

B.Sc. (With Credits)-Regular-Semester 2012 Sem V
B.Sc.3534 - Physics : Paper-I (Statistical Physics and Relativity)

P. Pages : 3

Time : Three Hours



GUG/W/16/3376

Max. Marks : 50

- Notes : 1. All the questions are compulsory.
2. Draw the neat labelled wherever necessary.

Either

1. a) i) What is meant by thermodynamic probability of a macrostate ? How it is related to probability of occurrence of that state ? 3
- ii) Explain the microstate and macrostate with the help of an example. 4
- iii) A card is drawn from a well shuffled pack of 52 cards. Calculate the probability for this card to be either a king or a queen. 3

OR

- b) i) Derive an expression for the Maxwell's law of distribution of molecular speeds of an ideal gas. 5
- ii) Assuming Maxwell's law of distribution of molecular speeds, derive an expression for the most probable speed. 3
- iii) Calculate the value of root mean square speed of a molecule of hydrogen at N.T.P. the Boltzmann's constant is 1.38×10^{-16} erg per degree and Avogadro's number is 6×10^{23} /gm.mol. 2

Either

2. a) i) What is Bose-Einstein's statistics ? What are basic postulates of it ? 2
- ii) Derive an expression $n_i = \frac{g_i}{e^{\alpha + \beta E_i} - 1}$ for the most probable distribution of the particles of a system obeying B.E. statistics. 5
- iii) The number of conduction electrons per C.C. is 24.2×10^{22} in beryllium and 0.91×10^{22} in cesium. If the fermi energy of conduction electrons in Be is 14.44 eV. Calculate that in cesium. 3

OR

- b) i) What are the postulates of special theory of relativity ? 2
- ii) Obtain Lorentz's transformation equations for space and time co-ordinates. 6
- iii) What would be the speed of a particle if its mass is equal to four times to its rest mass? 2

Either

3. a) State and explain the principle of equal a priori probability. 2½
- b) What are the limitations of Maxwell Boltzmann statistics ? 2½
- c) A system consists of 5 particles arranged in two compartments. The first compartment is divided into 6 cells and the second into 8 cells. They are of equal size. Calculate the number of microstates in the macrostate (2, 3), if the particles obey Fermi - Dirac statistics. 2½
- d) Derive Einstein's mass-energy relation. 2½

OR

- e) We throw a die twice and obtain two numbers. What is the probability that these numbers are 6 and 4 precisely in that order ? 2½
- f) Assuming M.B. distribution of molecular speeds, show that r.m.s speed is given by 2½
- $$V_{\text{rms}} = \sqrt{\frac{3kT}{m}}$$
- g) Calculate the value of Fermi energy at absolute zero temperature. 2½
- h) Compare inertial and non inertial frame of reference. 2½

Either

4. a) Show that the volume of μ -space corresponding to a single quantum state for particles of no spin is h^3 , where 'h' is Planck's constant. 2½
- b) At what temperature will be the mean speed of hydrogen molecule be the same as that of Nitrogen molecules at 35°C ? (M.W. of $N_2 = 28$ & that of $H_2 = 2$) 2½
- c) Distinguish between classical and quantum statistics. 2½
- d) What is mean by time dilation ? Derive an expression for it. 2½

OR

- e) Derive the condition of equilibrium between two systems in thermal contact. 2½
- f) Draw the graph of the Maxwell's Boltzmann velocity distribution curve and state any two features of the distribution curve. 2½
- g) Find out the number of distribution for three particles in four energy level if particle obey 2½
- i) B-E statistics
- ii) F-D statistics
- h) How fast would a rocket have to go relative to an observer for its length to be contracted to 99% of it's length at rest ? 2½

5. Attempt **any ten** of the followings.

- a) What is μ -space ? 1
- b) Differentiate accessible and inaccessible states. 1
- c) Define probability. 1
- d) Draw the graph showing mean, r.m.s. and most probable velocity. 1
- e) What is partition function for system of gas ? 1
- f) What are Bosons ? Give its examples. 1
- g) What are Fermions ? Give its examples. 1
- h) State the postulates of the Fermi Dirac statistics. 1
- i) Write the value of Planck's constant with unit. 1
- j) State inverse Lorentz transformation equations. 1
- k) What is length contraction ? 1
- l) What is mean by proper time ? 1
