Reg. No. : | | | | | | | | | | |

Question Paper Code: 31762

B.E. / B.Tech. DEGREE EXAMINATION, NOV 2016

Sixth Semester

Mechanical Engineering

01UME602 - HEAT AND MASS TRANSFER

(Regulation 2013)

Duration: Three hours Maximum: 100 Marks

Answer ALL Questions

(HMT data book is permitted)

PART A - (10 x 2 = 20 Marks)

1. Define heat transfer.
2. What are the modes of heat transfer?
3. What is conduction?
4. State Fourier law of conduction.
5. Define thermal conductivity.
6. List down the three types of boundary conditions.
7. What is convection?
8. Define radiation.
9. State Newtons law of cooling
10. What is eddy diffusion.

PART - B (5 x 16 = 80 Marks)

11. (a) A hallow cylinder 5 cm I.D and 10 cm OD has an inner surface temperature of 200˚C and an outer surface temperature of 100˚C. Determine the temperature of the point half way between the inner and outer surfaces. If the thermal conductivity of the cylinder material of 70 w/mK determine the heat flow through the cylinder per linear meter. (16)

Or

(b) A steel pipe line (k= 50 w/mk) of ID 100 mm and OD 110mm is to be covered with two layers of insulation each having a thickness of 50mm. The thermal conductivity of the first insulation material is 0.06 w/mk and that of the second is 0.12 w/mk. Calculate the loss of heat per metre length of pipe and the interface temp between the two layers of insulation when the temp of the inside tube surface is 250˚C and that of the outside surface of the insulation is 50˚C. (16)

12. (a) A Flat plate 1.0mm wide and 1.0mm long is placed is a wind funnel . The temperature and velocity of free stream air are 10˚C and 80m/s.The flow over the the whole length of the plate is made turbulent with the help of a turbulizing grid placed upstream of the plate. Determine the thickness of the boundary layer at the trailing edge of the plate. Also calculate the mean valve of the heat transfer co-efficient from the surface of the plate. (16)

Or

(b) Air flow at a rate of 0.314 m^3/s over a cross flow heat exchanger consisting of 7 tubes in the direction of flow and 8 tubes in the direction perpendicular to flow arranged in an inline fashion. The length of each tube is 1.25m and its outer diameter is 1.9 cm . The longitudinal and transverse pitches are S_L= 38 mm an S_T =28.6mm respectively. The temp of the air entering the heat exchanger is 200˚C and the tube surface temperature is 96˚C. Estimate the convective heat transfer co-efficient b/w the air and tubes. (16)

13. (a) Dry saturated stream at a pressure of 2.45 bar condenses on the surface of a vertical tube of height 1m. The tube surface temp is kept at 117˚C. Estimate the thickness of the condensate film and the local heat transfer co-efficient at a distance of 0.2m from the upper end of the tube. (16)

Or

(b) A counter flow concentric tube heat exchanger is used to cool engine oil (C=2130 J/kg k) from 160˚C to 60˚C with water ,available at 25˚C as the cooling medium.The flow rate of cooling water through the inner tube of 0.5m diameter is 2kg/s ,while the flow rate of oil through the outer annuals OD = 0.7m is also 2kg/s . If the value of the overall heat transfer co-efficient is 250w/m^2k . how long must be heat exchanger be to meet its cooling requirement. (16)

14. (a) Two black square plates of size 2 x 2 *m* are placed parallel to each other at a distance of 0.5 *m*. One plate is maintained at a temperature of 1000 $^\circ C$ and the other at 500 $^\circ C$. Find the heat exchange between the plates. (16)

Or

(b) A pyrometer records the temp of a body as 1400˚C with a red light filter (λ- =0.65μ) Find the true temp of the body if its emissivity of 0.65μ is 0. 6. (16)

15. (a) O_2 gas at 25˚C and a pressure of 2 bar is flowing through a rubber pipe of inside diameter 25mm and a wall thickness 2.5mm The diffusivity of O_2 through rubber is $0.21x10^{-2}$ m^2/s and the solubility of O_2 in rubber is $3.12x10^{-3}$ k mol /m^3 bar. Find the loss of 0_2 by diffusion per meter length of pipe. (16)

Or

(b) Dry air at 27˚C and 1 atm flows over a wet flat plate 50 cm long at a velocity of 50 m/s calculate the mass transfer co-efficient of water vapour in air at the end of the plate. (16)

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