SHAILABALA WOMEN'S (AUTO.) COLLEGE, CUTTACK

SOLID STATE PHYSICS

SEMESTER - V

C C - XII

DEPARTMENT OF PHYSICS

SHORT ANSWER QUESTIONS

1. What is a crystal ?
2. Give the difference between crystalline and amorphous materials ?
3. Explain what do you mean by a lattice ?
4. What is a motif or basis ?
5. Define crystal structure.
6. Define unit cell and primitive unit cell.
7. What is a condensed matter physics ?
8. What is a primitive cell and what is the volume in case of BCC and FCC lattice ?
9. Name the four types of crystalline solids ?
10. Define a metallic solid.
11. What is the meaning of word amorphous ?
12. In diamond structure what is the number of nearest neighbours?
13. What do you mean by point groups ?
14. What is a space group ?
15. Give the physical significance of packing fraction.
16. Explain why metallic bonds are stronger than other types of bonds?
17. Name a particle that effects the material properties mostly.
18. What is the mean distance between atoms.
19. In which bond the term electron sea exist.
20. What is the atomic diameter of BCC lattice ?
21. What are the Miller indices of octahedral plane in cubic crystal ?
22. Define translational operators.
23. How a Wigner-Seitz cell is drawn.
24. Which type of structure NaCl possess?
25. Why y-rays are not used to study crystal structure?
26. What is the difference between direct lattice and reciprocal lattice?
27. What is first Brillouin Zone?
28. Define reciprocal lattice. How is it constructed ?
29. What is the need of using reciprocal lattice ? Why should we not use direct lattice.
30. Why do crystals diffract X-rays ?
31. Define atomic scattering factor.
32. What are the considerations in deriving Laue's equations ?
33. What is the significance of Brillouin Zone ?
34. What is meant by axis of symmetry ?
35. What is the coordination number in case of BCC structure ?
36. Find the packing structure of SC structure.
37. Define a photon.
38. Which crystals exhibit optical phonon modes ?

39. Which restriction on the k-values for the lattice vibrations are found for one dimensional chain with one and two atoms per cell respectively ?
40. Is the group velocity same for optical and acoustical lattice vibration ? Explain.
41. What is common between phonon and a photon ?
42. How does elastic vibrations differ from electromagnetic waves ?
43. Which statistics does phonon obey ?
44. At what temperatures the result of Dulong-Petit's law is in agreement with the experimental values ?
45. Plot a graph to show the general temperature dependence of specific heats of solids?
46. Give the expression for the average energy for one dimensional oscillator according to classical theory of specific heats ?
47. When does the expression for specific heat of solid in Debye's theory approach the classical value 3R ?
48. What do you understand by the term magnetization ?
49. Distinguish between para, dia and ferromagnetic materials
50. Explain the classification of magnetic materials.
51. What are domains ?
52. Discuss domain theory of ferromagnetism.
53. What is Weiss theory of ferromagnetic materials ?
54. What is Curie Law ?
55. What is Curie temperature ?
56. What is hysteresis curve ?
57. What is hyteresis loss ?
58. Write short notes on
59. (i)Classification of magnetic materials.
60. (ii) Weiss theory of ferromagnetism. N m
61. Calculate magnetic moment of an atomic dipole.
62. Explain Langevin's theory of paramagnetism
63. Explain Langevin's theory of diamagnetism.
64. Define dielectric constant of a material.
65. Define dielectric strength.
66. What do you mean by dielectric strength ?
67. What do you mean by polar and non-polar molecules ? Give two examples each.
68. What are polar and non-polar dielectrics ?
69. Define the terms dipole moment and polarization.
70. What do you mean by polarization of a dielectric ?
71. Define two electric vectors D and E , What is the relation between them ?
72. Define electric polarization vector P . What is its S.I. units?
73. Explain the term permittivity

74. What do you understand by electric displacement, susceptibility and permittivity ?
75. What is dielectric polarization and electric displacement vector?
76. Name mechanism of dielectric polarization.
77. Derive the relation between dielectric constant and suscepitibility.
78. Define atomic polarizability.
79. Name different types of polarization.
80. Explain that electric field inside the dielectric is reduced when it is placed inside the electric field.
81. What do you understand by local field at an atom ?
82. What is local field at an atom ?
83. What do you mean by the term 'LASER' ?
84. What is basic principle of LASER ?
85. What is population inversion and why it is important for lasing ?
86. Why it is easy to use two-level atom in laser ?
87. Are there any two level atom laser ? What are they
88. What do you mean by stimulated absorption of light ?
89. What is stimulated emission of light ?
90. What is the need of stimulated emission of light ?
91. What do you mean by the term population inversion ?
92. What do you mean by pumping ?
93. What do you mean by optical pumping ?
94. What is difference between the continuous and pulsed laser output ?
95. Who made the first Ruby laser ? What is its output wavelength ?

LONG QUESTIONS

1. Discuss the quantization of lattice vibrations ? Explain the concepts of phonon ? Do they really exist ?
2. Describe the lattice vibrations of monoatomic linear lattice and obtain an expression for the dispersion relation for lattice vibrations of monoatomic linear chain ?
3. Obtain the various vibrational modes of a linear monoatomic lattice.
4. Derive an expression for the energy and momentum of phonons and explain normal process and umklap process
5. Obtain an expression using the inelastic scattering of photons by phonons, for the
6. frequency of phonon emitted in the process.
7. What is a phonon ? Describe the vibrational modes of a diatomic linear lattice ? Name the different branches of the dispersion relation curve ? What is the difference between the two branches?
8. Define molar specific heat at constant volume and lattice heat capacity ? Explain dulong and Petit's law. What are the limitations of this law?
9. What are para, ferro and diamagnetic substances ? Give their properties.
10. Explain Atomic Theory of Magnetism (Qualitative).
11. Discuss Langevin's theory of Diamagnetism and obtain the expression for diamagnetic susceptibility.
12. Discuss Langevin's theory of paramagnetism and derive and expression for paramagnetic susceptibility .
13. Discuss Domain theory of Ferromagnetism .
14. Explain diagmanetism, paramagnetism and ferromagnetism on the basis of dipoles of atoms.
15. Discuss the Weiss theory of ferromagnetism. Show from Langevin function that ferromagnets lose their spontaneous magnetization above Curie temperature.
16. Explain Curie law and Curie temperature.
17. Give Weiss Theory of Ferromagnetism.
18. Give an expression for paramagnetic susceptibility. How does the paramagnetic susceptibility of a material vary with temperature?
19. Draw the B-H curve for a ferromagnetic material and identify the retentivity and coercivity on the curve.
20. Explain ferromagnetism on the basis of Domain theory
21. Explain the use of hysteresis curve.
22. Explain what do you understand by Hysteresis, Retentivity and Coercivity. How will you determine the value of retentivity and coercivity from a loop ?
23. State Curie's law. What is Curie temperature?
24. Explain the term hysteresis and prove that hysteresis loss per cycle of magnetization is equal to the area of the B-H loop.
25. 20. Write notes on:

(i) Electron spin and paramagnetism.
(ii) Domain theory of ferromagnetism.
(iii) Ferrites
(iv) Diamagnetism

26. What are ferrites ? How do they differ from ferromagnetic substances ?
27. What is dielectrics ? Define dielectric constant of a material.
28. Explain the phenomenon of dielectric polarization in dielectric materials. Define dielectric constant.
29. Explain the terms atomic polarizability, dielectric susceptibility and atomic dipole moment.
30. Define local field at an atom. Derive the relation between local field and polarization of a dielectric.
31. Derive Clausius-Mossotti relation between polarizability and dielectric constant of a solid.
32. Derive Clausius-Mossotti relation
33. Derive molecular interpretation of Clausius-Mossotti equation ?
34. Deduce the Clausius-Mossotti relation for polarization of a medium and explain how it could be used to determine dipole moment of polar molecules.
35. Explain classical Theory of electronic polarizability.

36. Discuss different types of polarization. Discuss the frequency dependence of these polarizations.
37. Define polar and non-polar molecules. Deduce Clausius Mossotti relation for non-polar dielectrics.
38. What are the properties of laser light ?
39. Write four properties of laser light.
40. What do you mean by spatial coherence and temporal coherence ? Explain
41. Explain the mechanism of production of laser beam.
42. Explain the following terms :(i) Spontaneous emission (ji) Stimulated emission (iii) Population inversion (iv) Metastable state
43. What are the characteristics that distinguish laser from ordinary source of light?
44. Explain directionality and monochromaticity for laser light,
45. Distinguish between spontaneous and stimulated emissions. Which one of the two predominates in optical region at room temperature ?
46. Discuss in details the concept of directionality, monochromaticity, intensity and coherence of laser light.
47. What do you understand by spatial and temporal coherence of light source ? What is coherence time and coherence length ?

48. Define coherence, temporal coherence, spatial coherence, coherence time and coherence length.
49. Discuss the periodicity character of potential in a crystal. State Bloch theorem in this reference.
50. Discuss Kroning-Penny model. Using this model show that the energy spectrum of electron consists of a number of allowed energy bands separated by forbidden regions.
51. What do you mean by effective mass? Deduce the relation for effective mass of an electron. Show how it is different from rest mass of the electron.
52. Differentiate n-type and p-type semiconductors. How does the conductivity and mobility of electrons and holes change with temperature ?
53. Obtain an expression for density of electrons in conduction bond of n-type semiconductor.
54. Obtain an expression for density of holes in conduction band of p-type semi-conductor.
55. Discuss the motion of an electron in one dimension according to band theory and show how the energy, velocity and effective mass vary as function of wave vector.
56. Explain Hall effect ? Derive an expression in for the Hall coefficient of semi-conductor on two band model of carriers. Discuss Four probe method and uses of Hall Effect.
57. What is superconductivity ? Discuss the temperature dependence of resistivity in superconducting material
58. Define superconductors. What are the properties of superconductors ?
59. What is superconductivity ? What are the properties which do not change in super. conducting transitions ?
60. Define superconductors. What are the properties which change in superconducting transition?