Subject Code: KME501

PAPER ID-410836

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

B.TECH
(SEM- V) THEORY EXAMINATION 2021-22
HEAT AND MASS TRANSFER

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

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

SECTION A

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

Q no.	Question	Marks	CO
a.	What is the difference between thermodynamics and heat transfer?	2	1
b.	How the thermal conductivity of material is defined? What are its units?	2	1
c.	What is meant by transient heat conduction?	2	2
d.	Explain effectiveness and efficiency of fin.	2	2
e.	What is turbulent flow? Define it.	2	3
f.	Define Reynolds's number, also write the significance of Reynolds's number.	2	3
g.	Define Stefan Boltzmann's law.	2	4
h.	Explain black body, opaque body, white body and grey body also.	2	4
i.	How heat exchangers are classified?	2	5
j.	What are the various modes of mass transfer?	2	5

SECTION B

2. Attempt any *three* of the following:

Q no.	Question	Marks	CO
a.	Drive an expression for heat conduction through a composite wall.	10	1
b.	It is required to heat oil to about 300°C for frying purpose. A ladle is used in the frying. The section of the handle is 5 mm x 18 mm. the surroundings are at 30°C. The conductivity of the material is 205 W/m°C. If the temperature at a distance of 380 mm from the oil should not reach 40°C, Determine the convective heat transfer coefficient.	10	2
c.	Differentiate between:- (i) Natural and forced convection. (ii) Hydrodynamic and thermal boundary layer thickness.	10	3
d.	A 70 mm long circular surface of a circular hole of 35 mm diameter maintained at uniform temperature of 250°C. Find the loss of energy to the surroundings at 27°C, assuming the two ends of the hole to be as parallel discs and the metallic surfaces and surroundings have a black body characteristics.	10	4
e.	Derive an expression for effectiveness by NTU method for parallel flow.	10	5

SECTION C

3. Attempt any *one* part of the following:

Q no.	Question	Marks	CO
a.	Derive a general heat conduction equation for Cartesian co-ordinate. And also draw the temperature-thickness profile for it.	10	1
b.	A mild steel tank of thickness 12 mm contains water at 95°C. The thermal conductivity of mild steel is 50 W/m°C, and the heat transfer coefficients for the inside and outside the tank are 2850 and 10 W/m^2 °C, respectively. If the atmospheric temperature is 15 °C, calculate: (i) The rate of heat loss per square meter of the tank surface area. (ii) The temperature of the outside surface of the tank.	10	1

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4. Attempt any *one* part of the following:

Q no.	Question	Marks	CO
a.	An aluminium alloy plate of 400 mm x 400 mm x 4mm size at 200 °C is suddenly quenched into liquid oxygen at -183°C. Starting from fundamentals or deriving the necessary expression to determine the time required for the plate to reach a temperature of -70 °C. Assume h = 20000 KJ/m^2 h °C, c_p = 0.8 KJ/Kg °C and density = 3000 Kg/m^3.	10	2
b.	Prove that for a body whose thermal resistance is zero, the temperature required for cooling or heating can be obtained from the relation $(t-t_a)/(t_i-t_a) = \exp[-B_i F_a]$ Where the symbols have their usual meanings.	10	2

5. Attempt any *one* part of the following:

Q no.	Question	Marks	CO
a.	A nuclear reactor with its core constructed of parallel vertical plates of 2.2 m high and 1.4 m wide has been designed on free convection heating of liquid bismuth. The maximum temperature of the plate surface is limited to 960°C while the lowest allowable temperature of the bismuth is 340°C. Calculate the maximum possible heat dissipation from the both sides of each plate. For the convection coefficient for the plate is $Nu = 0.13\ (Gr.Pr)^{0.333}$ Where different parameter are evaluated at the mean film temperature.	10	3
b.	Air at 20°C flowing over a flat plate which is 200 mm wide and 500 mm long. The plate is maintained at 100°C. Find the heat loss per hour from the plate f the air is flowing parallel to 500 mm side with 2 m/s velocity. What will be the effect on heat transfer if the flow is parallel to 200 mm? The properties of air at (100+20)/2 = 60°C are ν = 18.97 × 10^{-6} m^2/s, k = 0.025W/m°C and Pr = 0.7.	10	3

6. Attempt any *one* part of the following:

Q no.	Question	Marks	CO
a.	Determine the radiant heat exchanger in W/ m^2 between two large parallel steel plates of emissivity's 0.8 and 0.5 held at temperature of 1000 k and 500k respectively, if a thin copper plate of emissivity 0.1 is introduced as a radiation shield between the two plates. Use σ = 5.67*10^{-8} W/ m^2k^4	10	4
b.	Derive the expression for net heat exchange between black bodies for infinite parallel planes.	10	4

7. Attempt any *one* part of the following:

Q no.	Question	Marks	CO
a.	The flow rates of hot and cold water streams running through a parallel flow heat exchangers are 0.2 Kg/s and 0.5 Kg/s respectively the inlet a temperatures 75°c and 20°c respectively. The exit temperature of hot water is 45°c. If the individual heat transfer coefficient on both sides are 650 W/m^2°C. Calculate: (i) The area of heat exchanger. (ii) the rate of heat transfer	10	5
b.	Differentiate between the mechanisms of filmwise and dropwise condensation.	10	5