

JK LakshmiPat University Jaipur
INSTITUTE OF ENGINEERING AND TECHNOLOGY

End Term Examination, May, 2022

Transport Phenomena

B. Tech. in Mechanical Engineering

Roll No.....

Course Code : ME1104

Time: 2 hours

Max. Marks: 30

Instructions to students:

Do not write anything other than your roll number on question paper.

Answer any three. Use of Heat transfer data Handbook is permitted.

Assume suitable data wherever required and mention it clearly.

Writing appropriate units, nomenclature, and drawing neat sketches/schematics/ flow chart wherever, required are an integral part of the answer.

- Q.1 Some aeronautical engineers are designing an airplane and wish to predict the lift produced by their new wing design (Fig. 1). The chord length L_c of the wing is 1.12 m, and its planform area A (area viewed from the top when the wing is at zero angle of attack) is 10.7 m^2 . The prototype is to fly at $V = 52 \text{ m/s}$ close to the ground where $T = 25^\circ\text{C}$. They build a one-tenth scale model of the wing to test in a pressurized wind tunnel. The wind tunnel can be pressurized to a maximum of 5 atm. At what speed and pressure should they run the wind tunnel in order to achieve dynamic similarity? **10**
CO2

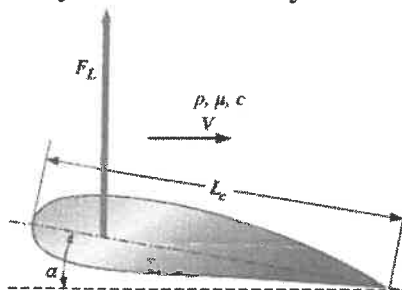


Figure 1

- Q.2 Two infinite parallel plates are placed on a slope which makes an angle θ with horizontal. The gap between two plates is $2H$. A steady incompressible flow fills the entire gap between the plates. The pressure at inlet and exit section of the flow is equal to atmospheric value. Assuming fully developed flow, determine the velocity field between the plates and shear stress value at top and bottom walls. **10**
CO2
- Q.3 Hot air at atmospheric pressure and 85°C enters a 10-m-long un-insulated square duct of cross section $0.15 \text{ m} \times 0.15 \text{ m}$ that passes through the attic of a house at a rate of $0.10 \text{ m}^3/\text{s}$. The duct is observed to be nearly isothermal at 70°C . Determine the exit temperature of the air and the rate of heat loss from the duct to the air space in the attic. **10**
CO1,3

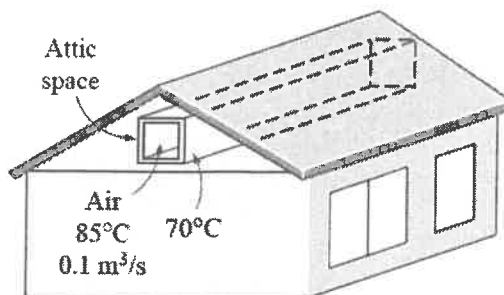


Figure 2

- Q.4 Consider a 15-cm×20-cm printed circuit board (PCB) that has electronic components on one side. The board is placed in a room at 20°C. The heat loss from the back surface of the board is negligible. If the circuit board is dissipating 8 W of power in steady operation, determine the average temperature of the hot surface of the board, assuming the board is (a) vertical, (b) horizontal with hot surface facing up, and (c) horizontal with hot surface facing down. Take the emissivity of the surface of the board to be 0.8 and assume the surrounding surfaces to be at the same temperature as the air in the room. 10
Co1,4

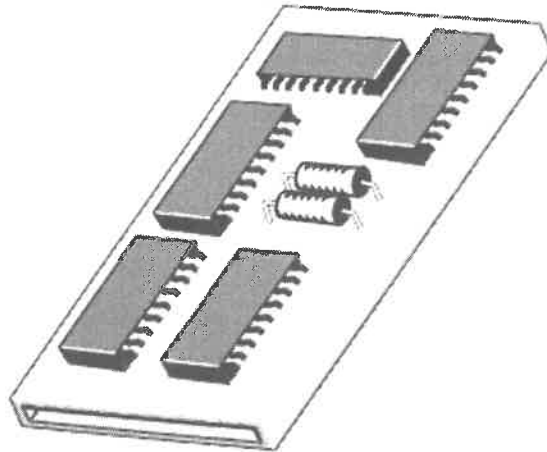


Figure 3