Paper Code: CH-401	**Roll No.**										

B. TECH.
FOURTH SEMESTER EXAMINATION, 2015-2016
HEAT TRANSFER OPERATIONS

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

Note: Attempt ***ALL*** questions. Assume suitable data, if required. All question carry equal marks.

1. Attempt any ***TWO*** parts of the following: - **(10x2)**

(a) Discuss the advantages and limitations of dimensional analysis, with the help of suitable example. Also compare Natural convection and Forced convection with suitable example.

(b) Derive the expression for heat- transfer rate for steady state conduction through a cylindrical wall. The temperature on one side of a plane wall of thickness 1.2cm is 142 ^{o}C. The heat loss through the wall is 4990 W/m^2. Determine the temperature on the other side of the wall. The thermal conductivity of the material is 16 W/m.K.

(c) What is critical thickness of insulation? Derive the critical thickness of insulation for sphere ($r_C = 2k/h_0$). Where k is thermal conductivity, h_0 is heat transfer coefficient at outer surface of insulation.

2. Attempt any ***TWO*** parts of the following: - **(10x2)**

(a) What do you understand with *View factor*? Discuss Kirchoff's law in the process of heat transfer by radiation with the help of suitable examples.

(b) Define the terms 'steam economy' & 'capacity' of an evaporator. Show the working of a Triple effect evaporator with the help of mathematical expressions.

(c) Define the term 'heat flux'. A vertical plate 49cm high and maintained at 32^{0}C is exposed to saturated steam at one atmospheric pressure. Calculate the rate of heat transfer and the condensate rate per hour per meter of the plate width for film condensation. The properties of water film at the mean temperature are :

ρ = 979.2 kg/m^3; k = 0.599 W/m ^{o}C; μ = 429 micro gram/m.s and h_{fg} = 2159 kJ/kg. Assume vapour density is small compared to that of the condensate.

3. Attempt any ***TWO*** parts of the following: - **(10x2)**

(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) Describe the method of determination of heat transfer coefficient outside the tubes in a Shell & Tube Heat Exchanger with complete calculation procedure.

(c) Crude oil flows at the rate of 990 kg/hr through the inside pipe of a double pipe heat exchanger and is heated from 32^0C to 92^0C. The heat is supplied by kerosene initially at 200^0C flowing through the annular space. If the temperature of approach (minimum temperature difference) is 10^0C, determine the heat transfer area for co-current flow. Given that *Cp* for crude oil=0.49 kcal/kg ^{0}C, *Cp* for kerosene= 0.58 kcal/kg ^{0}C and Uo= 440 kcal/hr m^2 ^{0}C

4. Attempt any ***TWO*** parts of the following:- **(10x2)**

(a) Discuss the contribution of 'Sieder-Tate equation' in the heat transfer process. A pipe 6.4 cm outside diameter is lagged with a 6cm layer of asbestos (conductivity =0.14 W/m.K) and a 3.8cm layer of cork (conductivity = 0.04 W/m.K). If the temperature of outer surface of the pipe is 163 ^{o}C and the temperature of outer surface of the cork is 39 ^{o}C, calculate the heat loss in cal/hr m.

(b) Discuss the variation of temperature of hot and cold streams along the length of a 1-2 Shell & Tube heat exchanger. In a double pipe heat exchanger, water enters at 55^0C and leaves at 85^0C. Hot gases enter at 300^0C and leaves at 160^0C. If the total heat area is 495 m^2 and the overall heat transfer co-efficient is 580 kcal/hr m^2 ^{0}C, determine the total heat transferred per hour for co-current flow of the two fluids.

(c) What is thermal boundary layer? Process fluid at ambient conditions is flowing inside a circular tube. The velocity of the fluid is 1 m/s. Calculate the heat transfer coefficient, by using following given data:
Density: 1gm/cc, Viscosity: 10^{-3} kg/m.s, Specific heat: 4.2×10^3 J/kg.K, Thermal conductivity: 0.6 W/m.K

5. Attempt any ***TWO*** parts of the following:- **(10x2)**

(a) Derive the expression for log mean temperature difference (LMTD). Also describe the 'Extended surfaces' with suitable examples, and give the applications of Fins.

(b) Define the term 'Boiling Point Rise (BPR)'. Also explain the different zones of a 'Boiling Curve' with the help of neat sketch.

(c) Classify the different types of furnaces. Explain their applications with suitable examples and neat sketches.