Roll No. .....

(07/22-II)

5217

B. Sc. EXAMINATION

(Fourth Semester)

PHYSICS

Paper–VII

Statistical Physics

Time : Three Hours *Maximum Marks :* 40

Note : Attempt *Five* questions in all. Q. No. **1** is compulsory. Attempt any *four* questions by selecting *one* question from each Unit. Use of scientific calculator is allowed.

1. (a) Explain the term constraints on a system. Give its examples. 1

   (b) Which type of particles are used in Maxwell–Boltzmann statistics ? 1

(c) Give Thermodynamic and Statistical definition of entropy. 2

(d) Determine the R.M.S. velocity of hydrogen molecule at N.T.P. 2

(e) What is basic difference between Einstein model and Debye model for specific heat of solids ? 1

(f) What do you mean by density of vibrational modes in a continuous medium ? 1

Unit I

2. (a) Define Microstate, Macrostate and Thermodynamic Probability. 2

(b) n coins are tossed together. Prove that the probability of getting r heads is $P = \frac{n!}{r!(n-r)!} \times \frac{1}{2^n}$. Calculate : 6

(i) The probability of most probable distribution.

(ii) Probability of least possible distribution.

3. (a) Give basic postulates of statistical physics and hence derive the condition of equilibrium between two systems in thermal contact. 6

(b) Eight coins are tossed for a large no. of times. Calculate (i) the probability of getting the heads of 5 coins upward, (ii) The probability of most probable combination. 2

Unit II

4. (a) Define phase space and occupation index and derive the relation for no. of phase space cells in the momentum interval P and (P + dP). 5

(b) Calculate the most probable velocity V_m, Average velocity V_{av} and Root mean square velocity V_{rms} for a sample of oxygen gas at 27°C. Given that $K = 1.8 \times 10^{-23}$ JK^{-1} and mass of oxygen mol. 3

5. Using Maxwell–Boltzmann Distribution, derive the relation for most Probable, Average speed and Root mean square speed. Also give the relation between them. 2,2,2,2

Unit III

6. What do you mean by Bose–Einstein condensation ? Derive the expression for critical temperature at which condensation starts. 8

7. Give minimum eight points of comparison between Maxwell–Boltzmann (MB), Bose Einstein (BE) and Fermi–Dirac (FD) statistics. 8

Unit IV

8. State DULONG and PETIT's law. Derive this law using classical physics. Explain its significance. 1,5,2

9. Explain Einstein's Theory of specific heat of solids. Compare its results with experimental facts at high as well as at low temperature. Also discuss its successes and shortcomings. 6,2