

22510

22223

3 Hours / 70 Marks

Seat No.

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- Instructions* –
- (1) All Questions are *Compulsory*.
 - (2) Answer each next main Question on a new page.
 - (3) Illustrate your answers 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) Define conduction with suitable example.
 - b) Define Natural convection. Give any two examples.
 - c) Give the Dittus-Bolter equation for turbulent flow.
 - d) Define radiation with a suitable example.
 - e) Name any four different types of heat exchangers.
 - f) Define capacity and economy of an evaporator.
 - g) Name different flow arrangements used in heat exchangers.

P.T.O.

- 2. Attempt any THREE of the following:** **12**
- a) Explain Fourier's law of heat conduction with its mathematical expression and terms involved in the expression.
 - b) Draw neat labelled sketch of double pipe heat exchanger for counter-current flow arrangement.
 - c) Explain with a neat sketch open pan evaporator.
 - d) Explain Absorptivity, Reflectivity and Transmissivity of a body. Give example for materials whose reflectivity = 1 and transmissivity = 1.
- 3. Attempt any THREE of the following:** **12**
- a) Calculate the total heat loss by convection and radiation from an unlagged steam pipe 50mm o.d at 415K to air at 290K.
Data :- Emissivity $e = 0.90$
The film coefficient (h_c) for calculation of the heat loss by natural convection is given by $h_c = 1.18 (\Delta T / D_o)^{0.25}$, W/(m².K)
 - b) Describe with sketch fixed tube sheet 1-2 shell and tube heat exchangers.
 - c) Explain with a neat sketch plate type heat exchanger.
 - d) Compare Evaporation and Drying. (Any four points)
- 4. Attempt any THREE of the following:** **12**
- a) Explain the concept of black body. State Kirchhoff's law with mathematical expression.
 - b) Find the overall heat transfer coefficient if
 - i) Inside and outside film heat transfer coefficients are 12 and 11600 W/(m².K) respectively.
 - ii) Inside and outside diameters are 25mm and 29mm respectively.
 - iii) Thermal conductivity of Metal = 34.9 W/(m.K)

- c) Derive the expression to calculate rate of heat flow by conduction through a composite wall of different materials.
- d) Explain Pool boiling of Saturated liquid.
- e) Explain the method of mechanical vapour recompression to increase the economy of the evaporator.

5. Attempt any TWO of the following: 12

- a) Derive the relation between overall and individual heat transfer coefficients.
- b) Water enters a two-fluid heat exchanger at 328k and leaves at 358k. Hot grades enters at 578k and leave at 433k. If the total heat transfer area is 500m^2 and the overall heat transfer coefficient is $700\text{W}/(\text{m}^2.\text{k})$, find the total heat transferred for
 - (i) parallel flow and
 - (ii) counter current flow of the two fluids.
- c) Explain methods used in chemical industry for feeding the multiple evaporation system.

6. Attempt any TWO of the following: 12

- a) Explain concept of optimum thickness of insulation and give any four characteristics of insulating materials.
- b) Calculate the inside heat transfer coefficient for a fluid flowing at a rate of $300\text{cm}^3/5$ through a 20mm inside diameter tube of heat exchanger.

Data :- Viscosity of flowing fluid = $0.8 \text{ (N.S)}/\text{m}^2$

Density of flowing fluid = $1.1 \text{ gm}/\text{cm}^3$

Specific heat of fluid = $1.26 \text{ KJ}/(\text{kg.k})$

Thermal conductivity of fluid = $0.384 \text{ W}/(\text{m.k})$

Viscosity at wall temperature = $1.0 \text{ (N.S)}/\text{m}^2$

Length of heat exchanger = 5m.

- c) Explain concept of optimum thickness of insulation and give any four characteristics of insulating materials.