17560

11920

3 Hours / 100 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. a) **Attempt any THREE of the following:** **12**

(i) Define the term thermal conductivity. How it varies with temperature? Give S. I. unit of it.

(ii) Define Black body, Grey body, Emmisive power and Emmisivity.

(iii) What are different modes of heat transfer? Explain with examples.

(iv) Give the physical significance of Reynolds No. and Nussult No.

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

(i) Derive the equation $Q = UA\Delta T_{lm}$

(ii) Draw a labelled diagram of 1-2 shell and tube heat exchanger.

Marks

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

a) Write in brief on fouling factor with respect to heat transfer.

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

c) State Kirchhoff's Law and Stefan - Boltmann Law of radiation.

d) Calculate the rate of heat transter Q, through a wall of red brick($k = 0.7 \frac{w}{(m.k)}$) 5m in length, 4m in height and 250 mm. in thickness if the wall surfaces are maintained at 373k and 313k respectively.

e) Write on optimum thickness of insulation.

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

a) Crude oil flows at the rate of 1000 kg/h through the inside pipe of a double pipe heat exchanger and is heated from 303k to 363k. The heat is supplied by kerosene intially at 473k flowing through the annular space. If the temperature of a approach is 10k, determine the heat transfer area for co-current flow and kerosene flow rate C_p for crude oil = 2.1 KJ/(Kg.k)
C_p for kerosene = 2.51 KJ/(kg.k)
$U_o = 465w/(m^2.k)$

b) What is the objective of evaporation. On what basis performance of tubular evaporators are calculated.

Define capacity and economy of evaporator.

Why economy of single effect evaporator is less than one? State the methods to increase the economy of single effect evaporator.

c) Write in brief on finned tube heat exchanger with neat sketch.

Marks

4. a) **Attempt any <u>THREE</u> of the following:** **12**

(i) Which is the driving force for heat transfer? State and explain the different mechanisms of heat transfer.

(ii) What do you mean by L.M.T.D; L.M.T.D correction factor? Where correction factor is applicable?

(iii) Give the Sieder-Tate equation for calculation of film coefficient in case of laminar flow and turbulent flow. Exlpain the term's involved.

(iv) Calculate the heat loss by radiation from an unlagged horizontal steam pipe, 50 mm o.d. at 377k to air at 283k take emissivity e = 0.90

b) **Attempt any <u>ONE</u> of the following:** **6**

(i) Derive the expression for heat flow through thick walled cylinder.

(ii) In a 1-2 shell and tube heat exchanger, 10,000 kg/h of an oil having a specific heat of 2095J/(kg.k) is cooled from 353k to 323k by 8000 kg/h of water entering at 298k and leaving at 318k. Calculate the number of tubes required, if diameter of tube is 20 mm.

Data : 1) $U = 300\ W/(m^2.k)$

2) $C_pH_2O = 4180\ J/(Kg.k)$

3) $F_T = 0.85$

4) Length of tubes = 1m.

5. **Attempt any <u>TWO</u> of the following:** **16**

a) 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 297k and the water enters at 353k and leaves at 309k use

(i) Dittus-Boeltev equation and

(ii) Sieder-Tate equation. Properties of water at mean temperature $\rho = 984.1\ kg/m^3$, $C_p = 4184J/(Kg.k)$

Marks

μ = 485 x 10^{-6} Pa.s, k = 0.657 w/(m.k)

μ H_2O at 297k = 920 x 10^{-6} Pa.s

b) A solution containing 10% solid 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 30,000 Kg/h. The evaporator is working at reduced pressure such that boiling point is 323k. The overall heat transfer coefficient is 2.9 kw/(m^2.k) Estimate steam economy and heat transfer surface when feed is introduced at 309k

Date : Sp. heat of feed = 3.98
Latent heat of condensation of steam at 0.20 Mpa = 2202 KJ/kg. Latent heat of vaporisation of water at 32k = 2383 KJ / kg

c) Write in brief on:

i) plate type heat exchanger

ii) maintenance of heat exchanger.

6. Attempt any <u>TWO</u> of the following: **16**

a) State the methods of feeding multiple effect evaporation system. Compare forward feed arrangement with backward feed arrangement.

b) With neat sketch explain construction and working of Long tube evaporator.

c) Explain in brief with curve heat transfer to boiling liquid.

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