Roll No. .....

(07/21-II)

5217

B. Sc. EXAMINATION

(For Batch 2011 & Onwards)

(Fourth Semester)

PHYSICS

Paper VII

Statistical Physics

Time : Three Hours *Maximum Marks :* 40

Note : Attempt *Five* questions in all, selecting *one* question from each Unit. Q. No. **1** is compulsory.

1. (a) Define a priori probability. Calculate the a priori probability of drawing a king out of a well shuffled pack of cards. 2

(b) List various postulates of statistical physics. 2

(c) Identify whether the following are bosons *or* fermions :

(i) H-atom

(ii) $^3He^+$ ion

(iii) α-particle

(iv) $^6Li^+$-ion.

(d) Give limitations of Debye model of specific heat of solids. 2

Unit I

2. (a) If n similar coins are tossed simultaneously for a large number of times, then find which combination has the minimum probability and also find the corresponding probability. 4

(b) Describe the distribution of four distinguishable and four indistinguishable particles in two boxes of equal size. 4

3. (a) Explain with examples the constraints and accessible states of a system. 4

(b) Derive Boltzmann's entropy relation. 4

Unit II

4. Differentiate between three kinds of statistics. Explain through an example of two particles which are to be arranged in two cells. Derive the relation $d(\log W) - \Sigma(\alpha + \beta u_i) dn_i = 0$. Where all the symbols have their usual meanings. 8

5. (a) Calculate the value of root mean square speed of a molecular of hydrogen at N.T.P. The Boltzmann constant is 1.38×10^{-23} Joules per degree and Avogadro's number is 6×10^{26} per kg.mol. Also find the most probable speed. 4

(b) Derive an expression for average speed for Maxwell distribution. 4

Unit III

6. Apply Bose-Einstein statistics to obtain Planc law for black body radiation.

7. (a) Calculate the free electron density a the Fermi energy in electron-volt sodium assuming that it has one fr electron per atom. Given density sodium = 0.97 gm/cm^3; atomic weig of sodium = 23.

(b) Show that Maxwell-Boltzma distribution is a limiting case of Fern Dirac distribution.

Unit IV

8. Describe Einstein theory of specific heat solids.

9. (a) Show that the heat capacity of a mono atomic lattice in one dimension in the Debye's approximation is proportional to T/θ for low temperature $T << \theta$, where θ is the effective Debye temperature in one dimension. 4

(b) Compare Einstein and Debye's theories of specific heat of solids. 4