Exam.Code:0942
Sub. Code: 7061

2062

B.E. (Mechanical Engineering)

Sixth Semester

MEC-604: Heat Transfer

Time allowed: 3 Hours

Max. Marks: 50

NOTE: *Attempt five questions in all, including Question No. I which is compulsory and selecting two questions from each Part.*

x-x-x

1. a Using an example, explain the difference between sciences of thermodynamics and heat transfer?
   b What are two purposes for studying heat transfer?
   c How can convection heat transfer be classified?
   d What do you understand from the efficiency of a fin?
   e What is transient or unsteady heat conduction?
   f What is Reynolds number? How is it useful?
   g What is Prandtl Number (Pr)? What is its significance?
   h What is quantum theory for radiation?
   i What do you understand from emissivity and emission from real body?
   j How is the analysis of heat exchanger done? 10

Part-A

2. A A standard iron pipe having 5 cm inner diameter and 2.5 mm of thickness is insulated with magnesium insulation (k = 0.02 W/m°C). Temperatures at the interface between the pipe and the insulation is 300°C. The permissible heat loss through the pipe is 600 W/m and the temperature of the outer surface of the insulation is not allowed to exceed 100°C. If the thermal conductivity of the pipe material is 20 W/m°C. Calculate the minimum thickness of insulation required and the temperature of inside surface of the pipe. 5

   b A pipe covered with insulating material has inner diameter 0.1 m and outer diameter 0.11 m. Thermal conductivity of insulating material is 1.0W/mK. The temperature of the fluid inside the pipe is 100°C and surroundings temperature is 20°C. Find the critical radius of insulation and heat loss per metre length of pipe for critical radius of insulation. Take $'h' = 8\ W/m^2K$. 5

3. Derive generalized 3 D heat conduction equation in spherical coordinate and deduce it for spherical coordinate in r direction. 10

4. a What are different conditions of fins which can yield a set of two boundary cases for solving temperature distribution equation for the fins?. 5

   b Derive expressions for temperature distribution and heat flow for a uniform cross-sectional fin which has insulated end. 5

Part-B

5. a What is film wise condensation? Why is it less effective but still preferred? 3

   b Explain dimensional analysis and apply the same to forced convection heat transfer process. 7

6. a Find the expression for effectiveness of counter-flow heat exchanger. 7

   b What are different forms in which boiling heat transfer phenomenon may occur? 3

7. a Prove Stefan-Boltzmann law using Max-Planck's equation. 5

   b Evaluate shape factor and prove reciprocity theorem. 5

x-x-x