22510

23124

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) Explain conduction with example.

b) Define :–

i) Natural convection

ii) Forced convection

c) Give the unit of overall heat transfer coefficient in SI and MKS.

d) Define :–

i) Black body

ii) Grey body

e) Give any two advantages of plate type heat exchanger.

P.T.O.

Marks

f) Name the methods to improve economy of evaporator.

g) Draw temperature line diagram for co-current and counter current flow.

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

a) Explain Fouvier's law with mathematical expression.

b) Differentiate filmwise condensation and dropwise condensation.

c) Draw a neat diagram of Calendria type evaporator.

d) Explain Kirchhoff's law.

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

a) Estimate the total heat loss by convection and radiation from an unlagged steam pipe 50mm o.d. at 415 k to air at 290 k e = 0.9, h = 1.18 $(\Delta T/Do)^{0.25}$ w/m^2k.

b) Draw a neat labelled diagram of 1-2 fixed tube sheet shell and tube heat exchanger.

c) In a double pipe counter current flow heat exchanger, 1000 kg/hr of an oil having specific heat of 2095 J/kg K is cooled from 353 k to 323 k by 8000 kg/hr of water entering at 298 k. Calculate outlet temperature of water.

d) Differentiate between forward feed and backward feed arrangement in evaporator (four points).

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

a) Explain any two laws of black body radiation.

b) Calculate U from following data –

h_i = 5800 w/m^2 k

h_o = 1750 w/m^2k

d_o = 30 mm

d_i = 20 mm

k = 46.52 w/mk

Marks

c) Estimate the heat loss per m^2 of the surface through a brick wall 0.5 m thick when the inner surface is at 400 k and the outside surface is at 310 k. k for brick is 0.7 w/m^2.

d) Differentiate between co-current and counter current flow.

e) Explain the type of feed arrangement preferred for viscous solution.

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

a) Derive the relation between overall and individual heat transfer coefficient.

b) With neat diagram explain construction and working of heat exchanger preferred for corrosive liquid.

c) A solution containing 10% solids is to be concentrated to a level of 50% solids. Steam is available at a pressure of 0.2 MPa. Feed rate to the evaporator is 3000 kg/hr. The evaporator is working at reduced pressure such that boiling point is 323 k. If feed enters at 308 k,

Calculate :–

i) Steam economy and

ii) Area of heat transfer

Overall heat transfer coefficient - 2.9 kw/m^2 k. Specific heat of feed = 3.98 kJ/kg K. Latent heat of condensation of steam at 0.2 MPa = 2202 kJ/kg.

Latent heat of vaporisation of water at 323 k = 2383 kJ/kg.

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

a) A steam pipe line 150/160 mm in diameter carries steam. The pipe line is lagged with a layer of heat insulating material (k = 0.08 w/mk) of thickness 50 mm. The temperature inside the pipe is 393 k and that at the outside surface of insulation is 313 k. Calculate the rate of heat loss per 1m length of pipe line. k for pipe is 50 w/mk.

Marks

b) Water enters a heat exchanger at 328 k and leaves at 358 k. Hot gases enter at 578 k and leaves at 433 k. If A = 500 m^2 and U is 700 w/m^2 k, determine the total heat transferred for –

i) Co-current flow

ii) Counter current flow

c) With neat labelled diagram, explain construction and working of Kettle/Reboiler type heat exchanger.

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