Code No: 09A60305 **R09**

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY, HYDERABAD B. Tech III Year II Semester Examinations, May – 2013

Heat Transfer

(Common to ME, AME)

Time: 3 hours **Max. Marks: 75**

Answer any five questions

All questions carry equal marks

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1.a) Derive the conduction shape factors for edges and corners and surface.

b) One meter long Nichrome wire of resistivity 1.2 μΩm is to dissipate 12 KW heat in the surrounding fluid which is at 820C. Find the diameter of the wire if the maximum operating temperature of the wire is 9800C. K for wire is 62W/mK and h = 1.32 KW/m2K [15]

2.a) Derive an equation for heat transfer and temperature through a short fin end not insulated.

b) One end of a long rod 40 mm in diameter is inserted in to a furnace with the other end projecting in the outside air. After the steady state is reached temperature of the rod is measured at two points 182 mm apart and found to be 1850C and 1430C. If the ambient air is 260C and h is 68 W/m2K, calculate the thermal conductivity of the rod. [15]

3.a) Explain the significance of Biot number and time constant of the thermo couple.

b) A long cylindrical bar (K = 18.4 W/mK; α = 0.022 m2/hr) of radius 82 mm comes

out of oven at 8360C throughout and is cooled by quenching it in a large bath of 420 C coolant. If h = 184W/m2K, calculate the time taken by the shaft center to reach 1240C, the surface temperature of the shaft when its centre temperature is 1240C and the temperature gradient at the outside surface at the same instant of time. [15]

4.a) Obtain the relation for Free convection heat transfer using Buckingham π-theorem.

b) A Vertical cylinder of 180mm diameter and 1.5m long is maintained at 1000C in an environment of 200C. Calculate the heat loss by free convection from surface of the cylinder. [15]

5.a) Derive an equation for the Reynold's analogy in forced convection heat transfer.

b) Compare the heat transfer coefficients under the following conditions (Assume flow is turbulent).

i) Two fold increase in the diameter of the tube; the flow velocity is maintained constant by a change in the rate of liquid flow.

ii) Two fold increase in the flow velocity by varying the mass flow rate. Comment on the results. [15]

6. a) Derive the equation for radiation shape factor and other conclusions.

b) Liquid Oxygen (boiling temperature = - 1820C) is to be stored in spherical container of 42cm diameter. The system is insulated by an evacuated space between inner space and surrounding 45cm inner diameter concentric sphere. For both spheres emissivity = 0.03 and temperature of the outer sphere is 300C. Estimate the rate of heat flow by radiation to the oxygen in the container. [15]

7. a) Obtain the relation for heat transfer coefficient in case of condensation on a flat vertical plate.

b) Steam at 1 bar enters the shell of a surface condenser in which the water flows through a bundle of tubes 25mm diameter at the rate of 0.05Kg/sec, the inlet and outlet temperatures of water are 150C and 700C respectively. Condensation taking place over the tubes if U is 242W/m2 K. Using NTU method, calculate the ectiveness of the heat exchanger, length of the tube and rate of condensation. [15]

8. Answer the following:

a) Thermometer well concept to measure temperature.

b) Lamberts cosine law

c) Variable thermal conductivity

d) Fick's law. [15]

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