conductivity.

b) Give the expression for Prandtle Number and explain the terms.

c) Write down the value of Stefan Boltzmann constant.

d) Draw the cross flow arrangement used in heat exchangers.

e) Define economy of an evaporator.

f) Give the classification of Shell and Tube heat exchanger.

g) Define forced convection.

P.T.O.

Marks

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

a) State Fourier's law with mathematical expression.

b) Compare Co-current and Counter current flow of heat exchanger.

c) State and explain Kirchoff's law.

d) Draw 2-4 Shell and Tube Heat Exchanger with following labels–

i) Shell

ii) Tubes

iii) Pass partition

iv) Baffle.

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.

b) A hollow sphere has an inside surface temperature is 573 K and the outside surface temperature is 303 K. Find the heat loss by conduction for an inside diameter of 50 mm and outside diameter of 150 mm. K = 17.45 w/m.k.

c) Explain the construction and working of a heat exchanger which is used for a handling corrosive liquid.

d) Answer with reason – Through which side of shell and Tube Heat Exchanger, The following liquids are directed –

i) Viscous liquid

ii) Corrosive liquid.

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

a) Compare dropwise and filmwise condensation. (Any four)

b) Derive the expression for rate of heat flow by conduction through a composite wall of different materials.

c) Differentiate forward feed and Backward feed feeding arrangements in evaporators.

d) Discuss the construction and working of double pipe heat exchanger.

Marks

e) List out the various properties which effects the evaporation operation.

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

a) Describe the relationship between overall and Individual heat transfer coefficient.

b) 88 mm OD pipe is insulated with a 40 mm thickness of an insulation having a thermal conductivity of 0.057 w/m.k. and 30 mm thickness of an insulation having thermal conductivity of 0.042 w/m.k. If the temperature of the outer surface of pipe is 560 K and temperature of the outer surface of insulation 310 K. Calculate the heat loss per meter of pipe.

c) A hot fluid enters a DPHE at a temperature of 423 K. and is to be cooled to 367 K by cold water entering of 311 K and heated to 339 K shall they be directed in parallel or counter current flow?

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

a) An evaporator is operating at atmospheric pressure. It is desired to concentrate a feed from 8% solute to 30% solute (by weight) at a rate of 10,000 kg/hr. Dry saturated steam at a pressure corresponding to the saturation temp. of 399 K is used. The feed is at 298K. and the b.p. rise is 6 k. The OHTH (U) is 2350 w/m^2k. Calculate the economy of the evaporator and the area of heat transfer to be provided.

i) λ Condensation of steam at 399 k = 2185 kJ/kg.

ii) λ Vaporisation of water at 373 k = 2257 kJ/kg.

Cp feed = 4.187 kJ/kg k.

b) With neat sketch, explain construction and working of Calendria Evaporator.

c) Determine the HTC for water flowing in a tube of 16 mm dia at a velocity of 3 m/s. The temp of the tube is 297 k and the water enters at 353 k. and leaves at 309 k.

Using –

i) Dittus Bolter equation

ii) Sider-Tate equation

Marks

Data given (Properties) of water at 331 k i.e. at arithmatic mean temp are –

$\varrho = 984.1 \text{ kg/m}^3$

Cp = 4187 J/kg.k

$\mu = 485 \times 10^{-6}$ pa.s.

k = 0.657 w/(m.k.)

μwater at 297 k = 920×10^{-6} Pa.s