22510

22223

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 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.

Marks

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

a) Explain Fourrier's law of heat conduction with it's 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 50 mm o.d at 415 k to air at 290 k.

Data :- Emissivity e = 0.90

The film coefficient (hc) for calculation of the heat loss by natural convection is given by hc = 1.18 $(^{\Delta T}/_{Do})^{0.25}$, w/($m^2$.K)

b) Describe with sketch fixed tube sheet 1-2 shell and tube heat exchanges.

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 $^{W}/(m^2.k)$ respectively.

ii) Inside and outside diameter's are 25 mm and 29 mm respectively.

iii) Thermal conductivity of Metal = 34.9 W(m.k)

Marks

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 328 k and leaves at 358 k. Hot grades enters at 578 k and leave at 433 k. If the total heat transfer area is 500 m^2 and the overall heat transfer coefficient is 700 W/(m^2.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 $cm^3/5$ through a 20 mm inside diameter tube of heat exchanger.

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

Density of flowing fluid = 1.1 gm/cm^3

Specific heat of fluid = 1.26 $KJ/(kg.k)$

Thermal conductivity of fluid = 0.384 $W/(m.k)$

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

Length of heat exchanger = 5m.

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