

2021
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 scientific calculator is allowed.

x-x-x

UNIT – I

- I. 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) Calculate the total number of ways of arranging 4 distinguishable particles in 3 compartments (6,3)
- II. a) Discuss the distribution of n distinguishable particles in k compartments which are further sub-divided into cells of equal a priori probability
- b) In a system of 8 distinguishable particles are distributed in 2 compartments with equal a priori probability. Calculate the probabilities of macrostates (4,4), (3,5) and (2,6). (6,3)
- III. a) For a dynamical system. show that the fraction of time spent in a given macrostate is proportional to the probability of that macrostate.
- 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). (6,3)

UNIT – II

- IV. 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.
- b) A 40W 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? (6,3)

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- V. 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.
 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 (6,3)
- VI. a) Starting from the basic assumptions, derive Bose-Einstein distribution law.
 b) Calculate the most probable speed of nitrogen at 27° C. (6,3)

UNIT – III

- VII. Attempt any eight of the following:-
- a) What is the difference between a microstate and macrostate?
 - b) What is the difference between a static and a dynamic system of particles?
 - c) How the thermodynamic probability of a macrostate is related to the probability of that macrostate?
 - d) What kind of statistics is obeyed by photons?
 - e) What are bosons and fermions?
 - f) Find out the number of possible arrangements of 3 particles in 2 cells, assuming that the particles obey M-B statistics
 - g) What is the minimum size of phase space cell in classical statistics?
 - h) What do you mean by Fermi energy of conduction electrons?
 - i) What do you mean by electron gas?
 - j) State Stefan's law. (8x1)

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