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(6th Semester)

PHYSICS

TWELFTH (A) PAPER

(Solid-State Physics—II)

(Pre-revised)

Full Marks : 55

Time : 2½ hours

(PART : B—DESCRIPTIVE)

(*Marks* : 35)

*The figures in the margin indicate full marks
for the questions*

1. Derive the dispersion relation for the vibrations of a one-dimensional monatomic lattice. Deduce the expression for the phase and group velocities from the dispersion relation. 4+3=7

Or

Considering the vibrations of diatomic linear lattice, derive the expressions for the frequency of acoustic and optical branches of vibrations. Draw the dispersion curves for the two branches of vibrations. 5+2=7

(**2**)

2. Derive the expression for paramagnetic susceptibility of a solid and hence derive the Curie's law. 5+2=7

Or

What are ferromagnetic domains? Write about the contributing factors in the total internal energy of the domain structure in a ferromagnetic material. 2+5=7

3. Evaluate the local field acting at an atom in the dielectric and derive the Clausius-Mossotti relation. 3+4=7

Or

What do you mean by polarizability? Discuss the classical theory of electronic polarizability. 7

4. What are the basic assumptions in Kronig-Penney model? Discuss the Kronig-Penney model for the motion of an electron in a linear lattice. 2+5=7

Or

How do the energy bands originate in solids? Explain the classification of solids in terms of energy bands. What are direct and indirect transitions? 2+3+2=7

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5. Derive the London's equations and obtain an expression for London's penetration depth. 5+2=7

Or

What are Cooper pairs and coherence length? Explain how the superconducting energy gap varies with temperature. 2+2+3=7

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Subject Code : PHY/VI/12 (a) (PR)

Booklet No. A

Date Stamp ....

To be filled in by the Candidate

DEGREE 6th Semester
(Arts / Science / Commerce /
........................) Exam., **2017**

Subject ....

Paper ....

INSTRUCTIONS TO CANDIDATES

1. **The Booklet No. of this script should be quoted in the answer script meant for descriptive type questions and vice versa.**

2. **This paper should be ANSWERED FIRST and submitted within** *45 minutes* **of the commencement of the Examination.**

3. **While answering the questions of this booklet, any cutting, erasing, over-writing or furnishing more than one answer is prohibited. Any rough work, if required, should be done only on the main Answer Book. Instructions given in each question should be followed for answering that question only.**

To be filled in by the Candidate

DEGREE 6th Semester
(Arts / Science / Commerce /
........................) Exam., **2017**

Roll No. ....

Regn. No. ....

Subject ....

Paper ....

Descriptive Type

Booklet No. B ....

2 0 1 7

(6th Semester)

PHYSICS

TWELFTH (A) PAPER

(Solid-State Physics—II)

(Pre-revised)

(PART : A—OBJECTIVE)

(*Marks* : 20)

The figures in the margin indicate full marks for the questions

SECTION—I

(*Marks* : 5)

Put a Tick (✓) mark against the correct answer in the brackets provided :   1×5=5

1. The phase velocity of the vibrational waves in an elastic media is given by

(a) $V_p = \sqrt{\dfrac{C}{\rho}}$ (   )

(b) $V_p = \dfrac{\rho}{C}$ (   )
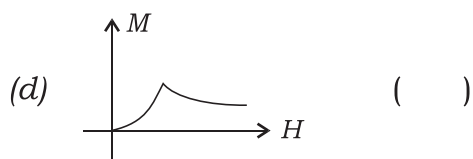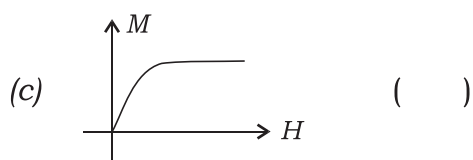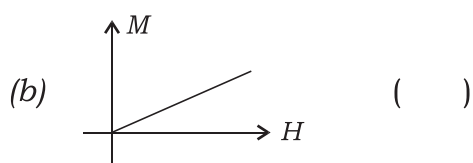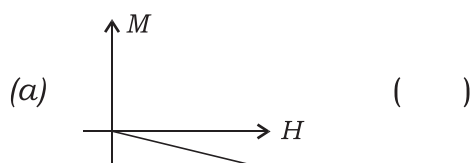
(c) $V_p = \sqrt{\dfrac{\rho}{C}}$ (   )

(d) $V_p = \dfrac{\rho}{C^2}$ (   )

where C is the elastic constant and ρ is the density of the medium.

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2. The susceptibility of diamagnetic material corresponds with

(a)

(   )

(b)

(   )

(c)

(   )

(d)

(   )

3. The relation between dielectric constant and electric susceptibility is given by

(a) $\varepsilon_r + 1 = \chi$ (   )

(b) $\varepsilon_r - 1 = \chi$ (   )

(c) $\varepsilon_r = 1 / \chi$ (   )

(d) $\varepsilon_r = \chi - 2$ (   )

where the symbols have their usual meanings.

4. The effective mass of an electron in an energy band is given by

(a) $m^* = \dfrac{\hbar}{\dfrac{d^2E}{dk^2}}$ ( )

(b) $m^* = \dfrac{\hbar^2}{\dfrac{d^2E}{dk^2}}$ ( )

(c) $m^* = \dfrac{\hbar^2}{\dfrac{dE}{dk}}$ ( )

(d) $m^* = \hbar \cdot \dfrac{dE}{dk}$ ( )

5. The magnetic flux density inside a metal in the superconducting state is always

(a) zero   ( )

(b) highest   ( )

(c) same as in the non-superconducting state   ( )

(d) low   ( )

SECTION—B

(*Marks* : 15)

Give short answers of the following questions :   3×5=15

1. What are phonons? Write the wave vector conservation law for inelastic collision.

2. What are the differences between diamagnetic, paramagnetic and ferromagnetic materials?

3. What are normal and anomalous dispersions?

4. Explain the concept of holes.

5. What is the isotope effect of superconductors?

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