G 1200 (Pages : 3) Reg. No.....

Name.....

B.TECH. DEGREE EXAMINATION, MAY 2015

Sixth Semester

Branch : Automobile Engineering/Mechanical Engineering/Production Engineering

AU 010 602/ME 010 602/PE 010 602—HEAT AND MASS TRANSFER (AU, ME, PE)

(Regular/Improvement/Supplementary)

Time : Three Hours Maximum : 100 Marks

Use of Approved data-book is permitted.

Assume any missing data if required.

Part A

Answer **all** *questions.*

Each question carries 3 *marks.*

1. Define thermal conductivity, thermal resistance and thermal conductance ?
2. Differentiate between mechanisms of heat transfer by free and forced convection.
3. How does a fin enhance heat transfer at a surface ?
4. State Kirchoff's law of radiation ?
5. State the different modes of mass transfer ?

(5 × 3 = 15 marks)

Part B

Answer **all** *questions.*

Each question carries 5 *marks.*

6. Derive the equation for overall thermal resistance to heat flow through multilayer composite cylindrical wall.
7. Distinguish between thermal boundary layer and hydrodynamic boundary layer ?
8. Derive the effectiveness — NTU relationship for a counter flow heat exchanger.
9. Explain Stefan Boltzmann Law.
10. Explain Fick's law of diffussion.

(5 × 5 = 25 marks)

Turn over

Part C

Answer **all** *questions*
Each full question carries 12 *marks.*

11. (a) Derive an expression for heat transfer through a composite wall of three layers of different materials.

Or

(b) Two insulation materials A and B, in powder form, with thermal conductivities of 0.005 W/m.-deg and 0.03 W/m.-deg. were purchased for use over a sphere of 40 cm. diameter. Material A was to form the first layer 4 cm. thick and material B was to be the next layer 5 cm. thick. Due to oversight during installation, whole of material B was applied first and subsequently there was a layer formed by material A. Investigate how the conduction heat transfer would be affected.

12. (a) An electrically heated square plate 50 cm. × 50 cm, has one of its surface thermally insulated and the other surface dissipates heat by free convection into atmospheric air at 20°C. The heat flux over the surface of the plate is uniform and results in a mean temperature of 60°C. If the plate is inclined at an angle of 50 degree from the vertical, make calculations for the heat loss from the plate for the heated surface facing up.

Or

(b) Explain in detail the mechanism of free convection? Show by dimensional analysia that problems in heat transfer involving free convection only, the Nusselt number can be expressed as a function of the Prandtl number and Grashof number.

13. (a) A rod of 10 mm. square section and 160 mm. length with thermal conductivity of 50 W/m.-deg protrudes from a furnace wall at 200°C, and is exposed to air at 30°C, with convection coefficient 20 W/m^2. deg. Make calculations for the heat convected upto 80 mm. and 158 mm. lengths and comment on the result. Adopt a long fin model for the arrangement.

Or

(b) A steam condenser is transferring 250 kW. of thermal energy at a condensing temperature of 65°C. The cooling water enters the condenser at 20°C with a flow rate of 7500 kg./hr. Calculate the log mean temperature difference. If overall heat transfer coefficient for the condenser surface is 1250 W/m.^{2}-deg, what surface area is required to handle this load ? What error would be introduced if the arithmetic mean temperature difference is used rather than the log mean temperature difference ?

14. (a) Explain : (a) intensity of radiation ; (b) Wein's displacement law ; (c) Planck's law ; and (d) Radiosity.

Or

(b) The net radiation from the surface of two parallel plates maintained at temperature T1 and T2 is to be reduced by 79 times. Calculate the number of screens to be placed between the two surfaces to achieve this reduction in heat exchange, assuming the emissivities of the screens on 0.5 and that of the surfaces on 0.8.

15. (a) Discuss in detail the various regimes in boiling and explain the condition for the growth of bubbles. What is the effect of bubble size on boiling ?

Or

(b) Explain two dimensional steady state heat conduction.