R20 Regulation *Subject code: 3P6CB*

TKR COLLEGE OF ENGINEERING AND TECHNOLOGY

(Autonomous, Accredited by NAAC with 'A' Grade)

B.Tech VI Semester Regular Examinations, June/July 2023

HEAT TRANSFER

(Mechanical Engineering)

Maximum Marks: 70 Date:24.06.2023 Duration: 3 hours

Note: **1.This question paper contains two parts A and B.**
2. Part A is compulsory which carries 20 marks. Answer all questions in Part A.
3. Part B consists of 5 Units. Answer any one full question from each unit which carries 10M.
4. Each question carries 10 marks and may have a, b, c, d as sub questions.

Part-A

All the following questions carry equal marks (10X2M=20 Marks)

1 Differentiate between Steady, Unsteady and Periodic heat transfer.
2 State Fourier's law of heat conduction? Why the negative sign is used.
3 What is the significance of Biot number?
4 What is the function of fin?
5 Define the thermal boundary layer.
6 What is Buckingham's π theorem?
7 Describe the selection criteria of heat exchanger.
8 What is fouling factor?
9 What are the practical difficulties in maintaining drop wise condensation?
10 Define irradiation.

Part-B

Answer All the following questions. (5X10M=50Marks)

11 Derive general differential heat conduction equation in cylindrical coordinates? [10M]

OR

12 A composite wall consists of two layers of thickness 10 &15 mm and their respective thermal conductivities are 35 W/m K& 8 W/m K. The inner surface of the wall is expressed to high temperature gas at 150°C and with convective heat transfer coefficient 150 W/m^2K. The outer surface exposed to at 25°C with convective heat transfer coefficient 20 W/m^2K. Determine the following
   a. Overall heat transfer coefficient?
   b. Rate of heat transfer per unit Area?
   c. Find interface temperature?

[10M]

13 Describe the temperature distribution along the length for fin in four various conditions of the tip. [10M]

OR

14 A 3mm thick copper plate of 0.4×0.4 m^2 area at 300°C is suddenly dipped into oil at 20 °C. Calculate the time required for the plate to reach 40 °C. Assume heat transfer co-efficient is 90 W/m^2k, density= 8800 kg/m^3, thermal conductivity = 350 W/m K, specific heat = 380 J/kg-k. [10M]

15 A. Explain the hydrodynamic boundary layer. Sketch the formation Boundary layer and show laminar, transition, and turbulent Flow. [5M]

B. What are the advantages and limitations of dimensional analysis? [5M]

OR

16 Air at a temperature of 27°C is moving at a velocity of 0.3 m/s past a 40 W incandescent bulb. The bulb may be treated as a sphere of 50 mm diameter with its surface at a temperature of 127°C. Estimate the heat transfer coefficient and compute the percentage of power loss due to convection. [10M]

17 A. What is a heat exchanger? [3M]

B. In a counter flow double pipe heat exchanger, water is heated from 25^0C to 65^0C by oil with a specific heat of 1.45 kJ/kg-K and mass flow rate of 0.9kg/s. the oil is cooled from 230^0C to 160^0C. If overall heat transfer coefficient is 420W/m^2 -K. Calculate the rate of heat transfer, mass flow rate of water and surface area of heat exchanger. [7M]

OR

18 Derive the expression for boundary layer thickness for free convection heat transfer on a vertical flat plate. [10M]

19 Describe the design of the simple shell and tube heat exchanger. [10M]

OR

20 A. Derive an expression for the shape factor in case of a radiation exchange between two surfaces. [5M]

B. Show that the emissive power if a black body is π – times the intensity of emitted radiation.

[5M]