22510

12425

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

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 the following: **10**

a) Define thermal conductivity and state It's S.I. Unit.

b) State and define two types of Convection.

c) Give the expression for Reynold's number and state it's significance.

d) State Kirchoff's law of Radiation.

e) Define condenser and cooler.

f) Define different types of condensation.

g) Define capacity and economy of an evaporator.

Marks

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

a) State Fouriers Law of heat conduction. Give it's mathematical expression and state the terms used in it.

b) Give the Sider - Tate equation used to calculate the film coefficient in case of Laminar flow and Turbulent flow.

c) Draw neat labelled sketch of standard vertical tube evaporator.

d) Explain in brief the concept of black body.

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

a) Calculate the total heat loss by convection and radiation from an Unlagged steam pipe 50 mm B.d at 415 K to air at 290 K. Data - Take emissivity. e = 0.9. The film co-efficient for calculation is given by $hc = 1.18 (\Delta T/Do)^{0.25}$ w/m^2k

b) Differentiate with sketch between parallel flow and counter current flow arrangement in Heat exchanger.

c) Explain construction and working of double pipe heat exchanger with diagram.

d) State Duhring's Rule. Explain boiling point elevation in Evaporation Operation.

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

a) Define emissivity, emissive power, black body and grey body.

b) Calculate the overall heat transfer coefficient if

i) Inside and outside, film heat transfer coeff are 12 and 11600 $w/(m^2.k)$ respectively.

ii) Inside and outside diameters are 25 mm and 29 mm respectively.

iii) Thermal conductivity of pipe material is 34.9 w/(m.k)

c) Derive the expression far rate of heat transfer by conducting through a plane wall.

d) Differentiate between dropwise and filmwise condensation. (Any four points.)

e) Compare forward feed and backward feed arrangements in case of multiple effect evaporator. (Any four points.)

Marks

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

a) An evaporator operating at atmospheric pressure is fed at rate of 5000 kg/h of weak liquor containing 4% caustic soda. Thick liquor leaving the evaporator contains 25% caustic soda. Find the capacity of the evaporator.

b) Derive the relationship $Q = UA\ \Delta T_{lm}$.

c) A hot fluid enters a double pipe heat exchanger at a temperature of 423 K and to be cooled to 363 K by a cold fluid entering at 308 K and heated to 338 K. Shall they be directed in parallel flow or counter current flow to have a high rate of heat transfer.

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

a) A furnace wall is constructed with 225 mm thick of fire brick, 120 mm of insulating brick and 225 mm of the building brick. The inside temperature is 1200 K and the outside temperature is 330 K. Find the heat loss per unit area and the temperature at the junction of the fire brick and insulating brick.

Data - K for fire, brick = 1.4 W/(m.k)

K for insulating brick = 0.2 W/(m.k)

K for building brick = 0.7 W/(m.k)

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 enter's at 353 K and leaves at 309 K. Using

i) Dittus - Bolter equation and

ii) Sider - Tate equation

Data - Properties of water at mean bulk tempt of 331 K are : ρ = 984.1 kj/m^3, Cp = 4187 J/(Kj.K), $\mu = 485 \times 10^{-6}$ Pa.s, K = 0.657 W/(m.k), viscosity of water at 297 K, $\mu_w = 920 \times 10^{-6}$ Pa.s.

c) Explain construction and working of Graphite block heat exchanger with neat sketch. Give it's advantages.