

III B. Tech II Semester Regular/Supplementary Examinations, October/November - 2020**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

PART -A**(14 Marks)**

1. a) Define the critical thickness of insulation. [3M]
- b) Define Fin effectiveness. [2M]
- c) Define the thermal boundary layer. [2M]
- d) Why airplanes are designed aerodynamic? [2M]
- e) What are the practical difficulties in maintaining drop wise condensation? [3M]
- f) What is visible light and to which part of the electromagnetic spectrum it belongs? [2M]

PART -B**(56 Marks)**

2. a) A metal ($k=45 \text{ W/m}^\circ\text{C}$) steam pipe of 5 cm ID and 6.5 cm OD is lagged with 2.75 cm radial thickness of inside and outside surface are $h_i=4650 \text{ W/m}^2\text{K}$ and $h_o=11.5 \text{ W/m}^2\text{K}$ respectively, if the steam temperature is 200°C and ambient is 25°C , Calculate: i) heat loss per meter length of pipe, and ii) temperature at interfaces. [7M]
- b) Derive an expression for the variation of temperature along the radius for a solid sphere of constant, k when there is uniform internal heat generation in the solid. [7M]
3. a) Derive an expression for heat dissipation for an infinitely long fin. [7M]
- b) A 50 cm x 50 cm copper slab, 6 mm thick at a uniform temperature of 350°C suddenly has its surface temperature lowered to 30°C . Find the time at which the slab temperature becomes 100°C . $h = 100 \text{ W/m}^2\text{C}$. Also, find the rate of cooling after 60 seconds. [7M]
4. a) Derive the momentum equation for a laminar boundary layer stating the assumptions made. [10M]
- b) What are dimensional homogeneity and state its uses? [4M]
5. a) Water flows at 45°C over a flat plate 1m x 1m size maintained at 22°C with a velocity of 1.5 m/s. Estimate the variation of heat transfer coefficient along the length of heating starts from 0.25 m from the leading edge. [7M]
- b) A vertical pipe 7.5 cm OD and 2.2 m long have a surface temperature of 95°C surrounded by air at 22°C , Estimate the rate of heat loss from the cylinder when i) vertical ii) horizontal. [7M]
6. a) Draw and explain with suitable graph various regimes of boiling. [7M]
- b) Water at a rate of 4080 kg/h is heated from 35°C to 75°C by the oil of $C_p 1.9 \text{ kJ/kgK}$. The heat exchanger is a double pipe counter flow. Oil enters at 110°C and leaves at 75°C . Determine: i) mass flow rate of oil, ii) area of the heat exchanger to handle heat duty if the overall heat transfer coefficient is $320 \text{ W/m}^2\text{K}$. [7M]

7. a) What is the intensity of radiation and prove total emissive power is π times the intensity of radiation. [7M]
- b) A long pipe 40 mm in diameter passes through a room and is exposed to air at 35°C. [7M]
The surface temperature of the tube is 95°C. Assuming the emissivity of the pipe as 0.6, estimate the radiation heat loss per meter length.
