QPC: RJ20MTECH031 AR 19 Reg. No | | | | | | | | | | |

GIET UNIVERSITY, GUNUPUR – 765022

M. Tech (First Semester – Regular) Examinations, June – 2021

MPCTE 1020 – Conductive and Radiative Heat Transfer

(Heat Power and Thermal Engineering)

Time: 2 hrs Maximum: 50 Marks

The figures in the right hand margin indicate marks.

Candidates are allowed to use Heisler's chart, Grober's chart and Radiation shape factor chart

PART–A **(2x 10 = 20Marks)**

Q1.Answer **ALL** questions

a. Explain briefly the following boundary conditions:
   i) Dirichlet boundary condition
   ii) Neumann boundary condition

b. Write down the governing equation for one dimensional transient heat conduction for isotropic material with heat generation.

c. Will the rate of heat loss decrease if foam insulation, k=0.09W/mK, is added to a 5cm outer diameter pipe carrying hot water? Assume the heat transfer coefficient on the outer surface is h_o=10W/m^2K.

d. How is the fin efficiency different from fin effectiveness?

e. Write down the boundary condition at the tip of an infinitely long fin and the expression for temperature distribution along the fin.

f. What do you mean by lumped heat capacity method?

g. What is a black body?

h. A 100W electric bulb has a filament temperature of 3001^0C. Assuming the filament to be black, calculate the diameter of the wire if the length is 250mm.

i. What do you mean by Radiosity and Irradiation?

j. What wavelengths correspond to maximum emissive powers of the sun and earth? Take T_{sun}=5762 K and T_{earth}=290 K.

PART–B **(6 x 5 = 30 Marks)**

Answer ***ANY FIVE*** questions **Marks**

2. Derive the generalized heat conduction equation for an isotropic material. **(6)**

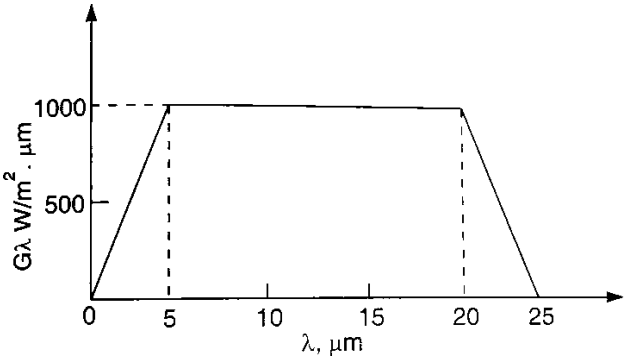
3. During quenching, a cylindrical rod made of 1080 steel, 1cm in diameter and 20 cm in length is first heated to 750°C and then immersed in a water bath at 100°C. The heat transfer coefficient can be taken as 250 W/m^{2o}C. The density, specific heat, and thermal conductivity of the steel are ρ = 7801 kg/m^3, c = 473 J/kg °C, and k =43W/m°C respectively. Calculate the time required for the rod to reach 300°C. **(6)**

4. An egg with a mean diameter of 40 mm and initially at 20°C is placedinaboilingeaterpanfor4minutesandfoundtobeboiledtoconsumer's taste. For how long should a similar egg for the same consumer be boiled when taken from a refrigerator at 5 °C. Take the following properties for egg: ρ =1200kg/m^3, c=2kJ/kgK, k=10 W/mK and h =100 W/m^{2}K.Uselumpcapacitymethod. **(6)**

5. A very long 25 mm diameter copper (k = 380 W/m K) rod extends from a surface at 120^{0}C. The temperature of surrounding air is 25^{0}C and the heat transfer coefficient over the rod is 10W/m^{2}K. Calculate (i)heat loss from the rod, (ii)how long the rod should be in order to be considered infinite? **(6)**

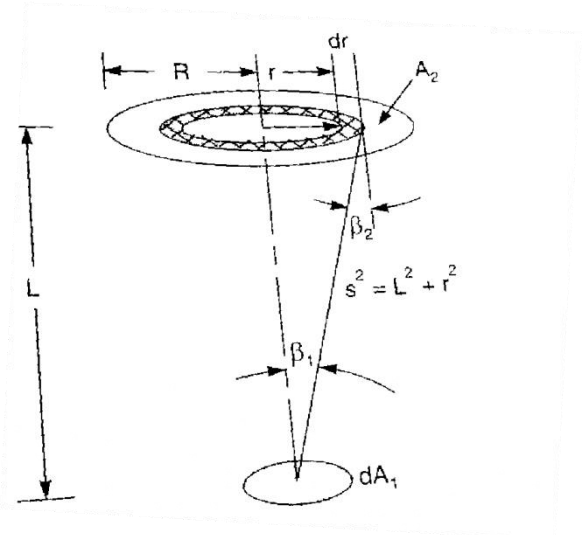
6. An aluminium alloy fin (k = 200 W/m K), 3.5 mm thick and 2.5 cm long protrudes from a wall. The base is at 420^{0}C and ambient air temperature is 30^{0}C. The heat transfer coefficient may be taken as 11W/m^2.K. Find the heat loss and fin efficiency, if the heat loss from the tip is negligible. Take width of the fin tobe1m. **(6)**

7. ThespectraldistributionofsurfaceirradiationisshownintheFiguregivenbelow. What is the total irradiation? **(6)**



Spectral distribution of irradiation

8. Calculate the view factor F_{1-2} between a small area dA_1 and a parallel circular disc A_2.The elemental area dA_1 is located at the axis of the disc A_2, at a distance L **(6)**



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