Registration No : | | | | | | | | | | |

Total Number of Pages : 02 **B.Tech**
PCE4I102

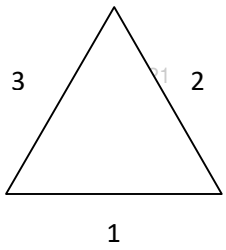
4th Semester Regular / Back Examination 2018-19
HEAT TRANSFER
BRANCH : CHEM, PT
Max Marks : 100
Time : 3 Hours
Q.CODE : F845

Answer Question No.1 (Part-1) which is compulsory, any EIGHT from Part-II and any TWO from Part-III.
The figures in the right hand margin indicate marks.

Part- I

Q1 **Only Short Answer Type Questions (Answer All-10)** **(2 x 10)**

a) Why fins are used? Write down two types boundary conditions for fin analysis.
b) Mention the value of Nusselt number for constant heat flux and constant wall temperature case in tube forced convection flow condition.
c) What is the difference between hydrodynamic boundary layer and thermal boundary layer? How these are related in forced convection heat transfer?
d) What do you mean by fully developed flow in tube? Draw the velocity profile for fully developed condition.
e) Find the shape factors F_{1-1} F_{1-2}, F_{1-3} of the following triangular cavity. All sides are having same length and area.



f) Define Rayleigh number. Give its significance.
g) Write down the applications of boiling heat transfer.
h) Why are counter flow heat exchangers mostly used compared to parallel flow type?
i) Snow is a black body. Justify.
j) What is the critical insulation radius when k=0.50 W/mK and h=10 W/m^{2}K?

Part- II

Q2 **Only Focused-Short Answer Type Questions- (Answer Any Eight out of Twelve)** **(6 x 8)**

a) Derive critical insulation thickness for a cylinder.
b) Air is flowing over a flat plate 5 m long and 2.5 m wide with a velocity of 4 m/s at 15°C. If density is 1.208 kg/m^3 and kinematic viscosity is 1.47×10^{-5} m^2/s, calculate:
i) length of plate over which the boundary layer is laminar and the thickness of boundary layer (laminar)
ii) shear stress at the location where boundary layer ceases to be laminar
iii) total drag force on the both sides on that portion of plate where boundary layer is laminar.

c) A vertical cylinder 1.5 m high and 180 mm in diameter is maintained at 100°C I an atmosphere environment of 20 °C, calculate heat loss by free convection from the surface of the cylinder. Assume properties of air at mean temperature as *ρ=1.06 kg/m^3, $v=19\times10^{-6}$ m^2/s, c_P=1.004 kJ/kgK and pr=0.7.*

d) Water (c_P=4.2 kJ/kg K) is heated at the rate of 1.4 kg/s from 40°C to 70°C by an oil (c_P=1.9 kJ/kg K) entering at 110°C and leaving at 60 °C in a counterflow heat exchanger. If U_o=350 W/m^{2}K, calculate the surface area required.

e) Differentiate between parallel flow, counter flow and cross flow heat exchangers.

f) Write a short note on Lumped heat capacity method.

g) Define the following terms :
(i) Thermal diffusivity (ii) Biot number (iii) Nusselt number

h) Explain Boiling curve with sketch.

i) What do you mean by thermal boundary layer and hydraulic boundary layer? Draw both for flow over a flat plate.

j) Differentiate between LMTD and NTU method.

k) Classify and explain different methods of condensation.

l) Classify and explain different methods of boiling.

Part-III

Only Long Answer Type Questions (Answer Any Two out of Four)

Q3 Name and explain briefly the various modes of heat transfer. **(16)**

A 0.8 m high and 1.5 m wide double-pane window consists of two 4 mm thick layers of glass(k=78W/m K) separated by a 10 mm wide stagnant air space (k=0.026 W/mK). Determine the rate of heat transfer through this window and temperature of inside surface, when the room is maintained at 20°C and the out side air is at -10°C. take the convection coefficient on the inside and out side surfaces of the window as 10 and 40 W/m^{2}K respectively. Find the overall heat transfer coefficient.

Q4 Steam enters a counter flow heat exchanger, dry saturated at 10 bar and leaves at 350^{0}C. The mass flow of stream is 800 kg/min. The gases enter the heat exchanger at 650^{0}C and mass flow rate is 1350 kg/min. If the tubes are 300 mm diameter and 3 m long, determine the number of tubes required. Neglect the resistance offered by metallic tubes. **(16)**

Q5 Two parallel gray planes have emissivities of 0.8 and 0.7 and are maintained at 800^{0}C and 1500^{0}C. What is the net radiant energy exchange? What would be the reduction in heat transfer if a radiation shield of polished aluminum (ε = 0.04) is placed between them? **(16)**

Q6 Derive general heat conduction equation in Cartesian coordinates. **(16)**

A stainless fin (k=20 W/mK) having a diameter and length of 0.1 m is attached to a wall of 300^{0}C. the ambient temperature is 50^{0}C and the heat transfer coefficient is 10 W/m^{2}K. The fin tip is insulated. Determine

a) The rate of heat dissipation from the fin
b) The temperature at the fin tip
c) Fin efficiency
d) Fin effectiveness