01324

Printed Pages—5   **ME—505**

(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 4018   **Roll No.** | | | | | | | | | | |

B.Tech.

FIFTH SEMESTER EXAMINATION, 2005-2006

HEAT & MASS TRANSFER

Time : 3 Hours   *Total Marks : 100*

Note : (i) *Attempt **ALL** Questions.*

(ii) *All questions carry equal marks.*

(iii) *All symbols have usual meaning.*

(iv) *Use the data and relations provided in the question paper.*

(v) *Be precise in your answer.*

1. Attempt *any two* of the following questions : **(10x2=20)**

(a) Answer *any two* of the following :

(i) For a cylindrical wall, discuss the effect of variation of insulation radius on the thermal resistance.

(ii) What do you understand by contact resistance ?

(iii) What are the various boundary conditions for conduction ?

(b) (i) Discuss Fourier's Law of Heat Conduction. Why a negative sign is inserted in its expression ?

(ii) Derive an expression for thermal resistance of cylindrical wall.

(c) An electrical wire of diameter 10mm and a resistance per unit length of 10^{-4} Ω/m is coated with an insulation of thermal conductivity k = 0.20 W/m K. The surrounding air temperature is 27°C and h = 10 W/m² K. If the insulation has a maximum allowable temperature of 177°C, what is the maximum possible current that may be passed by the wire ?

Attempt *any two* of the following questions : **(10x2=20)**

(a) For a plane wall subjected to uniform volumetric heat generation and exposed to a fluid at same temperature on both the sides, derive an expression for temperature distribution within the wall and prove that the heat generated is equal to the heat lost from the sides. Assume one dimensional case.

(b) Balls of 12 mm diameter are annealed by heating to 877 °C and then slowly cooling to 127 °C in an air at a temperature of 52°C and h = 20 W/m² K. Calculate the time required for the cooling process. For the balls take: ρ = 7800 kg/m³, k = 40 W/m K, c = 600 J/kg K.

(c) What do you understand by the corrected length of a fin ? Derive an expression for the temperature distribution and heat transfer rate for a rectangular fin with insulated tip.

    (a)   What do understand by the followings, answer any two only :

        (i)   Laminar free convection over a vertical surface.

        (ii)   Grashof Number and Rayleigh Number.

        (iii)   The bulk mean or cup mean temperature (for internal flow).

    (b)   A circular cylinder of radius 12.5 mm is initially at 150°C and is suddenly exposed to oil at 80°C, which moves at a velocity of 2 m/s in cross flow over the cylinder. What is the initial rate of heat loss per unit length of the cylinder ? For the oil take :

        (At $T_\infty = 353$ K) $v = 38.1 \times 10^{-6}$ m²/s, $Pr_\infty = 501$, $k = 0.138$ W/m K;

        (At $T_s = 423$ K) $Pr_s = 98$.

    (c)   Prove that the local convection coefficient for the thermally fully developed internal flow of a fluid with constant properties is independent of axial location.

4.   Attempt *any two* of the following questions : **(10x2=20)**

    (a)   What do you understand by the followings, answer *any two* only :

        (i)   Radiosity

        (ii)   Kirchhoff's Law

        (iii)   Colored surface