



**Q.1. Answer the following short questions:**

**(15x2=30)**

1. How does the critical magnetic field of a typical superconductor depend upon temperature?
2. How does the cooper-pair formation occur?
3. Why critical temperature is sensitive to the isotopic mass?
4. Discuss the appearance of energy band gap in metals in their superconducting state.
5. Describe the mechanism that induces resistivity in superconductors due to incident photons.
6. Discuss various steps involved to form electron-hole drops (EHD).
7. Using classical theory, find an expression for the static electronic polarizability for an electron bound to an atom.
8. How would you show polarization of a crystal in terms of atomic polarizabilities?
9. Describe the construction and basic principle of electron spectroscopy with X-rays.
10. What are ferroelectric domains? How does their structure depend upon electric field?
11. Graphically show and discuss frequency dependence of several contributions to the polarizability.
12. How would you characterize displacive transitions from order-disorder transitions?
13. Discuss and write the expression for local electric field at an atom at a general lattice site.
14. What is macroscopic quantum interference?
15. Differentiate piezoelectric and ferroelastic behaviors.

**Q.2. Answer the following questions.**

**(3x10=30)**

1. How would you show that flux is quantized in a superconducting ring?
2. Discuss Landau theory and characterize first-order and second-order phase transitions.
3. Describe tightly bound type of excitons and derive the expression for the energy eigenvalues.