B.Tech. SEM -V Mechanical 2014 Course (CBCS) : SUMMER - 2019

SUBJECT: HEAT AND MASS TRANSFER

Day: Tuesday
Date: 14/05/2019

Time: 10.00 AM TO 01.00 PM
Max. Marks: 60

S-2019-2688

N.B:

1) All questions are **COMPULSORY.**
2) Figures to the right indicate **FULL** marks.
3) Assume suitable data if necessary.

Q.1 Explain the variation of thermal conductivity with respect to followings. **(10)**

i) Temperature in metals and Nonmetals
ii) Porosity
iii) Direction
iv) Temperature in Gases and Liquids

What at 75^0c is flowing through a pipe whose wall is at 100^0c. Calculate the heat transfer if the heat transfer coefficient is $500 W/m^{20}_c$.

OR

Q.1 Explain thermal resistance and overall heat transfer coefficient. **(10)**

A furnace wall is composed of the following:

i) 6mm thick steel plate (K= 40W/mK)
ii) 70mm thick fire brick (K = 1.1 W/mK)
iii) 200mm thick common brick (K = 0.66 W/mK)

Temperature of the gas side surface of mild steel plate is 900K and that of the outside air is 27^0c. Heat transfer coefficient on outside surface is $60 W/m^2K$. Calculate the heat loss per square meter of surface and temperature of the outside surface of furnace.

Q.2 Explain the economic thickness of insulation. A 1m long nichrome wire dissipated a power of 10kW to surrounding fluid at 80^0c. Find the diameter of the wire if the maximum operating temperature of wire is 1000^0c. Take h = 1000 W/m^2k and K for nicrome as 60W/mK. **(10)**

OR

Q.2 Explain the use of insulation and give some examples of insulating materials used in heat transfer. A long hollow cylinder has inner and outer radii as 5cm and 15cm respectively. It generates heat at the rate of $1kW/m^3$ (K = 0.5 W/mk). If maximum temperature occurs at radius of 10cm and temperature of outer surface is 50^0c. Find **(10)**

i) Temperature of inner surface
ii) Maximum temperature in the cylinder

Q.3 Explain thermo well with neat sketch. Derive the expression for temperature distribution for convective off end fin. **(10)**

OR

Q.3 Give the significance of Biot and Fourier number. Pin fins are provided to increase the heat transfer rate from hot surface. Two arrangements are used: **(10)**

i) 6 fins of 98mm length
ii) 10 fins of 60mm length.

By calculation, show that which of these arrangements is more effective.

P.T.O.

Q.4 Discuss the dimensional analysis of natural convection. Air stream at 27^0c is moving at 0.3m/s across a 100W electric bulb at 400K. If the bulb is approximated by a 60mm diameter sphere, calculate the heat transfer rate. The properties of air are as: $\upsilon = 2.08 \times 10^{-5} m^2/s$; K = 0.03W/mK; Pr = 0.69. **(10)**

OR

Q.4 Give the significance of hydraulic diameter. Air at 30^0c is flowing across a tube at a velocity of 25m/s. The tube could be either a square with side of 50mm or a circular diameter cylinder of 50mm. Compare the rate of heat transfer in each case if the tube surface is maintained at 124^0c. The physical properties of air at film temperature of 77^0c are as: $K = 3 \times 10^{-2}$W/mk; Pr = 0.7; $\upsilon = 20.9 \times 10^{-6} m^2/s$. **(10)**

Q.5 Explain the followings: **(10)**

a) Shape factor
b) Radiation shield
c) Rodiosity
d) Irradiation
e) Film wise condensation

OR

Q.5 Explain drop wise condensation with sketch. Calculate the rate of heat loss from a thermo flask if the polished silvered surfaces have emissivities of 0.05, the liquid in the flask is at 95^0c and the casing is at 20^0c. Calculate the loss if both surfaces were black. **(10)**

Q.6 Derive the expression for LMTD for counter flow heat exchanger. Explain storage type heat exchanger. **(10)**

OR

Q.6 Explain the shell and tube heat exchanger. Derive the expression for parallel flow heat exchanger using NTU- ϵ method. **(10)**

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