CBCS SCHEME

USN | | | | | | | | | | **15MR64**

Sixth Semester B.E. Degree Examination, June/July 2019
Heat Transfer

Time: 3 hrs. Max. Marks: 80

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. Use of heat transfer data hand book and steam tables are permitted.

Module-1

1 a. Derive the general 3-D Heat conduction equation in Cartesian coordinate system and hence obtain Laplace equation. **(08 Marks)**

b. A spherical Vessel 1m in diameter contains liquefied gas at -185°C. Two insulating Layers each 100mm thick are applied to the outer surface of the vessel. The thermal conductivity for the inner layer is 0.043W/mK, and for the outer surface layer 0.058W/m. The outside surface coefficient is $10.2 W/m^2K$. The ambient temperature is 15°C. Determine the heat leakage per hour, and the temperature of the outer surface of the lagging. **(08 Marks)**

OR

2 a. What is the physical significance of critical thickness of in solution? Derive an expression for critical thickness of insulation for a cylinder. **(08 Marks)**

b. A wire of 1.8mm diameter carries an electic current which generates 2.1 watts of heat per meter, length. It is covered with insulating 1.22mm thick and thermal conductivity 0.11 W/mK. If the surrounding air temperature and surface heat transfer coefficient remain unchanged at 27°C and $12W/m^2K$ respectively. Calculate :

i) The temperature of the wire without insulation
ii) The temperature of the wire with in solution
iii) The surface temperature of the in insulated cable. **(08 Marks)**

Module-2

3 a. Derive an expression for the temperature distributing for a pinfin, when the tip of the fin is insulated. **(08 Marks)**

b. A motor body is 360mm in diameter (outside) and 240mm ling. Its surface temperature should not exceed 55°C when dissipating 340W. Longitudinal fins of 15mm thickness and 40mm height are proposed. The convection coefficient is $40W/m^2C$. determine the number of fins required. Atmospheric temperature is 30°C, thermal conductivity = 40W/m°C. **(08 Marks)**

OR

4 a. Derive an expression for instaneous and total heat flow in terms of the product of biot number and Fourier number in the dimensional transient heat conduction. **(04 Marks)**

b. A solid iron rod of diameter 60mm initially at temperature of 800°C is suddenly dropped into oil bath at 50°C the heat transfer coefficient between the fluid and surface is $400W/m^2K$. The properties of iron rod are as follows ($\alpha = 2 \times 10^{-5} m^2S$, K = 60W/m°C) Calculate :

i) The centre line temperature 10 minutes after immersion in the fluid.
ii) Temperature at a radius of 20mm, 10 minute after immersion in the fluid
iii) How long will it take to reach for the centre line temperature to reach 100°C. **(12 Marks)**

Module-3

5 a. With the help of dimensional analysis, derive expression for the Reynolds number, Prandtl number and Nusselt number. **(10 Marks)**

b. Assuming that a man can be represented by a cylinder 350mm in diameter and 1.65m high with a surface temperature of 28°C. Calculate the heat he would lose while standing in a 30Km/hr wind at 12°C. **(06 Marks)**

OR

6 a. Explain the following :

i) Velocity boundary layer

ii) Thermal boundary layer

iii) Thermal boundry length. **(06 Marks)**

b. A refrigerated truck is moving on a high way at 90Km/h in a desert area where the ambient air temperature is 50°C. The body of the truck may be considered as a rectangular box measuring 10m (length) × 4m (width) ×3m (height). Assume that the boundary layer on the four walls is turbulent, the heat transfer takes place only from the four surfaces and the wall surface of the trunk is maintained at 10°C. Neglecting heat transfer from the front and back and assuming the flow to be parallel to 10m long side, calculate the following :

i) The heat loss from the four surfaces

ii) The tonnage of refrigeration

iii) The power required to overcome the resistance acting on the four surfaces [Take proportion of air at t_f = 30°C, ρ = 1.165Kg/m^3, C_p = 1.005kJ/Kg °C, K = 0.02673 W/m^2°C, $\gamma = 16 \times 10^{-6}$ m^2/s P_r = 0.70]. **(10 Marks)**

Module-4

7 a. Derive an expression for the effectiveness of a parallel flow heat exchanger. **(10 Marks)**

b. Exhaust gases enter the centre of a double pipe cooler at 350°C and leaves at 100°C. the gas flow rate is 200Kg/hr, and C_p = 1.13kJ/Kg K. The water enters the annular space at 10°C. The water flow rate is 1400Kg/hr and C_p = 4.19kJ/Kg K. The diameter of the inner pipe is 75mm, thickness may be disregarded, and the surface coefficients are gas side 0.3kW/m^2 K, waterside 1.5kW/m^2 K. Determine the pipe length required for counter flow heat exchanger. **(06 Marks)**

OR

8 a. With the help of typical experimental boiling curve explain the different regions of pool boiling. **(08 Marks)**

b. State and explain Fick's law diffusion. What are the assumptions made in Nusselt theory? **(08 Marks)**

Module-5

9 a. State and explain the following :

i) Stefan – Boltzmann law ii) Kirchhoff's law iii) Plancki law

iv) Wien's displacement law iv) Lamberts cosine law. **(10 Marks)**

b. For a black body enclosed in a hemispherical space show that emissive power of the black body is π times the intensity of radiation. **(06 Marks)**

OR

10 a. Explain the concept of black body. **(06 Marks)**

b. Calculate the neat radient heat exchange per m^2 area for two large parallel plates at temperature of 427°C and 27°C respectively. E for hot plates is 0.9 and for clod plate it is 0.6. if polished aluminium shield is placed between them, find the percentage reduction in the heat transfer. Assume E for shield = 0.4. **(10 Marks)**

* * * * *