Q.P. Code: 16ME8802 **R16**

Reg. No: | | | | | | | | | | |

SIDDHARTH INSTITUTE OF ENGINEERING & TECHNOLOGY:: PUTTUR

(AUTONOMOUS)

M.Tech I Year I Semester (R16) Regular Examinations January 2017

ADVANCED HEAT AND MASS TRANSFER

(Thermal Engineering)

(For Students admitted in 2016 only)

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

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

UNIT-I

Q.1 Derive general 3D conduction equation for steady state? 12M

OR

Q.2 a. How does the science of heat transfer differ from the science of thermodynamics? 4M

b. Two rods of same diameter, one made of brass(k = 85 W/mK.) and the other made of copper (k = 375 W/mK.) have one of their ends inserted into the furnace. Both rods are exposed to the same atmosphere. At a distance of 105mm away from the furnace end the temperature of the brass rod is 120^{o}C. At what distance from the furnace end, the same temperature would be attained by the copper rod? 8M

UNIT-II

Q.3 a. What is critical Reynolds number for flow over flat plate 4M

b. Calculate the average heat transfer coefficient and heat transfer at a distance of 10 cm from the leading edge of an entirely heated plate placed in an air stream. The air velocity is 10 m/sec, Its temperature T=30^{0}C the surface temperature of plate is 70^{0}C. The plate is 1m wide. 8M

OR

Q.4 a. Define Grashoff number and Nusselt number 4M

b. The maximum allowable surface temperature of an electrically heated vertical plate 15 cm height and 10 cm wide is 140^{0}C.Estimate the maximum rate of Heat dissipation from both sides of the plate in an atmosphere at 20^{0}C.The radiation heat transfer coefficient is 8.72 W/m2K.For air at 80^{0}C take v = 21.09x10^{-6} m^{2}/sec, Pr=0.692 and k=0.03W/mK. 8M

UNIT-III

Q.5 Explain the Nusselts theory of film condensation on a vertical plate 12M

OR

Q.6 a. How heat exchangers are classified? 4M

b. A and B exchange heat in a counter flow heat exchanger. Fluid A enters at 420 ^{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

Q.7 Explain the Stefan-Boltzmann law, Planck's law and Wien's displacement law 12M

OR

Q.8 a. Explain the Kirchhoff's law of radiation. 6M

b. Two parallel rectangular surfaces 1m x 2m are opposite to each other at a distance of 4m. the surfaces are black and at 100^0C and 200^0c respectively. Calculate the heat exchange by radiation between the two surfaces. 6M

UNIT-V

Q.9 a. What do you understand by diffusion coefficient? Give its units. 4M

b. Calculate the mass transfer coefficient of water vapour in air in turbulent flow at 60 m/s at 1 atm. 300 K, over a flat plate 0.3 m long. Assume concentration of vapour in air is sufficiently dilute so that. $P_B/p=1$. 8M

OR

Q.10 Gaseous nitrogen is stored at elevated pressure in a rectangular steel container of 10 mm wall thickness. The molar concentration of nitrogen in steel at the outer surface is 2kgmol/m^3, while the concentration of nitrogen in steel at the outer surface is 0.5kgmol/m^3. The binary diffusion coefficient for nitrogen in steel is 0.26x 10^{-12} m^2/s. what is the mass flux of nitrogen through the steel? 12M

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