Total No. of Questions : 10]

P1299

SEAT No. :

[Total No. of Pages : 3

[4858] - 1013

T.E. (Mechanical S/W) (Semster - I) (End Semester)

HEAT TRANSFER

(2012 Pattern)

Time : 2 Hours 30 min.] *[Max. Marks : 70*

Instructions to the candidates:

1) ***Solve Q.1 or Q.2, Q.3 or Q.4, Q.5 or Q.6, Q.7 or Q.8, Q.9 or Q.10.***
2) ***Draw Neat diagrams wherever necessary.***
3) ***Use of scientific calculator is allowed.***
4) ***Assume suitable data where ever necessary.***
5) ***Figures to the right indicate full marks.***

Q1) a) Explain the following: **[4]**

i) Thermal diffusivity,

ii) Thermal contact resistance

b) Derive the expression for critical radius of insulation for cylinder with usual notations **[6]**

OR

Q2) a) Explain significance of Biot number and Fourier number **[4]**

b) A current of 200 amperes is made to pass through a stainless steel wire of 2 mm in diameter and 2 metre in length. The resistivity of the wire is 70×10^{-6} ohm.cm. Calculate the centre temperature of the wire if the outer surface temperature of the wire is maintained at 150 °C. The thermal conductivity may be taken as 29 W/mK. **[6]**

Q3) a) Explain temperature boundary condition. **[4]**

b) A 5cm diameter steel ball, initially at a uniform temp of 450°C is suddenly placed in an environment at 100°C with h = 10 W/m^2K. Steel properties: Cp = 460 J/kgK, density = 7800 kg/m^3, k =35 W/mK. Verify whether lumped system analysis is applicable. Calculate the time required for the ball to attain a temp of 150°C. **[6]**

P.T.O.

OR

Q4) a) A cylindrical metal rod of 5 cm diameter and 20 cm long with thermal conductivity 225 W/mK protrudes in atmosphere at 30°C. It projects from furnace wall at 300°C. A convective heat transfer coefficient of air is 10 W/m^2K. Determine temperature at the free end of the rod assuming it as a fin insulated at end. **[6]**

b) Define Fin efficiency. Identify the important parameters responsible for increase in fin efficiency **[4]**

Q5) a) Explain significance of i) Nusselt number, ii) Grashof number **[4]**

b) The heat transfer coefficient will be more in Natural or Forced convection? Justify your answer **[4]**

c) A rectangular plate of length 7cm and width 4cm is maintained at 115°C. It is exposed to still air at 25°C. Calculate convective heat transfer rate if smaller side of the plate is held vertical Use Correlation $Nu=0.59(Gr.Pr)^{0.25}$ Properties of air, k = 0.03 W/mK, Pr = 0.697, $\upsilon = 2.076 \times 10^{-6} m^2/s$ **[8]**

OR

Q6) a) Define Prandtl number and give its significance. Give its relation with thermal boundary layer and velocity boundary layer. Also give its value for liquid metals, heavy oils, water and air. **[8]**

b) Water flows at the rate of 360 kg/hr through a metallic tube of 10mm diameter and 3m length. It enters the tube at 25 °C. Outer surface of the tube is maintained at a constant temperature of 100 °C. Calculate the exit temperature of the water. Properties of water: **[8]**

$\mu = 5.62 \times 10^{-4}$ Ns/m^2; Cp = 4174 J/kgK, k = 0.664W/mK.

Use the following correlation:

$Nu = 0.023 Re^{0.8} Pr^{0.4}$ for turbulent flow

Nu = 3.66 for laminar flow

Q7) a) Explain the significance of shape factor **[2]**

b) Consider a black body at a temperature of 2000 K. Calculate its total hemispherical emissive power. Also calculate the wavelength at which the maximum emissive power is available from this body. State and explain the law of radiation which you have used to calculate the above mentioned quantities. **[8]**

c) Write a note on Radiation shield **[6]**

OR

Q8) a) Explain surface resistance and space resistance **[8]**

b) Two large parallel plates are maintained at temperatures of 600 °C and 300 °C having their emissivities of 0.9 and 0.4 respectively. A radiation shield having emissivity of 0.02 is inserted in between them. Calculate **[8]**

i) Heat transfer rate without shield,

ii) Heat transfer rate with shield and

iii) Temperature of shield.

Q9) a) Explain drop wise condensation and film wise condensation. **[6]**

b) A counter flow double pipe heat exchanger using superheated steam is used to heat water at the rate of 10500 kg/hr. The steam enters the heat exchanger at 180 °C and leaves at 130 °C. The inlet and exit temperatures of water are 30 °C and 80 °C respectively. If the overall heat transfer coefficient from steam to water is 814 $W/m^{20}C$, calculate the heat transfer area. What would be the increase in area if the fluid flows were parallel **[10]**

c) Define LMTD **[2]**

OR

Q10)a) Establish expression for LMTD for parallel flow heat exchanger **[8]**

b) Explain regimes of pool boiling. What is the significance of critical heat flux **[10]**