PAPER ID-310660

Subject Code: RME502

Roll No: | | | | | | | | | | | | | |

B. TECH
(SEM-V) THEORY EXAMINATION 2020-21
HEAT & MASS TRANSFER

Time: 3 Hours *Total Marks: 70*

Note: 1. Attempt all Sections. If require any missing data; then choose suitably.

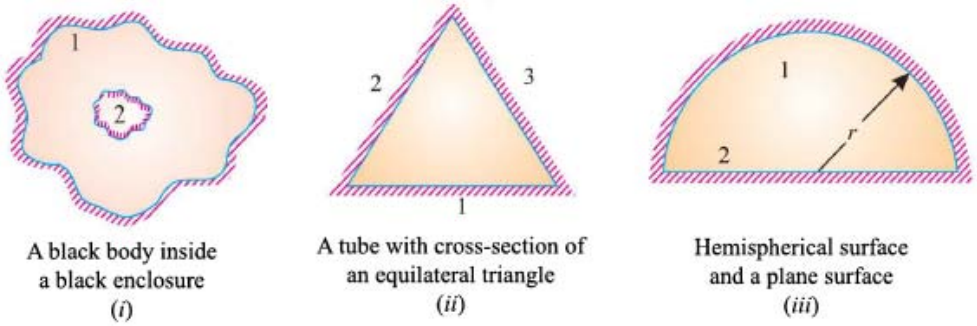
SECTION A

1. Attempt *all* questions in brief. 2 x 7 = 14

a.	What are the assumptions of Fourier's law?
b.	How does a human body maintain its temperature during summer?
c.	How the concept of lump body is helpful in heat transfer problem?
d.	Explain the term "fin efficiency".
e.	Show the physical significance of following dimensionless numbers. (i) Nusselt number (ii) Prandtl number
f.	Define the following: (i) Reflectivity (ii) Absorptivity
g.	Define the term "effectiveness" for heat exchanger.

SECTION B

2. Attempt any *three* of the following: 7 x 3 = 21

a.	A plane wall of area 5 m^2 and thickness 10 cm is subjected to one dimensional heat conduction. Find the heat transfer rate if the surfaces of the wall are at 400°C and 100°C and the conductivity of the wall is given by K= 0.5(1+0.0065t) where K is in W/m°C and t is in °C.
b.	A copper slab (p = 9000 kg/m^3, c = 380 J/kg°C, k = 370 W/m°C) measuring 400 mm x 400 mm x 5 mm has a uniform temperature of 250°C. Its temperature is suddenly lowered to 30°C. Calculate the time required for the plate to reach the temperature of 90°C. Assume convective heat transfer coefficient as 90 W/m^2 °C.
c.	Air at 20°C and 1 atm, flows over a flat plate at 35 m/s. The plate is 75 cm long and is maintained at 60◦C. Assuming unit depth in the z direction, calculate the heat transfer from the plate. Properties of the fluid are given as: ρ=1.128 kg/m^3, μ=1.906×10^{-5} kg/m·s, Pr = 0.7, k = 0.02723 W/m·°C, c_p=1.007 kJ/kg·°C Use $Nu_L = Pr^{1/3}(0.037\ Re_L^{0.8} - 871)$
d.	Calculate the shape factor for the following:  A black body inside a black enclosure (*i*) — A tube with cross-section of an equilateral triangle (*ii*) — Hemispherical surface and a plane surface (*iii*) Assume all geometrical parameter.
e.	How heat exchangers are Classified. Explain the different types of heat exchanger with their temperature distribution graph.

SECTION C

3. Attempt any *one* part of the following: 7 x 1 = 7

(a)	What is the importance of critical radius? Derive the expression for same in case of insulation of a cylinder and sphere.
(b)	are joined together by bolting using four steel bolts of 1 cm diameter at the corners (k= 40 W/m°C). Calculate the heat flow per unit area if one surface is at 350°Cand the other at 200°C.

4. Attempt any *one* part of the following: 7 x 1 = 7

(a)	Derive an expression for the heat loss from a rod connecting with heat source on both ends. Assume all the required data.
(b)	Calculate the amount of energy required to solder together two very long pieces of bare copper wire 1.625 mm in diameter with solder that melts at 195°C. The wires are positioned vertically in air at 24°C. Assume that the heat transfer coefficient on the wire surface is 17 W/m°C and thermal conductivity of wire alloy is 335 W/m°C.

5. Attempt any *one* part of the following: 7 x 1 = 7

(a)	A cylindrical body of 300 mm diameter and 1.6 m height is maintained at a constant temperature of 36.5°C. The surrounding temperature is 13.5°C. Find out the amount of heat to be generated by the body per hour if p = 1.025 kg/m3; cp = 0.96 kJ/kg°C; υ = 15.06 x 10-5 m2/s; k = 0.0892 kJ/m-h-°C and β = (1/298) K-1, Assume Nu = 0.12 (Gr. Pr)1/3 (the symbols have their usual meanings).
(b)	A plate of length 500 mm and width 250 mm has been placed longitudinally in a stream of crude oil which flows with a velocity of 6 m/s. If the oil has a specific gravity of 0.9 and kinematic viscosity of 1 stoke, calculate: (i) Boundary layer thickness at the middle of plate, (ii) Shear stress at the middle of plate, and (iii) Friction drag on one side of the plate.

6. Attempt any *one* part of the following: 7 x 1 = 7

(a)	What do you understand by radiation shield? Derive the expression of net heat transfer rate for a system of two parallel plates separated by n-shields of emissivity's $\varepsilon_1, \varepsilon_2, \varepsilon_3, \varepsilon_4, \varepsilon_5 \ldots\ldots \varepsilon_n$
(b)	The large parallel plates with emissivities 0.3 and 0.8 exchange heat. Find the percentage reduction when a polished aluminum shield of emissivity 0.04 is placed between them. Use the method of electrical analogy.

7. Attempt any *one* part of the following: 7 x 1 = 7

(a)	State Fick's law of diffusion. what are the limitations of Fick's law?
(b)	Discuss the various regimes of pool boiling heat transfer.