Hall Ticket Number:

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VASAVI COLLEGE OF ENGINEERING *(AUTONOMOUS)*, HYDERABAD

Accredited by NAAC with A++ Grade

B.E. (Mech. Engg.) V-Semester Supplementary Examinations, June-2023

Heat Transfer

Time: **3 hours** Max. Marks: **60**

*Note: Answer all questions from **Part-A** and any **FIVE** from **Part-B***

Part-A (10 × 2 = 20 Marks)

Q. No.	Stem of the question	M	L	CO	PO
1.	What are the different applications of heat transfer in engineering practice?	2	1	1	1
2.	What is the effect of thickness of insulation on heat transfer through systems in cartesian and cylindrical coordinates?	2	3	1	1
3.	Define fin efficiency and fin effectiveness.	2	1	2	1
4.	Write at least two applications of Transient heat conduction.	2	2	2	1
5.	What is the importance of convection heat transfer- electricity analogy?	2	3	3	1
6.	Differentiate between Reynolds Number and Grashof Number.	2	2	3	1
7.	What is the effect of fouling on the performance of heat exchangers?	2	2	4	1
8.	What are the advantages of drop wise condensation over film wise condensation?	2	1	4	1
9.	Differentiate between Black and Gray bodies.	2	2	5	1
10.	Define Irradiation and Emissive Power.	2	1	5	1
	Part-B (5 × 8 = 40 Marks)				
11. a)	Derive the general heat conduction equation in cartesian coordinates from first principles.	5	2	1	1
b)	The wall of a residential building is made of 10.2 cm layer of brick (k=0.70 W/m K) and 3.8 cm gypsum plaster (k=0.48 W/m K). Calculate the thickness of rock wool insulation layer (k=0.065 W/m K) that should be provided to bring down the rate of heat transfer through the wall by 80%.	3	3	1	2
12. a)	An aluminium alloy fin (k=200 W/mK), 3.5 mm thick and 2.5 cm long protrudes from a wall. The base is at 420^{0}C and the ambient air temperature is 30^{0}C. The heat transfer coefficient may be taken as 11 W/mK, find the heat loss and fin efficiency, if the heat loss from the fin tip is negligible.	4	3	2	2
b)	Explain the concept of Lumped System Analysis.	4	2	2	1

Contd... 2

13. a)	Water at 10^0C is heated to 40^0C in the tube of 0.02 m ID at a mass flow rate of 0.01kg/s. The tube is supplied with a heat flux of 15000 W/m^2 over the surface. Neglecting the entrance effect, obtain the length of pipe needed to achieve the given temperature rise.	4	3	3	2
b)	Vertical door of a hot oven is 0.5m high and is maintained at 200^0C. It is exposed to quiescent ambient at 20^0C. Find the heat loss per unit width from the oven door.	4	3	3	2
14. a)	Air at 25^0C flows over a cross flow car radiator and cools water from 99^0C to 60^0C. Water flows at a rate of 4 kg/min, while the mass flow rate of air is 14 kg/min. Consider air as mixed fluid. Determine the heat duty of the heat exchanger, effectiveness of the heat exchanger and the overall heat transfer coefficient.	4	3	4	2
b)	With a neat sketch, explain the pool boiling curve of Nukiyama.	4	2	4	1
15. a)	Two parallel and infinite gray surfaces are maintained at temperatures of 127^0C and 227^0C respectively. If the temperature of the hot surface is increased to 327^0C, by what factor is the net radiation exchange per unit area increased? Assume the emissivities of the cold and hot surfaces as 0.9 and 0.7 respectively.	4	3	5	2
b)	Define (i) opaque body, (ii) white body, (iii) black body and (iv) transparent body.	4	1	5	1
16. a)	Explain the terms: i) Overall Heat Transfer Coefficient, ii) Contact Resistance	4	1	1	1
b)	A mild steel sphere of 15 mm diameter is initially at 625^0C. It is exposed to a current of air at 25^0C, with a convection coefficient of 120W/m^{2}K. Calculate the time required to cool the sphere to 100^0C. The density, specific heat and thermal conductivity of the material respectively is 7800 kg/m^3, 470 J/kg-K and 60 W/mK.	4	3	2	2
17.	Answer any ***two*** of the following:				
a)	With the help of an appropriate sketch, explain the development of velocity boundary layer over an isothermal flat plate.	4	1	3	1
b)	What are the assumptions made by Nusselt in his theory of film condensation over a vertical flat plate?	4	2	4	1
c)	Air at 27^0C and 1 atmosphere pressure flows over a flat plate with a speed of 2 m/s. Calculate the hydrodynamic boundary layer thickness and the rate of heat transfer from the plate, if the plate is held at 60^0C.	4	3	5	2

M : Marks; L: Bloom's Taxonomy Level; CO; Course Outcome; PO: Programme Outcome

i)	Blooms Taxonomy Level – 1	20%
ii)	Blooms Taxonomy Level – 2	31.25%
iii)	Blooms Taxonomy Level – 3 & 4	48.75%

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