http://www.rgpvonline.com

In a food processing plant, a brine solution is heated from −12°C to −65°C in a double pipe parallel flow heat exchanger by water entering at 35°C and leaving at 20.5°C at the rate of 9 kg/min. Determine the heat exchanger area for an overall heat transfer coefficient of 860 W/m^2 K. For water take $C_p = 4.186 \times 10^3$ J/kg K.

5. a) Define Emissive power and Emissivity in Radiation heat transfer.

   b) Discuss Planck's law of distribution applicable for a black body radiation.

   c) Differentiate between film wise and drop wise condensation with the help of neat diagram.

   d) Two very large parallel planes with emissivities 0.3 and 0.8 radiative energy. Determine the percentage reduction in radiative energy transfer when a polished aluminium radiation shield ($\varepsilon = 0.04$) is placed between them.

OR

If the inside surface temperature of a hemispherical cavity of 0.5 m diameter is 400°C and its emissivity is 0.6, calculate the rate of radiant heat transfer from the cavity with the help of neat diagram.

******

http://www.rgpvonline.com

http://www.rgpvonline.com

http://www.rgpvonline.com

http://www.rgpvonline.com

http://www.rgpvonline.com

http://www.rgpvonline.com

http://www.rgpvonline.com

Total No. of Questions : 5] [Total No. of Printed Pages : 4

Roll No ....

ME-605

B.E. VI Semester

Examination, December 2016

Heat and Mass Transfer

Time : Three Hours

Maximum Marks : 70

Note: i) Answer five questions. In each question part A, B, C is compulsory and D part has internal choice.

ii) All parts of each question are to be attempted at one place.

iii) All questions carry equal marks, out of which part A and B (Max.50 words) carry 2 marks, part C (Max.100 words) carry 3 marks, part D (Max.400 words) carry 7 marks.

iv) Except Numericals, Derivation, Design and Drawing etc.

v) Assume suitable data if required. Use of HMT Data Book is permitted.

1. a) Discuss the mechanism of convection heat transfer with the help of neat diagram.

   b) Explain the concept of $\frac{d^2T}{dx^2} = 0$.

   c) Derive the concept of critical insulation thickness for pipes.

   d) The wall in a furnace consists of 125 mm thick refractory bricks and 125 mm thick insulating firebricks separated by an air gap of 12 mm. A 12 mm thick plaster covers the insulating firebrick to form the outer wall. The inner surface of the wall is at 1100°C and the ambient temperature is 25°C. The heat transfer coefficient on the outside wall to the air is 17 W/m^2K, and the resistance to heat flow of the air gap is 0.16 K/W. The thermal conductivities of refractory brick, insulating fire brick and plaster are 1.6, 0.3 and 1.4 W/m K, respectively. Sketch

http://www.rgpvonline.com

http://www.rgpvonline.com

the configuration of the furnace with the help of neat diagram and calculate (i) the rate of heat loss per unit area of wall surface and (ii) the interface temperature throughout the wall and (iii) the temperature at the outside surface of the wall.

OR

A tube 2cm outer diameter maintained at uniform temperature of T_1 is covered with insulation (K = 0.20 W/m K) to reduce heat loss to the ambient air at T_∞ with heat transfer coefficient at ambient is 15 W/m^2 K. Calculate (i) the critical thickness of insulation and (ii) the ratio of heat loss from the tube with insulation to that without insulation.

2. a) Where extended surfaces are used? Give suitable examples for justifying your point.

   b) How performances of Fins are measured? Define those parameters.

   c) Discuss response of thermocouples with the help of suitable temperature-time plot.

   d) A steel rod (k = 30 W/m K) 1cm in diameter and 5cm long protrudes from a wall which is maintained at 100°C. The rod is insulated at its tip and is exposed to an environment with h = 50 W/m^2 K and temperature 30°C. Calculate the fin efficiency, temperature at the tip of the fin and the rate of heat dissipation.

OR

A straight rectangular fin 2.0 cm thick and 14 cm long is constructed of Chrome steel with 20% chromium and placed on the outside of a wall maintained at 200 °C. The environment temperature is 15 °C, and the heat transfer coefficient for convection is 20 W/m^2 K. Calculate the heat lost from the fin per unit depth.

http://www.rgpvonline.com

http://www.rgpvonline.com

3. a) Differentiate between free and forced convection with the help of suitable examples.

   b) Discuss the role of Nusselt number in convection heat transfer.

   c) Discuss the flow regimes obtained in the convection heat transfer with the help of neat diagram.

   d) What is Buckingham π-theorem? Write its statement and derive a correlation between Nusselt number, Reynolds number and Prandtl number in a forced convection problem.

OR

Air at 1 bar and 40°C flows across a 5.0 cm diameter cylinder at a velocity of 50 m/s. The cylinder surface is maintained at a temperature of 140 °C. Calculate the heat loss per unit length of the cylinder.

4. a) Discuss the change in approach while calculating overall heat transfer coefficient in hollow pipe when compared with double slab arranged in series.

   b) How NTU method is different from L.M.T.D. method of heat exchanger analysis?

   c) Discuss parallel and counter flow heat exchanger with neat diagram.

   d) Air enters a cooler at 115°C and at 3 bar and is brought to 45°C by passing through tubes of 10mm inner diameter surrounded by water which enters the cooler at 15°C and leaves at 30°C. Assuming the heat exchanger is counter flow, find the mean temperature difference. If the air velocity in the tube is limited to 6.5 m/s. Find the length of the tube required. Neglect the tube resistance and assume water side heat transfer coefficient is 200 W/m^2 K.

OR

http://www.rgpvonline.com