**Model Question Paper**

**Total Duration (H:M):3:00**

**Course: Heat and Mass Transfer (BMET-501)**

**Maximum Marks: 100**

| Q.No | Questions | Marks | CO | BL | PI |
|---|---|---|---|---|---|
| **1a** | What are the heat exchanger? Where they are used? | **5** | **CO1** | **L1** | |
| **1b** | Show that total emissive power is π times the intensity radiation. | **5** | **CO4** | **L2** | |
| **1c** | Hot oil is being cooled from 160°C to 110°C in a parallel flow heat exchanger by water entering at 24°C and exiting at 60°C. Determine the outlet temperature of both streams if the heat exchanger is made counter flow. | **5** | **CO5** | **L3** | |
| **1d** | Define fin efficiency and fin effectiveness. What are the general types of fins and their specific applications? | **5** | **CO2** | **L1** | |
| **2a** | Drive an expression for logarithmic mean temperature difference of parallel flow heat exchanger and state the assumption clearly. | **8** | **CO5** | **L3** | |
| **2b** | Air at 20°C and 1 atm flows over a flat plate at 40 m/s. The plate is 80 cm long and is maintained at 60°C. Assuming unit depth in z-direction, calculate the heat transfer rate from the plate. (Properties of air at 40°C are: Pr =0.7, k=0.02723 W/m K, $c_p$=1.007 kJ/kg K and μ=1.906 x $10^{-5}$ kg/ms). | **8** | **CO3** | **L4** | |
| **3a** | What is mean by fouling factor? How does it affect the performance of a heat exchanger? | **5** | **CO5** | **L1** | |
| **3b** | What is the displacement and energy thickness in forced convection? Derive their expressions | **5** | **CO3** | **L1** | |
| **3c** | **Explain the mass transfer processes.** | **5** | **CO5** | **L1** | |
| **3d** | What is Grashof number. What is its physical significance? | **5** | **CO3** | **L2** | |
| **4a** | Describe the lumped heat capacity method in detail. | **8** | **CO2** | **L1** | |
| **4b** | Derive the expression for the effectiveness of a counter flow type heat exchanger | **8** | **CO5** | **L2** | |
| **4c** | An aluminium (k=185 W/mK) pipe of inner diameter 10 cm and outer diameter 12 cm carrying steam at 110°C loses heat to the room air at 30°C having h=15 W/$m^2$K. Find (i) the rate of heat transfer (ii) the percentage reduction in the heat transfer if an insulation (k=0.2 W/mK) of 5 cm thickness covers the pipe. | **8** | **CO1** | **L4** | |
| **5a** | A lubricating oil (ρ = 865 kg/$m^3$, k = 0.14 W/mK, $c_p$=1.78 kJ/kg K, and ν = 9 x $10^{-6}$ $m^2$/s) at 60°C enters a 1 cm diameter tube with a velocity of 3.5 m/s. Calculate the tube length required to cool the oil to 45°C. ($T_w$ = 30°C and, Dittus-Boelter equation $Nu_d = 0.023 (Re_d)0^{.8} (P_r)^{0.3}$). | **10** | **CO3** | **L4** | |
| **5b** | Explain the boiling heat transfer. | **5** | **CO5** | **L1** | |
| **5c** | What is thermal insulation and overall heat transfer coefficient. | **5** | **CO1** | **L1** | |
| | Planck's constants: $C1$ = 3.743 x $10^8$ $W\,\mu m^4/m^2$ and $C2$ = 1.4387 x $10^4$ $\mu m \cdot K$; Wien's displacement law constant = 2897.6 $\mu m \cdot K$. Stefan-Boltzmann constant = 5.67 x $10^{-8}$ $W/m^2K^4$ | | | | |