Code No.: ME602PC | R20 | H.T.No. | | | 8 | R | | | | | |

CMR ENGINEERING COLLEGE: : HYDERABAD
UGC AUTONOMOUS
III–B.TECH–II–Semester End Examinations (Regular) - May- 2023
HEAT TRANSFER
(MECH)

[Time: 3 Hours] **[Max. Marks: 70]**

Note: This question paper contains two parts A and B.
Part A is compulsory which carries 20 marks. Answer all questions in Part A.
Part B consists of 5 Units. Answer any one full question from each unit. Each question carries 10 marks and may have a, b, c as sub questions.

PART-A **(20 Marks)**

1. a)	Write the importance of heat transfer in various fields of Engineering.	[2M]
b)	What is meant by critical radius of insulation?	[2M]
c)	Give one example for steady state and unsteady state heat transfer.	[2M]
d)	Write the expressions for Biot number and Fourier number.	[2M]
e)	What is the significance of non-dimensional numbers in free convection heat transfer?	[2M]
f)	Mention the importance of Heisler charts in solving the transient heat transfer problems.	[2M]
g)	Classify the types of heat exchangers.	[2M]
h)	How do you understand the concepts of hydrodynamic and thermal boundary layers?	[2M]
i)	How boiling heat transfer differs from condensation heat transfer?	[2M]
j)	State the Planck's law of radiation.	[2M]

PART-B **(50 Marks)**

2. a)	Differentiate between Conductivity and Conductance. What are their units.	[3M]
b)	Derive generalized 3-dimensional heat conduction equation in Cartesian coordinate system.	[7M]

OR

3.	A composite slab consists of 250 mm fire clay brick (K = 1.09 W/m K) inside, 100 mm fired earth brick (K = 0.26 W/m K) and the outer layer of common brick (K = 0.6 W/m K) of thickness 50 mm. If the inside surface is at 1200 ^{0}C and outside surface is at 100 ^{0}C find (i) heat flux (ii) the temperature of the interfaces and (iii) the temperature at 200 mm from the outer surface of the wall.	[10M]
4.a)	Derive an expression for temperature distribution of a slab of variable thermal conductivity.	[4M]
b)	Calculate the rate of heat loss for a red brick wall of length 5m, height 4m, and thickness 0.25m. The temperature of the inner surface is 110°C and that of the outer surface is 40°C. The thermal conductivity of red brick, K=0.70 W/m K, Calculate also the temperature at an interior point of the wall, 20cm distant from the inner wall.	[6M]

OR

5.a)	What is Lumped Heat Capacity? What are the assumptions considered for Lumped capacity analysis?	[4M]
b)	A Carbon steel rod (k = 55 W/m K) has been attached to a plane wall which is maintained at a temperature of 350 ^{0}C. The rod is 8cm long has the cross section of an equilateral triangle which each side is 5mm. Determine the heat dissipation from the rod if it is exposed to a convection environment at 25^0 C with unit surface Convection coefficient of 100 W/m^2 K. Consider end surface loss to be negligible.	[6M]

6.a) State Buckingham's π theorem with an example. [4M]

b) What are the non-dimensional numbers influences the heat transfer rates in natural convection? Explain. [6M]

OR

7. A flat plate of length L=1 m is exposed to air flow parallel to its surface. The velocity and temperature of the free steam air flow U_0= 80 m/s and $t_0 = 10^0$C. A turbulizing grid is placed upstream of the plate, resulting in that the fluid is in turbulent flow in the boundary layer over the whole length of the plate. Calculate the mean local coefficient of heat transfer from the surface of the plate and the value of the local heat transfer coefficient on the back edge. Also calculate the hydrodynamic boundary layer on the back edge of the plate. [10M]

8.a) Explain characteristics of boundary layer? [5M]

b) Explain the mechanism of heat flow by natural convection. [5M]

OR

9. Hot oil with a capacity rate of 2500 W/K flows through a double pipe heat exchanger. It enters at 360 ^{0}C and leaves at 300 ^{0}C. Cold fluid enters at 30 ^{0}C and leaves at 200 ^{0}C. If the overall heat transfer coefficient is 800 W/m^{2}K, determine the heat exchanger area required for (i) parallel flow and (ii) counter flow. [10M]

10.a) Explain the regimes of boiling process with a diagram. [5M]

b) Describe the condensation heat transfer for a vertical plate. [5M]

OR

11.a) Enlist the laws of radiation heat transfer. [3M]

b) Two parallel plates each of emissivity 0.8 are maintained at temperature of 400 K and 600 K in an evacuated space. A screen of emissivity 0.05 is now introduced between these plates. Determine the temperature of the screen and also the heat flux per unit area of the screen. [7M]

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