**BBBDNITM, LKO**

**MECHANICAL AND AERONAUTICAL DEPARTMENT**

**SUBJECT-HEAT AND MASS TRANSFER**

**UNIT-2**

**ASSIGNMENT-2**

**SECTION-A**

**Short Questions :(2 Marks)**

1).What areBiot no. and Fourier no?What is the physical Significance of these numbers?

2). Explain the efficiency & effectiveness of fin.

3). Explain the lumped parameter analysis.

4). Explain the significances of Hesiler charts.

5). Give examples of use of fins in various engineering applications.

**SECTION-B**

**Questions upto 200 words :(10 Marks)**

6).Show that for transient heat conduction-

$\frac{θ}{θi}$=$e^{-BiF0}$

2). A 15 mm diameter mild steel sphere (k=42 W/m◦C is exposed to cooling air flow at 20◦C resulting ic convective coefficient h= 120 W/m2 C.Determine the following-

(i)Time required to cool the sphere from 550 C to 90 C

(ii)Instantaneous heat transfer rate 2mins after start of cooling.

7).One end of a long rod,30 mm in diameter, is inserted into the furnace with the other end projecting in the outside air. After the steady state is reached, the temperature of the rod is measured at two points 150 mm apart and found to be 140˚C and 100˚C.The temperature of atmospheric air is 30˚C. If the heat transfer coefficient is 60 W/$m^{2}$˚C, determine the thermal conductivity of the rod.

8). A motor body is 300 mm in diameter (outside) and 200 mm long. Its surface temperature should not exceed 50˚C when dissipating 150 W. Longitudinal fins of 12 mm thickness and 30 mm height are proposed. The convention coefficient is 40 W/m ˚C. Determine the number of fins required. Atmospheric air temperature is 35˚C.

9). One end of copper rod (k=380 W/m ˚C) and 300 mm long is connected to wall which is maintained at 300˚C. The other end is firmly connected to a wall which is maintained at 100˚C. Air is blown across the rod so that the heat transfer coefficient 20 W/$m^{2}$˚C is maintained. The diameter of the rod is 15mm and temperature of air is 40˚C. Determine the net heat transferred to the air and the heat conducted to the other end which is at 100˚C. 1).A hot mild sphere (k=42.5 W/m ˚C) having 12mm dia. is planned to be cooled by an air flow at 27˚C.The convective heat transfer coefficient is 114 W/$m^{2}$ ˚C. Determine the following:

(a)Time required to cool sphere from 540 ˚C to 95 ˚C.

(b)Instantaneous heat transfer rate 2 minutes after the start of cooling.

(c)Total energy transferred from the sphere during the first 2 minutes. Take mild steel properties as$ ρ$=7850 kg/$m^{3}$, c=475 J/kg ˚C,$∝$=0.043 $m^{2}$/h.

10).A long cylindrical bar (k=17.5 W/m˚ C,$∝=$0.0185 $m^{2}$/h)of radius 75 mm comes out of oven at 815˚C throughout and is cooled by quenching it in a large bath of 38˚C coolant. The surface coefficient of heat transfer between the bar surface and the coolant is 175 W/m˚ C. Determine -

(a)The time taken by the shaft centre to reach 116˚C.

(b) The surface temperature of the shaft when its centre temperature is 116˚C.Also calculate the temperature gradient at the outside surface at the same instant of time.

11). Derive expression for temperature distribution and heat dissipation in a straight fin of rectangular profile for the fin insulated at the tip.

12).A person is found dead at 5 p.m in a room where temperature is 20 ⁰C. The temperature of the body is measured to be 25 ⁰C when found, the heat transfer coefficient is estimated to be 8 W/m2K. Modelling the human body a 30 cm diameter, 1.70 mt long cylinder, Calculate the actual time of death of the person. Take k=6.08 W/m K, ρ= 900kg/m3, C=4000J/kg K.

**SECTION-C**

**Very Long Questions :(15 Marks)**

13).An electric motor is to connected by a horizontal steel shaft (k=42.56 W/mK) 25 mm in diameter to an impeller of a pump circulating liquid metal at a temperature of 540 ⁰C. If the temperature of electric motor is limited to a maximum value of 52⁰ C with the ambient air at 27 ⁰C and the heat transfer coefficient of 40.7 W/m2K, what length of the shaft should be specified between the motor and pump.

14). A long rod is exposed to air at 298°C. It is heated at one end. At steady state conditions, the temperature at two points along the rod separated by 120 mm are found to be 130°C and110°C respectively. The diameter of the rod is25mmOD and its thermal conductivity is 116W/m°C. Calculate the heat transfer coefficient at the surface of the rod and also the heat transfer rate.

15).An aluminium rod (k =204 W/m K) 2 cm in diameter and 20 cm long protrudes from a wall which is maintained at 300°C. The end of the rod is insulated and the surface of therod is exposed to air at 30°C. The heat transfer coefficient between the rod's surface and air is 10 W/m2K. Calculate the heat lost by the rod and the temperature of the rod at a distance of 10 cm from the wall.