TE - sem - V - CBGS - Mechanical

HT

11/12/15

QP Code : 5722

(3 Hours) **[Total Marks: 80**

Instructions:

1) Question No-1 is compulsory
2) Answer any 3 from the remaining.
3) Assume suitable data if necessary.

Q-1 Answer **ANY FOUR** Questions. [20]

a) Two pin fins are identical except that the diameter of one is twice of other. For which fin will (i) Fin Effectiveness (ii) Fin Efficiency be higher?

b) What is Thermal Boundary Layer.?Illustrate the same with the help of a neat diagram.

c) What is fouling in Heat Exchangers?

d) During the ripening process of orange, the average heat energy release is estimated as 4715 KJ/ m^3hr. If the orange is assumed to be homogenous sphere having K=0.175 W/mK, compute the temperature at centre of orange.

e) A Filament of a 75 W light bulb may be considered as a black body radiating into a black enclosure of 70°C.The filament diameter is 0.1 mm and length 50mm.Considering the radiation , determine the filament temperature.

Q-2 a) A standard cast iron pipe (inner diameter = 50 mm and outer diameter = 55 mm) is insulated with magnesium insulation (k = 0.02 W/mK). Temperature at the interface between the pipe and insulation is 300°C. The allowable heat loss through the pipe is 600 W/m length of pipe for the safety; the temperature of the outside surface of insulation must not exceed 100 °C. Determine minimum thickness of insulation required. [08]

b) Derive a relation of heat transfer through fin with heat loosing at tip [8]

c) Define thermal conductivity. How thermal conductivity is varied with temperature?. [4]

Q-3 a) Air at 200°C and at atmospheric pressure flows at a velocity of 2 m/s over a plate maintained at 1000°C . The length and width of the plate are 800mm and 400mm resp. Using exact solution; calculate the heat transfer rate from. [10]

i) First half of the plate ii) Full plate and iii) Next half of the plate.
$Nu = 0.332\ Re^{0.5}\ Pr^{0.333}$ Properties of air at 600°C are $\rho = 1.06$ kg/ m^3, $\mu = 7.211$kg/mh, $\nu = 18.97 \times 10^{-6}$ m^2/s, Pr=0.696

b) With the help of Buckingham π-theorem show that for forced convection [10]
$Nu = C\ Re^m\ Pr^n$.

Q-4 a) Show that the radiant heat transfer between two infinitely large parallel plates separated by n shields is [8]

$$Q_{n-shields} = \frac{A\,\sigma\,(T_1^4 - T_2^4)}{(n+1)[\frac{2}{\epsilon} - 1]}$$

b) The net radiation from the surfaces of two parallel plates maintained at temperature T_1 and T_2 is to be reduced by 79 times. Calculate the number of screens to be placed between the two surfaces to achieve this reduction in heat exchange. Assuming the emissivity of screens as 0.05 and that of the surfaces as 0.8. [8]

[TURN OVER

c) What is the mode of heat transfer in vacuum? Define Absoptivity, Reflectivity, Transmisivity and establish the relation among them. [4]

Q-5 a) Derive the expression for log mean temperature difference (LMTD) in a parallel flow heat exchanger. State your assumptions. [8]

b) A counter flow heat exchanger is employed to cool 0.55 kg/s (Cp = 2.45 kJ/kg^{0}C) of oil from 115^{0}C to 40^{0}C by the use of water. The inlet and outlet temperature of cooling water are 15^{0}C and 75^{0}C respectively. The overall heat transfer coefficient is expected to be 1450 W/m^2 ^{0}C. Using NTU method. Calculate the following: [8]

i) The mass flow rate of water
ii) The effectiveness of the heat exchanger
iii) The surface area required.

c) Classify Heat Exchangers on various arrangements. [4]

Q-6 a) Answer (any **Two**) [8]

(i) What is Filmwise and Dropwise condensation?
(ii) Why Extended surface are used?
(iii)How Numerical methods are used in conduction heat transfer.

b) An egg with mean diameter of 4cm and initially at 20^{0}C is placed in a boiling water pan for 4 min and found to be boiled to the consumers taste. For how long should a similar egg for same consumer be boiled when taken from refrigerator at 5^{0}C? Take the following properties for egg: k = 10 W/mK, ρ = 1200 kg /m^3, C_p = 2 kJ/kg K and h = 100W/m^{2}K. Use lump theory. [8]

c) Explain the physical significance of Reynold number and Prandtl number [4]

Course: T.E. (SEM-V) (REV-2012) (CBSGS) (MECH ENGG) C.W. (AUTO ENGG.) (T3525 CW T2225)

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Correction:

Q.1 d) Take diameter of orange = 90mm

Outer surface temperature of orange = 8^0 C.

Q.2 a) K for cast iron = 20 W/m° C.

Q.3 a) K for air 0.02894 W/m° C.

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