Total No. of Printed Pages:2

SUBJECT CODE NO:- P-295
FACULTY OF ENGINEERING AND TECHNOLOGY
T.E.(MECH) Examination MAY/JUNE-2016
Heat Transfer
(Revised)

[Time: Three Hours] **[Max Marks:80]**

"Please check whether you have got the right question paper."

N.B
i) Attempt any three questions from each section.
ii) Use of data book, steam tables, Mollier charts, non-programmable calculator is allowed.
iii) Neat diagrams must be drawn wherever necessary.
iv) Figures to right indicate full marks.
v) Assume suitable data, if necessary.

Section A

Q.1 a) Derive general heat conduction equation in Spherical Coordinate system. 08

b) An insulating wall 15 cm thick has one face at 500^0 C while the other is at 120^0 C. The thermal conductivity of the material is given by k=0.075 (1+16.50 x 10^{-4}T) W/m K and T is in ^{0}C. Determine the heat loss per unit area and the mid plane temperature. 05

Q.2 a) What is an error function? Explain its significance in a semi-infinite body in a transient state. 05

b) One end of a long rod 35mm In diameter is inserted into 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 180mm apart and found to be 180^0C and 145^0C. The atmospheric air temperature is 25^0C. If the heat transfer coefficient is 65W/m^2 ^{0}C, calculate the thermal conductivity of the rod 08

Q.3 a) Explain fin effectiveness. How can the effectiveness of a fin be increased? 08

b) Find an expression for the drag force on smooth sphere of diameter 'D' moving with a uniform velocity 'V' in a fluid density 'ρ' and dynamic viscosity 'μ'. 05

Q.4 a) Find the convective heat loss from a radiator 0.6m wide and 1.2 m high maintained at a temperature of 90^0 C in a room at 14^0 C. Consider the radiator as a vertical plate. 08

b) Assuming that man can be represented by a cylinder 350 mm in diameter and 1.65 m high with a surface temperature of 28^0 C. Calculate the heat he would lose while standing in a 30 km/hr wind at 12^0C. 05

Q.5 Write short notes on (any two) 14

a) Heat conduction through composite slab
b) Model studies and similitude
c) Empirical correlations for heat transfer in turbulent flow over flat plate

Section B

Q.6 a) Water is boiled at the rate of 25Kg/h in a polished copper pan, 280 mm in diameter at atmospheric pressure. Assuming nucleate boiling conditions. Calculate the temperature of the bottom surface of the pan 05

b) Explain film and drop wise condition with neat sketch 08

Q.7 a) State and explain Wien's displacement law 08

b) Calculate the following for an industrial furnace in the form of a black body and emitting radiation at 2500^0 C. 05
(i) Monochromatic emissive power at 1.2 µm length. (ii) Wavelength at which the emission is maximum. (iii) Maximum emissive power (iv) total emissive power, (v) total emissive power of the furnace if it is assumed as real surface with emissivity equal to 0.9

Q.8 a) The large parallel planes with emissivities 0.3 and 0.8 exchange heat. Find the percentage reduction when a polished aluminum shield of emissivity 0.04 is placed between them. 08

b) Explain intensity of radiation 05

Q.9 a) Derive LMTD for counter flow 08

b) In a counter flow double pipe heat exchanger, water is heated from 25^0 C to 65^0 C by an oil with a specific heat of 1.45 KJ/Kg K and mass flow rate of .09 Kg/s. The oil is cooled from 230^0 C to 160^0 C. if the overall heat transfer coefficient is 420 $W/m^2\ ^0$C. Calculate (i) the rate of heat transfer (ii) the mass flow rate of water. (iii) the surface area of the heat exchanger 05

Q.10 Write explanatory notes on <u>any two</u> 14

a) Radiation shield
b) The effectiveness NTU method for parallel flow heat exchanger
c) LMTD for parallel flow