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Reg. No. : .....

Name : .....

First Semester M.Tech. Degree Examination, February 2015

(2013 Scheme)

Branch : Mechanical Engineering

Stream : Thermal Science

MTC 1002 : ADVANCED HEAT TRANSFER

Time : 3 Hours Max. Marks : 60

Instructions : 1) *Answer **any two** questions from **each** Module.*
2) ***Use** of HMT data book is **permitted**.*
3) ***All** questions carry **equal** marks.*

MODULE – I

1. a) Explain the finite difference method for the solution of two dimensional heat conduction problem. 5

   b) Describe the analytical method for the solution of transient heat conduction in semi-infinite slab with negligible surface resistance. 5

2. a) Explain the utility of Heisler and Grober charts. 4

   b) A copper slab of thickness 5 cm is immersed in air at 40°C. The initial temperature of the plate was 250°C. It is found that the temperature of the plate was decreased by 50°C within a time span of 5 min. Calculate the heat transfer coefficient at the solid fluid interface. 6

3. a) Differentiate between lumped and distributed systems. 3

   b) At what depth should a water pipe be buried under the ground, whose thermal diffusivity is 0.005 m^2/h, if the ground surface temperature drops to – 10°C and remains at this value for 24 hours, so that the pipe temperature should remain above 0°C. The initial temperature of the ground is 20°C. 7

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MODULE – II

4. a) Derive the general equation for the momentum transport. 5

   b) State and prove Reynold's analogy . 5

5. a) Obtain an exact solution for 2D boundary layer energy equation. 5

   b) A thin 1 m long and 20 cm wide horizontal plate is maintained at a temperature of 150°C in a tank full of water at 50°C. Calculate the loss of heat from the plate. 5

6. a) Derive the energy integral equation. 6

   b) Obtain the time averaged equations of momentum for turbulent heat flow problem. 4

MODULE – III

7. a) State and prove reciprocity theorem. 6

   b) Explain the electromagnetic wave and quantum theories of radiation. 4

8. a) Explain configuration factor. Derive an expression for the configuration factor for the heat exchange between a small area dA and a flat disk of area A. Take the perpendicular distance between the areas as R. 5

   b) A thin radiation shield with an emissivity 0.15 on both sides is placed between two large plates that are maintained at 400°C and 250°C and have emissivities 0.25 and 0.55 respectively. Calculate the net rate of radiation between the two plates per unit area of the plates and compare the result with that without the shield. 5

9. a) An open pan of diameter 0.3 m and height 10 cm is exposed to ambient air at 30°C and 30% RH. Determine the rate of evaporation of water. 5

   b) Explain in detail the various dimension less numbers involved in mass transfer analysis. 5