Seat No.

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OCT-NOV 2025 WINTER EXAMINATION

1154 B.Tech. CBCS

Sub. Name: Heat and Mass Transfer

Sub. Code: 66243/80755/81009

Day and Date: Wednesday,17-12-2025 **Total Marks: 70**

Time: 02:30 PM To 05:00 PM

Instructions:
1. **All questions are compulsory**
2. **Assume suitable data wherever necessary and mention it boldly**
3. **Figures to the right indicate full marks**
4. **Use of Scientific calculator is allowed**

Q1) Solve any two. **[12]**

a) Explain mass transfer and Fick's Law of Diffusion.

b) Define overall heat transfer coefficient. Also derive the expression of overall heat transfer for at a wall having thickness b and conductivity K .Inside and outside heat transfer Coefficient as hi and ho.

c) A plane wall is 20 cm thick of surface area 6 m^2.Thermal conductivity of wall is 9.5 W/m-K. The inner and outer surface temperatures of the wall are maintained at 170°C and 40°C respectively. Determine heat flow across wall and temperature gradient in the heat flow direction.

Q2) Solve any two. **[12]**

a) Explain lumped heat capacity analysis.

b) Write the one dimensional heat conduction equation with heat generation for plane wall and state the boundary condition for various cases.

c) A 50cm x 50cm copper slab 6.25mm thick has a uniform temperature of 300 ˚c is suddenly lowered to 36°C .Calculate time required for plate to reach the temperature 108°C .Take ρ = 9000 kg/m^3, Cp = 0.38KJ/kg °C ,k = 370W/m-°C and h= 90W/m^2- °C.

Q3) Solve any two. **[12]**

a) Explain classification of fin with neat Sketch.

b) Derive the expression for temperature distribution in fin of finite length with insulated end.

c) A long rod 12 mm square section made of low carbon steel protrudes into air at 35°C from a furnace wall at 200°C. The convective heat transfer coefficient is estimated at 22 W/m^2-K. The conductivity of the material is 51.9 W/m-K. Determine the location from the wall at which the temperature will be 60°C.

Q4) Solve any two. **[12]**

a) Write a short note on thermal boundary layer.

b) Explain factors affecting the convective heat transfer coefficients.

c) A flat plate is 2 m long, 1 m wide and 3 mm thick. Density of plate= 3000 Kg/m^3. Specific heat of plate material =700J/Kg-K. Its initial temperature is 80°C.A stream of air at 20°C is blown over both surfaces of the plate along its width, at a velocity 2 m/s Calculate heat transfer coefficient. ρ=1.09 kg/m^3, k=0.028 W/m-K, Cp=1.007 KJ/Kg-K, μ=2.03x 10^{-5} kg/m-s, Pr=0.698, $Nu=0.664 \times (Re)^{0.5} \times (Pr)^{0.3333}$

Q5) Solve any two. **[12]**

a) State and prove Kirchhoff's Law.

b) Explain the following terms 1) black body 2) Grey body 3) Opaque body.

c) The filament of a 75 W light bulb may be considered as a black body radiating into a black enclosure at 70° C, the filament diameter is 0.10 mm and length is 5 cm. considering the radiation, determine the filament temperature. Assume Stefan-Boltzmann constant- $\sigma = 5.67 \times 10^{-8}$ W/m^2- K^4

Q6) Solve any two. **[10]**

a) Explain types of condensation and boiling.

b) Define Fouling factor and explain causes of fouling.

c) Determine the area required in parallel flow heat exchanger to cool oil from 60°C to 30°C using water available at 20°C. The outlet temperature of the water is 26°C. The rate of flow of oil is 10 kg/s. The specific heat of the oil is 2200 J/kg K. The overall heat transfer coefficient U = 300 W/m^2- K.

End Of Question Paper

Important Note for Chief Exam Officer / SRPD Coordinator / Sr Supervisor/ Student -
This Question Paper may be distributed for following Subjects as common code.
सदरची प्रश्नपत्रिका खालील विषयांकरिता वितरित करता येईल.

1] (101) Bachelor of Engineering (81009) Heat and Mass Transfer Part 3 SEM 5

2] (1154) B.Tech. CBCS (80755) Heat and Mass Transfer Part 3 SEM 5

3] (101) Bachelor of Engineering (66243) Heat and Mass Transfer Part 3 SEM 5