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(6th Semester)

PHYSICS

TWELFTH (A) PAPER

(**Solid-State Physics—II**)

(Revised)

Full Marks : 55

Time : 2½ hours

(PART : B—DESCRIPTIVE)

(Marks : 35)

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

1. Discuss the lattice vibration of one-dimensional monatomic chain of linear atom and show that the condition at the boundary of the first Brillouin zone is equivalent to Bragg reflection of X-ray. 5+2=7

Or

Obtain the dispersion relation for the case of vibration of one-dimensional diatomic chain of linear atom. Find the value of wave vector for the optical and acoustic branches as $k \rightarrow 0$. 6+1=7

2. Describe the classical theory of diamagnetism and obtain the expression for susceptibility. 5+2=7

Or

Discuss the Weiss theory of ferromagnetism and obtain Curie-Weiss law. 5+2=7

3. What is depolarization field? Obtain the expression for local electric field at an atom in dielectric material. 1+6=7

Or

Discuss the classical theory of electronic polarizability and obtain Clausius-Mosotti relation. 4+3=7

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

(3)

Or

Discuss the concept of effective mass of an electron. Explain how electron in a crystal can behave dynamically like a particle with variable mass. 5+2=7

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

Or

- (a) Define superconductivity. What are type I and type II superconductors? 1+4=5
- (b) Briefly explain isotope effect of superconducting material. 2

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

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Booklet No. **A**

Date Stamp

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To be filled in by the Candidate

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

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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

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)

PHY/VI/12 (a) (R)

2 0 1 7

(6th Semester)

PHYSICS

TWELFTH (A) PAPER

(Solid-State Physics—II)

(Revised)

(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. The forbidden frequency of solids disappears at $k = \pi / 2a$, if

(a) $m = M$ ()

(b) $m < M$ ()

(c) $m > M$ ()

(d) $mM = 1$ ()

where the m 's are masses of atoms of one-dimensional diatomic linear chain, a being the nearest neighbor distance.

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(2)

2. If the susceptibility of a material is independent of temperature, then it is

(a) ferromagnetic ()

(b) paramagnetic ()

(c) diamagnetic ()

(d) antiferromagnetic ()

3. Bloch theorem is applicable to

(a) constant potential ()

(b) periodic potential ()

(c) infinite potential ()

(d) free electrons ()

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(3)

4. Spontaneous polarization takes place due to

(a) atoms ()

(b) free electrons ()

(c) permanent dipoles ()

(d) ions ()

5. The formation of Cooper pair according to BCS theory is the exchange of virtual phonons between two electrons through

(a) spin-orbit interaction ()

(b) lattice deformation ()

(c) magnetic field ()

(d) Auger effect ()

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(4)

SECTION—B

(Marks : 15)

Answer the following questions :

3×5=15

1. What are phonons? Write the wave vector conservation law for inelastic collision of photons accompanied by creation and also absorption of phonons.

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(5)

2. What is crystal anisotropy energy? What is its role in the formation of ferromagnetic domain?

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(6)

3. What are the different polarization processes? On what factor does the contribution of a particular process of polarization of dielectric depend?

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(7)

4. Explain how beryllium with electronic configuration $1s^2 2s^2$ is an electrical conductor using energy band concept.

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(8)

5. What is coherence length? What is the effect of presence of impurities in a superconductor on the coherence length?

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