Subject Code: NME504

PAPER ID-310649

Roll No:

B. TECH.

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

Time: 3 Hours ***Total Marks: 100***

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

SECTION A

1. Attempt *all* questions in brief. 2 x 10 = 20

a.	Explain black body, white body, gray body and opaque body.
b.	What is radiation shield?
c.	What is lumped system analysis? When it is applicable?
d.	Define three modes of heat transfer. Give a practical example where all three modes are occurring simultaneously.
e.	Define Nusselt number.
f.	State the Wein's displacement law?
g.	Define Biot number.
h.	Why metals are good thermal conductors, while non-metals are poor conductors of heat? Explain with examples.
i.	What is thermal conductivity?
j.	Explain Fourier Law of Heat conduction in detail.

SECTION B

2. Attempt any *three* of the following: 10x3=30

a.	Derive the general heat conduction equation in Cartesian co-ordinates.
b.	What are the applications of the fins? Establish an expression for temperature distribution in straight fin of rectangular profile, when fin tip is uninsulated.
c.	State Fick's law of diffusion. What are its limitations?
d.	What do you mean by shape factor? Write its salient features.
e.	What is Critical thickness? Derive the formula for critical radius of cylinder.

SECTION C

3. Attempt any *one* part of the following: 10x1=10

a.	A metal plate with dimension 5 mx 3 m with negligible thickness has a surface temperature of 300°C. One side of it loses heat to the surroundings air at 30°C. The heat transfer coefficient between plate surface and air is 20 W/m^{2}K. The emissivity of the plate surface is 0.8. Calculate. (i) Rate of heat loss by convection. (ii) Rate of heat loss by radiation
b.	The composite wall of an oven consists of three materials, two of them are of known thermal conductivity, k_A = 20 W/m K and k_C = 50 W/m K and known thickness L_A = 0.3 m and L_C = 0.15 m. The third material B, which is sandwiched between material A and C is of known thickness, L_B = 0.15 m, but of unknown thermal conductivity k_B. Under steady state operating conditions, the measurement reveals an outer surface temperature of material C is 20°C and inner surface of A is 600°C and oven air temperature is 800°C. The inside convection coefficient is 25 W/m^{2}K. What is the value of k_B?

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4. Attempt any *one* part of the following: 10x1=10

a.	Differentiate between dropwise and film wise condensation.
b.	Define pool boiling and also explain regimes of pool boiling with the help of diagram.

5. Attempt any *one* part of the following: 10x1=10

a.	Explain the analogy between momentum and heat transfer in turbulent flow over flat plate.
b.	A small convex object of area A1, temperature T1 and emissivity Є1 is enclosed within a large enclosure at temperature T2 and emissivity Є2. Derive an expression for the net heat exchange between the two objects.

6. Attempt any *one* part of the following: 10x1=10

a.	Prove that for a body whose thermal resistance is zero, the temperature required for cooling or heating can be obtained from the relation **(t-ta)/(t-ta) = exp[-Bi Fo],** where the symbols have their usual meanings.
b.	Derive an expression for effectiveness by NTU method for parallel flow.

7. Attempt any *one* part of the following: 10x1=10

a.	An egg with mean diameter of 40 mm and initially at 20°C is placed in boiling water pan for 4 minute and found to be boiled to customer's taste. For how long should a similar egg for same consumer to be boiled when taken from refrigerator at 5°C.Take the following properties of egg: k=10W/m°C, ρ=1200 kg/m^3,c=2kJ/kg°C, And h=100W/m^2 °C.
b.	Engine oil (cp= 2100J/kg^{0}C) is to be heated from 20^0 C to 60^0 C at a rate of 0.3 kg/s in a 2 cm diameter thin-walled copper tube by condensing steam outside at a temperature of 130^0 C (h_{fg} =2174kJ/kg) for an overall heat transfer coefficient of 650W/m^2 ^{0}C. Determine the rate of heat transfer and the length of the tube required to achieve it.