This question paper contains 4 printed pages.]

Your Roll No. ....

1229

B.Sc. (Hons.) / III **A**

PHYSICS – PAPER – XIX

(Statistical Physics)

Time : 3 Hours **Maximum Marks : 38**

(Write your Roll No. on the top immediately on receipt of this question paper.)

Attempt **five** questions in all.
Question No. **1** is compulsory.
Answer **one** question from each unit.
(Symbols have their usual meanings.)

1. Attempt any **five** : 5 × 2

(a) Under what conditions do the Bose-Einstein and Fermi Dirac distribution approach Maxwell Boltzmann distribution ? Represent graphically.

(b) What is the difference between a degenerate gas and a degenerate energy level ?

(c) Give the units of Einstein's A & B coefficients.

(d) Determine the wavelength corresponding to the maximum emissivity of a black body at a temperature equal to 300 K. Take b = 2898 μm K.

(e) Discuss the variation of the chemical potential of a Fermi gas with temperature graphically.

(f) Show that electron gas in a white Dwarf Star is strongly degenerate and relativistic in nature.

(g) Show that absolute zero is unattainable on the basis of the third Law of Thermodynamic.

UNIT – I

2. Derive Sackur Tetrode equation for the entropy of an ideal monoatomic gas. How does it resolve the Gibb's Paradox ? 7

3. (a) State and derive the law of equipartition of energy. Discuss its relevance and limitations with respect to the specific heat of a diatomic gas. 5

(b) Three distinguishable particles have to be accommodated in four available states. Find the number of ways in which this can be done if the particles obey Maxwell Boltzmann Statistics. 2

UNIT – II

4. (a) Show that for an adiabatic expansion of a black body radiation

$$TV^{1/3} = \text{constant}.$$ 2

(b) Deduce Weins law for energy distribution in Black Body radiation. 5

5. Define Saha's ionisation formula and discuss one of its important applications. 7

UNIT – III

6. (a) Explain Bose-Einstein condensation. How does it differ from ordinary condensation ? Derive an expression for the critical temperature at which this phenomenon sets in. 4

(b) Show that the molar specific heat of a strongly degenerate Bose gas is given as

$$C_V = 1.92\, R \left(\frac{T}{T_C}\right)^{3/2}$$

Represent it graphically. 3

7. Derive the vibrational partition function for a diatomic molecule. Derive the expression for vibrational specific heat and show that it reduces to the classical value at high temperatures. 7

UNIT – IV

8. Derive Richardson Dishman equation for thermionic emission of electrons from a metal surface. How can it be used to calculate the work function of the metal ? 7

9. (a) Plot and explain the variation of the distribution function for a Fermi gas at T = 0 K and T > 0 K. Obtain therein the expression for Fermi energy and pressure for a completely degenerate Fermi gas. 5

(b) Calculate the temperature at which there is 1% probability that a state with an energy 0.5 eV above the Fermi energy will be occupied by an electron. 2