Name: Enrolment No:	UPES

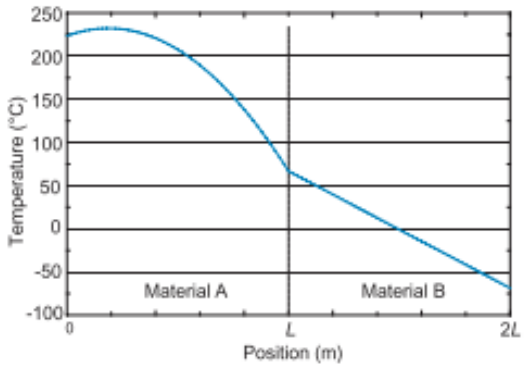
UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

Online End Semester Examination, May 2021

Programme Name: B.Tech- ADE **Semester : VI**
Course Name : Heat Transfer **Time : 03 hrs**
Course Code : MECH3015 **Max. Marks: 100**

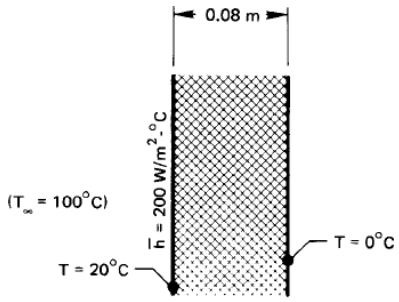
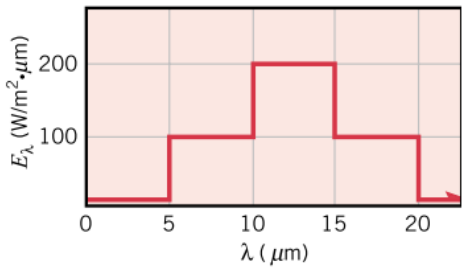
SECTION A

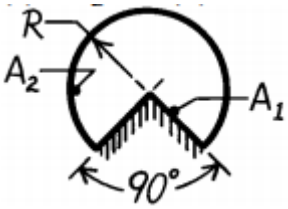
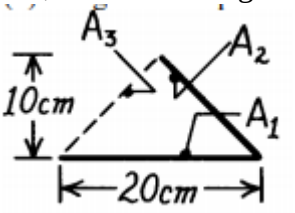
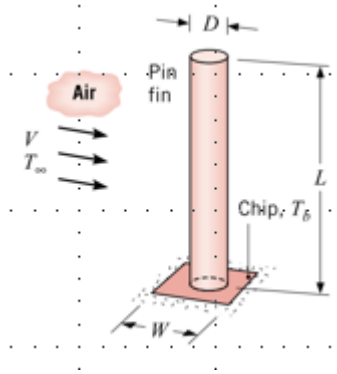
1. **Each Question will carry 5 Marks**
2. **Instruction: Complete the statement / Select the correct answer(s)**

S. No.	Questions	CO
Q 1	Examine the solution provided by the engineer shown in figure and write the characteristic of solution in terms of heat generation and thermal conductivivty of material A and B. 	CO1
Q 2	Explain thermal diffusivity of material and examine the effect of temperature on thermal conductivity of metals and non-metals?	CO1
Q 3	Critically examine the Grashof number for different orientation of cylinder of length L and diameter D?	CO2
Q.4	Define Spectral Intensity of radiation and explain spectral emissive power in terms of intensity of radiation?	CO1
Q.5	Explain velocity and thermal boundary layer formation for different range of Prandtl number?	CO3
Q.6	Explain conservation of energy requirement and explain control volume energy balance and surface energy balance.	CO1

SECTION B

1. **Each question will carry 10 marks**
2. **Instruction: Write short / brief notes**

Q 1	The thermal conductivity in a particular plane wall depends as follows on the wall temperature: $k = A + BT$, where A and B are constants. The temperature are T_1 and T_2 on either side. If the wall and its thickness is L. Develop an expression for q.  	**CO2**
Q 2	 (a) What is the total emissive power? (b) What is the total intensity of the radiation emitted in the normal direction and at an angle of 30° from the normal? ***OR*** The sun emits maximum radiation at λ = 0.52 μ. Assuming the sun to be a black body, calculate the surface temperature of the sun. Also calculate the monochromatic emissive power of the sun's surface.	**CO3**
Q.3	Water of kinematic viscosity (ϑ) equal to 9.29×10^{-7} m^2 /s is flowing steadily over a smooth flat plate at zero angle of incidence, with a velocity of 1.524 m/s. The length of the plate is 0.3048 m. Calculate: (a) The thickness of the boundary layer at 0.1524 m from the leading edge. (b) Boundary layer rate of growth at 0.1524 m from the leading edge. (c) Total drag coefficient on the plate.	**CO2**
Q.4	A loaf of bread is removed from an oven at 125 ^{0}C and set on the counter to cool in a kitchen at 25 ^{0}C. The loaf is 30 cm long, 15 cm high and 12 cm wide. If k = 0.05 W/mK and $\alpha = 5 \times 10^{-07}$ m^2/s for bread, and h = 10 W/m^2K, when will be the hottest part of the loaf have cooled to 60 ^{0}C?	**CO1**

Q.5	Find shape factor F_{12} and F_{21}, for each configuration?  (a)  (b)	**CO3**
SECTION C **1. Each Question carries 20 Marks.** **2. Instruction: Write long answer.**		
Q 1	To enhance heat transfer from a silicon chip of width 4mm on a side, a copper pin fin is brazed to the surface of the chip. The pin length and diameter are l = 12mm and D = 2mm, respectively. And atmospheric air at v = 10 m/s and T_∞ = 300 K is in cross flow over the pin. The surface of the chip and hence the base of the pin are maintained at a temperature of T_b = 350 K.  (a) Assuming the chip to have a negligible effect on flow over the pin, what is the average convection coefficient for the surface of the fin? (b) Neglect the radiation and assuming the convection coefficient at the pin tip to equal that calculated in part (a), determine the pin heat transfer rate. ***OR*** A counter flow heat exchanger is used to cool 2200 kg/hr of oil (c_p=2.5 kJ/kg.K), from 100°C to 35°C by the use of water entering at 17°C. If the overall heat transfer coefficient is expected to be 1.5 kW/m^{2}k, make calculations for the water flow rate, the surface area required and the effectiveness of heat exchanger. Presume that the exit temperature of water is not to exceed 85°C. Use NTU-effectiveness approach.	**CO4**