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) Number of micro-states in a particular macro-state is called ..... probability.

(ii) The conductivity of a semiconductor ..... with increase in temperature.

(iii) Electromagnets are made up of ..... iron.

(iv) Type I superconductors perfectly obey ..... effect.

(B) Choose correct alternative : 2

(i) The dimensions of phase space is :

(a) 3 (b) 6

(c) 9 (d) none of these

(ii) Which of the following is quantum statistics ?

(a) M-B Statistics (b) B-E Statistics

(c) F-D Statistics (d) both (b) and (c)

(iii) The co-ordination number of bcc structure is :

(a) 6 (b) 8

(c) 12 (d) 16

(iv) S.I. unit of conductivity is :

(a) Siemens per metre (b) $(ohm.m)^{-1}$

(c) ohm.m (d) both (a) and (b)

(C) Answer the following in one sentence : 4

(i) What are nano materials ?

(ii) What is curie temperature ?

(iii) Define Mean Free path.

(iv) What are bosons ?

EITHER

2. (A) What is unit cell in phase space ? Show that the volume of unit cell is h^3. 4

(B) Explain the concept of thermodynamic probability. 3

(C) Deduce Boltzmann entropy relation S = klogw. 5

OR

3. (P) Explain the concept of phase space. 4

(Q) Show that the root mean square speed of a gas molecule is given by $V_{rms} = \sqrt{\frac{3kT}{m}}$ by using M-B distribution law of molecular speed. 4

(R) What are macro-state and micro-state ? 4

EITHER

4. (A) Derive an expression for Fermi-Dirac distribution law. 6

(B) What is Fermi energy ? Derive an expression for Fermi-energy at absolute zero temperature. 4

(C) What is Fermi-temperature ? 2

OR

5. (P) Derive Bose-Einstein Distribution Law. 6

(Q) Derive Planck's law of energy distribution in black body radiation. 6

EITHER

6. (A) What are different types of defects in crystal ? 4

(B) What are Miller Indices ? Explain the procedure to find Miller Indices. 4

(C) Define unit cell of crystal. Explain primitive and non primitive unit cells. 4

OR

7. (P) Derive Bragg's law for X-ray diffraction. 4

(Q) Calculate the interplaner spacing for (3 2 1) plane in a simple cubic lattice of which the lattice constant is 4.2×10^{-10}m. 3

(R) Describe how a Bragg's X-ray spectrometer is used to study the structure of NaCl crystal ? 5

EITHER

8. (A) Derive an expression for electrical conductivity of metals in terms of mean free path. 4

(B) Discuss the classification of solids an insulator, semiconductor and conductor on the basis of band theory of solids. 6

(C) Explain the concept of Energy gap. 2

OR

9. (P) What is density of states ? Derive an expression for density of states. 6

(Q) Explain the term drift velocity. 2

(R) State and explain Bloch theorem. 4

EITHER

10. (A) Define :

(i) Magnetisation 2

(ii) Magnetic permeability.

(B) State the properties of ferromagnetic materials. 4

(C) Give the Langerin's theory of paramagnetism and hence prove that the susceptibility of paramagnetic materials is inversely proportional to absolute temperature. 6

OR

11. (P) State and explain Curie-Weiss law. 4

(Q) State the properties of paramagnetic materials. 4

(R) What is hysteresis ? Explain the hysteresis loop. 4

EITHER

12. (A) What is superconductivity ? Explain critical temperature in super-conductors. 4

(B) State and explain meissner effect. 4

(C) State any four applications of super-conductors. 4

OR

13. (P) Give brief idea of BCS theory of super-conductivity. 6

(Q) What is Quantum Dot ? 2

(R) State any four applications of nano materials. 4