Register No : _____

THE KAVERY ENGINEERING COLLEGE

(An Autonomous Institution)

B.E/B.TECH DEGREE END SEMESTER THEORY EXAMINATIONS, NOV /DEC 2024

Sixth Semester

Mechanical Engineering

ME3691 - Heat and Mass Transfer

(Uses of Heat and Mass Transfer 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.	Name and define the law that governs the heat conduction.	UN	1	2
2.	List out the methods of enhanced thermal conduction.	RE	1	2
3.	Recall the term boundary layer thickness.	RE	2	2
4.	Draw the velocity profile in free convention on a heated vertical plate.	RE	2	2
5.	Compare dropwise and flim-wise condensation.	RE	3	2
6.	Mention the applications of heat pipes.	UN	3	2
7.	Relate black body and grey body in radiation.	UN	4	2
8.	Define view factor.	RE	4	2
9.	Give some examples of diffusion mass transfer.	UN	5	2
10.	Write the analogy between heat and mass transfer.	UN	5	2

*PART – B (ANSWER ALL QUESTIONS) (Marks 5*13 = 65)*

Q.No		*Questions*	*BLT*	*CO*	*Marks*
11.	a	An aluminium alloy fin of 7 mm thick and 50 mm long protrudes from a wall, which is maintained at 120°C. The ambient air temperature is 22°C. The heat transfer coefficient and conductivity of the fin material are 140 W/m^2K and 55 W/mK respectively. Determine total heat dissipated by the fin.	AP	1	13
		Or			
	b	A steel ball (specific heat = 0.46 KJ/kgK. and thermal conductivity = 35 W/mK) having 5 cm diameter and initially at a uniform temperature of 450°C is suddenly placed in a control environment in which the temperature is maintained at 100°C. Calculate the time required for the balls to attained a temperature of 150°C. Take h = 10 W/m^2K.	AP	1	13
12.	a	Air at 20°C, at a pressure of 1 bar is flowing over a flat plate at a velocity of 3 m/s. If the plate maintained at 60°C, calculate the heat transfer per unit width of the plate. Assuming the length of the plate along the flow of air is 2m.	AP	2	13
		Or			
	b	A large vertical plate 4 m height is maintained at 106°C and exposed to atmospheric air at 34°C. Calculate the heat transfer if the plate is 10 m wide.	AP	2	13

13.	a	Taking heat flux as X-axis and excess temperature in Y-axis, draw the pool boiling curve of water and discuss the various regimes in the curve.	UN	3	13
		Or			
	b	Derive LMTD equation for parallel flow heat exchanger with suitable assumptions and sketches.	UN	3	13
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. Calculate the total emissive of the furnace if it is assumed as a real surface having emissivity equal to 0.85	AN	4	13
		Or			
	b	Two large parallel planes with emissivity's 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. Find the percentage reduction in radiation heat exchange and temperature of the shield.	AN	4	13
15.	a	A vessel contains binary mixture of O_2 and N_2 with partial pressure in the ratio 0.21 and 0.79 at 15°C. The total pressure of the mixture is 1 bar. Calculate the following. i. Molar concentrations ii. Mass densities iii. Mass fractions iv. Molar fraction for each species	AP	3	13
		Or			
	b	Air at 10°C with a velocity of 3 m/s flows over a flat plate. The plate is 0.3 m long. Calculate the mass transfer coefficient. Assume D_{ab}= 2.50 X 10^{-5} m^2/s.	AP	3	13

*PART – C (Marks 1*15 = 15)*

Q.No		*Questions*	*BLT*	*CO*	*Marks*
16.	a	A furnace wall made up of 7.5 cm of fire plate (K=1035 X 10^{-3} W/mK) and 0.65 cm of mild steel plate (K= 53.6 W/mK). Inside surface exposed to hot gas at 650°C and outside air temperature 27°C. The convective heat transfer coefficient for inner side is 60 W/m^2K. The convective heat transfer co-efficient for outer side is 8 W/m^2K. Calculate the heat lost per square meter area of the furnace wall and also find outside surface temperature.	AN	1	15
		Or			
	b	In a counter flow double pipe heat exchanger, water is heated from 25°C to 65°C by oil with a specific heat of 1.45 kJ/kgK and mass flow rate is 0.9 kg/s. The oil is cooled from 230°C to 160°C. If the overall heat transfers co-efficient is 420 $W/m^{2\circ}C$, calculate the following i. The rate of heat transfer ii. The mass flow rate of water iii. The surface area of the heat exchanger	AN	3	15