H.T.No. | | | | | | | | | | |

Code No: ME1540 **GEC-R14**

IV B. Tech I Semester Supplementary Examinations, February 2018

HEAT TRANSFER

(Mechanical Engineering)

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

Note: All Questions from **PART-A** are to be answered at one place.
Answer any **FOUR** questions from **PART-B.** All Questions Carry Equal Marks.

PART-A

6 × 2 = 12M

1. Write down one dimensional heat conduction equation in Cartesian coordinate system.
2. What is lumped system analysis?
3. What do you mean by no-slip boundary condition?
4. Define the terms: boiling and condensation.
5. Sketch the temperature distribution of fluids in condenser and evaporator.
6. What is a solid angle? What is its unit?

PART-B

4 × 12 = 48M

1. a) Derive the expression for critical radius of insulation in case of cylinder. (6M)

   b) A plane wall 10 cm thick, generates heat at the rate of 4×10^4 W/m^3, when an electric current is passed through it. The convective heat transfer coefficient between each face of the wall and ambient air is 50 W/m^{2}K, Determine
   i) The surface temperature
   ii) The maximum temperature of the wall.
   Assume ambient air temperature to be 20^0C and the thermal conductivity of wall material to be 15 W/mK. (6M)

2. a) Write the general boundary conditions for longitudinal fin
   i) Long fin
   ii) Fin with insulated tip
   iii) Fin with convection off the end. (6M)

   b) An aluminum sphere weighing 5.5 kg and initially at a temperature of 290^0 C is suddenly immersed in a fluid at 15^0C. The convective heat transfer coefficient is 58 W/m^{2}K. Estimate the time required to cool the aluminum to 95^0C. (6M)

3. In a straight tube of 60 mm diameter, water flowing at a velocity of 12 m/sec. The tube surface temperature is maintained at 70^0C and the flowing water is heated from inlet temperature of 15^0C to an outlet temperature of 45^0C. Calculate the heat transfer coefficient from the tube surface to the water and the length of the tube. (12M)

4. a) A heated polished copper plate is immersed in a pool of water boiling at atmospheric pressure. If the surface temperature of the copper plate is maintained at a temperature of 113^0C, determine the surfaces heat flux and the evaporation rate per unit area of the plate. (6M)

   b) Show that the average heat transfer for condensation on a vertical plate is 4/3 times the local value at the end of the plate. (6M)

5. a) What is parallel flow, counter flow and cross flow heat exchangers? Which is more effective? (4M)

   b) Water enters a cross flow heat exchanger (both fluids unmixed) at 5^0C and flows at the rate of 4600 kg/hr to cool 4000 kg/hr of air that is initially at 40^0C. Assume U value to be 150 W/m^2-K, for a heat exchanger surface area of 25 m^2, calculate the exit temperature of air and water. (8M)

6. a) State and prove Kirchhoff's law of radiation. (4M)

   b) A pipe carrying steam having and outside diameter of 20 cm runs in a large room and is exposed to air at a temperature of 30°C. The pipe surface temperature is 400°C.

      i) Calculate the loss of heat to surroundings per meter length of pipe due to thermal radiation. The emissivity of the pipe surface is 0.8.

      ii) What would be the loss of heat due to radiation if the pipe is enclosed in a 40 cm diameter brick conduit of emissivity 0.91?

      (8M)

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