QP Code: RJ23MTECH039 | Reg. No | | | | | | | | | | | AY 23

GIET UNIVERSITY, GUNUPUR – 765022

M. Tech (First Semester) Examinations, January – 2024

MPCTE1020 – Conductive and Radiative Heat Transfer

(Heat Power and Thermal Engineering)

Time: 3 Hrs | Maximum: 70 Marks

(The figures in the right hand margin indicate marks.)

PART – A **(2 x 10 = 20 Marks)**

Q.1. Answer all questions	CO#	Blooms Level
a. Describe conduction. Write down the two types of conduction.	CO1	K1
b. Define thermal resistance.	CO1	K1
c. Describe Fourier's law of conduction.	CO1	K1
d. Define orthotropic solids.	CO1	K1
e. Define fins (or) extended surfaces.	CO3	K1
f. Define Fin efficiency and Fin effectiveness.	CO3	K1
g. Write the differential equation governing the heat transfer in fins.	CO3	K1
h. State Kirchhoff's law of radiation.	CO4	K1
i. Describe black body and gray body.	CO4	K1
j. Describe the purpose of radiation shield.	CO4	K1

PART – B **(10 x 5=50 Marks)**

Answer ***ANY FIVE*** questions	Marks	CO#	Blooms Level
2. a. Explain in brief about the semi-infinite solid.	5	CO1	K1
b. Define isotropic and anisotropic solids? Give few differences between them.	5	CO1	K1
3.a. An aluminium rod and a copper rod of equal length 2.0 m and cross-sectional area 2 cm^2 are welded together in series. One end is kept at a temperature of 10 °C and the other at 30 °C. Calculate the amount of heat taken out per second from the hot end. (Thermal conductivity of aluminium is 200 W / m °C and of copper is 390 W / m °C).	5	CO1	K3
b. The energy lost from a 10 cm thick slab of steel is 50 W. Assuming the temperature difference of 10.0 K, find the area of the slab. (Thermal conductivity of steel = 45 W / m K).	5	CO1	K3
4. A steel ball of diameter 60 mm is initially in thermal equilibrium at 1030°C in a furnace. It is suddenly removed from the furnace and cooled in ambient air at 30°C, with convective heat transfer coefficient h = 20 W/m^2K. The thermophysical properties of steel are: density ρ =7800 kg/m^3, conductivity k = 40 W/mK and	10	CO2	K3

	specific heat c = 600 J/kgK. Describe the time required in seconds to cool the steel ball in the air from 1030°C to 430°C ?			
5.a.	An infinitely long pin fin, attached to an isothermal hot surface, transfers heat at a steady rate of Q_1, to the ambient air. If the thermal conductivity of the fin material is doubled, while keeping everything else constant, the rate of steady-state heat transfer from the fin becomes Q_2. Describe the ratio Q_2/Q_1?	5	CO3	K2
b.	The heat loss from a fin is 6 W. The effectiveness and efficiency of the fin are 3 and 0.75, respectively. Describe the heat loss (in W) from the fin, keeping the entire fin surface at base temperature?	5	CO3	K2
6. a.	A 3 cm long, 2 mm x 2 mm rectangular cross-section aluminium fin [k = 237 W/m^oc] is attached to a surface. If the fin efficiency is 65%, Describe the effectiveness of this single fin?	5	CO3	K3
b.	A body takes 4 minutes to cool from 100°C to 70°C. If the room temperature is 15°C, what will be the time taken to cool from 70°C to 40°C?	5	CO3	K3
7.a.	Calculate the following for an industrial furnace in the form of a black body and emitting radiation at 2500^0C Monochromatic emissive power at 1.2□m wave length**.** (i)Total emissive power, (ii)The total emissive power of the furnace if it is assumed as a real surface having emissivity equal to 0.9.	5	CO4	K3
b.	A black body at 3000 K emits radiation Calculate the following (i) Wave length at which emission is maximum (ii) Maximum emissive power (iii) Total emissive power,	5	CO4	K3
8. a.	Prove Kirchhoff's law of thermal radiation.	5	CO4	K2
b.	Derive relation for heat exchange between infinite parallel planes.	5	CO4	K2

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