

M.Sc. Physics Examination

Semester - III

Paper No – C303 Condensed Matter and Material Physics

Paper Code- 4705

Time : 2 Hours 30 min

Nov- 2014

Maximum Marks 70

Instruction : (1) Attempt all questions

(2) Symbols used have their usual meanings

Q.1 [a] Why X-rays are used for crystal structure determination? Using Bragg's law, explain X-ray powder diffraction technique. [07]

Q.1 [b] Describe necessary theory and method of neutron diffraction for study of phonons in crystals. Mention its advantages and limitations. [07]

OR

Q.1 [a] Explain Einstein model for heat capacity in solids. Draw the density of states for phonons as a function of frequency in such a model. [07]

Q.1 [b] Show that every reciprocal lattice vector is normal to a lattice plane of the crystal lattice. [07]

Q.2 [a] Differentiate between Fermi surface and Brillouin zone. What inference do you draw from a spherical and ellipsoidal Fermi surface [07]

Q.2 [b] On the basis of free electron theory, derive an expression for electrical and thermal conductivity of metal and hence establish Wiedemann Franz law. [07]

OR

Q.2 [a] State and prove the Bloch theorem and explain the reduced zone scheme. [07]

Q.2 [b] State the limitations of free electron model. Show that the model leads to finite discontinuities in energy at the boundaries of the Brillouin zone. [07]

Q.3 [a] For a dielectric material, obtain the Clausius-Mosotti relation. [07]

Q.3 [b] What do you mean by type I and type II superconductor? Show that the Meissner effect demonstrates perfect diamagnetism of a superconductor. [07]

OR

Q.3 [a] Explain the terms : (i) polarizability, (ii) dipolar polarizability and (iii) electronic polarizability [07]

Q.3 [b] Using neat diagrams, explain the Josephson effect for a superconductor. [07]

Q.4 [a] What do you mean by spin waves ? Explain how this leads to the concept of a magnon. [07]

Q.4 [b] Give an account of Weiss theory of ferromagnetism and explain hysteresis and Curie point. [07]

OR

Q.4 [a] Explain the concept and applications of (i) ESR and (ii) NMR techniques. [07]

Q.4 [b] Explain the Heisenberg's exchange interaction in ferromagnetism. Draw the temperature dependence of the susceptibility of all types of magnetic materials. [07]

Q.5 [a] Give detailed physical and magnetic properties of ferrofluid. [07]

Q.5 [b] Discuss the industrial applications of ferrofluid. [07]

OR

Q.5 [a] Discuss any one technique of ferrofluid synthesis. [07]

Q.5 [b] State the role of surfactant in preparation of a ferrofluid. Explain any two applications of ferrofluid. [07]
