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Reg. No. : ....

Name : ....

Sixth Semester B.Tech. Degree Examination, May 2018
(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. Thermal diffusivity values are higher for metals and gases. Give suitable reasons.
2. What are the methods can be used to solve transient heat conduction problems.
3. Define Newton's law of cooling.
4. What is physical significance of Prandtl Numbers ?
5. State the causes of fouling in heat exchangers.
6. Differentiate between filmwise and dropwise condensation.
7. How monochromatic emissive power differ from total emissive power.
8. State the modes of mass transfer with suitable examples.
9. List out application of heat pipe.
10. At what situation Nusselt number should be considered ?

PART – B **(4×20=80 Marks)**

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

Module – I

11. a) Derive an expression of overall heat transfer coefficient for hollow cylindrical system with electrical analogy.

P.T.O.

b) A plane wall 45 W/m.K, 10 cm thick generated at a uniform rate of 8x106W/m^3. The two sides of the wall are maintained at 180°C and 120°C. Neglect end effects calculate

i) temperature distribution across the plate

ii) position and magnitude of maximum temperature

iii) the heat flow rate from each surface of the plate.

OR

12. a) i) Explain the electrical analogy of the heat transfer with the help of a thermal network.

ii) How do the thermal conductivity of liquids and gases vary with temperature ?

b) A pipe 4 cm in outer diameter is maintained at uniform temperature at T_1 and is covered with insulation 0.20 W/m.K, in order to reduce the heat loss. The heat is dissipated from outer surface of insulation into an ambient at T_∞ with heat transfer coefficient of 8 W/m^2.K. Determine the thickness of insulation at which the heat dissipation rate would be the maximum. Calculate the ratio of the heat loss from the outer surface of insulated pipe and that of from bare pipe for

i) thickness of insulation equal to critical thickness

ii) the thickness of insulation is 2 cm thicker than the critical thickness.

Module – II

13. a) What do you mean by hydrodynamically developed flow in a circular tube ? Explain.

b) Water flows through a straight tube at a velocity of 15m/s and 50 mm diameter. The tube surface is maintained at a uniform temperature of 60°C and the flowing water is heated from an inlet temperature of 20°C to an outlet temperature of 40°C. Find the heat transfer coefficient from the tube surface to the water, the heat transferred and the tube length.

OR

14. a) Explain Buckingham π theorem. What are its merits and demerits ?

b) A copper heating coil is used to heat a large cylinder of water. The coil may be considered to be a horizontal cylinder, 1.5 m long and an outer diameter of 0.05 m. It has uniform surface temperature of 80°C. Estimate the heat transfer to water at 10°C.

Module – III

15. a) Derive an expression for logarithmic mean temperature difference (LMTD) in the case of counter flow heat exchanger.

b) Hot water at 2.5 kg/s and 100°C enters a concentric tube counter flow heat exchanger having a total area of 23 m^2. Cold water at 20°C enters at 5 kg/s and the overall heat transfer coefficient is 1000 $W/m^2.K$. Determine the total heat transfer rate and the outlet temperature of hot and cold fluids.

OR

16. a) Saturated steam at 90°C and 70kPa is condensed on outer surface of a 1.5 m long 2.5 cm diameter vertical tube maintained at uniform temperature of 70°C. Assuming film wise condensation. Calculate the heat transfer rate on the tube surface.

b) A very long 25 mm diameter copper (380 W/m.K) rod extends from a surface at 120°C. The temperature of surrounding air is 25°C and the heat transfer coefficient over the rod is 10 $W/m^2.K$. Calculate

i) heat loss from the rod

ii) how long the rod should be in order to be considered infinite.

Module – IV

17. a) State and explain Stefan Boltzmann law. Derive an expression for total emissive power of a blackbody.

b) The effective temperature of a body having an area of 0.12m^2 is 527°C. Calculate the following

i) the total rate of energy emission

ii) the intensity of normal radiation

iii) the wavelength of maximum monochromatic emissive power.

OR

18. a) Discuss the mass transfer coefficient

b) Define and explain the physical significance of following

i) Schmidt number

ii) Lewis number

iii) Sherwood number.