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TF- sem-IV - CBGS - Mechanical - H.T

2/6/16

QP Code : 31207

(3HOURS)

[TOTAL MARKS 80

Question no.1 is compulsory.
Attempt any **THREE** from question no. 2 to 6.
Use of steam table is permitted.

Q1) Solve any **Four**

- What is the radiation shield?
- What is heat exchanger? Define 'heat exchanger effectiveness'.
- Discuss 'Electrical analogy' of combined heat conduction and convection in a composite wall.
- Explain briefly the condensation mechanism.
- A solid copper sphere of 10 cm diameter ($\rho = 8954 \text{ kg/m}^3$, $C_p = 383 \text{ J/kg K}$, $k = 386 \text{ W/m K}$), initially at uniform temperature $t_i = 250^\circ\text{C}$, is suddenly immersed in a fluid which is maintained at a uniform temperature $t_f = 50^\circ\text{C}$. The heat transfer coefficient between the sphere and the fluid is $h = 200 \text{ W/m}^2 \text{ K}$. Determine the temperature of the copper block at $\tau = 5 \text{ min}$ after the immersion.

Q2) a) Derive expression for temperature distribution and heat dissipation in a straight fin of rectangular profile for infinitely long fin. 08

b) In a straight tube of 60 mm diameter, water is flowing at a velocity of 12 m/s. The tube surface temperature is maintained at 70°C and the flowing water is heated from the inlet temperature 15°C to an outlet temperature of 45°C . Calculate the following: 08

- The heat transfer coefficient from the tube surface to the water,
- The heat transferred, and
- The length of the tube.

Take the physical properties of water at its mean bulk temperature of 30°C ,
 $\rho = 995.7 \text{ kg/m}^3$, $C_p = 4.174 \text{ kJ/kg K}$, $k = 61.718 \times 10^{-2} \text{ W/m K}$,
 $\nu = 0.805 \times 10^{-6} \text{ m}^2/\text{s}$, $Pr = 5.42$

c) Define the natural convection and state few practical examples of it. 04

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- Q3) a) Show by dimensional analysis for forced convection, $Nu = \phi (Re, Pr)$ 08
- b) A refrigerant suction line having outer diameter 30 mm is required to be thermally insulated. The outside air film coefficient of heat transfer is $12 \text{ W/m}^2 \text{ K}$. The thermal conductivity of insulation is 0.3 W/m K , 06
- Determine whether the insulation will be effective;
 - Estimate the maximum value of thermal conductivity of insulating material to reduce heat transfer;
 - Determine the thickness of cork insulation to reduce the heat transfer to 22% if the thermal conductivity of cork is 0.038 W/mK .
- c) What are Fourier and Biot Numbers? What is physical significance of these numbers? 06
- Q4) a) Derive expression for effectiveness by NTU method for parallel flow. 08
- b) Determine heat lost by radiation per meter length of 80 mm diameter pipe at 300°C , if 08
- Located in a large room with red brick wall at a temperature of 27°C ;
 - Enclosed in a 160 mm diameter red brick conduit at a temperature of 27°C .
- Take $\epsilon (\text{pipe}) = 0.79$ and $\epsilon (\text{brick conduit}) = 0.93$
- c) One side of metallic plate absorbs a heat flux of 1000 W/m^2 . Its other side is insulated. The emissivity of surface is 0.8 and the convective heat transfer coefficient is $20 \text{ W/m}^2 \text{ K}$. Ambient is maintained at 300 K. Determine the temperature of plate under steady state conditions ($\alpha = 5.67 \times 10^{-8}$) 04
- Q5) a) Derive an expression for shape factor in the following cases: 08
- Hemispherical shape of radius R
 - Two concentric cylinders
- b) Hot air at 66°C is cooled up to 38°C by means of cold air at 15°C . Mass flow rate of hot and cold air are 1.25 kg/s and 1.6 kg/s respectively. Specific heat of hot and cold air are 1.05 kJ/kg K , $U = 80 \text{ W/m}^2 \text{ K}$, find the area of the heat exchanger for parallel and counter flow configuration. 08
- c) Explain Reynold's Analogy. 04
- Q6) Write short note (any three) 20
- Radiosity and Irradiation
 - Discuss in brief various modes of Boiling.
 - Significance of dimensionless numbers used in heat transfer by convection.
 - Lump system analysis.

Course: TE (all Branches)

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Correction

Q.No.2 (b)

For turbulent flow $NU = 0.023(Re)^{0.8} (Pr)^{0.333}$

Q.6

Write Short note on any Two instead of any three

Date and Time 02/06/2016 04:56 PM