KNT/KW/16/5170

Bachelor of Science (B.Sc.) Semester—V (C.B.S.) Examination

PHYSICS

Paper—1 (501)

(Atomic Physics, Free Electron Theory and Statistical Physics)

Time : Three Hours] [Maximum Marks : 50

N.B. :— (1) **All** questions are compulsory.

(2) Draw neat and labelled diagrams wherever necessary.

(3) Symbols wherever mentioned in the questions have their usual meanings.

EITHER

1. (A) Explain Zeeman effect. Discuss Lorentz theory of Normal Zeeman Effect. 5

(B) (i) Explain the basic concepts of Vector Atom Model in detail. 3

(ii) Calculate the value of Bohr magneton from the given data :

$e = 1.6 \times 10^{-19}C$, $h = 6.63 \times 10^{-34}$ J-s,

$m = 9.1 \times 10^{-31}$ kg. 2

OR

(C) What are the quantum numbers associated with an atom ? Explain. 2½

(D) State and explain Pauli's exclusion principle. 2½

(E) Describe the experimental arrangement of Stark effect. 2½

(F) Find the separation between the adjacent components of wavelengths 4500 Å, if the source is placed in magnetic field of flux density 0.3 T. 2½

EITHER

2. (A) State the assumptions of Drude-Lorentz theory. Obtain an expression for coefficient of thermal conductivity of an electron on the basis of Drude-Lorentz theory. 5

(B) (i) Obtain an expression for density of states of free electrons inside the metal. 3

(ii) Calculate the ground state energy of free electrons in a monatomic one dimensional wire of length 1 cm. 2

OR

(C) Define Fermi function and explain its significance. 2½

(D) Obtain an expression for the electrical conductivity of an electron on the basis of Free Electron theory. 2½

(E) Explain the difference between metals, semiconductors and insulators on the basis of Band Theory of Solids. 2½

(F) The resistivity of a rectangular bar of p type silicon is 2×10^5 Ω cm. The magnetic field Hz is 0.1 Wb/m^2 and the width and thickness of the bar are each 3 mm. If the measured values of the Current and Hall voltage are 10 μA and 50 mV respectively, find Hall coefficient and mobility of charge carriers. 2½

EITHER

3. (A) State any four postulates of statistical mechanics. Derive Maxwell-Boltzmann distribution law. 5

(B) (i) Distinguish between accessible and inaccessible microstates. 2

(ii) Find the most probable, average and root mean square speed of nitrogen molecules at 27°C. Given, the molar mass of nitrogen molecule is 28×10^{-31} kg/mole, gas constant R = 8.31 J/mol.K. 3

OR

(C) Derive Boltzmann entropy relation. 2½

(D) At what temperature will the mean speed of hydrogen molecules be the same as that of Nitrogen molecules at 35° C ?

Given molecular weight of N_2 = 28 and H_2 = 2. 2½

(E) Define :

(a) μ-space

(b) gamma space. 2½

(F) Explain the terms Microstates and Macrostates with examples. 2½

EITHER

4. (A) Derive an expression for the probability distribution function for particles obeying Fermi-Dirac statistics. 5

(B) (i) Starting form Bose-Einstein energy distribution law, derive Planck's law of black body radiation. 3

(ii) Find the fermi temperature for free electrons in silver. Given that, for silver

$$E_F(0) = 5.52 \text{ eV}, \; K = 1.38 \times 10^{-23} \text{ J/K}.$$ 2

OR

(C) State the differences between classical statistics and quantum statistics. 2½

(D) State the basic postulates of Bose-Einstein Statistics. 2½

(E) Estimate the temperature of sun from the following data :

$\lambda m = 4900$ Å and constant for Wien's displacement law is 2898 μm.K. 2½

(F) What are distinguishable and indistinguishable particles ? Give examples. 2½

5. Attempt any **TEN** :

(i) Find the possible values for four quantum number for an electron in K shell.

(ii) State the selection rules for intensities of spectral lines.

(iii) State the applications of Zeeman effect.

(iv) Define mobility of an electron.

(v) State applications of Hall effect.

(vi) What is Lorentz number ?

(vii) Define Fermi temperature.

(viii) Define phase space.

(ix) Give the relationship V_p, $\overline{V}$ and V_{rms} speed in terms of K,T and m, where

K = Boltzman constant and

T = Absolute temperature

m = mass.

(x) State the formula for thermodynamic probability W for Bosons.

(xi) State principle of a Priori Probability.

(xii) What is symmetric and antisymmetric wave function ? 1×10=10