Reg. No.												

Question Paper Code	12666

B.E. / B.Tech. - DEGREE EXAMINATIONS, APRIL / MAY 2024

Sixth Semester

Mechanical Engineering

20MEPC602 - HEAT TRANSFER

Regulations - 2020

(Use of Standard Heat and Mass Transfer Data Books and Steam Tables is permitted)

Duration: 3 Hours Max. Marks: 100

PART - A (10 × 2 = 20 Marks)

Answer ALL Questions

		Marks	*K – Level*	*CO*
1.	Define thermal conductivity.	2	K1	CO1
2.	State any four important engineering applications of fins.	2	K1	CO6
3.	What is a Radiation Shield? When it is used?	2	K1	CO2
4.	State Stefan Boltzmann law and define emissive power of a black body.	2	K1	CO2
5.	Write down the relation between skin friction coefficient and surface shear stress.	2	K2	CO3
6.	Distinguish between natural and forced convection heat transfer.	2	K2	CO3
7.	Mention any two techniques commonly used to achieve drop wise condensation	2	K2	CO4
8.	What is meant by drop wise condensation?	2	K1	CO4
9.	List out the different types of heat exchangers.	2	K1	CO5
10.	What is meant by Fouling factors?	2	K1	CO5

PART - B (5 × 13 = 65 Marks)

Answer ALL Questions

11.	a)	Derive generalized heat conduction equation in Cartesian coordinate system.	13	K3	CO1
		OR			
	b)	A solid steel ball 5 cm in diameter and initially at 450°C is quenched in a controlled environment at 90°C with convection coefficient of 115 W/m^{2}K. Determine the time taken by center to reach a temperature of 150°C. Take thermo-physical properties as: c = 420 J/kgK ;ρ = 8000 kg/m^3; c =; k = 46 W/mK.	13	K3	CO1
12.	a)	The sun emits maximum radiation at λ = 0.52μ. Assuming the sun to be a black body, calculate the surface temperature of the sun. Also calculate the monochromatic emissive power of the sun's surface.	13	K3	CO2
		OR			
	b)	Two circular discs of diameter 20 cm each are placed 2 m apart. Calculate the radiant heat exchange for these discs if they are maintained at 800°C and 300°C respectively, and the corresponding emissivities are 0.3 and 0.5.	13	K3	CO2

13\. a) Air at 25°C, flows over a flat plate at a velocity of 5m/s and heated to 135°C. The plate is 3 m long and 1.5 m wide. Calculate the local heat transfer coefficient at x = 0.5 m and the heat transferred from the first 0.5 m of the plate. *13 K3 CO3*

OR

b) A horizontal pipe of 6 m length and 8 cm diameter passes through a large room in which the air and walls are at 18°C. The pipe outer surface is at 70°C. Find the rate of heat loss from the pipe by natural convection. *13 K3 CO3*

14\. a) Explain the various regimes of pool boiling of water at atmospheric pressure with a neat sketch. *13 K2 CO4*

OR

b) Dry saturated steam at a pressure of 2.45bar condenses on the surface of a vertical tube of height 1m. The tube surface temperature is kept at 117°C. Estimate the thickness of the condensate film and the local heat transfer coefficient at a distance of 0.2 m from the upper end of the tube. *13 K3 CO4*

15\. a) In a cross flow heat exchangers, both fluids unmixed, hot fluid with a specific heat of 2300 J/kg K enters at 380°C and leaves at 300°C. Cold fluid enters at 25°C and leaves at 210°C. Calculate the required surface area of heat exchanger. Take overall heat transfer coefficient as 750 W/m^2K. Mass flow rate of hot fluid is 1 kg/s. *13 K3 CO5*

OR

b) In a counter flow double pipe heat exchanger, Water is heated from 50°C to 75°C by oil entering at 115°C and leaving at 70°C. The specific heat of oil is 1780J/Kg K. The mass flow rate of water is 65Kg/min and specific heat of water is 4186J/Kg K. Determine the heat exchanger area and heat transfer rate for an overall heat transfer coefficient of 340W/m^2K. *13 K3 CO5*

PART - C (1× 15 = 15 Marks)

16\. a) A long thin glass walled 0.3 cm diameter mercury thermometer is placed in a stream of air with convection coefficient of 60 W/m^2K for measuring transient temperature of air. Consider cylindrical thermometer bulb consists of mercury only. For which: k = 8.9 W/mK; and α = 0.016 m^2/h; Calculate the time constant and time required for the temperature change to reach half of its initial value. *15 K4 CO6*

OR

b) A turbine blade 6 cm long and having a cross sectional area 4.65 cm^2 and perimeter 12 cm is made of stainless steel (k = 23.3 W/mK). The temperature at the root is 500 °C. The blade is exposed to a hot gas at 870 °C. The heat transfer coefficient between the blade surface and gas is 442 W/m^2K. Determine the temperature distribution and rate of heat flow at the root of the blade. Assume the tip of the blade to be insulated. *15 K4 CO6*