(i) Printed Pages : 4 Roll No. .....

(ii) Questions : 7 Sub. Code : 0 2 4 7

Exam. Code : 0 0 0 3

B.A./B.Sc. (General) 3rd Semester

(2122)

PHYSICS

Paper : A (Statistical Physics & Thermodynamics–I)

Time Allowed : Three Hours] **[Maximum Marks : 44**

Note :— (1) Attempt **FIVE** questions in all, selecting **TWO** questions each from Unit-I and Unit-II. Unit-III is compulsory.

(2) Use of log tables and non-programmable calculator is allowed.

UNIT—I

1. (a) For n distinguishable particles to be distributed in two compartments, prove that the thermodynamic probability of macrostate (n_1, n_2) is :

$$W(n_1, n_2) = \frac{n!}{n_1! n_2!} \text{ ; where, } n = n_1 + n_2.$$ 6

(b) In a system of 8 distinguishable particles are distributed in 2 compartments with equal a priori probability. Calculate the probabilities of macrostates (7, 1), (5, 3) and (6,2). 3

2. (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. 6

(b) Calculate the percentage error in using Stirling's formula

$$\ln n! = n \ln n - n, \text{ when } n = 7.$$ 3

3. (a) Discuss the distribution of n distinguishable particles in k compartments which are further sub-divided into cells of equal a priori probability. 4.5

(b) 100 molecules of a gas are enclosed in a cubical volume. Let this volume be divided into 2 equal halves by means of an imaginary partition. Calculate the ratio of time spent by the system in most probable macrostate (50, 50) and macrostate (45, 55). 4.5

UNIT—II

4. Discuss the basic assumptions in the M-B, B-E and F-D statics. Explain, with the help of a suitable example, the effect of these assumptions on the distribution of particles among phase space cells. 9

5. (a) What are three kinds of statistics ? How these are different from each other ? Compare them by taking an example of distribution of 2 particles in 2 cells. 6

(b) A 40 W electric bulb has 10 cm long filament of 200 micron thick tungsten wire in a evacuated glass bulb. If we assume the filament to be a perfect black body radiator, what would be its temperature ? 3

6. (a) Starting from the basic approach, discuss the Maxwell-Boltzmann statistics for the case of an ideal gas and hence, find the volume in phase. 6

(b) Draw diagrams to show all possible meaningful arrangements of 3 particles in 3 cells, assuming that the particles obey :

(i) M-B statistics

(ii) B-E statistics, and

(iii) F-D statistics. 3

UNIT—III

7. Attempt any **EIGHT** questions. Each question carries 1 mark.

(a) What is the principle of equal a priori probability ?

(b) What is the difference between microstate and macrostate ?

(c) How thermodynamic probability of a macrostate is related to the probability of occurrence of that macrostate ?

(d) Discuss, with the help of examples, the difference between a static and dynamic systems of particles.

(e) What are the main points of difference between B-E and F-D statistics ?

(f) Find out the number of possible arrangements of 3 particles in 2 cells, assuming that the particles obey M-B statistics.

(g) Explain the terms position space, momentum space and phase space.

(h) What do you mean by Fermi energy of conduction electrons ?

(i) What do you mean by photon gas ?

(j) State Wien's displacement law. $8 \times 1 = 8$