Register Number:……..

KUMARAGURU college of technology
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B.E/B.TECH DEGREE EXAMINATIONS: APRIL / MAY2024

(Regulation 2018)

Sixth Semester

MECHANICAL ENGINEERING

U18MEI6201: Heat and Mass Transfer

(Use of Heat and Mass Transfer Data Book is permitted)

CO1: Apply steady state heat conduction problems for composite systems and fins.

CO2: Solve transient heat conduction problems.

CO3: Solve problems in natural and forced convection for internal and external flows.

CO4: Calculate the effectiveness of heat exchanger using LMTD and NTU methods.

CO5: Illustrate radiation shape factors for various geometries.

CO6: Explain the phenomenon of diffusion and convective mass transfer.

Time: Three Hours **Maximum Marks: 100**

Answer all the Questions:-
PART A (10 x 2 = 20 Marks)
(Answer not more than 40 words)

1.	Define critical thickness of insulation		CO1	[K_1]
2.	What is the significance of fin effectiveness?		CO1	[K_1]
3.	What is lumped parameters in unsteady conduction?		CO2	[K_1]
4.	What is the significance of Biot Number and Fourier Number?		CO2	[K_2]
5.	Draw the hydrodynamic boundary layer distribution for a flow over a flat plate		CO3	[K_2]
6.	Define pool boiling and nucleate boiling		CO4	[K_2]
7.	Define shape factor for a geometries subject to radiation		CO5	[K_2]
8.	What are the applications of gas radiation?		CO5	[K_2]
9.	Compare diffusion and convective mass transfer		CO6	[K_2]
10.	Define Fick's law of diffusion		CO6	[K_2]

Answer any FIVE Questions: -
PART B (5 x 16 = 80 Marks)
(Answer not more than 400 words)

11.	a)	Derive one dimensional steady state conduction heat transfer equation for a plane wall with uniform conductivity	6	CO1	[K_2]

	b)	A cylinder 0.5m long and 6 cm long is placed in an atmosphere at 35^0C.It is provided with 12 longitudinal fins of material having conductivity of 130W/m K. The height of fin is 1.5cm with a thickness of 0.52mm from the cylinder surface. The convection heat transfer coefficient between cylinder surface and atmospheric air is 20W/m^2K. Calculate the rate of heat transfer if the surface temperature of the cylinder is 120^0C	10	CO1	[K_4]
12.	a)	Describe the temperature distribution and heat transfer in a semi-infinite solid	6	CO2	[K_2]
	b)	A copper wire 0.8 mm diameter at 150^0C is suddenly dipped into water at 35^0 C. If h=85.5 W/m^2K, estimate the time required to cool the wire to 95^0C.If the same wire were placed in air instead of water , estimate the time required to cool it to 95^0C, h_{air}= 11.65W/m^2K. Take suitable properties of copper.	10	CO2	[K_4]
13.	a)	Draw the velocity profile and temperature profile for a flow over a flat plate and describe the various regimes on it.	6	CO3	[K_2]
	b)	Air at 20^0C flows over a flat plate at 3.5m/s. The plate is 75 cm long and maintained at 60^0C.Calculate the heat transfer the plate per unit width of the plate. Also calculate the boundary layer thickness at the end of the plate assuming it to develop from the leading edge of the plate.	10	CO3	[K_4]
14.	a)	Illustrate the NTU method of solving heat exchanger problems. What are advantages of NTU compared to LMTD?	6	CO4	[K_2
	b)	Water (Cp = 4180 J/kg · °C) is to be heated by solar heated hot air (Cp = 1010 J/kg · °C) in a double pipe counterflow heat exchanger. Air enters the heat exchanger at 80°C at a rate of 0.4 kg/s, while water enters at 25°C at a rate of 0.2 kg/s. The overall heat transfer coefficient based on the inner side of the tube is given to be 180 W/m^2 °C. The length of the tube is 2 m and the internal diameter of the tube is 2.5 cm. Determine the outlet temperatures of the water and the air.	10	CO4	[K_4]
15.	a)	Derive an expression for net heat transfer between two black surfaces separated by a distance.	6	CO5	[K_2]
	b)	Consider two rectangular surfaces perpendicular to each other with a common edge which is 1.8 m long. The horizontal surface is 0.6 m wide and the vertical surface is 1.5 m high. The horizontal surface has an emissivity of 0.85 and is maintained at 300 K. The vertical surface is black and is maintained at 450 K. The back sides of the surfaces are insulated. Determine the net rate of radiation heat transfers between the two surfaces	10	CO5	[K_4]
16.	a)	Describe the diffusion mass transfer through a stationary medium	6	CO6	[K_2]
	b)	The molar analysis of a gas mixture at 295 K and 260 kPa is 65 percent N_2, 20 percent O_2, and 15 percent CO_2. Determine the mass fraction and partial pressure of each gas	10	CO6	[K_4]

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