

B.Sc. (Part-III) Semester-VI Examination**6S-PHYSICS****(Statistical Mechanics and Solid State Physics)**

Time : Three Hours]

[Maximum Marks : 80

Note :- Attempt all questions.

1. (A) Fill in the blanks : 2
- (i) The phase space of N particles have _____ dimensions.
 - (ii) Quantum statistics is applicable to identical and _____ particles.
 - (iii) Schottky defects are _____ defects.
 - (iv) Superconductors are perfectly _____.
- (B) Choose correct alternative of the following : 2
- (i) Pauli's exclusion principle is applicable to :
 - (a) M-B statistics
 - (b) B-E statistics
 - (c) F-D statistics
 - (d) None of these
 - (ii) Structure of NaCl crystal is :
 - (a) BCC
 - (b) FCC
 - (c) Simple cubic
 - (d) Hexagonal
 - (iii) For diamagnetic materials, magnetic susceptibility is :
 - (a) small and negative
 - (b) small and positive
 - (c) large and negative
 - (d) large and positive
 - (iv) Nanometer is equal to :
 - (a) 10^{-3}m
 - (b) 10^{-6}m
 - (c) 10^{-7}m
 - (d) 10^{-9}m
- (C) Answer the following in **one** sentence : 4
- (i) What are Bosons ?
 - (ii) What is point defect ?
 - (iii) What is Curie temperature ?
 - (iv) On what factors properties of nanomaterial depend ?

2. (A) Write expression for thermodynamic probability in M-B distribution and find expression for M-B distribution law. 6
- (B) By using M-B distribution law of molecular speed show that root mean square speed of gas molecule is given by $V_{rms} = \sqrt{\frac{3kT}{m}}$. 4
- (C) Find the thermodynamic probability for four distinguishable particles for the microstate (2, 2). 2

OR

3. (P) State and explain principle of a priori probability. 4
- (Q) Show that most probable velocity of gas molecule is $V_p = \sqrt{\frac{2kT}{m}}$. 4
- (R) Explain the terms :
 (i) Thermodynamic probability
 (ii) Statistical weight. 4

EITHER

4. (A) What are the main postulates of Fermi-Dirac statistics ? 4
- (B) Using Bose-Einstein distribution law, deduce an expression for Planck's law of energy distribution in black body radiation. 7
- (C) What is Fermi energy ? 1

OR

5. (P) Explain the concept of distinguishable and indistinguishable particles. 3
- (Q) Obtain an expression for Fermi-Dirac distribution law by assuming thermodynamic probability. 5
- (R) What is Fermi function ? How it behaves at absolute zero ? 4

EITHER

6. (A) Define unit cell of crystal. Explain primitive and non-primitive unit cell. 4
- (B) Derive Bragg's law for diffraction of X-rays. 4
- (C) What is line defect in crystal ? Explain the screw dislocation in crystal with neat diagram. 4

OR

7. (P) Give the names of seven crystal systems and state the parameters of their unit cells. 6
- (Q) What are Miller indices ? Find Miller indices of the plane having intercepts (a, 2b, c/2). 4
- (R) What is reciprocal lattice ? 2

EITHER

8. (A) Obtain an expression for electrical conductivity in terms of mean free path of electrons. 4
- (B) Discuss formation of insulator, semiconductor and conductor on the basis of band theory of solid. 6
- (C) What are conduction electrons ? 2

9. (P) Explain the motion of electron in metals and hence derive an expression for drift velocity of electron. 5
- (Q) Explain qualitatively conduction band, valence band and energy gap in solids. 4
- (R) Explain nearly free electron model. 3
- EITHER**
10. (A) State properties of paramagnetic materials. 4
- (B) Explain ferromagnetism on the basis of domain theory. 4
- (C) What is magnetic dipole moment ? Obtain an expression for orbital magnetic dipole moment. 4
- OR**
11. (P) Give Langevin's theory of paramagnetism; hence prove that the susceptibility of paramagnetic material is inversely proportional to absolute temperature. 8
- (Q) State properties of diamagnetic material. 4
- EITHER**
12. (A) Give brief idea of BCS theory of superconductivity. 6
- (B) Explain type-I and type-II superconductor. 4
- (C) Define : 2
- (i) Critical temperature
- (ii) Critical magnetic field.
- OR**
13. (P) Explain importance of surface to volume ratio and quantum size effect in nanomaterials. 6
- (Q) State any four applications of nanomaterials. 4
- (R) What are nanomaterials ? 2

