

PHY/VI/12 (a)

2 0 1 6

(6th Semester)

PHYSICS

TWELFTH (A) PAPER

(Solid-State Physics—II)

Full Marks : 55

Time : 2½ hours

(PART : B—DESCRIPTIVE)

(*Marks : 35*)

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

1. Derive dispersion relation for a one-dimensional diatomic lattice and differentiate between optical and acoustical branches. Why are these branches named so? 4+2+1=7

Or

Obtain dispersion relation for the lattice waves in a monoatomic linear lattice and hence discuss the dispersion behaviour at low frequency and high frequency respectively. 4+3=7

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(*Turn Over*)

(2)

2. What are paramagnetic materials? Describe Langevin's theory of paramagnetism and obtain an expression for paramagnetic susceptibility. 1+6=7

Or

Describe the Weiss molecular field theory of ferromagnetism and derive Curie-Weiss law. 4½+2½=7

3. What is meant by polarization in dielectrics? Obtain an expression for the Lorentz field in a dielectric material and hence derive the Clausius-Mosotti equation. 1+3+3=7

Or

Obtain an expression for dielectric loss when a dielectric is subjected to an alternating field. Also obtain real and imaginary parts of the dielectric constant in terms of the frequency ω and the relaxation time τ . 4+3=7

4. Discuss the Kronig-Penny model for the motion of an electron in a periodic potential. 7

Or

What is meant by the effective mass of an electron? What is its significance? Show that the effective mass of an electron in a crystal is inversely proportional to the second derivative of the E - k curve. 1+2+4=7

(3)

5. Derive London's equation. Also describe how Cooper pair are formed. 4½+2½=7

Or

Describe the Meissner effect. Explain the difference between type I and type II superconductors using the Meissner effect. 3+4=7

Subject Code : PHY/VI/12 (a)

Booklet No. **A**

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Date Stamp

To be filled in by the Candidate

DEGREE 6th Semester
(Arts / Science / Commerce /
.....) Exam., **2016**
Subject
Paper

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To be filled in by the Candidate

DEGREE 6th Semester
(Arts / Science / Commerce /
.....) Exam., **2016**

Roll No.

Regn. No.

Subject

Paper

Descriptive Type

Booklet No. B

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, overwriting 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.

Signature of
Scrutiniser(s)

Signature of
Examiner(s)

Signature of
Invigilator(s)

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2 0 1 6

(6th Semester)

PHYSICS

TWELFTH (A) PAPER

(Solid-State Physics—II)

(PART : A—OBJECTIVE)

(Marks : 20)

The figures in the margin indicate full marks for the questions

SECTION—A

(Marks : 5)

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

1. Diamagnetic materials possess

- (a) permanent magnetic dipoles ()
- (b) no permanent magnetic dipoles ()
- (c) induced dipole moment ()
- (d) magnetic domains ()

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(2)

2. Dispersion relation relates

(a) frequency and wavelength ()

(b) wavelength and velocity ()

(c) frequency and velocity ()

(d) frequency and amplitude ()

3. Relative permittivity of a dielectric is related to the electric susceptibility as

(a) $\epsilon_r = \epsilon_0 + 1$ ()

(b) $\epsilon = 1 + \epsilon_r$ ()

(c) $\epsilon_r = 1 + \epsilon$ ()

(d) $\epsilon = \epsilon_r + 1$ ()

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(3)

4. Forbidden energy gap of Ge is

(a) 1.08 eV ()

(b) 1.43 eV ()

(c) 0.7 eV ()

(d) 0.45 eV ()

5. The temperature at which a conductor becomes a superconductor is called

(a) superconducting temperature ()

(b) Curie temperature ()

(c) Onnes temperature ()

(d) transition temperature ()

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(4)

SECTION—B

(Marks : 15)

Answer the following questions briefly :

3×5=15

1. Explain the cause of hysteresis phenomenon in ferromagnetic materials. What does the area of the loop signify?

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(5)

2. What are phonons? Express the law of conservation of energy and momentum in the case of inelastic scattering of photon by phonons.

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(6)

3. Explain different polarization mechanisms in dielectrics.

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(7)

4. Distinguish among a metal, a semiconductor and an insulator on the basis of their energy band structure.

(8)

5. Describe the isotope effect in superconductors.

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