2016

M.Sc.

2nd Semester Examination

ELECTRONICS

PAPER—ELC-203

Full Marks : 50

Time : 2 Hours

The figures in the right-hand margin indicate full marks.

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

Illustrate the answers wherever necessary.

(*Electronic Materials*)

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

1. (a) Classify crystals based on lattice parameters.

   (b) What do you understand by degenerate and non-degenerate semiconductors ?

   (c) Explain complex dielectric constant.

(d) What do you mean by spin wave?

(e) Mention the uses of silicon based dielectric in VLSI technology.

2. (a) Obtain an expression for the energy change due to creation of vacancies inside a solid.

(b) The fraction of vacancy sites in a metal is 1×10^{-10} at 500°C. What will be the fraction of vacancy sites at 1000°C?

(c) Explain tilt and twin boundary crystal defects.

$3+2+\left(2\frac{1}{2}+2\frac{1}{2}\right)$

3. (a) Discuss drawbacks of classical free electron theory.

(b) Calculate the free electron concentration, mobility and drift velocity of electron in aluminium wire of length 5m and resistance 0·06 Ω carrying a current of 15A, assuming that each aluminium atom contributes 3 free electrons for conduction.

(c) Derive Boltzman transport equation.

$2+(2+1+2)+3$

4. (a) Show that a soft superconductor is a perfect diamagnetic material.

   (b) Explain the significance of the term penetration depth.

   The penetration depth for lead are 396Å and 1730Å at 3K and 7·1K respectively. Calculate the critical temperature for lead.

   (c) Show that if a dc voltage V applied across a Josephon junction, the current oscillates with frequency

   $\omega = \frac{2eV}{\hbar}$; symbols have their usual meanings.

   2+(2+2)+4

5. (a) 'Stoichiometric ZnO is an insulator but non-stoichiometric ZnO is an n-type semiconductor' — Explain.

   (b) How does electrical conduction take place in polyacetylene ?

   (c) What are ceramics ? Why most ceramics have lower spalling resistance than metal ?

   3+3+(2+2)

6. (a) Explain intrinsic and extrinsic transitions.

   (b) How are the photocurrent gain and response time of a photoconductor improved?

   (c) Calculate the photocurrent and gain when 5×10^{12} photons/s arriving at the surface of a photoconductor of quantum efficiency 0·8. The minority carrier lifetime is 0·5 ns, and the device has μ_n = 2500 $cm^2/V\text{-}s$, electric field inside the photoconductor 5000 V/cm, and gap between the ohmic contacts 10 μm.

$$\left(1\tfrac{1}{2}+1\tfrac{1}{2}\right)+\left(1\tfrac{1}{2}+1\tfrac{1}{2}\right)+(2+2)$$

[Internal Assessment — 10 Marks]