Scheme – G

Sample Test Paper-I

Course Name : Diploma in Chemical Engineering

Course Code : CH

Semester : Fifth **17560**

Subject Title : Heat Transfer Operation

Marks : 25 **Time: 1 hour**

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. Preferably, write the answers in sequential order

Q1. Attempt any THREE. **09 Marks**

a) State different modes of heat transfer with example. Why is it necessary to study different modes of heat transfer?

b) State and explain Fourier's law of heat transfer by conduction.

c) State and explain Wilson plot.

d) Define thermal conductivity. How is it related with temperature?.

Q2. Attempt any TWO. **08 Marks**

a) Give any four requirements of an insulating material. What is optimum thickness of insulation?

b) Give the physical significance of dimensionless groups.

c) Give Sider Tate equation for laminar flow. Explain the terms involved in it.

Q3. Attempt any ONE. **08 Marks**

a) An ice box has walls constructed of a 10 mm layer of cork-board contained between two wooden walls, each of 20 mm thick. Find the rate of heat removed per unit area if the inner wall surface is kept at 263 K(-10^0C), while the outer surface temperature is 303 K(30^0C). Find out the zone in the wall where the temperature is 293 K(20^0C).

b) Explain heat transfer to boiling liquids.

Scheme – G

Sample Test Paper-II

Course Name : Diploma in Chemical Engineering

Course Code : CH

Semester : Fifth **17560**

Subject Title : Heat Transfer Operation

Marks : 25 **Time: 1 hour**

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. Preferably, write the answers in sequential order

Q1. Attempt any THREE. **09 Marks**

a) What is the function of baffle? What do you mean by 25% cut baffle?

b) List different heat transfer equipment used in chemical industries.

c) State and explain Stefan Boltzmann law of radiation.

d) What are different properties of solution to be considered during design of evaporators.

Q2. Attempt any TWO. **08 Marks**

a) Draw a neat labeled diagram of 2-4 shell and tube heat exchanger

b) Define the following terms: i) Absorptivity ii) Emissivity iii) Opaque material iv)Gray body.

c) State and explain the law giving relationship between emissive power of a body to its absorptivity.

Q3. Attempt any ONE. **08 Marks**

a) An evaporator is operating at atmospheric pressure. It is desired to concentrate a feed from 5% solute to 20% solute (by weight) at a rate of 5000kg/h. Dry saturated steam at a pressure corresponding to the saturation temperature of 399 K(126^0C) is used. The feed is at 298 K(25^0C) and the boiling point elevation is 5K. The overall heat transfer coefficient is 2350 W/m^2K. Calculate the economy of the evaporator and the area of heat transfer to be provided.

b) Give comparison of forward feed and backward feed arrangements.

Scheme - G

Sample Question Paper

Course Name : Diploma in Chemical Engineering

Course Code : CH

Semester : Fifth **17560**

Subject Title : Heat Transfer Operation

Marks : 100 **Time: 03 Hrs.**

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. Preferably, write the answers in sequential order

Q.1 A) Attempt any THREE of the following: **12 Marks**

a) Define sensible heat and latent heat. Give the mathematical equation to calculate them.

b) State and explain Kirchhoff's law of radiation.

c) Define thermal conductivity. How it depends on temperature.

d) Draw a neat labeled diagram of fixed tube sheet heat exchanger.

Q.1 B) Attempt any ONE of the following: **06 Marks**

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

b) Give the construction and working of forced circulation evaporator with horizontal external heating element.

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

a) Why is it necessary to study the different modes of heat transfer? Give three modes of heat transfer with example.

b) A wall is made of brick of thermal conductivity 1.0 W/ m K,, 230 mm thick. It is lined on the inner face with plaster of thermal conductivity 0.4 W/m K and of thickness 10 mm. If a temperature difference of 30 K is maintained between the two faces, what is the heat flow per unit area of the wall?

c) List different types of finned tube heat exchangers? State one applications of each heat exchanger.

d) Give the difference between single pass and multi pass shell and tube heat exchanger.

e) Define absorptivity, reflectivity and transmissivity. Name the material for which $\alpha + \tau = 1$

Q.3 Attempt any TWO of the following: 16 Marks

a) Draw a neat labeled diagram of plate type heat exchanger. Give its construction and working.

b) Derive the relationship between individual and overall heat transfer coefficients.

c) Find the overall heat transfer coefficient if :

i) Inside and outside film heat transfer coefficients are 12 and 11600 W/ m^2 K.

ii) Inside and outside diameters are 25 mm and 29 mm respectively

iii) Thermal conductivity of the metal = 34.9 W/ m. K

Q.4 A) Attempt any THREE of the following: 12 Marks

a) Calculate the rate of heat transfer by radiation from an unlagged steam pipe, 50 mm o. d. at 393 K to air at 293 K.

b) Describe the process of maintenance of heat exchanger.

c) Define capacity and economy of evaporator.

d) 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. The thermal conductivity of the brick may be taken as 0.7 W/ m. K.

Q.4 B) Attempt any ONE of the following: 06 Marks

a) Derive an expression to find out rate of heat transfer through a composite wall of three materials of different thickness having different thermal conductivities.

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

Q.5 Attempt any TWO of the following: 16 Marks

a) Thermic fluid flowing at a rate of 5000 kg/h is to be cooled from 423 K to 363 K by circulating water at a rate of 15000 kg/h. If the water is available at 303 K, find the outlet temperature of water.

Data: Specific heat of thermic fluid = 2.72 KJ/Kg. K

Specific heat of water = 4.187 KJ/Kg. K

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

c) A single effect evaporator is to concentrate 20000 Kg/h of a solution having a concentration of 5 % salt to a concentration of 20% salt by weight. Steam is fed to the evaporator at a pressure corresponding to the saturation temperature of 399 K. The evaporator is operating at atmospheric pressure and the boiling point rise is 7 K. Calculate the heat load and steam economy.

Data: Feed temperature = 298 K

Specific heat of feed = 4KJ/ KgK

Latent heat of condensation of steam at 399 K = 2185 KJ/Kg

Latent heat of vaporisation of water at 373 K = 2257 KJ/Kg

Q.6 Attempt any TWO of the following: 16 Marks

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

b) Give the mechanism of heat transfer to boiling liquid.

c) Derive the relation $\Delta T_{lm} = (\Delta T_1 - \Delta T_2)/\ln(\Delta T_1/\Delta T_2)$