Exam.Code:0003
Sub. Code: 0247

2121

B.A./B.Sc. (General) Third Semester

Physics

Paper – A: Statistical Physics and Thermodynamics – I

Time allowed: 3 Hours

Max. Marks: 44

NOTE: *Attempt five questions in all, including Question No. VII (Unit-III) which is compulsory and selecting two questions each from Unit I - II. Use of non-programmable Calculator is allowed.*

x-x-x

UNIT – I

I. a) Derive an expression for probability of a macrostate $(N_1,N_2.....N_k)$ corresponding to distribution of N distinguishable particles in K compartments of unequal sizes.

b) A bag contains 4 white and 5 black balls. Two balls are drawn in succession from the bag. Calculate the probability that the two balls drawn are both white. (7,2)

II. a) What do you mean by most probable macrostate? Derive an expression for the probability of this state corresponding to distribution of N particles in two identical compartments.

b) $5x10^{10}$ gas molecules are enclosed in a cubical volume. Imagine the volume to be divided into two equal halves. Calculate the probability for a state in which the number of molecules in a given state are only 0.001% different from that of equilibrium state. (6,3)

III. a) Prove that the fraction of time spent by a system in a macrostate is equal to probability of system to exist in that macrostate.

b) 8 distinguishable particles are distributed in 2 compartments of unequal sizes. The first compartment is further divided into 2 cells of equal sizes. Calculate probability of

i) Macrostate

ii) Most probable macrostate (6,3)

P.T.O.

UNIT - II

IV. a) Explain in detail about experimental verification of Maxwell-Boltzmann Distribution of molecular speeds.

b) Derive an expression for phase space volume of energy compartment. (6,3)

V. a) Derive Fermi-Dirac distribution law

b) 12 fermions are distributed in three compartment having energies -E,0,E. Find energy of Macrostate

(i) (6,4,2)
(ii) (5,2,5) (7,2)

VI. a) Derive an expression for Planck's law for energy distribution of Black body radiation.

b) Obtain the short and long wavelengths limits of Planck's law for black-body radiation. (6,3)

UNIT - III

VII. Attempt any eight of the following:-

(a) How does classical statistics differ from quantum statistics?

(b) Do electrons have zero energy at 0 K? If not, explain why?

(c) Does Fermi energy depend upon size or volume of conductor?

(d) What is occupation index? What is its functional form at T = 0K for a system of fermions?

(e) Why there is need to divide compartments into cells if we take the concept of phase space?

(f) What is difference between Macrostate and Microstate?

(g) What is difference between static and dynamic system?

(h) Distinguish between position, momentum and phase space.

(i) What is the importance of most probable macrostate?

(j) What is the maximum probability for an event to occur? (8x1)

x-x-x