

**Met 3<sup>rd</sup> Year 2<sup>nd</sup> Semester Examination 2012**  
**Physics of Metals**

Time: 3 hours

Marks: 100

Attempt *three* questions from **Group A** and *two* questions from **Group B**  
 Use *separate* answer scripts for **each** Group

**Group A**

1. a Using quantum mechanical operator formalism, find the time independent Schrodinger Wave equation. (10)
- b Find the wave function of a free particle in a rigid box of length L. Compute the expectation value of the position of the particle in the rigid box. (5+5)
- 2.a Define density of states. Assuming quantum mechanical expression for the energy of free electron, find the expression for the density of states. (2+5)
- b The electronic heat capacity of metals is about 1% or less than that predicted classically. Explain. (6)
- c Show that the electrons lying near the Fermi energy take part in the electrical conduction process. (7)
3. a For a cubic system of lattice parameter 'a', as the wave vector of electrons approaches the zone boundary it deviates from the free electron E – K curve and the stronger the interaction of electrons, the higher the range of deviations. Explain. (10)
- b For a square lattice of lattice parameter 'a', draw and explain the first and second zone. (10)
4. a With reference to spin angular momentum explain space quantization. Show that each spin contributes 1Bohr Magneton of magnetic moment. (5+3)
- b State the Curie law of paramagnetism. Discuss a simple theory based on spin system to explain the Curie law. (2+10)
5. a Find an expression for the electrical conductivity of metals which is based on Classical mechanical approach. (10)
- b Based on the theory of the paramagnetic spin system, explain the occurrence of spontaneous magnetization of ferromagnets below the Curie temperature. (10)

**Group B**

6. a Differentiate between external and internal symmetry of crystals. (5)
- b What are point groups? Explain Herman-Mauguin's symbols for tetragonal, orthorhombic and hexagonal systems. (2+5)
- c Draw the following point groups: mm2, 32, 422 and 6mm. (8)
7. With reference to stereographic projection answer the following:
  - a What is a pole and what is a trace? (5)
  - b A pole is to be rotated clockwise about N-S axis by 120°. After 60° rotation it comes to the edge of the latitude line. What will you do to accomplish the full rotation. (5)
  - c Why planes of a zone lie on a great circle. (5)
  - d Show that (hkl) of a pole of a cubic system is given by  $h:k:l = \cos\alpha : \cos\beta : \cos\gamma$ . (5)
8. a Explain the following terms: i) ionization potential; ii) electron affinity; iii) electronegativity; & iv) bond energy. (12)
- b How mechanical properties and thermal properties of metals can be explained from their corresponding bonding characteristics. (8)