M.Sc. 2nd Semester Examination, 2012

ELECTRONICS

(*Electronic Materials*)

PAPER– ELC-203

(Theory)

Full Marks : 50

Time : 2 hours

Answer **Q. No. 1** and any **three** from the rest

The figures in the right-hand margin indicate marks

Candidates are required to give their answers in their own words as far as practicable

Illustrate the answers wherever necessary

1. (*a*) What is a Burgers vector ?

(*b*) What do you understand by "free electron gas" ?

(*c*) Explain briefly the difference between non -degenerate and degenerate semiconductors.

(*d*) Distinguish between type I and type II superconductors.

(*e*) Mention the uses of SiO_2 material in VLSI technology. 2 × 5

2. (*a*) What is meant by crystal imperfections ? Classify them in order of geometry.

(*b*) Describe with suitable diagrams edge dislocations and screw dislocations in crystal lattice. (1 + 3) + (3 + 3)

3. (*a*) Discuss general features of electrical conductivity of metals.

(*b*) Define fermi energy. Derive an expression for the density of states and hence show that at OK, the average energy of electron is (3/5)th of the fermi energy. 2 + (2 + 6)

4. (*a*) Name the different scattering processes involved in the transport of electrons in semiconductors and identify the dominant process.

(*b*) Consider a semiconductor with effective mass $m^* = 0{\cdot}26\ m_0$. The optical phonon energy is 50 meV. The carrier scattering relaxation time is

10^{-13} s at 300 K. Calculate the electric field at which electron can emit optical phonons on the average.

(*c*) Explain low-field and high-field mobility. (2 + 1) + 3 + (2 + 2)

5. (*a*) What is Meissner effect ? Show that a soft superconductor is a perfect diamagnetic material.

(*b*) What is superconducting energy gap ? Name the experimental evidence in support of that.

(*c*) Explain 1-2-3 superconductors. (2 + 3) + (2 + 1) + 2

6. Indium antimonide has $E_g = 0{\cdot}23$ eV; dielectric constant $\epsilon = 18$; electron effective mass $m_e = 0{\cdot}015$ m. Calculate (*a*) the donor ionization energy; (*b*) the radius of the ground state or bit (*c*) At what minimum donor concentration will appreciable overlap effects between the orbits of adjacent impurity atoms occur. 3 + 3 + 4

[*Internal Assessment* ; 10 Marks]