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Total No. of Questions : 09

M.Sc.(Physics) (2015 to 2017) (Sem.-3)

CONDENSED MATTER PHYSICS

Subject Code : MPH-304

Paper ID : [72617]

Time : 3 Hrs.

Max. Marks : 100

INSTRUCTIONS TO CANDIDATES :

- 1. Attempt FIVE questions in all including the compulsory question no.9**

- Q1 (a) Derive an expression for the local electric field acting at an atom in SI system. Explain the terms, depolarization field and Lorentz field. (8+4=12)
- (b) Deduce Clausius-Mosotti relation and explain its use in predicting the dielectric constant of solids. (8)
- Q2 (a) Explain the phenomenon of spontaneous polarisation in ferroelectric materials. Discuss the ferroelectric domain theory. (3+5=8)
- (b) What are polarons? Derive Kramers-Kronig relations to find the real part of the response of a linear passive system. (2+10=12)
- Q3 (a) Deduce Boltzmann transport equation. (12)
- (b) Discuss the thermoelectric phenomenon in solids. (8)
- Q4 (a) Discuss the basic concepts of quasi particles. (8)
- (b) Determine the Hartree-Fock equation for one electron system. (12)
- Q5 (a) What is the significance of tight binding approximation in solid? How to calculate energy in two-band Hubbard model? (6+6=12)
- (b) Write the electronic and magnetic properties of oxides. (8)
- Q6 (a) Calculate the singlet-triplet energy splitting of two electron system by applying Heitler- London approximation. (12)
- (b) Explain the Heisenberg's exchange interaction in ferromagnetism. (8)

- Q7 (a) What is coherence length? Discuss in detail Ginzburg-Landau theory which leads to explain successfully various properties exhibited by superconductors. (4+8=12)
- (b) Distinguish between type I and type II superconductors. (8)
- Q8 (a) Derive the London equations for superconductivity. Show that London equations could explain the Meissner effect and flux penetration. (8+4=12)
- (b) Give brief outline of BCS theory of superconductivity. (8)
- Q9 **Answer briefly :**
- (a) What are piezoelectric materials?
- (b) What is spontaneous magnetisation?
- (c) What are polarons?
- (d) What are Mott insulators?
- (e) Explain spintronics.
- (f) What is critical current density?
- (g) What are multiferroic materials?
- (h) What are Cooper pairs? (8×2.5=20)