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(Revision 2015)

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DIPLOMA EXAMINATION IN ENGINEERING/TECHNOLOGY/MANAGEMENT/ COMMERCIAL PRACTICE, OCTOBER 2017.

HEAT TRANSFER AND EVAPORATION

(Maximum Marks : 100) Time : 3 Hrs

PART–A
(Maximum marks: 10) Marks

I. Answer all questions in one or two sentences. Each question carries 2 marks.

1. Define convection.
2. Define radiation.
3. List two types of shell and tube heat exchanger.
4. State Duhring's rule.
5. Define Fourier's law of thermal conduction. (5X2=10)

PART - B
(Maximum marks : 30)

II Answer any five of the following questions . Each question carries 6 marks.

1. Derive an equation for conduction through spherical wall.
2. 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, Compute the heat flow rate per unit area.
3. Summarize the concept of Black body.
4. Classify the finned tube heat exchanger and explain them.
5. A hot fluid enters a double pipe heat exchanger at a temperature of 420K and is to be cooled to 364K. A cold fluid entering at 308 K and heated to 336 K. Compute LMTD in parallel flow.
6. Summarise forward feed arrangement in multiple effect evaporation system with a neat sketch.
7. Draw the neat sketch of standard horizontal tube evaporator and label its parts.

[5x6 =30]

PART - C
(Maximum marks : 60)

(Answer one full question from each unit. Each full question carries 15 marks)

UNIT I

III (a) Derive the conduction equation for composite plane wall. (6)

(b) A steam pipeline, 150/160 mm in diameter is covered with a layer of insulating material of thickness 49 mm. The temperature inside the pipeline is 392 K and that of the outside surface of insulation is 312K. Compute the rate of heat loss per 1 m length of pipeline.

DATA: k for pipe is 50W/(m.K) and k for insulating material is 0.08 W/(m.K) (9)

OR

IV (a) Derive an equation for conduction through a cylindrical wall. (6)

(b) A furnace is constructed with 225 mm thick of fire brick, 120 mm of insulating brick and 225 mm of building brick. The inside temperature is 1200 K and the outside temperature is 330 K. Find the heat loss per unit area and the temperature of the junction of the fire brick and insulating brick.

DATA: k for fire brick = 1.4 W/(m.K)
k for insulating brick = 0.2 W/(m.K)
k for building brick = 0.7 W/(m.K). (9)

UNIT- II

V (a) Differentiate between Natural convection and Forced convection with example. (6)

(b) Find the inside heat transfer coefficient using Sieder-Tate equation for turbulent flow.

DATA: I.D of tube= 20 mm, N_{Re} = 15745, N_{pr}=36
Viscosity of fluid at average wall temperature = 900×10^{-6} pa.s
Viscosity of fluid at bulk mean temperature =550×10^{-5} Pa.s
Thermal conductivity of fluid, k=0.25 W/(m.K). (9)

OR

VI (a) Justify plank's Law. (6)

(b) Determine the heat transfer coefficient for water flowing in a tube of 16 mm diameter at a velocity of 3 m/s. The temperature of the tube is 297 K and the water enters at 353 K and leaves at 309 K. Use the Dittus – Boelter equation for cooling.

DATA: Properties of water at 331 K, density = 984.1 Kg/m^3,
C_P= 4187 J/(Kg.K), Viscosity=485 x 10^{-6} pa.s, k=0.657 W/(m.K)
Viscosity of water at 297 K, Viscosity of water is = 920x10^{-6} Pa.s (9)

UNIT- III

VII (a) Explain the constructional details and working of a U tube heat exchanger. (7)

(b) Hot oil at a rate of 1.2 kg/s (C_P =2083 J (Kg.K) flows through double pipe heat exchanger. It enters at 633 K and leaves at 573 K. The cold fluid enters at 303 K and leaves at 400K. If the overall heat transfer coefficient is 500 W/(m^2.K), Calculate the heat transfer area for Parallel flow. (8)

OR

VIII (a) Explain the constructional details and working of a double pipe heat exchanger. (7)

(b) In a double pipe counter current flow heat exchanger, 10000Kg/h of an oil having a specific heat of 2095 J/(Kg.K) is cooled from 353 K to 323 K by 8000 Kg/h of water entering at 298K. Compute the heat transfer coefficient of 300 W/(m^2.K). Take C_P for water as 4180 J/(Kg.K). (8)

UNIT – IV

IX (a) Illustrate the working of a Long tube evaporator. [6]

(b) A single effect evaporator is to concentrate 20000Kg/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 boiling point rise is 7 K. Calculate the heat load and steam economy.

DATA : Feed temperature = 298 K
Specific heat of feed = 4.0 KJ/(Kg.K)
Latent heat of condensation of steam at 399 K=2185 KJ/Kg
Latent heat of vapourisation of water at 373 K=2257 KJ/Kg. [9]

OR

X (a) Illustrate the working of a short tube evaporator. [6]

(b) A single effect evaporator is fed with 5000 Kg/h of solution containing 1% solute by weight. Feed temperature is 303 K and is to be concentrated to a solution of 2% solute by weight. The evaporation is at atmospheric pressure and area of evaporator is 69 m^2. Saturated steam is supplied at 143.3 kPa as a heating medium. Calculate steam economy and overall heat transfer coefficient.

DATA: Enthalpy of feed at 303 K = 125.79 KJ/Kg
Enthalpy of vapour at 101.325 kPa = 2676.1 KJ/Kg
Enthalpy of saturated steam at 143.3 kPa = 2691.5 KJ/Kg
Saturation temperature of steam = 383 K
Boiling point of saturation = 373 K
Enthalpy of product =419.04 KJ/Kg
Enthalpy of saturated water at 383 K = 461.30KJ/Kg. [9]

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