Printed Pages : 4

NCH402

(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 151410

Roll No. | | | | | | | | | | |

B. Tech.

(SEM. IV) THEORY EXAMINATION, 2014-15

HEAT TRANSFER

Time : **3** Hours] [Total Marks : **100**

Note: Attempt all questions. All questions carry equal marks. In case of numerical problems assume data wherever not provided

1 Attempt **any four** parts of the following: **5×4=20**

(a) How the conduction heat transfer differ from convective heat transfer?

(b) How is the thermal conductivity of a material defined? What are its units?

(c) Derive the expression for fin efficiency of a rectangular fin.

(d) Derive the expression for conduction in 3 dimensions assuming unsteady heat flow.

(e) Write a brief notes on the role of Reynolds number in heat transfer processes.

(f) Discuss the physical significance of Prandtl number (P_r).

2 Attempt **any four** parts of the following: **5×4=20**

(a) Consider heat exchange between a gas and a liquid phase separated by a wall. Which,one of the side resistances is likely to control the rate of heat exchange?

(b) Describe natural convection and forced convection.

(c) How is the boundary layer thickness defined?

(d) What are the advantage and limitations of dimensional analysis?

(e) By using Dimensional Analysis prove that $Nu = \Phi[R_e, P_r]$ for forced convection.

(f) Water flows at 50°C inside a 2.5cm ID tube such that h_i =3,500 W/m^2 °C. The tube has a wall thickness of 0.8mm with K=16 W/m^2 °C. The outside of the tube losses heat by free convection with h_o=7.6 W/m^2 °C. Calculate the overall heat transfer co-efficient and heat loss per unit length to surrounding air at 20°C.

3 Attempt **any two** parts of the following: **10×2=20**

(a) Explain the film wise condensation and drop wise condensation with Nusselt's analysis. Why, the higher heat transfer rate experienced in drop wise condensation than in film wise condensation.

(b) Saturated steam at 95°C condenses on a vertical pipe of 0.04m outside diameter and 0.4 m length. The average heat transfer coefficient on tube is 11580 W/m^2K. Assuming the condensate flow to be laminar, find the rate of steam condensation and check if the flow is laminar or not. Steam and condensate properties are:

Enthalpy of inlet steam = 2670 KJ/kg

Enthalpy of outlet condensate = 400 KJ/kg

Viscosity of condensate = $4x10^{-4}$ Pa.s

Outside water temperature =80°C

(c) Explain the phenomenon of Nucleate boiling and film boiling. Discuss the effect of ΔT on 'boiling heat transfer coefficient during the entire boiling operation.

4 Attempt **any two** parts of the following: **10×2=20**

(a) Explain why radiation is usually treated as a surface phenomenon. A thin aluminum sheet with an emissivity of 0.1 on both sides is placed between two very large parallel plates that are maintained at uniform temperatures T_1= 800K and T_2 = 500K and have emissivities 0.2 and 0.7 respectively. Determine the net rate of radiation heat transfer between the two plates and compare the result to that without shield.

(b) Why do evaporators generally operate under vacuum? Discuss various methods of feeding in multiple effect evaporators with the help of neat sketches. Discuss their relative merits and demerits.

(c) Evaporator at atmospheric pressure is fed at the rate of 10,000 kg/hr of 4% concentration of caustic soda. Thick liquor leaving evaporator contains 20% caustic soda. Find:

(i) Capacity of evaporator.

(ii) If 9000 kg of steam is fed. What will be the economy of an evaporator?

5 Attempt **any two** parts of the following: **10×2=20**

(a) Explain versatility of shell and tube heat exchanger. Explain the principle and working of 2-4 shell and tube heat exchanger with neat labeled sketch.

(b) It is desired to heat 230kg/hr of water from 35 to 93°C with oil (Cp=2.1kJ/kg.K) having an initial temperature of 175°C. The mass flow of oil is also 230 kg/hr. two double pipe heat exchangers are available:

Exchanger 1 : $U=570 W/m^2.K$ $A=0.47 m^2$

Exchanger 2 : $U=370 W/m^2.K$ $A=0.94 m^2$

(c) Explain the classification and application of furnaces with neat sketches.