17560

15162

3 Hours / 100 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.*
(8) ***Use*** *of Steam tables, logarithmic, Mollier's chart is* ***permitted****.*

Marks

1. A) Attempt **any three** of the following : **12**
a) Write down the difference between evaporation and drying.
b) State and explain Fourier's law.
c) State and explain Stefan-Boltzman law.
d) Write down the effect of non-condensable gases in condensation process.

B) Attempt **any one** of the following : **6**
a) Derive an expression to find out rate of heat transfer through a sphere.
b) Give the construction and working of long tube vertical evaporation.

2. Attempt **any four** of the following : **16**
a) Write down the difference between three modes of heat transfer.
b) A furnace is constructed with 225 mm thick of fire brick, 120 mm of insulating brick and 225 mm of the building block. The inside temperature is 1200 k and the outside temp. is 330 k. Find the heat loss per unit area.
Data : k for fire brick = 1.4 w/mk
k for insulating brick = 0.2 w/mk.
k for building brick = 0.7 w/m.k.
c) Write down the name of heat exchanger used for handling corrosive and radioactive fluid. Write its construction and working.
d) Give the difference between single pan and multi pan shell and tube heat exchanger.
e) Define monochromatic emissive power and total emissive power.

3. Attempt **any two** of the following : **16**
a) Draw a neat labelled diagram of plate type heat exchanger. Give its construction and working.
b) Derive the relationship between individual and overall heat transfer coefficient.

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Marks

c) Find the overall heat transfer coefficient from the following data :
   i) LMTD = 23 k for counter current flow.
   ii) Heat transfer area = 1.5 m^2
   iii) Rate of heat transfer = 116 kW
   iv) Correction factor for LMTD = 0.85.

4. A) Attempt **any three** of the following : **12**

a) A 50 mm i.d., iron pipe at 423 k passes through a room in which surroundings are at 300 k. If the emissivity of the pipe metal is 0.8, what is the net interchange of radiation energy per meter length of pipe ? The outside diameter of pipe is 60 mm.

b) Draw a neat labelled diagram of fixed tube sheet heat exchanger.

c) Define capacity and economy of evaporation.

d) Estimate the heat loss per m^2 of surface area for a furnace wall, 300 mm thick. The inner and outer surface temperatures are 593 k and 311 k respectively. The variation in thermal conductivity (w/m.k.) with temperature in k is given by the following relation :
$k = 0.003T - 10^{-6}T^2$.

B) Attempt **any one** of the following : **6**

a) Derive an expression to find out rate of heat transfer through a cylinder.

b) Give the advantages and disadvantages of short tube evaporator.

5. Attempt **any two** of the following : **16**

a) Cold fluid is flowing through the heat exchanger at a rate of 15 m^3/hr. It enters the heat exchanger at 303 k and leaves at 328 k. A hot thermic fluid enters the heat exchanger at a rate of 21 m^3/hr at a temp. of 388 k. Find the exit temperature of hot fluid.
Data : Density of cold fluid = 1000 kg/m^3
Density of thermic fluid = 950 kg/m^3
Specific heat of cold fluid = 4.187 kJ/kgk
Specific heat of thermic fluid = 2.93 kJ/kgk.

b) 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.

c) A solution containing 10% solids is to be concentrated to a level of 50% solids. Steam is available at a pressure of 0.20 MPa [saturation temperature of 393 k]. Feed rate to the evaporator is 30000 kg/hr. The evaporator is working at reduced pressure such that boiling point is 323 k. The overall heat transfer coefficient is 2.9 kW/m^2.k. Estimate the steam economy and heat transfer surface for :
   i) Feed introduced at 293 k.
   ii) Specific heat of feed = 3.98 kJ/kgk.
   iii) Latent heat of condensation of steam at 0.20 MPa = 220 kJ/kg.
   iv) Latent heat of vaporisation of water at 323 k = 2383 kJ/kg.

6. Attempt **any two** of the following : **16**

a) What is multiple effect evaporation system ? Describe any two methods of feeding a multiple effect evaporation system.

b) Describe the dropwise and filmwise condensation process.

c) Derive the equation of LMTD.
