2008

PHYSICS

PAPER—PH 2203 A & B

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

(*Semiconductor Physics*)

[*Marks* : 20]

Attempt *all* questions

1. Answer any *five* bits: 2×5

(*i*) What do you mean by contact potential? Can you measure contact potential by connecting a voltmeter across the p-n junction diode?

(*ii*) The resistivity of a semiconductor is ·00893 Ωm at room temperature. The flux density B_z in the Hall model is 0·5 Weber/m^2. Calculate the Hall angle for a Hall coefficient of $3{\cdot}66 \times 10^{-4}$ m^3/C.

(*iii*) Draw the energy band diagram of an unbiased $p-n$ junction.

(*iv*) Prove that there is no discontinuity in the fermi level when a $p-n$ junction is in equilibrium condition.

(*v*) A 0·46 μm thick sample of GaAs is illuminated with monochromatic light of $h\nu = 2$ eV. The absorption coefficient α is 5×10^4 cm^{-1}. The power incident on the sample is 10 mW. Find the rate of excess thermal energy given up by electrons to the lattice before recombination. Band gap of GaAs = 1·43 eV.

(*vi*) Explain with neat diagram the mechanism of oscillation of current in a Gunn effect oscillator.

(*vii*) Show that for a $p-n$ junction diode $\delta P(x) = \Delta P e^{-x/L_p}$ where L_p is the diffusion length.

2. Answer any *one*: 10 x 1

(*a*) (*i*) Assuming the Schockley ideal diode approximation, obtain the I- V relation (diode equation) of a p - n junction diode.

(*ii*) Describe in details the approximation for an abrupt p - n junction and hence find an expression of width of the junction. 5 + 5

(*b*) Describe in details the growth of current when light of weak intensity falls on a semiconducting material. How life time of a carrier can be determined experimentally? 10

GROUP—B

[*Marks* : 20]

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

1. Answer any *five* bits: 2×5

(*i*) Why high vacuum is essential when a film is grown by thermal evaporation?

(*ii*) How a junction is fabricated by alloyed technique?

(*iii*) What is meant by Homoepitaxy?

(*iv*) What are the electron beam energies required for SEM and TEM instruments?

(*v*) Why do we get spots in Laue diffraction pattern?

(*vi*) Write down two different methods for Glass preparation.

(*vii*) What is surface probe microscopy (SPM)? Name three SPM instruments.

(*viii*) Clearly distinguish Gaussian profile and complementary error function.

2. (*a*) Describe with neat diagram how films are grown by thermal evaporation technique.

   (*b*) What are the advantages of plasma film deposition over thermal evaporation technique? 7 + 3

3. (*a*) Compare SEM and TEM in terms of resolution.

   (*b*) What are the defects in TEM imaging ? Explain briefly.

   (*c*) Schematically represent the interaction of electron beam with a specimen in an electron microscope.

   (*d*) Briefly describe the use of the following instrument; (any *two*):

   (*i*) UV - VIS spectrophotometer

   (*ii*) XRD

   (*iii*) LEED

   (*iv*) PL. 2 + 3 + 2 + 3
