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SIDDHARTH INSTITUTE OF ENGINEERING & TECHNOLOGY:: PUTTUR
(AUTONOMOUS)
M.Tech I Year I Semester Regular & Supplementary Examinations February 2018
ADVANCED HEAT AND MASS TRANSFER
(Thermal Engineering)

Time: **3** hours Max. Marks:**60**

(Answer all Five Units **5 X 12 =60** Marks)

UNIT-I

1 Define thermal conductivity and explain its significance in heat transfer
(b) An un insulated wire suspended in air produces electrical heating at the rate of q^i =2 W/m. The wire is a bare cylinder of radius ri = 0.5 mm, and the temperature difference between it and the atmosphere is 25^o C. It is recommended that this wire be covered with a plastic sleeve of electrical insulation, the outer radius of which is ro = 1 mm. The thermal conductivity of plastic is k = 0.15 W/mk. calculate the critical radius. 12M

OR

2 A stainless steel fin (K=20W/mK) having a diameter of 20 mm and length of 0.1 m is attached to a wall at 300^0C.The ambient temperature is 50^0C and the heat transfer coefficient is 10W/m^2K.The fin tip is insulated.Determine (a) The rate of heat dissipation from the fin,(b) The temperature at the fin tip. 12M

UNIT-II

3 Lubricating oil at a temperature of 600c enters a 1 cm diameter tube with a velocity of 3.5 m/sec. The tube surface is maintained at 30 0c.Calculate the tube length required to cool the oil to 450c.Assume that the oil has the following average properities.
ρ=865 kg/m3,K=0.14W/mK,Cp=1.78KJ/kgK,and v=9x10-6 m2/sec. 12M

OR

4 . A fine wire having a diameter of 0.02mm is maintained at a constant temperature of 54^0C by an electrical current .The wire is exposed to air at 1 atm and 0^0c. Calculate the electrical power necessary to maintain the wire temperature if the length is 50 cm. 12M

UNIT-III

5 a Explain the film wise condensation 4M

b A tube of 15 mm outside diameter and 1.5 m long is used for condensing steam at 40 kPa. Calculate the average heat transfer coeffient when the tube is (a) horizontal,(b) vertical and its surface temperature is maintained at 50^0 C. 8M

OR

6 a. Explain the Overall heat transfer coefficient and Fouling factor? 4M

b. A and B exchange heat in a parallel heat exchanger. Fluid A enters at 450 ^{0}C and has a mass flow rate of 1kg/s. Fluid B enters at 20 ^{0}C and has a mass flow rate of 1kg/s. The effectiveness of heat exchange is 75%.determine (i) the rate of heat flow,(ii) the exit temperature of fluid B. Specific heat of fluid A is 1kj/kgK and that of fluid B is 4kj/kgK 8M

UNIT-IV

7 a Explain the Absorptivity,Reflectivity and Transmissivity. 6M

b A 100 W electrical bulb has a filament temperature of 3001 ^{0}C.Assuming the filament to be black. Calculate (a) the diameter of the wire if the length is 250 mm and (b) the efficiency of the bulb if visible radiation lies in the range of wavelength from 0.5μ to 0.8μ. 6M

OR

8 Two very large parallel planes with emissiveties 0.3 and 0.8 exchange radiative energy.Determine the percentage reduction in radiative energy transfer when a polished aluminium radiation shield (ε =0.04) is placed between them 12M

UNIT-V

9 a. Define mass fraction and molar concentration 5M

b. Estimate the value of mass transfer coefficient for the absorption of NH_3 by the wet surface of a cylinder placed in a turbulent air steam flowing across the cylinder at 5m/s. No data on mass transfer exist for this process, but heat transfer tests with the same geometry and air velocity show h= 56.8W/m^{2}K.For air, pr= 0.74, ρ = 1.2 kg/m^3 and Cp = 1.005kj/gk. For dilute NH_3-air mixture, p_{Bm} = P and Sc= 0.61. 7M

OR

10 A thin plastic membrane is used to separate hydrohen from a gas steam. Under state conditions, the concentration of hydrogen in the membrane is known to be 0.02 and 0.005 kmol/m^3 at the inner and outer surfaces, respectively. If the membrane is 1mm thick and the binary diffusion coefficient of hydrogen with respect to plastic is 10^{-9} m^3/s, what is the diffusion flux? 12M

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