(b) Derive Wein's displacement law and Rayleigh-Jeans' law, Stefan's Law from the Planck's law of blackbody radiation. (9)

(b) At what temperature a black body will radiate thermal energy at the rate of 8 watt/cm^2? Given $\sigma = 5.7 \times 10^{-8}$ watt m^{-2} K^{-4}. (3)

6. Write short notes on :

(i) Macrostate and microstate (3)

(ii) Define and establish relation between Entropy and Thermodynamic probability. (6)

(iii) Obtain an expression for thermodynamic probability and the most probable distribution function for a system obeying Fermi Dirac statistics. (9)

[This question paper contains 4 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 5128 **J**

Unique Paper Code : 2224001202

Name of the Paper : Thermal Physics

Name of the Course : **B.Sc. Hons. - (Physics)_NEP: UGCF-2022**

Semester : IV / VI (GE Paper)

Duration : 3 Hours Maximum Marks : 90

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Attempt any **five** questions in all.
3. Question no. **1** is compulsory.
4. Use of non-programmable Scientific Calculator is allowed.

1. Attempt **any six** questions from the following : (6×3=18)

(a) State the Zeroth Law of Thermodynamics.

(b) Using Clausius- Clapeyron equation, discuss the effect of pressure on melting point of solids.

(c) Distinguish between the reversible and irreversible processes.

(d) Define a perfectly black body. Give one example.

(e) The mean free path of nitrogen molecules at 0^0C and 1 atm is 0.8×10^{-5} cm, having 2.7×10^{19} molecules/cm^3. Calculate the molecular diameter.

(f) Explain the concept of entropy and disorder.

(g) What is thermodynamic probability?

2. (a) Derive an expression for the efficiency of Carnot's cycle in terms of temperature of the source and sink. (15)

(b) Draw the T-S diagram for Carnot Cycle. What is the significance of T-S diagram? (3)

3. (a) Define the four thermodynamic potentials (U, F, G and H) and give their physical significance. Using the above, derive Maxwell's four thermodynamic relations. (12)

(b) Prove from the laws of thermodynamics

$$C_p - C_v = (p + (\frac{\partial U}{\partial V})_T (\frac{\partial V}{\partial T})_P$$

Hence prove that for an ideal gas $C_p - C_v = R$. (6)

4. (a) Derive Maxwell- Boltzmann distribution law of velocity. (12)

(b) How does the mean free path depend on temperature and pressure of a gas? (3)

(c) The mean free path of molecules of a gas at pressure P and temperature T is 3×10^{-5}cm. Calculate the mean free path when the temperature is raised to 2T. (3)

5. (a) Explain the spectral distribution of blackbody radiation with proper graphical representation. (6)

P.T.O.