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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 *Cv*, 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)