Code No: **R1632034** **R16** SET - 1

III B. Tech II Semester Regular/Supplementary Examinations, August-2021

HEAT TRANSFER

(Mechanical Engineering)

Time: 3 hours Max. Marks: 70

Note: 1. Question Paper consists of two parts (**Part-A** and **Part-B)**
2. Answer **ALL** the question in **Part-A**
3. Answer any **FOUR** Questions from **Part-B**
4. Heat transfer data book allowed

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PART –A (14 Marks)

1. a) What is electrical analogy in heat transfer? [3M]
   b) Define fin efficiency. [2M]
   c) What is the physical significance of Prandtl number? [2M]
   d) What are the criteria for transition from laminar to turbulent flow in natural convection? [3M]
   e) Define the effectiveness of heat exchanger. [2M]
   f) Write the properties of view factor. [2M]

PART –B (56 Marks)

2. a) A large window glass of thickness 4 mm is exposed to warm air at 20^0C at its inner surface with h_i = 155 W/m^2 ^{0}C. Outside air is at 10^0C and h_o = 45 W/m^2 ^{0}C. Find the inner and outer surface temperature of glass and the overall heat transfer coefficient. [7M]
   b) A hollow cylinder whose k varies with temperature as k(T)=0.5(1+0.001T), where T is in 0C has an ID of 7.5 cm and OD of 12.55 cm. If the inside and outside surfaces are at a uniform temperature of 250^0C and 100^0C respectively. Find the steady state heat transfer per meter length of tube. [7M]

3. a) Calculate the rate of heat transfer from a rectangular fin of length 2 cm, on a plane wall. Thickness of the fin is 2 mm and its breadth is 20 cm. Take T_1 = 200^0C, h = 17.5/m^2 ^{0}C, k = 52 W/m^{0}C. Assume the heat loss from the tip is negligible. [7M]
   b) A house hold electric iron has aluminum base which weighs 1.4 kg. Total area of the iron is 0.05 m^2 and is heated with a 500 W heating element. Initially the iron is at ambient temperature of 20^0C. How long will it take for the iron to reach 120^0C once it is switched on? Take heat transfer coefficient as 18 W/m^2 ^{0}C. [7M]

4. a) Using dimensional analysis prove: Nu = f(Re,Pr). [7M]
   b) Briefly explain how roughness affect pressure drop and heat transfer in internal flows. [7M]

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5. a) A 10 mm diameter cable carrying a current of 75 A and its resistance of 0.005 Ω/m. Determine the surface temperature of the cable if air is blowing at 25^0C across the cable at a velocity of 1.25 m/s. [7M]
   b) A hot plate 100 cm height and 25 cm width is exposed to atmospheric air at 20^0C. The surface temperature of the plate is 100^0C. Find the heat loss from both surface of the plate. If the height of the plate is reduced to 50 cm and width increased to 40 cm, what will be change in heat transfer? [7M]

6. a) Differentiate between nucleate boiling and film boiling. [7M]
   b) A double pipe heat exchanger is used to heat water with a mass flow rate of 12 kg/s from 22^0C to 45^0C. The hot fluid enters at 75^0C with a capacity rate 25 kW/K and overall heat transfer coefficient is 1550 W/m^{2}K. Determine the surface area for counter and parallel flow arrangement. [7M]

7. a) State Weins law of displacement and prove that monochromatic emissive power of black body is maximum when λT = 2900 μmK. [7M]
   b) Two parallel rectangular surfaces 1m x 2m are opposite to each other at a distance of 4 m. The surfaces are black and at temperatures of 100^0C and 200^0C respectively. Calculate the net rate of heat exchange by radiation between the two surfaces. [7M]

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