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Reg. No. : ....

Name : ....

Sixth Semester B.Tech. Degree Examination, May 2016
(2013 Scheme)
13.604 : HEAT AND MASS TRANSFER (MSU)

Time : 3 Hours Max. Marks : 100

Instructions : *1) Heat and mass transfer data book is **permitted**.*
*2) Answer **all** questions.*

PART – A **(10×2=20 Marks)**

1. How does the heat conduction differ from convection ? Give suitable reasons.
2. Define overall heat transfer coefficient.
3. Write a Fourier law of heat conduction with variable thermal conductivity.
4. Define the fully developed velocity profile.
5. Distinguish between Rayleigh's method and Buckingham π theorem.
6. What are the limitations of LMTD method ?
7. What are factor should be considered for the selection fins ?
8. Discriminate between absorptivity and reflectivity.
9. What is a radiation shield ? Where is it used ?
10. List out applications of dimensional analysis in heat transfer.

PART – B **(4×20=80 Marks)**

Answer **any one** question from **each** Module; **each** carries **20** marks.

Module – I

11. a) Derive an expression for temperature distribution during steady state heat conduction in a solid sphere with internal heat generation and exposed to convection environment.

P.T.O.

b) An industrial freezer is designed to operate with an internal air temperature of – 21°C, when the external air temperature is 26°C, the internal and external heat transfer coefficients are 12 $W/m^2.K$ and 8 $W/m^2.K$ respectively the wall of the freezer consists of an inner layer of plastic 1 W/m.K, 3 mm thick and an outer layerof stainless steel 16 W/m.K, 1mm thick. A layer of insulation material 0.07 W/m.K is sandwitched between these two layers. Find the thickness of insulation to reduce the convection heat loss to 15 W/m^2.

OR

12. a) Derive an expression of overall heat transfer coefficient for multilayer hollow sphere with electrical analogy.

b) An aluminum sphere weighing 5 kg and initially at temperature of 350°C is suddenly immersed in a fluid at 35°C with convection coefficient of 60 $W/m^2.K$. Estimate the time required to cool the sphere to 100°C. Take thermophysical properties a C = 900 J/.K, k = 205 W/m.K and density 2700 kg/m^3.

Module – II

13. a) Explain the dimensional analysis for forced flow through a circular tube.

b) Air at 20°C and at a pressure of 1 bar is flowing over a flat plate at a velocity of 3m/s. If the plate is 280 mm wide and at 56°C. Calculate the following quantities at x = 280 mm.

   i) Local heat transfer coefficient
   ii) Drag force on the plate
   iii) Shearing stress due to friction
   iv) Rate of heat transfer by convection.

OR

14. a) Derive an expression for momentum transfer equation for flow over a flat plate.

b) Find the convective heat loss from a radiator 0.6 m wide and 1.2 m high maintained at a temperature of 90°C in a room at 14°C. Consider the radiator as a vertical plate.

Module – III

15. a) Obtain an expression for overall heat transfer coefficient for tubular heat exchanger subjected to fouling on its two sides of the heat transfer surface.

    b) 8000 kg/h of air at 100°C is cooled by passing it through a single pass cross flow heat exchanger. To what temperature is the air cooled if water entering at 15°C flows through the tubes unmixed at the rate of 7500 kg/h.

OR

16. i) Derive expression for effectiveness by NTU of parallel flow heat exchanger.

    ii) List out the applications of heat pipe.

    iii) What are the applications of fin ?

Module – IV

17. a) State and explain Kirchhoff's Law of Radiation.

    b) Two large parallel planes with emissivity 0.6 are at 900 K and 300 K. A radiation shield with one side polished and having emissivity of 0.05, while the emissivity of other side is 0.4 is proposed to be used. Which side of the shield to face the hotter plane, if the temperature of shield is to be kept minimum ?

OR

18. a) Explain equimolar counter diffusion.

    b) A tray 40 cm long and 20 cm wide is full of water. Air at 30°C flows over the tray along the length at 2m/s. the moving air at 1.013 bar and partial pressure of water in the air is 0.007 bar. Calculate the rate of evaporation, if the temperature of the water is 25°C. take density of air is 1.2 kg/m^3, $\nu = 15 \times 10^{-6}$ m^2/s, $D_{AB} = 0.145$ m^2/h.
