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Reg. No. : .....

Name : .....

Second Semester M.Tech. Degree Examination, September 2015

Thermal Sciences

MTC 2001 : CONVECTION AND TWO PHASE FLOW

(2013 Scheme)

Time: 3 Hours Max. Marks: 60

Instructions : *Use of approved heat and mass transfer data book permitted.*
Answer ***any two full*** *questions from* ***each*** *Module.*

MODULE – 1

1. Consider Hagen-Poiseuille flow in a tube of radius r_0. The flow is extremely viscous, so that the energy equation reduces to $0 = k\frac{1}{r}\frac{d}{dr}\left(r\frac{dT}{dr}\right) + \mu\Phi$ where Φ, viscous dissipation $= \left(\frac{du}{dr}\right)^2$. Determine the temperature distribution inside the pipe subject to $T = T_0$ at $r = r_0$. Let Q be the heat transfer rate through the wall over the pipe length L. Prove that $Q = (\dot{m}\,\Delta P)/\rho$, where $\dot{m}$ and ΔP are the mass flow rate and pressure drop over the length L. Comment on the thermodynamic (lost-work) significance of this result. **10**

2. Power generation in a nuclear reactor is limited principally by the ability to transfer heat in a reactor. A solid fuel reactor is cooled by liquid sodium flowing inside small diameter stainless tubes :

   a) Develop an expression for Nusselt number with suitable assumptions

   b) Would water have been a better coolant ?

   Take $\frac{k_{liqsodium}}{k_{water}} = 117.3$, $Pr_{(water)} = 10$, $Pr_{(liquid\ sodium)} = 0.005$. **10**

3. Prove that in laminar duct entry regime, $\frac{x/D}{R_eD}$ is a function of core and free stream velocities. Where D is the duct diameter. **10**

P.T.O.

MODULE – 2

4. Derive turbulent thermal and hydraulic boundary layer equations and explain how these equations are related. **10**

5. Stating the assumptions made in homogeneous flow model, formulate total pressure drop differential equation and integrate it over the length. **10**

6. Water at 0.13 kg/s flows through a vertical tube with a power of 100 kW applied to the tube. The tube has 10 mm inner diameter and is 3 m long heated uniformly over its length. The water enters the tube at 86 bar at 250°C. Calculate the frictional pressure drop using homogeneous model. **10**

MODULE – 3

7. a) Distinguish between pool boiling and forced convective boiling. **6**

   b) Explain any three pool boiling correlations. **4**

8. a) Explain the mechanisms of film and drop wise condensation. **5**

   b) Write short note on : **5**

      a) droplet growth

      b) crude theory.

9. Why is the superheat necessary in pool boiling ? Derive the expression for superheat requirement. Show the relationship between superheat and equilibrium radius. **10**
