Register No : _____

THE KAVERY ENGINEERING COLLEGE

(An Autonomous Institution)

UG/PG DEGREE END SEMESTER THEORY EXAMINATIONS, APRIL-MAY 2026

Sixth Semester

Mechanical Engineering

ME3691 – HEAT AND MASS TRANSFER

(Use of Approved HMT Data Book Can be Permitted)

Regulations - 2021

Duration : 3 Hrs ***Maximum : 100 Marks***

PART – A (ANSWER ALL QUESTIONS) (Marks 10*2=20)

Q.No	*Questions*	*BLT*	*CO*	*Marks*
1.	Define thermal diffusivity of a material with its importance.	L1	1	2
2.	Can you list few techniques to enhance the conduction heat transfer?	L1	1	2
3.	How will you distinguish between hydrodynamic boundary layer and thermal boundary layer?	L2	2	2
4.	Explain the analogy between forced and free convection in the aspect of using non-dimensional numbers.	L2	2	2
5.	Define dropwise condensation.	L1	3	2
6.	Discuss the effect of fouling factor in heat exchanger.	L2	3	2
7.	State Wien's displacement law.	L1	4	2
8.	Define radiosity.	L1	4	2
9.	Can you list few examples of mass transfer taking place in our day-today life?	L2	5	2
10.	What can you say about the importance of Lewis number in mass transfer.	L2	5	2

PART – B (ANSWER ALL QUESTIONS) (Marks 5*16 = 80)

Q.No		*Questions*	*BLT*	*CO*	*Marks*
11.	a	Calculate the rate of heat flow per m^2 through a furnace wall consisting 200 mm thick inner layer of chrome brick (K= 1.25 W/m ^oC), a centre layer of kaolin brick (K= 0.074 W/m^oC) with 100 mm thick and an outer layer of masonry brick (K= 0.555 W/m^oC) with 100 mm thick. The unit surface conductance at the inner surface is 74 W/m^2 ^oC and the outer surface temperature is 70^oC. Temperature of gas inside furnace is 1670^oC. Find temperature of all surfaces.	L3	1	16
		Or			
	b	Alloy steel ball of 2 mm diameter heated to 800^oC is quenched in a bath at 100^oC. The material properties of the ball are K = 205 kJ/m hr K, ρ = 7860 kg/m^3, Cp = 0.45 kJ/kgK, h = 150 kJ/hr m^2 K. Determine (i) temperature of ball after 10 second and (ii) time for ball to cool to 400^oC.	L3	1	16
12.	a	Air at 290^oC flows over a flat plate at a velocity of 6 m/s. The plate is 1m long and 0.5 m wide. The pressure of the air is 6 kN/m^2. If the plate is maintained at a temperature of 70^oC, estimate the rate of heat removed from the plate.	L3	2	16
		Or			
	b	A circular disc heater 0.2m in diameter is exposed to ambient air at 25°C. One surface of the disc is insulated at 130°C. Calculate the amount of heat transferred from the disc when it is (i) horizontal with hot surface facing up (5) (ii) horizontal with hot surface facing down (5) (iii) vertical (6)	L3	2	16
13.	a	i Demonstrate the various regimes of pool boiling heat transfer.	L2	3	8
		ii Water is boiled at the rate of 25 kg/h in a polished copper pan, 280 mm in diameter, at atmospheric pressure. Assuming nucleate boiling condition, calculate the temperature of	L3	3	8

the bottom surface of the pan.

Or

	b	i	Describe the principle of evaporators and condensers showing the axial temperature distribution.	L2	3	8
		ii	A parallel flow heat exchanger has hot and cold water stream running through it, the flow rates are 10 and 25 kg/min respectively. Inlet temperatures are 75°C and 25°C on hot and cold sides. The exit temperature on the hot side should not exceed 50° C. Assume $h_i = h_o = 600$ W/m^{2}K. Calculate the area of heat exchanger using ε-NTU approach.	L3	3	8
14.	a		A black body at 3000 K emits radiation. Calculate the following: i) Monochromatic emissive power at 7 μm wave length. ii) Wave length at which emission is maximum. iii) Maximum emissive power. iv) Total emissive power, v) Total emissive of the furnace if it is assumed as a real surface having emissivity equal to 0.85 and comment your inference by comparing the results with the block body.	L4	4	16

Or

	b		Two large parallel planes with emissivities of 0.35 and 0.85 exchange heat by radiation. The planes are respectively 1073 K and 773 K. A radiation shield having the emissivity of 0.04 is placed between them. Analyze the percentage reduction in radiation heat exchange and find the temperature of the shield.	L4	4	16
15.	a	i	An open pan 20 cm in diameter 20 mm deep is filled with water to a level of 10 mm and is exposed to air at 25°C. Assuming mass diffusivity of 0.25×10^{-4} m^2/s, calculate the time required for all the water to evaporate.	L3	5	8
		ii	Estimate the diffusion rate of water from the bottom of a test tube 1.5 cm in diameter and 15 cm long into dry atmospheric air at 25°C. Take a diffusion coefficient of 25.6×10^{-6} m^2/s.	L3	5	8

Or

	b	i	Air at 35°C and 1 atm flows at a velocity of 60 m/s over a (i) flat plate of 0.5 m long (ii) sphere of 5 cm in diameter Calculate the mass transfer coefficient of water vapor in air. Ignore the concentration of vapor in air.	L3	5	10
		ii	How would you apply your understanding to discuss the analogy between heat and mass transfer?	L3	5	6

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