G 362 (Pages : 2) Reg. No.................................

Name.................................

B.TECH. DEGREE EXAMINATION, MAY 2014

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)

(New Scheme—2010 Admission onwards)

[Regular/Improvement/Supplementary]

Time : Three Hours Maximum : 100 Marks

Use of approved data book is permitted.
Assume any missing data if required.

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Part A

Answer **all** *questions.*
Each question carries 3 *marks.*

1. How will you estimate heat transfer through corners ?
2. Define Nusselt number.
3. What is the importance of effectiveness of a fin ?
4. Define black and grey surfaces.
5. Write the analogy between heat and mass transfer.

(5 × 3 = 15 marks)

Part B

Answer **all** *questions.*
Each question carries 5 *marks.*

6. Compare one-dimensional heat transfer with and without internal heat generation.
7. How will you apply dimensional analysis for forced connection ?
8. Write and discuss all the governing equations for extended surface heat transfer.
9. With sketches, explain the concept of radiation shields.
10. Define and explain Fick's law of diffusion.

(5 × 5 = 25 marks)

Part C

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

11. With necessary assumptions, derive the general heat conduction equation in Cartesian co-ordinates.

Or

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12. What is critical thickness of insulation ? Obtain critical thickness of insulation for different conditions of heat transfer.

13. A rectangular duct, 30 cm × 20 cm in cross-section, carries cold air. The temperature of the outer surface of the duct is 5°C and the surrounding air temperature is 25°C. Estimate the rate of heat gain by the duct, assuming that the duct, one metre in length, is exposed to the air in the vertical position. Properties of air at 15°C = ρ = 1.22 kg/m^3, γ = 14.6 × 10^{-6} m^2/s, k = 0.03 W/mK, and Pr = 0.7.

Or

14. Explain Newton's law of cooling. With examples, clearly differentiate between a thermal boundary layer and hydrodynamic boundary layer. Derive the expressions for each case, indicating the behaviour of the system.

15. A counter flow double-pipe heat exchanger using super heated steam is used to heat water at the rate of 10,500 kg/h. The steam enters the heat exchanger at 180°C and leaves at 130° C. The inlet and exit temperature of water are 30°C and 80°C respectively. If the overall heat transfer coefficient from steam to water is 814 W/m^2 K, calculate the heat transfer area. What would be the increase in area be if the fluid flows were parallel ?

Or

16. Explain the physical significance of a heat exchanger. Discuss, in detail the classification of heat exchangers according to (i) type of energy transfer ; (ii) size ; and (iii) area to volume ratio.

17. Determine the heat lost by radiation per metre length of 7.5 cm oxidized steel pipe at 300°C, if (a) located in a large room with red brick walls at a temperature of 25°C, and (b) enclosed in a 25 cm × 25 cm red brick conduct at a temperature of 25°C. The emissivity of oxidized steel is 0.79 and that of red brick is 0.93.

Or

18. Two concentric spheres, 21 cm and 30 cm in diameter, with the space between them evacuated, are to be used to store liquid air (–153°C) in a room at 27°C. The surfaces of the spheres are flushed with aluminium (ϵ = 0.03) and the latent heat of vaporization of liquid air is 209.35 kJ/kg. Calculate the rate of evaporation of liquid air.

19. Discuss the governing equations and boundary conditions of two dimensional heat conduction system. Give any three practical applications.

Or

20. Determine the change in entropy when 2 kg of O_2 at 60°C are mixed with 6 kg of N_2 at the same temperature. The initial pressure of each constituent is 103 KPa and is the same as that of the mixture.

[5 × 12 = 60 marks]