M. Sc. (Sem. II) (CBCS) (Physics) Examination

May / June – 2015

Solid State Physics (CT-08)

(New Course)

Faculty Code : 003
Subject Code : 020204

Time : 3 Hours]   [Total Marks : 70

Instructions (1) All questions are compulsory
(2) All questions carry equal marks

Q.1 Answer in brief (any seven)   14
  (a) Define primitive and non primitive unit cell.   02
  (b) Draw *(211)* and *(100)* planes in cubic unit cell.   02
  (c) Define Bravais and Non Bravais lattices.   02
  (d) List various point defects.   02
  (e) What are Schottky and Frankel defects?   02
  (f) What is Slater's criterion?   02
  (g) What are Brillouin zones?   02
  (h) Define penetration depth (λ) and coherence length (ξ) in 02
       superconductor.
  (i) State Bloch theorem for periodic potentials.   02
  (j) What are ferrites?   02

Q.2 Answer the following (any two)   14
  (a) Describe various X-ray diffraction methods used for 07
       structural characterization. Give detailed account of
       powder diffraction method.
  (b) Describe various types of defects in solids. Explain the 07
       formation of color centres and their usefulness.
  (c) Define atomic scattering factor (f) and geometric 07
       structure Factor (S) and hence obtain their expressions.
       Write a note on their importance in structural analysis.

Q.3 Answer the following   14
   (a) Define superconductivity. Prove that, zero resistance and   05
      perfect Diamagnetism are necessary but independent
      properties of superconductor.
   (b) Describe Type I and Type II superconductors with   05
      suitable examples. List various applications of
      superconductivity.
   (c) What is dc and ac Josephson effect in superconductors?   04
      Give significance of SQUID?

OR

Q.3 Answer the following   14
   (a) Prove Bloch theorem for periodic potentials. Comment   05
      on effective mass of an electron.
   (b) Draw a well labeled E-K diagram for simple cubic lattice   05
      and explain the formation of Brillioun zones. Define
      effective mass of an electron.
   (c) The critical temperature T_C of mercury with isotopic   04
      mass 199.5 is 4.185 K. Calculate its critical temperature
      when isotopic mass changes to 203.4

Q.4 Answer the following (any two)   14
   (a) Describe various methods used in band structure   07
      calculations. Comment on their merits and demerits.
   (b) Discuss qualitatively the BCS theory of   07
      superconductivity. Comment on the BCS ground state.
   (c) Give the classification of magnetic materials with   07
      suitable examples. Write a note on Heisenberg's
      exchange interaction theory for ferromagnetism.

Q.5 Answer the following (any two)   14
   (a) Derive an expression for the concentration of vacancies   07
      in crystalline solids.
   (b) Obtain an expression for diamagnetic susceptibility of   07
      solid using the classical approach.
   (c) Describe ferrimagnetism and properties of ferrites.   07
   (d) On the basis of Weiss – molecular field theory obtain a   07
      relationship between T_C and λ. Comment on temperature
      dependence of saturation magnetization.