Code No: 56020 **R09**

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY, HYDERABAD
B. Tech III Year II Semester Examinations, December-2014/January-2015
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) State some essential features of Fourier's law.
b) Derive general heat conduction equation in Cartesian coordinates.

2. Heat is conducted through a circular rod of 200 mm length. The ends A and B having diameters 50 mm and 25 mm are maintained at 27^0 C and 227^0 C respectively. k (rod material)=40W/m^{0}C. Find
a) Heat conducted through the rod
b) The temperature at the midpoint of the rod.
Assume there is no temperature gradient at a particular cross-section and there is no heat transfer through the peripheral surface.

3.a) What are Fourier and Biot numbers? What is the physical significance of these numbers?
b) An average convective heat transfer coefficient for flow of 100^0C air over a flat plate is measured by observing the temperature-time history of a 30 mm thick copper slab(ρ = 9000 kg/m^3, c=0.38 KJ/kg ^{0}C, k=370 W/m^{0}C) exposed to 100^0 C air. In one test run, the initial temperature of the plate was 210^0C, and in 5 minutes the temperature decreased by 40^0C. Find the heat transfer coefficient for this case. Neglect internal thermal resistance.

4.a) Describe Buckingham's method of π-terms to formulate a dimensionally homogenous equation.
b) A flat plate 1m wide and 1.5 m long is to be maintained at 90^0C in air when free stream temperature is 10^0C.determine the velocity at which air must flow over the plate so that the rate of energy dissipation from the plate is 3.75KW.

5. Calculate the heat transfer from a 60W incandescent bulb at 125^0C to ambient air at 25^0C. Assume the bulb as a sphere of 50 mm diameter. Also find the percentage of power lost by free convection. The correlation is given by $Nu=0.60(Gr.Pr)^{1/4}$.

6.a) Explain briefly the various regimes of saturated pool boiling.
b) Differentiate between the mechanism of filmwise and dropwise condensation.

7. A chemical having specific heat of 3.3 KJ/kg k flowing at the rate of 20000 kg/hr enters a parallel flow heat exchanger at 120^0C. The flow rate of cooling water is 50000 kg/hr with an inlet temperature of 20^0C. The heat transfer area is 10 m^2 and the overall heat transfer coefficient is 1050 W/m^{2}K. Find
a) The effectiveness of the heat exchanger
b) The outlet temperature of water and chemical. Take for water, specific heat=4.186KJ/kg K.

8.a) Derive an expression for the shape factor in case of radiation exchange between two surfaces.
b) Explain about the radiation shield in brief.