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A - 2693

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) Answerall questions.

PART-A

 $(10\times2=20 \text{ Marks})$ 

- 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  $\pi$  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<sup>2</sup>.K and 8 W/m<sup>2</sup>.K respectively the wall of the freezer consists of an inner layer of plastic 1 W/m.K, 3 mm thick and an outer layer of stainless steel 16 W/m.K, 1 mm 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<sup>2</sup>.

OF

- 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<sup>2</sup>.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<sup>3</sup>.

## 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

- 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.



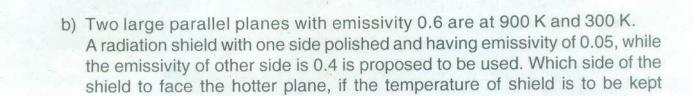
## Module - III

- 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



OR

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

18. a) Explain equimolar counter diffusion.

minimum?

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<sup>3</sup>,  $v = 15 \times 10^{-6} \text{m}^2/\text{s}$ ,  $D_{AB} = 0.145 \text{m}^2/\text{h}$ .