

III B. Tech II Semester Supplementary Examinations, February-2022

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**

PART -A**(14 Marks)**

1. a) What is the convection mode of heat transfer? [2M]
- b) How the fin thickness influences the efficiency of a fin. [2M]
- c) What is dimensional analysis in heat transfer? [2M]
- d) What is meant by a thermal boundary layer? How is Prandtl number related to its thickness? [3M]
- e) Drop wise condensation is faster than film condensation. State the reason. [3M]
- f) Define Black body and Grey Body. [2M]

PART -B**(56 Marks)**

2. a) Differentiate three modes of heat transfer? [7M]
- b) Derive the heat conduction equation in cylindrical co-ordinates. [7M]
3. a) A 0.5 cm thick and 4 cm long fin has its base on a plane plate which is maintained at 110°C . The ambient air temperature is 20°C . The conductivity of the fin material is 60 W/m-K and the heat transfer coefficient $h = 150 \text{ W/m}^2\text{-K}$. Assume that the tip of the fin is insulated. Determine: [7M]
 - (i) Temperature at the end of the fin
 - (ii) Temperature at the middle of the fin
 - (iii) Total heat dissipated by the fin
- b) Define fin efficiency. What are the assumptions made in deriving an expression for finding temperature distribution along a circular fin? [7M]
4. a) Explain the concept of momentum and energy equation. [7M]
- b) State and explain Buckingham π theorem. [7M]
5. a) Explain velocity and temperature profile for a flat plate and vertical plate in forced convection. [7M]
- b) Air at 15°C and at a pressure of 1 atm is flowing along a flat plate at a velocity of 4.75 km/sec . If the plate is one meter wide and at 70°C , find the quantities given below at $x = 1\text{m}$. [7M]
 - (i) Hydrodynamic Boundary layer thickness.
 - (ii) Local friction factor
 - (iii) Average friction
 - (iv) Local heat transfer co-efficient
 - (v) Rate of heat transfer



6. a) In an industry 0.6 kg/Sec of oil ($C_p=2.5$ kJ/kg-K) is to be cooled in a counter flow heat exchanger from 110 °C to 35 °C by the use of water entering at 20 °C. The overall heat transfer coefficient is 1500 W/m²-K. Presuming the exit water temperature should not exceeds 80 °C, using NTU method, Calculate: [7M]
- (i) Water flow rate
 - (ii) Surface area required
 - (iii) The effectiveness of heat exchanger.
- b) With the help of a neat sketch explain the various boiling regimes in the case of a pool boiling operation. [7M]
7. a) Define total emissive power (E_b) and intensity of radiation (I_b). Show that $E_b = \pi \times I_b$. [7M]
- b) A long pipe 40 mm in diameter passes through a room and is exposed to air at 35°C. 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. [7M]

