B.Sc. (Part-III) Semester-VI Examination

6S : PHYSICS

Statistical Mechanics and Solid State Physics

Time : Three Hours] [Maximum Marks : 80

Note :— (1) **ALL** questions are compulsory.

(2) Draw neat and well labelled diagrams wherever necessary.

1. (A) Fill in the blanks : 2

(i) Maximum volume of unit cell in six dimensional phase space is _____.

(ii) The reciprocal of the specific resistance is the _____ of the metal.

(iii) In conductor the _____ overlap on the conduction band.

(iv) The phenomenon of hysteresis is exhibited by _____ materials.

(B) Choose correct alternative of the following : 2

(i) Platinum is the example of :

(a) Diamagnetic material (b) Paramagnetic material

(c) Ferromagnetic material (d) Ferrimagnetic material

(ii) In type I superconductor, at critical magnetic field, the diamagnetization drops :

(a) Gradually to zero (b) Abruptly to zero

(c) Exponentially to zero (d) None of these

(iii) At any temperature T, for $E = E_F$, $f(E) = ?$

(a) $f(E) = 1$ (b) $f(E) = 0$

(c) $f(E) = -1$ (d) $f(E) = \frac{1}{2}$

(iv) The coordination number for face centered cubic (FCC) lattice is :

(a) 12 (b) 8

(c) 6 (d) 26

(C) Answer the following questions in one sentence each : 4

(i) What are different types of point defects ?

(ii) What is ferromagnetic domain ?

(iii) State F.D. distribution formula

(iv) What are nano particles ?

EITHER

2. (A) What is Phase Space ? 2

(B) Define thermodynamic probability. 2

(C) State and prove the Boltzmann's Entropy relation. 6

(D) What is principle of equal a priori probability ? 2

OR

3. (P) Write the expression for thermodynamic probability in Maxwell Boltzmann distribution system. Hence find the expression for Maxwell-Boltzmann distribution formula. 6

(Q) Define most probable speed 'V_p' and show that $V_p = \sqrt{\frac{2KT}{m}}$. 6

EITHER

4. (A) Distinguish between Bosons and Fermions. 4

(B) Write the expression for thermodynamic probability in Bose-Einstein Statistics and hence derive BE distribution law. 6

(C) Define Fermi energy. 2

OR

5. (P) Differentiate between distinguishable and indistinguishable particles. 4

(Q) Write the expression for thermodynamic probability in F.D. Statistics and obtain an expression for Fermi Dirac Distribution Law. 6

(R) Explain Fermi function. 2

EITHER

6. (A) What are primitive and non-primitive unit cell ? 2

(B) What are Miller indices ? 2

(C) Find Miller indices of the plane having intercepts 2, 3 and 4 units along three axes. 4

(D) Explain Schottky defect and Frenkel defect. 4

OR

7. (P) Define coordination number. 2

(Q) State and explain Bragg's law. 5

(R) What are line defects ? Explain edge dislocation. 5

EITHER

8. (A) What is conduction electron ? 2

(B) Define electrical conductivity and derive an expression in terms of mean free path. 6

(C) Explain valence band and conduction band. 4

OR

9. (P) Define mean free path. 1

(Q) Derive an expression for the density of states, $n(E) = \frac{4\pi}{h^3}(2m)^{3/2}\sqrt{E}$. 6

(R) Distinguish between metal, semiconductor and insulator on the basis of band theory of solids. 5

EITHER

10. (A) Explain :

(i) Atomic magnetic moment

(ii) Magnetization vector. 4

(B) Why is diamagnetic material feebly repelled by external magnetic field ? 2

(C) State the properties of ferromagnetic material. 4

(D) Explain Curie law. 2

OR

11. (P) What is spontaneous magnetization ? 1

(Q) What is hysterisis effect in Ferromagnetic materials ? 3

(R) Distinguish between paramagnetic, diamagnetic and ferromagnetic materials. 6

(S) Explain variation of Langevin's function :

$$L(\alpha) = \left[\coth(\alpha) - \frac{1}{\alpha}\right] \text{against } \alpha = \frac{\mu_B}{KT}.$$ 2

EITHER

12. (A) What is superconductivity ? 1

(B) State and explain Meissner effect. 4

(C) Explain type II super conductor. 4

(D) Write the applications of super conductor. 3

OR

13. (P) Explain quantum size effect in nano materials. 4

(Q) Give brief history of nano materials. 4

(R) State applications of nano materials. 4