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BTECH
(SEM V) THEORY EXAMINATION 2024-25
HEAT AND MASS TRANSFER

TIME: 3 HRS

M.MARKS: 100

Note: Attempt all Sections. In case of any missing data; choose suitably.

SECTION A

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

Q no.	Question	CO	Level
a.	Define three mode of heat transfer.	1	K 2
b.	What is thermal diffusivity? Explain its physical significance.	1	K 2
c.	What is the use of fins on surfaces?	2	K 3
d.	Describe Lumped Parameter Analysis.	2	K 3
e.	Describe Biot number.	3	K 3
f.	Define Reynold's number.	3	K 3
g.	What is irradiation?	4	K 3
h.	What is radiation shield?	4	K 3
i.	How counter flow heat exchangers are better than Parallel flow heat exchanger?	5	K 4
j.	Describe Fick's law of diffusion.	5	K 4

SECTION B

2. Attempt any three of the following: 10 x 3 = 20

a.	Using electrical analogy determine the thermal resistance expression for parallel and series combination in a composite wall of different materials.	1	K 2
b.	Define fin effectiveness and discuss the conclusion that can be made from the fin effectiveness.	2	K 3
c.	Explain velocity and thermal boundary layer.	3	K 3
d.	Derive an expression for the view factor integral for two surfaces 1 and 2 which are exchanging heat.	4	K 3
e.	Derive an expression for effectiveness by NTU method for counter flow.	5	K 4

SECTION C

3. Attempt any one part of the following: 10 x 1 = 10

a.	Write general three-dimensional heat conduction equation in Cartesian co-ordinates for steady state without heat generation.	1	K 2
b.	The temperature distribution in a plate of thickness 20 mm is given by $T (^{\circ}\text{C}) = 6x^2 + 10x + 4$. Assume no heat generation in the plate; calculate heat flux on two sides of the plate. Also calculate rate of temperature change with respect to time, if $k = 300\text{W/m.K}$, $\rho = 580\text{ kg/m}^3$ and $C = 420\text{ J/kgK}$.	1	K 2

4. Attempt any one part of the following: 10 x 1 = 10

a.	Derive an expression for heat conduction equation in the finite long fin and with negligible heat loss from fin tip.	2	K 3
b.	An aluminium alloy fin ($k = 200\text{ W/m.K}$), 3.5 mm thick and 2.5 cm long protrudes from a wall. The base is at 420°C and ambient air temperature is 30°C . The heat transfer coefficient may be taken as $11\text{ W/m}^2.\text{K}$. Find the heat loss and fin efficiency, if the heat loss from fin tip is negligible.	2	K 3



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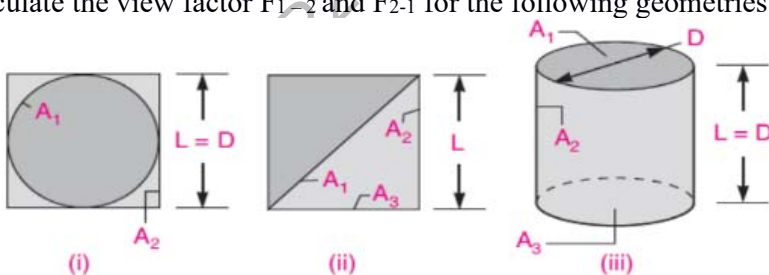
TIME: 3 HRS

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5. Attempt any one part of the following:**10 x 1 = 10**

a.	Define the following terms : (i) Natural and forced convection (ii) Nusselt number and Grashoff number	3	K 3
b.	The crank case of an automobile is approximated as 0.6 m long, 0.2 m wide and 0.1 m deep. Assuming that the surface temperature of the crank case is 350 K. Estimate the rate of heat flow from the crank case to atmosphere at 276 K at a road speed of 30 m/s. Assume that the vibration of the engine and chassis induce the transmission from laminar to turbulent flow very near to leading edge that for practical purposes the boundary layer is turbulent over the entire surface. Neglect the radiation and use for the front and rear surfaces, same heat transfer coefficient as for bottom and sides. <i>Use relation $Nu_L = 0.036 Re_L^{0.8} Pr^{1/3}$</i> <i>and</i> $\rho = 1.092 \text{ kg/m}^3,$ $\mu = 19.123 \times 10^{-6} \text{ Ns/m}^2$ $k_f = 0.0265 \text{ W/m.K},$ $Pr = 0.71.$	3	K 3

6. Attempt any one part of the following:**10 x 1 = 10**

a.	Define absorptivity, reflectivity and transmissivity.	4	K 3
b.	Calculate the view factor F_{1-2} and F_{2-1} for the following geometries : 	4	K 3

7. Attempt any one part of the following:**10 x 1 = 10**

a.	Derive LMTD for the counter flow heat exchangers.	5	K 4
b.	Cold water at 1495 kg/h enters at 25°C through a parallel flow heat exchanger to cool 605 kg/h of hot water entering at 70°C and leaving at 50°C. Find the area of the heat exchanger. The individual heat transfer coefficients on both sides are 1590 W/m ² .K. Use LMTD and NTU methods.	5	K 4