PG/IIS/ELC-203/13

M.Sc. 2nd Semester Examination, 2013

ELECTRONICS

(*Electronic Materials*)

(Theory)

PAPER—ELC-203

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. Answer *all* questions : **2 × 5**

(*a*) Differentiate between a point defect and a planar defect.

(*b*) What do you mean by 'Fermi Surface' ?

(*c*) Define 'electronic' and dipolar polarizability.

(*d*) Explain the concept of solitons for conduction mechanism in polymers.

(*e*) Why is silicon not used as an LED materials ?

2. (*a*) Derive the equation relating the number of vacancies n found in a monoatomic crystal to the energy E_a required to remove one atom to the crystal's exterior.

(*b*) If 1 eV is required to move an atom from the monoatomic crystal's interior to the surface, what is the proportion of vacancies present in the crystal at 1000 K ? At 300 K ?

(*c*) State the difference between high-angle and low-angle boundary and their relative effects on materials. 4 + (1 + 1) + (2 + 2)

3. (*a*) The following data are given for Si at 300 K with the usual symbols :

$$n_i = 1{\cdot}45 \times 10^{10}\ \text{cm}^{-3}$$
$$\mu_e = 1500\ \text{cm}^2\text{V}^{-1}\text{s}^{-1}$$
and $\mu_h = 450\ \text{cm}^2\ \text{V}^{-1}\text{s}^{-1}$.

It is doped with 10^{11} donor atoms per cm^3. Assuming that the donors are all ionized, calculate the percentage increase in conductivity of the doped material over the intrinsic value.

(*b*) Derive the Hall coefficient for an intrinsic semiconductor. When is the Hall coefficient zero in a semiconductor? 4 + (4 + 2)

4. (*a*) Derive an expression for the local field in a dielectric.

(*b*) Find the expression for the energy loss in a dielectric placed under a high frequency electric field. 6 + 4

5. (*a*) Describe the structure of ferrites. How is the magnetic moment of ferrite molecule calculated?

(*b*) Give reason why in Fe_3O_4, some of the magnetic Fe^{2+} ions are replaced by non-magnetic ions such Zn^{2+} or Cd^{2+}, the magnetization increases.

(*c*) How are ferrites superior to magnetic metals? 3 + 3 + (3 + 1)

6. (*a*) To be considered solar cell materials, semiconductors of what bandgaps are critical ? Give reason on which side you will illuminate a *p-n* junction solar cell to get a better performance.

(*b*) Derive the expressions for open-circuit voltage (V_{oc}), maximum output power (P_m) and power conversion efficiency (η) of a *p-n* junction solar cell. (1 + 2) + (2 + 3 + 2)

[*Internal Assessment* : 10 Marks]