B.Tech. SEM -V Mechanical 2014 Course (CBCS) : WINTER - 2018

SUBJECT: HEAT AND MASS TRANSFER

Day: Thursday
Date: 29/11/2018

W-2018-2423

Time: 02.30 PM TO 05.30 PM
Max. Marks: 60

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 followings: **(10)**

a) Fourier's Law of heat conduction
b) Thermal diffusivity
c) Thermal conductivity
d) Mechanism of Heat Conduction
e) Electrical Analogy

OR

Q.1 Derive the 3-D general differential heat conduction equation in Cartesian Co-ordinate. The wall of a boiler is built by using fireclay bricks of thermal conductivity $1.3 W/m^0c$. The thickness of the brick is 0.28m. The inside temperature of the brick is 302^0c. While the outside is 55^0c. Estimate the loss of heat per m^2 of area of the furnace. **(10)**

Q.2 Discuss the critical radius of insulation for cylinder. Derive the expression for heat conduction in cylinder with internal heat generation. **(10)**

OR

Q.2 Give the different applications of insulating materials with its examples. The average heat produced by oranges ripening is estimated to be $600 W/m^3$. Calculate the temperature at the centre of the orange for an orange of 10cm diameter and having thermal conductivity of 0.15W/mK. Assume ambient temperature to be 15^0c and surface heat transfer coefficient to be $3 W/m^2K$. **(10)**

Q.3 Give the classification of fins. A steel tube carries steam at a temperature of 310^0c. A thermometer pocket of iron ($K = 50 W/m^0c$) of inside diameter 15mm and 1mm thick is used to measure the temperature. The error to be tolerated is 1.5% of maximum. Estimate the length of the pocket necessary to measure the temperature with in this error. The diameter of steel tube is 95mm. Assume $h = 93 W/m^20_c$ and the tube wall temperature is 120^0c. Suggest a suitable method of locating the thermometer pocket. **(10)**

OR

Q.3 Derive the expression for temperature distribution in infinity long fin. Also give significance of time constant. **(10)**

P.T.O.

Q.4 Give the significances of followings: **(10)**

i) Reynolds number
ii) Nusselt Number
iii) Rayleigh Number
iv) Prandtl Number
v) Peclet Number
vi) Grashoff's Number

OR

Q.4 Draw natural convection flow patterns. A circular disc insulated from the other side of diameter is exposed to air at 20^0c. If the disc of diameter of 25cm is maintained at 120^0c. Calculate the amount of heat transferred from it when. **(10)**

i) The disc is horizontal with hot surface facing upward
ii) The disc is vertical

The properties of air at film temperature of 70^0c are as:
$K = 0.03 W/mk$; $Pr = 0.697$; $\upsilon = 2.07 \times 10^{-6} m^2/s$
$B = 0.0029 K^{-1}$

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

a) Shape factor
b) Stefan-Boltzmann Law
c) Radiation shield
d) Wein's displacement Law

OR

Q.5 Explain Lambert's cosine Law. Two very large and parallel planes each having emissivity of 0.7. Surface 'A' is at 866K and surface 'B' is at 315^0c. What is the net radiation loss of surface A? To reduce this loss, two additional radiation shields also having emissivity's of 0.7 are placed between the original surfaces. What is the new radiation loss? **(10)**

Q.6 Explain the analogy of mass transfer. Derive the expression for LMTD for counter flow heat exchanger. **(10)**

OR

Q.6 Give the classification of heat exchangers. In an oil cooler, oil is cooled from 130^0c to 60^0c, by water entering at 15^0c and leaving at 50^0c when flow is parallel Co-current. What will be exit temperature if water flow direction is reversed for same exchanger, keeping inlet condition same? **(10)**

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