PG/IVS/PHS-403/14

M.Sc. 4th Semester Examination, 2014

PHYSICS

PAPER – PHS-403

Full Marks : 40

Time : 2 hours

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

GROUP – A

[*Marks* : 20]

Answer **Q. Nos. 1 & 2** and **one** from the rest

1. Answer any *two* bits : 2×2

   (*a*) Find an expression for barrier potential in a symmetric *p-n* junction which is under equilibrium condition.

(*b*) Explain what is meant by indirect recombination.

(*c*) The minority carrier lifetime in *p*-type material is 10^{-7} second. The mobility of electron in silicon is $0{\cdot}15\ m^2V^{-1}S^{-1}$ at 300 K. If 10^{20} electron/m^3 are injected at $x = 0$, what is the diffusion current density just at the junction.

2. Answer any *two* bits : 3 × 2

(*a*) Clearly explain with help of band diagram the formation of ohmic contact. What is varicaps ? 2 + 1

(*b*) Assuming average relaxation time $<z>$ in a non-degenerate semiconductor. Find an expression of mobility in the low temperature region. 3

(*c*) A hypothetical semiconductor has an intrinsic carrier concentration of $1{\cdot}0 \times 10^{10}/cm^3$ at 300 K, it has conduction band and valence band effective densities of states N_c and N_v, both equal to $10^{19}/cm^3$.

(*i*) What is the band gap E_g ?

(*ii*) If the semiconductor is doped with $N_d = 1 \times 10^{16}$ donors/cm^3, what are the equilibrium electron and hole concentrations at 300 K. $1\frac{1}{2} + 1\frac{1}{2}$

3. Explain what is meant by diffusion length. Find an expression of diffusion length of hole assuming a *p-n* junction is forward biased. Find an expression of diode equation. 2 + 4 + 4

4. What is meant by equilibrium and nonequilibrium carriers in a semiconductor. Find an expression of growth of carriers in a semiconductor when the light is switched on (Assuming $h\nu > E_g$). What is meant by linear recombination ? 2 + 5 + 3

GROUP – B

[*Marks* : 20]

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

1. Attempt any *five* : 2 × 5

(*a*) What is the difference between X-ray diffraction and neutron diffraction ?

(*b*) What is the difference between sputtering and thermal evaporation ?

(*c*) What do you mean by low-dimensional material ? Give example.

(*d*) What do you mean by e-gun ? Give example.

(*e*) What is the basic principle of XPS ?

(*f*) Give schematically different part of SEM with proper name.

(*g*) What do you mean by adsorption and desorption ? Give example.

2. (*a*) Describe briefly the synthesis technique of MOCVD.

(*b*) How ALD is better than MBE ?

(*c*) What do you mean by "bottom up" approach and "top down" approach ?

(*d*) VLS technique is a good method of CNT synthesis. True or false ? Justify. 4 + 2 + 2 + 2

3. (*a*) What is the working principle of STM ?

(*b*) If an electron beam interacts with an unknown material then what are different possibilities that may take place ?

(*c*) Write a short note on VSM or TEM.

(*d*) What will be pressure level in UHV system ?

3 + 3 + 3 + 1
