

(Pages : 3)

G – 5247

Reg. No. :

Name :

Fourth Semester M.Sc. Degree Examination, September 2019

Physics

PH:241 : CONDENSED MATTER PHYSICS

(2014 Admission onwards)

Time : 3 Hours

Max. Marks : 75

PART – A

(Answer any **five** questions: Each question carries **3** marks)

- I. (a) What are Miller indices?
- (b) Explain the concept of reciprocal lattice.
- (c) Give the salient features of nearly free electron model.
- (d) Explain the phenomenon of Hall effect in semiconductors.
- (e) Explain the properties of ferroelectric crystals.
- (f) Discuss the paramagnetic behavior of conduction electrons.
- (g) What is meant by London penetration depth?
- (h) What are the advantages of pulsed laser deposition?

(5 × 3 = 15 Marks)

P.T.O.


PART – B

(Answer **all** questions ; Each question carries **15** mark)

- II. A. (a) Obtain the dispersion relation for one dimensional diatomic lattice and explain the formation of forbidden band. (10)
- (b) Show that in the case of a diatomic lattice the neighboring atoms move in opposite directions in optical branch while in the same direction for acoustical branch (5)

OR

- B. (a) Explain Bloch theorem (3)
- (b) Explain the formation of energy bands in a one dimensional lattice on the basis of Kronig-Penny model. (12)

- III. A. (a) Derive an expression for the density of electrons in the conduction band of an intrinsic semiconductor. (10)
- (b) With the help of diagrams explain the location of Fermi level in the case of an intrinsic semiconductor and n type semiconductor. (5)

OR

- B. (a) Discuss the variation of spontaneous magnetization on the basis of Weiss molecular field theory. (10)
- (b) Show that ferromagnetic Curie temperature is proportional to the internal field constant. (5)

- IV. A. (a) Distinguish between AC and DC Josephson effects. (5)
- (b) Show that the current density across the AC Josephson junction is oscillatory. (10)

OR

- B. (a) Describe the sol gel technique for the synthesis of nanomaterials. (7)
- (b) Explain the working principle of atomic force microscope. (8)

(3 × 15 = 45 Marks)



PART – C

(Answer any **three** questions : Each question carries **5** marks)

- V. (a) The average energy required to create a Frenkel defect in an ionic crystal is 1.4 eV. What is the ratio of the number of Frenkel defects at 300 K and at 600 K per gram of the crystal.
- (b) Einstein's temperature of a material is 157 K. Find C_v for the material at 100 K using Einstein's formula.
- (c) Find the probabilities for an electron state to be occupied at 20 °C for the energy states lying 0.11 eV above and 0.11 eV below the Fermi level.
- (d) The dielectric constant of helium at 0°C and one atmospheric pressure is 1.000074. Calculate the dipole moment induced in each helium atom when the gas is subjected to an electric field of 3×10^4 V/m.
- (e) The susceptibility of a paramagnetic material at 350 K is 2.8×10^{-4} . Calculate the susceptibility at 300 K.
- (f) A superconducting material has a critical temperature of 7.26 K at zero magnetic field and a critical field 8×10^5 A/m at 0 K. Calculate the critical field at 5 K.

(3 × 5 = 15 Marks)

