EITHER

AQ—744

12. (a) Define :

    (i) Critical temperature in superconductor

    (ii) Critical magnetic field in superconductor.   4

  (b) Give brief idea of BCS theory of superconductivity.

            6

  (c) State any four applications of nanomaterials.   2

OR

13. (p) Explain Type-I and Type-II superconductors.   4

  (q) Explain the effect of reduction of dimension on the physical properties of nanomaterials.   4

  (r) State applications of superconductors.   4

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

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) The minimum volume of unit cell in phase space is _____.

    (ii) The Co-ordination number of FCC structure is _____.

    (iii) $\bar{J} = \sigma \bar{E}$ is vector form of _____ law.

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

  (B) Choose correct alternative :   2

    (i) The number of different Bravais Lattice is _____.

      (a) 3

      (b) 14

      (c) 167

      (d) Unlimited

(ii) Which of the following is not boson ?

    (a) α-particle

    (b) electron

    (c) photon

    (d) π-meson

(iii) In a cubic crystals all the sides of unit cell meet at :

    (a) 90°

    (b) 60°

    (c) 45°

    (d) 120°

(iv) Superconductors are perfectly :

    (a) Ferromagnetic

    (b) diamagnetic

    (c) Paramagnetic

    (d) Ferrimagnetic

(C) Answer the following in **ONE** sentence :   4

    (i) What are quantum dots ?

    (ii) What is cooper pair ?

    (iii) What is curie temperature ?

    (iv) What are crystal defects ?

EITHER

2. (a) Explain the concept of phase space.   3

(c) What are conduction electrons ?   2

OR

9. (p) Distinguish metal, semiconductor and insulator on the basis of Band theory of solids.   3

(q) State and explain Bloch Theorem.   4

(r) Derive an expression for electrical conductivity in terms of mean free path of electrons in a metal.   5

EITHER

10. (a) State the failures of Langevin's theory of paramagnetism and hence give quantum theory of paramagnetism.   6

(b) State properties of ferromagnetic material.   3

(c) State and explain Curie Weiss law.   3

OR

11. (p) Derive expression for diamagnetic susceptibility on the basis of Langevin's theory of diamagnetism in brief.   6

(q) Show that the loss of energy per unit volume per cycle of Hysteresis is equal to the area of B-H loop.   4

(r) What are ferromagnetic domains ?   2

(q) State the conditions for applicability of F.D. statistics.   3

(r) By using F.D. statistics obtain an expression for Fermi energy at absolute zero temperature.   4

EITHER

6. (a) Explain Schottky and Frankel defect in crystal.   6

   (b) State the names of crystal systems.   2

   (c) What are Miller indices of a crystal plane having intercepts at a, 3b and ∞ on x, y, z axes respectively ?   4

OR

7. (p) Explain X-ray diffraction method to determine lattice parameter of crystal.   4

   (q) What are line defects ? What is edge dislocation ? Explain with diagram.   5

   (r) If X-rays of wavelength 0.9 A° are diffracted at an angle of 7° in the first order, what is the spacing between the adjacent planes of the crystal ?   3

EITHER

8. (a) Explain Formation of conduction band, Valence band and energy gap in solids.   4

   (b) Explain the concept of Fermi energy. Assuming the expression for fermi energy $E = \dfrac{\hbar^2}{2m}(3\pi^2 \dfrac{N}{V})^{2/3}$

   obtain expression for density of states.   6

(b) By using M-B energy distribution, derive molecular speed distribution law.   5

(c) What is most probable distribution ? Show that the most probable speed $V_p = \sqrt{\dfrac{2KT}{m}}$.   4

OR

3. (p) What are microstates and macrostates ? Explain with example.   4

(q) By assuming thermodynamic probability in M.B. distribution, derive expression for M.B. distribution law.   5

(r) Find most probable velocity when :

m = 3 × 10⁻²³ gm, T = 27° C and K = 1.38 × 10⁻¹⁶ ergs/K.   3

EITHER

4. (a) What are Bosons and Fermions ? State examples of Bosons and Fermions.   4

(b) Obtain an expression for Fermi-Dirac distribution law by assuming thermodynamic probability.   5

(c) Explain the effect of temperature on Fermi function.   3

OR

5. (p) By assuming thermodynamical probability obtain an expression for B.E distribution law.   5