This question paper contains 4 printed pages]

May 2013

Roll No. | | | | | | | | | | | |

S. No. of Question Paper : **1602**

Unique Paper Code : **222603**

C

Name of the Paper : **Solid State Physics (PHHT-621)**

Name of the Course : **B.Sc. (Hons.) Physics**

Semester : **VI**

Duration : **3 Hours**

Maximum Marks : **75**

(Write your Roll No. on the top immediately on receipt of this question paper.)

Attempt *five* questions in all. Question No. **1** is compulsory.

All questions carry equal marks.

1. Attempt any *five* questions of the following : 3×5=15

   (*a*) What is the number of nearest neighbours for the three types of cubic lattices ? What are their nearest neighbour distances ?

   (*b*) Discuss the structure of Diamond cubic unit cell.

   (*c*) Show that the reciprocal lattice of a bcc lattice is a fcc lattice.

   (*d*) Name the seven crystal systems in a 3-D lattice. Give the relation between the length and angles of the axes of unit cell in each type.

   (*e*) Prove that 5-fold rotation axis cannot exist in a crystal lattice.

P.T.O.

(*f*) How does the dielectric constant of a polar dielectric (like water) vary from zero optical frequencies of an applied electric field ?

(*g*) Discuss the concept of effective mass. How does it vary with wave-vector ?

(*h*) Distinguish between dia, para, and ferromagnetic materials on the basis of susceptibility.

(*i*) How do entropy and specific heat vary with temperature for a superconductor ?

2. (*a*) Given the basis vector of hcp structure :

$$\boldsymbol{a} = (\sqrt{3/2}\, a)\boldsymbol{i} + (a/2)\boldsymbol{j},\quad \boldsymbol{b} = (-\sqrt{3/2}\, a)\boldsymbol{i} + (a/2)\boldsymbol{j},\quad \boldsymbol{c} = c\boldsymbol{k}$$

Find its reciprocal lattice and to which crystal class it belongs.

(*b*) Explain how the planes of a crystal are specified. Prove for an orthorhombic system the interplanar distance is :

$$d_{hkl} = 1/(h^2/a^2 + k^2/b^2 + l^2/c^2)^{1/2}$$

Find the value of d_{210} for a cubic crystal with side 'a'. 5

(*c*) Deduce the Bragg's sine law from the diffraction condition $2\mathbf{K}\cdot\mathbf{G} + G^2 = 0$ and show that its geometrical interpretation leads to the concept of Brillouin Zones in crystals. 5

3. (*a*) Derive the dispersion relation for a linear diatomic lattice, stating the assumptions involved. Discuss the salient features of various branches in the dispersion curve. Under what condition a diatomic lattice behaves as a monatomic lattice ? 12

(*b*) Give the qualitative description of the dispersion curves in a 3-dimensional diatomic lattice. 3

4. (*a*) Discuss the failure of classical theory in explaining the observed temperature dependence of specific heat of a solid. 3

(*b*) Give the modifications incorporated by Debye and derive T^3 law. Calculate the vibrational frequency of carbon whose Debye's temperature is 1650 K. Given $h = 6.6 \times 10^{-34}$ Js, $k_B = 1.38 \times 10^{-23}$ J/K. 12

5. (*a*) Obtain the Lorentz relation for local field at a point inside a dielectric. How is local field different from Maxwell field ? 5

(*b*) Derive an expression for the electronic polarizability in a varying electric field. What is the implication of complex dielectric constant ? 10

6. (*a*) What is hysteresis ? Discuss its occurrence on the basis of domain concept. 5

(*b*) What is the origin of magnetic properties in a material ? Obtain an expression for paramagnetic susceptibility on the basis of Langevin's theory. Explain briefly an experimental method used to measure paramagnetic susceptibility. 10

7. (*a*) State Block Theorem. Obtain the energy spectrum of an electron in a one-dimensional periodic potential. Show that in the limiting case of vanishing potential barrier leads to the results obtained in a free electron model. 12

(*b*) Discuss the symmetry properties of the energy spectrum as obtained from the reduced zone scheme. 3

P.T.O.

1602

8. (*a*) Starting with expressions of electron and holes densities, show that the Fermi level lies midway between the band gap for an intrinsic semiconductor. How does its position change with doping concentration and temperature for an extrinsic semiconductor ? 5

(*b*) What is Meisener effect in superconductors ? Enumerate the properties of type I and type II superconductors. 6

(*c*) Discuss 'isotope effect' and 'critical field' in superconductors. 4

This question paper contains 3 printed pages]

Roll No. | | | | | | | | | | | |

S. No. of Question Paper : 6895

Unique Paper Code : 222663 D

Name of the Paper : Solid State and Nuclear Physics (PHPT-606)

Name of the Course : B.Sc. Physical Science

Semester : VI

Duration : 3 Hours

Maximum Marks : 75

(Write your Roll No. on the top immediately on receipt of this question paper.)

Attempt any *Five* questions.

All questions carry equal marks.

1. (*a*) What is a reciprocal lattice ? Derive the relationship between the primitive vectors of the reciprocal lattice and primitive vectors of direct lattice. 7

(*b*) What is Bragg's diffraction law ? Describe the Laue method or the powder method of X-ray diffraction. 8

2. (*a*) What do you mean by polarization of a solid ? Find an expression for the local field that is responsible for polarizing molecules or atoms of a solid. 7

(*b*) Explain polarizability of atoms and molecules. Derive Clausius-Mossotti relation between polarizability and dielectric constant of a solid. 8

P.T.O.

3. (*a*) What is superconductivity ? Explain Meissner effect. 5

(*b*) Discuss the Kronig-Penny model. How does it explain the formation of energy band separated by forbidden energy gap in solids. 10

4. (*a*) Explain hysteresis in ferromagnetic materials. Prove that work done is equal to the area of B-H curve. 9

(*b*) Distinguish between diamagnetic, paramagnetic and ferromagnetic materials. 6

5. (*a*) Explain with graph the variation of binding energy per nucleon *Vs.* atomic mass number. Identify the regions which are suitable for nuclear fusion and nuclear fission. 10

(*b*) Calculate the binding energy per nucleon for $_{28}Ni^{64}$. Given mass of $_{28}Ni^{64} = 63.9280$ u. Mass of neutron = 1.008665 u, mass of hydrogen atom = 1.007825 u. mass of proton = 1.007276 u. 5

6. (*a*) What is radioactive decay law. Derive the relation between disintegration constant (λ) and half-life of radioactive substance. 8

(*b*) Explain the following :

(*i*) nuclear fission

(*ii*) γ-decay. 5+2

7. (a) Complete the following reaction : 5

(i) ${}_{Z}X^{A} \rightarrow ?? + {}_{2}He^{4}$

(ii) ${}_{Z}X^{A} \rightarrow ?? + e^{-}$

(iii) ${}_{Z}X^{A} \rightarrow ?? + e^{+}$

(iv) ${}_{Z}X^{A} + e^{-} \rightarrow ??$

(v) $p \rightarrow n + e^{+} + ?$

(b) Explain nuclear shell model. 10

8. (a) Name the *four* types of fundamental interactions and explain these interactions between elementary particles. 10

(b) What are quarks ? Name various quarks. 5

This question paper contains **3** printed pages]

Roll No. | | | | | | | | | | | |

S. No. of Question Paper : **957**

Unique Paper Code : **222603**

E

Name of the Paper : **Solid State Physics (PHHT-621)**

Name of the Course : **B.Sc. (Hons.) Physics**

Semester : **VI**

Duration : **3 Hours**

Maximum Marks : **75**

(Write your Roll No. on the top immediately on receipt of this question paper.)

Attempt *Five* questions in all.

Question No. **1** is compulsory.

All questions carry equal marks.

1. Attempt any *five* questions of the following : 5×3=15

   (*a*) Differentiate between covalent and van der Waal bonding with examples.

   (*b*) Calculate the glancing angle on the cube (100) of a rock salt crystal (a = 2.84 Å) corresponding to second order diffraction maximum for X-ray of wavelength 0.710 Å.

   (*c*) Explain B-H curve of a ferromagnetic substance on the basis of domain theory.

   (*d*) Lead in superconducting state has critical temperature 6.2° K at zero magnetic field and a critical field of 0.064 T at 0° K. Determine the critical field at 4° K.

P.T.O.

(*a*) What are the major differences between diamagnetic, paramagnetic and ferromagnetic substances ? Give an example of each. 5

(*b*) Give quantum theory of paramagnetism and explain how it overcomes the shortcomings of classical Langevin's theory. 10

(*a*) Derive the expression for electronic polarizability in a time varying electric field. 10

(*b*) Distinguish between normal and anomalous dispersion. 5

(*a*) Discuss the Kronig Penny model for the motion of an electron in a periodic potential. 10

(*b*) Obtain an expression for effective mass of an electron in a metal. 5

(*a*) Derive London's equations for a superconductor and obtain an expression for the penetration depth. 10

(*b*) The transition temperature of mercury with an average atomic mass of 200.59 amu is 4.153°K. Determine the transition temperature of one of its isotope $^{204}_{80}Hg$. 5

This question paper contains 2 printed pages]

Roll No. | | | | | | | | | | | |

S. No. of Question Paper : 1851

12 MAY 2015.

Unique Paper Code : 222663 E

Name of the Paper : **Solid State and Nuclear Physics (PHPT 606)**

Name of the Course : **B.Sc. (Physical Sciences)**

Semester : **VI**

Duration : **3 Hours** Maximum Marks : 75

(Write your Roll No. on the top immediately on receipt of this question paper.)

Attempt any *five* questions.

All questions carry equal marks.

1. (*a*) What is a Reciprocal Lattice ? Explain the properties and importance of reciprocal lattice. 10

(*b*) What do Miller indices signify ? Show the following planes diagrammatically in a simple cubic lattice :

$(\bar{1}\ 2\ 1)$, $(2\ \bar{1}\ 0)$ and $(1\ 1\ 1)$. 5

2. (*a*) Obtain the Clausius-Mossotti relation between polarizability and dielectric constant of a solid. 8

(*b*) Obtain an expression for paramagnetic susceptibility on the basis of Langevin's theory. 7

3. (*a*) Discuss the formation of allowed and forbidden energy bands on the basis of Kronig-Penny model. 10

(*b*) Define effective mass of an electron and give its physical significance. 5

P.T.O.

4. (*a*) Differentiate between hard and soft superconductors. 5

(*b*) What is meant by critical temperature of a superconductor ? 5

(*c*) What is a vortex state of a superconductor ? 5

5. (*a*) What are the features of α, β and γ-decays ? 9

(*b*) Find the binding energy per nucleon for $_1H^2$ nucleus :

Mass of neutron = 1.008665 u

Mass of $_1H^1$ = 1.007825 u

Mass of $_1H^2$ = 2.016490 u. 6

6. (*a*) What are the salient features of nuclear forces ? 10

(*b*) Write the following reactions by putting appropriate particles on the arrows :

$_{92}U^{238} \rightarrow {}_{90}Th^{234} \rightarrow {}_{91}Pa^{234} \rightarrow {}_{92}U^{234} \rightarrow {}_{90}Th^{230} \rightarrow {}_{88}Ra^{226}$. 5

7. (*a*) Discuss the stability of nuclei on the basis of semiempirical binding energy formula. 10

(*b*) Use the semiempirical binding energy formula to calculate the binding energy of $_{20}Ca^{40}$ with a_1 = 14 MeV, a_2 = 13.0 MeV, a_3 = 0.6 MeV, a_4 = 19 MeV, a_5 = 34 MeV. 5

8. (*a*) Classify various types of elementary particles in reference to their lepton numbers, baryon numbers and spins. 10

(*b*) What are Leptons and Hadrons ? 5

[This question paper contains 3 printed pages.] 27 MAY 2016

Sr. No. of Question Paper : 5790 F **Your Roll No.....**

Unique Paper Code : 222603

Name of the Paper : Solid State Physics (PHHT-621)

Name of the Course : **B.Sc. (Hons.) Physics**

Semester : VI

Duration : 3 Hours Maximum Marks : 75

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Attempt **five** questions in all.
3. Question No. **1** is compulsory.
4. **All** questions carry equal marks.

1. Attempt any **five** questions of the following:

(a) Calculate the glancing angle on the cube (100) of a rock salt crystal (a=2.84Å) corresponding to second order diffraction maximum for X-ray of wavelength 0.710Å.

(b) Distinguish between optical and acoustical phonons

(c) How does specific heat of metals vary with temperature experimentally?

(d) What do you understand by direct and indirect band gap? Give an example of each.

(e) Distinguish between dia-, para- and ferro-magnetic materials and give an example of each.

(f) Describe how the Claussius- Mossoti relation can be used to determine the radius of atoms of monoatomic gas.

(g) The transition temperature of mercury with an average atomic mass of 200.59amu is 4.153^0K. Determine the transition temperature of one its isotope $^{204}_{80}Hg$

(h) Define coherence length. Give its relationship with the penetration depth. (5X3 = 15)

2. (a) Discuss X-ray diffraction and obtain Bragg's law $\mathbf{2K.G + G^2 = 0}$. Show that its geometrical interpretation leads to the concept of Brillouin zones in crystals. (5, 5)

(b) Explain the concept of reciprocal lattice. Prove that the reciprocal lattice vector $\mathbf{G_{hkl}}$ is perpendicular to the crystal plane (hkl). (5)

3. (a) Derive the dispersion relation for a linear mono-atomic lattice. Calculate the number of normal modes of vibration for a monoatomic lattice. (10)

(b) How do the vibrations of a linear diatomic lattice differ from that of a monoatomic lattice? Explain only qualitatively. (5)

4. (a).State the assumptions used in Einstein's theory and obtain an expression for the specific heat of solids. What are the limitations of this model? (9, 3)

(b) The Debye temperature for diamond is 2230^0K. Calculate the highest possible vibrational frequency in diamond.

Given: $h = 6.6X\ 10^{-34}$Js; $k_B = 1.38X\ 10^{-23}$ J/K (3)

5. (a) What are ferromagnets? Explain the phenomenon of spontaneous magnetization and obtain Curie-Weiss law. (2, 7)

(b) Discuss the B-H Hysteresis loop for a ferromagnetic substance. Show that the area of the hysteresis curve is a measure of energy loss per unit volume. (3, 3)

6. (a) Discuss various sources of polarizability. Derive an expression for electronic polarizability in an ac electric field. (3, 10)

(b) What is anamolous dispersion? (2)

7. (a) Using Kronig –Penny model obtain the energy spectrum of an electron in a one-dimensional periodic potential. (10)

(b) Obtain an expression for effective mass. What is negative mass? (5)

8. (a) Derive London's equation and apply them to explain Meissner effect in a superconductor. (10)

(b) Explain BCS theory of superconductivity qualitatively. (5)

This question paper contains 2 printed pages.

Your Roll No. .....

Sl. No. of Ques. Paper	: 5117
Unique Paper Code	: 222663
Name of Paper	: Physics VI— Solid State and Nuclear Physics (PHPT-606)
Name of Course	: B.Sc. Physical Sciences
Semester	: VI
Duration :	: 3 hours
Maximum Marks	: 75

13 MAY 2016 F

(Write your Roll No. on the top immediately on receipt of this question paper.)

Attempt any five questions. All questions carry equal marks.

1. (a) Define reciprocal lattice vectors. Discuss their properties and physical significance. 7
   (b) Distinguish between diamagnetic, paramagnetic, and ferromagnetic materials. 8

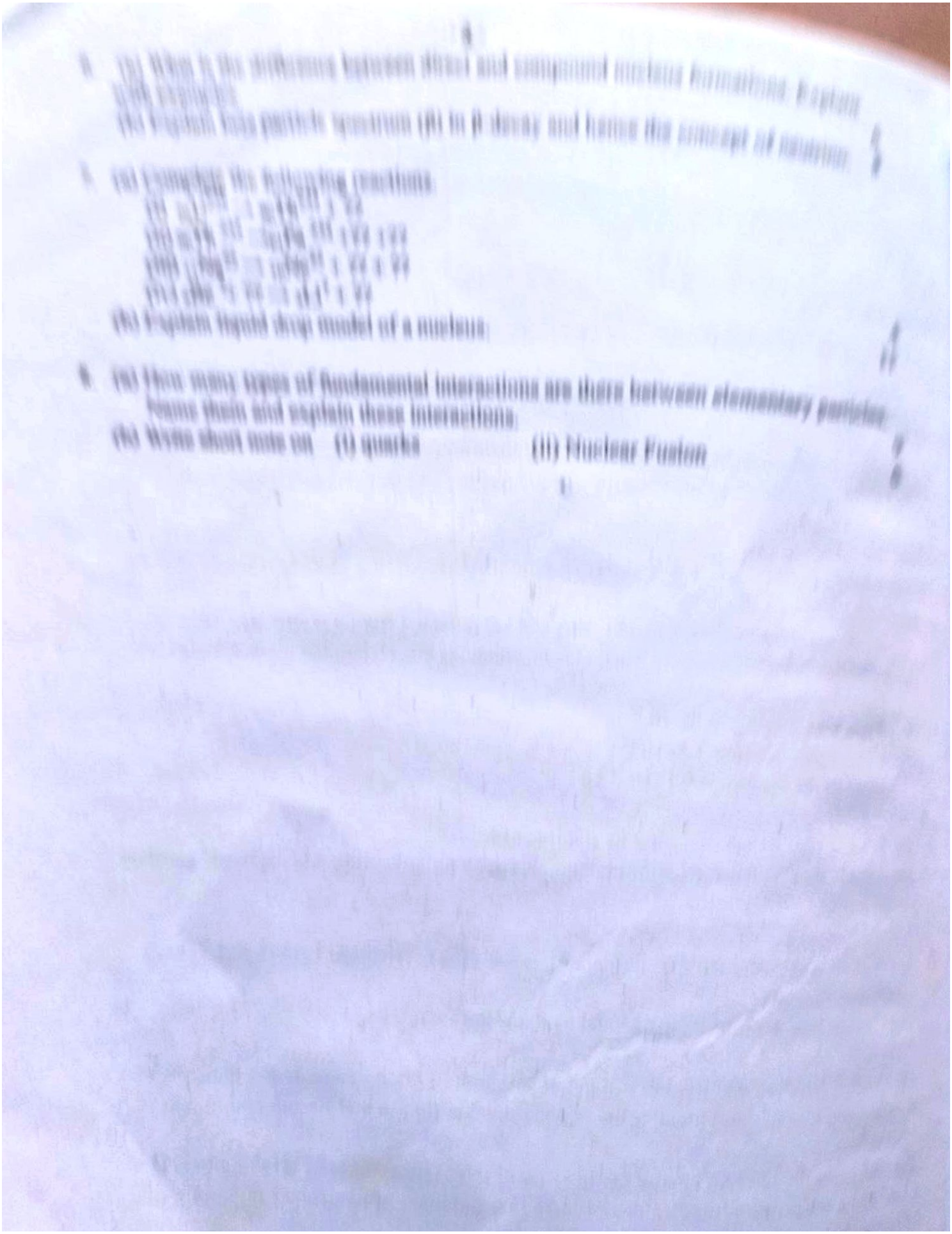
2. (a) Explain Bragg's law for X-ray Diffraction. Also describe powder method of X-ray diffraction with diagram. 10
   (b) Electrons are accelerated to 344 volts and are reflected from a crystal. The first reflection maximum occurs when glancing angle is 60° Determine the spacing of the planes.
   Planck's constant= 6.6×10^{-34} js
   Charge on electron= 1.6×10^{-19} c
   Mass of the electron= 9.1×10^{-31} kg 5

3. (a) What is Hall Effect. Discuss its significance. 5
   (b) Obtain the Clausius- Mossotti relation between polarizability and dielectric constant of a solid. 10

4. (a) What is superconductivity. Explain Meissner effect. What are Type-1 and Type-2 superconductors. 5
   (b) Discuss how Kronig-Penny Model explains the energy band structure of solids. 10

5. (a) What is Binding energy. Give graph of variation of binding energy per nucleon vs atomic mass number and identify the regions suitable for nuclear fission and fusion reactions. 10
   (b) Calculate the binding energy per nucleon of $_2He^4$. Given mass of $_2He^4$ nucleus is 4.002634u, mass of hydrogen atom= 1.007825 u and mass of neutron=1.008665u, mass of proton=1.007276u. 5

P.T.O



[This question paper contains 2 printed pages.]

Sr. No. of Question Paper : 7126 **F-6** **Your Roll No.....**

Unique Paper Code : 2221601

Name of the Paper : Solid State Physics

10 MAY 2016

Name of the Course : **B.Sc. (Hons.) Physics : Erstwhile FYUP**

Semester : VI

Duration : 3 Hours Maximum Marks : 75

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Attempt **Five** questions in all.
3. Question Number **1** is compulsory.

1. Attempt any **five** of the following : (3×5)

   (a) Find coordination number and packing fraction for fcc lattice.

   (b) Show that five-fold symmetry is not possible in a crystal.

   (c) Explain the fact that (100) reflection line does not vanish for CsCl, having bcc structure.

   (d) Prove that the number of normal modes of vibration in monoatomic lattice of finite length is equal to number of atoms in the lattice.

   (e) How does total polarizability depend on frequency ?

   (f) What are ferrites ? Why are they considered technically important solids ?

   (g) Discuss P-E hysteresis Loop of ferro-electric materials. What is its significance ?

   (h) What do you understand by Cooper pairs ?

2. (a) Describe the scheme to determine the Miller indices of a plane. Show the following planes in simple cubic lattice (111), (120), (020).

P.T.O.

(b) Derive an expression for interplanar spacing between nearest planes (hkl) in a cubic crystal of side 'a'.

(c) Discuss Ewald construction and deduce Bragg's law in vector form. (4,5,6)

3. (a) What are Phonons ?

(b) Derive dispersion relation for monoatomic chain. How it is different from continuous string ?

(c) Discuss the variation of group and phase velocity in First Brillouin Zone. (2,8,5)

4. (a) State the assumptions made in Debye's theory of specific heat of solids.

(b) Derive a formula for Debye's T^3 law for molar heat capacity of solids.

(c) Compare Debye and Einstein model to explain the low temperature behaviour of lattice heat capacity. (2,10,3)

5. (a) Obtain an expression for diamagnetic susceptibility using Langevin's theory. What is the significance of negative susceptibility ?

(b) Discuss the physical origin of domains in ferro-magnetic materials. (10,5)

6. (a) What is electronic polarizability ?

(b) Derive an expression for the electronic polarizability in a varying field.

(c) Obtain an expression for complex dielectric constant. What is its significance ? (2,6,7)

7. (a) Discuss Meissner effect and distinguish between Type I and Type II superconductor.

(b) Determine the critical field required to destroy superconductivity at 5K in Pb whose T_c is 7.19K and $H_c(0) = 0.0803$ T.

(c) Discuss piezo and pyroelectric effects. Give examples. (6,3,6)

[This question paper contains 4 printed pages]

Your Roll No. : .....

Sl. No. of Q. Paper : **6677** **HC**

Unique Paper Code : 32221502

Name of the Course : **B.Sc. (Honours) Physics**

Name of the Paper : Solid State Physics

Semester : V

Time : 3 Hours ***Maximum Marks : 75***

Instructions for Candidates :

(a) Write your Roll No. on the top immediately on receipt of this question paper.

(b) Attempt any **five** questions. Question No. **1** is compulsory. **All** questions carry equal marks

1. Attempt any **five** of the following : 5×3=15

(a) Prove that c/a ratio in hcp is $\sqrt{\frac{8}{3}}$.

(b) Sketch the dependence of polarization in dielectrics on the frequency of the applied electric field clearly indicating frequency ranges for the electronic, ionic, and dipolar polarization.

P.T.O.

5. (a) Derive an expression for diamagnetic susceptibility on the basis of classical langevin's theory. 9

(b) Distinguish between dia, para, ferro-and ferri-magnetic materials with examples. 6

6. (a) Obtain an expression for local electric field inside a dielectric with cubic symmetry. 10

(b) Derive Clausius-Mossotti formula constant. 5

7. (a) Discuss the Kronig – Penny model for a linear lattice. How does it lead to the formation of energy bands in solids ? Find the energy of electron with the change in the strength of the periodic potential under following cases : 9+3+3

(i) $V \to \infty$

(ii) $V \to 0$

8. (a) Derive London equations for a superconductor and obtain an expression for penetration depth. 12

(b) A superconducting tin has a critical temperature of 3.7 K in zero magnetic field and a critical field of 0.0306 tesla at 0K. Find the critical field at 2K. 3

[This question paper contains 4 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 8900 **HC**

Unique Paper Code : 42227637

Name of the Paper : Solid State Physics

Name of the Course : **B.Sc. (Prog.) Physics – DSE – 3B**

Semester : VI

Duration : 3 Hours Maximum Marks : 75

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Do any **five** questions.
3. Question No. **1** is compulsory.

1. Attempt any **five** :

(a) Give the differences between amorphous and crystalline substances with one example each.

(b) Distance between (111) planes in a cubic crystal is 2A°. Determine the lattice parameters.

P.T.O.

(c) Prove that the volume of the reciprocal lattice is inverse of the volume of direct lattice.

(d) What is the significance of the complex dielectric constant?

(e) Distinguish between conductors, semiconductors and insulators on the basis of band theory of solids.

(f) What is the origin of diamagnetism in a free atom?

(g) What is Hall effect? Give one application. (3×5)

2. (a) How are X rays useful for investigating the structure of a single crystal?

(b) What is meant by geometrical factor. Calculate it for bcc unit cell and determine from which planes X rays will not be reflected? (5,10)

3. (a) Derive and discuss the dispersion relation for a linear diatomic lattice.

(b) Discuss the behaviour in the limits

(i) M and m are equal

This question paper contains 3 printed pages]

Roll No. | | | | | | | | | | |

S. No. of Question Paper : 108

12 DEC 2016

Unique Paper Code : 32221502 I

Name of the Paper : **Solid State Physics**

Name of the Course : **B.Sc. (H) Physics**

Semester : **V**

Duration : **3 Hours** Maximum Marks : **75**

(Write your Roll No. on the top immediately on receipt of this question paper.)

Attempt any *five* questions. Question No. **1** is compulsory.

All questions carry equal marks.

1. Attempt any *five* of the following : 5×3=15

(*a*) Draw P-E hysteresis loop for a ferroelectric material. Write mathematical statement of Curie-Weiss law for ferroelectric materials.

(*b*) Differentiate between acoustical and optical phonons.

(*c*) Explain the formation of cooper pair in superconductors.

(*d*) Write the primitive translational vectors of hexagonal lattice.

P.T.O.

(*e*) Show that every reciprocal lattice vector $\vec{G}_{hkl}$ is normal to the plane (*h k l*).

(*f*) Calculate the Hall coefficient of Na based on free electron model. Na has b.c.c structure and side of the cube is 4.28 Å.

(*g*) Draw the variation of total polarizability with frequency of external electric field.

(*h*) What is the difference between Phonon and Plasmon ?

2. (*a*) Derive Bragg's law in the reciprocal lattice. 8

(*b*) In a simple cubic crystal, show that the first order reflection from (n00) planes is equivalent (mathematically) to the *n*th order reflection from (100) plane ? 7

3. (*a*) Derive an expression for the specific heat of a solid on the Debye model and show that, at low temperature, it follows T^3-law. 10

(*b*) Derive the dispersion relation for a linear monoatomic lattice and show that the group velocity and phase velocity of a wave are equal in the long wavelength limit. 5

4. (*a*) Show that the classical paramagnetic susceptibility is given by $\chi = \frac{\mu_0 N}{3kT}\mu^2$, where symbols have their usual meanings. 10

(*b*) How was the classical Langevin's theory of paramagnetism modified by Weiss ? 5

5. (*a*) Derive an expression for the electronic polarizability in a time varying electric field, and hence derive the Cauchy and Sellmeir relations. 12

(*b*) Distinguish between normal and anomalous dispersion ? 3

6. (*a*) Explain the formation of allowed and forbidden energy bands for the motion of an electron in one-dimensional periodic potential in solids. 10

(*b*) Prove that effective mass of electron is given by $m^* = \hbar^2 / (d^2E / d^2k)$. 5

7. (*a*) Explain how the *Meissner-effect* was explained by London. 6

(*b*) What is *Isotope effect* ? 3

(*c*) What do you understand by Piezoelectric effect, Pyroelectric effect & Electrostrictive effect ? 6

8. (*a*) Prove that reciprocal lattice of bcc is fcc and that of fcc is bcc. 10

(*b*) Show that five-fold rotational symmetry does not exist ? 5

[This question paper contains 4 printed pages.]

Your Roll No.....

IC

Sr. No. of Question Paper : 2610

Unique Paper Code : 42227637

10 MAY 2019

Name of the Paper : Solid State Physics

Name of the Course : **B.Sc. (Prog.) : DSE-3B**

Semester : VI

Duration : 3 Hours Maximum Marks : 75

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Attempt any **five** questions.
3. Question No. **1** is compulsory.

1. Attempt any **five** of the following : (5×3=15)

   (a) List three differences between amorphous and crystalline solids with one example of each.

   (b) Show that reciprocal lattice vector $\vec{G}_{hkl}$ is normal to the plane (hkl).

   (c) Calculate Einstein's frequency for copper having Einstein's temperature $\theta_E = 230K$.

P.T.O.

(d) What are phonons? Differentiate between acoustical and optical phonons.

(e) Explain Meissner effect with the help of a diagram.

(f) What do you understand by the term 'Domains'? Why do large number of domains exist in a ferromagnetic material?

(g) Distinguish between Conductors, Semiconductors and Metals on the basis of E-K curve.

(h) What are plasmons?

2. (a) What are Miller Indices? How are they defined for a plane? Name the six faces of a unit cube in terms of Miller Indices. (3)

(b) Derive Bragg's Law and express it in terms of Reciprocal lattice vector $\vec{G}$. (7)

(c) Show that Reciprocal Lattice of a bcc is fcc. (5)

3. (a) Derive the dispersion relation for a linear monoatomic lattice and discuss under what conditions it can act as a 'low pass filter'. (10)

(b) Discuss three types of E-K zone-schemes and representing them diagrammatically. (5)

7. (a) What is Superconductivity? Give 4 applications of superconductors. (6)

(b) With the help of diagram discuss Type I and Type II superconductor. (5)

(c) What is the effect of magnetic field on critical temperature of a superconductor? (4)

Values of constants

$h = 6.6 \times 10^{-34}$ J-s

$k = 1.38 \times 10^{-23}$ J/K