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End Semester Examination of Semester–III, 2015
Subject : PHYSICS (PG)
Paper : PHS–304 (Theory)
Full Marks : 40
Time : 2 Hrs

The figures in the margin indicate the marks corresponding to the question

Candidates are requested to give their answers in their own word as far as practicable.

Illustrate the answers wherever necessary.

Answer Question **No. 1** and any **three** out of the rest:

1. Answer **any five** questions: 2x5=10

   i) Show that the geometrical structure factor vanishes unless the number h, k and *l* all are even or all odd for fcc lattice.

   ii) Indicate the essential characteristics of a Ferroelectric crystal.

   iii) What is Debye-Waller Factor?

   iv) Explain what is meant by F-center.

   v) Explain what is meant by ultraquantum region when De Haas Van Alphen effect is considered.

   vi) Why vigible light is reflected by a metal?

vii) Find the electron plasma frequency considering motion of positive ions in a metal.

viii) Find the Dispersion relation in a Simple cubic crystal along [110] according to Tight Binding Approximation. Find also the Bandwidth.

2. a) Discuss the frequency dependence of the dielectric constant of a dipolar system.

b) Write down Landau theory of the ferroelectric phase transition. What is the condition for second order phase transition? Give an example. 5+(2+2+1)

3. a) Calculate the empty lattice band energy diagram for a fcc lattice in 100 direction upto first four bands.

b) According to Nearly free Electron Model the energy ε satisfies,

$$\begin{vmatrix} \lambda_K - \varepsilon & U \\ U & \lambda_{K-G} - \varepsilon \end{vmatrix} = 0$$

From the above statement calculate the energy at the Zone boundary and near the zone boundary. Draw the ε-K diagram. (Where the symbols have their usual meanings.) 5+5

4. a) Explain the origin of Polariton. 2

b) Considering the interaction between photon and TO phonon derive LST relation. 6

c) Discuss Mott metal – insulator tramition. 2

5. a) Derive the expression for energy corresponding to Landau levels. Explain the origin of degeneracy of such levels. 6+2

   b) Explain why low temperature is required for the appearance of Landau levels. 2

6. a) What is meant by Screw Dislocation. Find an expression of dislocation energy for screw dislocation. 1+4

   b) Derive an expression for conductivity in an ionic crystal. 5