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| Bon Secours College for Women Nationally Accredited with “A” Grade by NAAC (Affiliated to Bharathidasan University, Trichy-24) Recognized by UGC Under Section 2(f) & 12 (B)    Vilar Bypass, Thanjavur-613 006. |

**DEPARTMENT OF PHYSICS**

**SOLID STATE PHYSICS**

**UNIT-I**

**2 Marks**

1. Give the restrictions on the axes and angles for orthorhombic crystal.
2. What is point group?
3. Explain briefly Bragg’s law of x-ray diffraction.
4. What is phase problem in x-ray diffraction studies?
5. What is Bravais lattice?
6. Define the space group.
7. **Marks**
8. What is Ewald construction? How does it help us interupt X-ray diffraction photographs?
9. Prove that the reciprocal lattice of FCC is BCC.
10. Show that the reciprocal lattice for a B.C.C. lattice is a F.C.C. structure.
11. Obtain the expression for the atomic structure factor.What role does it play x-ray diffraction studies?
12. Derive the expression for atomic packing factor for BCC and FCC structures.
13. Explain the laue method of determining the crystal structure.

**10 Marks**

1. Find the geometrical structure factor for FCC structure in which all atoms are indentical.Hence show that for FCC lattice no reflections can occur for which the indices are partly even and partly odd.
2. Discuss in detail with suitable diagrams,
3. Lave method and
4. Powder method of crystal structure analysis.
5. Describe seven crystal systems in three dimension with suitable diagrams.

**UNIT – II**

**2-Marks**

1. What is phonon momentum?
2. Find the group velocity of the wave at the Brillouin zone in a mono atomic lattice.
3. What are phonons?
4. State Debye’s T3 law .
5. What is meant by quantization of lattice vibrations?
6. What is Hall effect?

**5 Marks**

1. Give an account of (i) quantization of lattice vibrations and (ii) inelastic scattering of neutrons by phonons.
2. (i) Find an expression for the thermal conductivity. (ii) Explain umklapp process.
3. What do you mean the quantization of lattice vibrations? Write notes on phonon momentum.
4. What are normal and umklapp processes.Explain by drawing vector diagrams.
5. Explain umklapp process in detail with figure.
6. Discuss the density of states in one dimensional crystal.

**10 Marks**

1. Find the dispersion relation of a one-dimensional crystal with two types of atoms and discuss the nature of the optical and acoustical modes.
2. Obtain the dispersion relation for elastic waves in a linear monoatomic chain with nearest neighbour interaction and show that the group velocity vanishes at the Brillouin zone boundaries.
3. Discuss the vibration of crystal with one atom in the primitive cell. Also explain the range of K for elastic waves.

**UNIT-III**

**2 Marks**

1. The experimental value of the heat capacity of electron gas is only 1% of its classical value.Explain.
2. What is Hall effect?
3. Distinguish between direct and indirect band gap semiconductors.
4. What is the main diffrence between free electron theory and band theory?
5. Mention any two application of Hall effect.

**5 Marks**

1. Discuss free electron gas in three dimensions and find the expression for density of orbitals of Fermi energy.
2. Discuss the motion of electron in a magnetic field and obtain the expression for the cyclotron frequency for a free electron.
3. Explain nearly free electron model.
4. Derive the equation of motion of an electron in an energy band.
5. Explain the free electron gas in three dimension and obtain the expression for the density of states.
6. What is effective mass? Calculate the concentration of intrinsic carriers in terms of the band gap.

**10 Marks**

1. Derive expression for intrinsic carrier concentration of electrons and holes and obtain law of mass action.
2. Derive the expression for intrinsic carrier concentration in terms of energy gap.
3. Explain the nearly free electron model. Write notes on the origin and magnitude of the energy gap.State the Bloch theorem.

**UNIT-IV**

**2 Marks**

1. Why is the diamagnetic susceptibility negative?
2. What is coercive force?
3. Explain Curie-Weiss law.
4. What is hysteresis in magnetic materials?
5. How does paramagnetic susceptibility of a substance vary with temperature?
6. What are ferroelectric crystals?

**5 Marks**

1. State and explain Hund’s rules.
2. Derive Langevin’s diamagnetic equation.
3. Find an expression for the paramagnetic susceptibility of conduction electrons.
4. Give the domain theory of ferromagnetism.
5. Describe the quantum theory of paramagnetism.
6. What are ferromagnetic domains and explain their origin? What is Bolch wall?

**10 Marks**

1. Explain the quantum theory of paramagnetism.
2. Obtain magnum dispersion relation and deduce Bloch’s T3/2 law.
3. Obtain the magnon dispersion relation for a ferromagnetic cubic lattice with nearest neighbour interactions.Also deduce the bloch T3/2 law.

**UNIT – V**

**2 Marks**

1. Explain polarization catastrophe.
2. What is SQUID?
3. What is the principle of SQUID?
4. How do you differentiate a dielectric material from an insulating material?
5. What does cooper pair mean?

**5 Marks**

1. Derive clausius – mossotti equation .
2. Show that the magnetic flux which passes through a superconducting ring is quantized.
3. Obtain the Claussius – Mossotti relation. Write note on the polarization catastrophe.
4. Outline the basis ideas of BCS theory of super – conductivity. Explain flux quantization in a superconducting ring.
5. Explain AC Josephsen effect.
6. Discuss the electronic polarizability.

**10 Marks**

1. Give the theory of AC and DC Josephsen effect.
2. Derive the expression for local field at an atom and hence deduce Clasiius-Mossotti equation.
3. Obtain london equation and show how this leads to Meissner effect .Give the importance of london penetration depth.

**INTRODUCTION TO NANOSCIENCE AND NANOTECHNOLOGY**

**UNIT – I**

**2 Marks**

1. Define nanostructure.
2. What is nanotechnology?
3. Give any two challenges in nanotechnology.
4. What is carbonage?
5. Give the postulates of atomic theory.
6. Define nanotechnology.

**5 Marks**

1. Explain carbon age.
2. Discuss the challenges in nano-technology.
3. State the postulates of atomic theory.Explain Dalton’s atomic theory.
4. Discuss the emergence of nanotechnology.
5. Discuss about atomic and molecular size.
6. Discuss in detail about the emergence of nanotechnology.

**10 Marks**

1. Discuss in detail about new form of carbon from grapheme sheet to CNT.
2. Discuss about scientific revolution in the field of nanotechnology.
3. Write an essay on scientific revolution that leads to the development of nanotechnology.

**UNIT – II**

**2 Marks**

1. What is bottom-up approach?
2. Define nucleation.
3. What do you mean by large surface to volume ratio?
4. What are grain boundaries in nano crystals?
5. What is self assembly?

**5 Marks**

1. Explain carbon age.
2. Discuss the challenges in nanotechnology.
3. Describe self assembly process.
4. Write a note on defects in nanocrystals.
5. Explain bottom-up approach.
6. Give an account on grain boundary volume is nanocrystals.

**10 Marks**

1. Describe the self – assembly process.
2. Explain top down and bottom up approaches.
3. Discuss briefly about:
4. Defects in nano crystals.
5. Surface effects on the properties of nano crystal.