2017

M.Sc. 2nd Semester Examination

PHYSICS

PAPER—PHS-202

Full Marks : 40

Time : 2 Hours

The figures in the margin indicate full marks.

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

Illustrate the answers wherever necessary.

Use separate Answer-scripts for Group-A & Group-B

Group—A

1. Answer any *two* of the followings : 2×2

(a) Determine the frequency of the electromagnetic waves radiated by a Josephson junction across which a d.c. voltage of 0.5 mV is applied.

(b) Write four technological applications of super-conductivity.

(c) How the permanent dipole moment of a polar molecule (μ_0) can be measured by using clausius-Mosotti relation.

2. Answer any *two* of the followings : 2×3

(a) What is the order of phase change for normal to super-conducting phase transition ? Justify your answer.

(b) Explain Meissner effect.

(c) Derive the expression of current density for cooper pair in a super-conductor.

3. Answer any *one* of the followings : 1×10

(a) Describe the AC Josepson effect in details and hence find an expression for tunneling current. Show how the frequency of an unknown radiation incident on a biased junction can be measured by using AC Josepson effect. 7+3

(b) Describe the phenomenon of electronic polarizability and hence show the variation of $\in'$ and $\in''$ with frequency for it.

Show that $\in'$ and $\in''$ becomes frequency dependent when a dielectric is subjected to an alternating field. What do you mean by dielectric loss ? 5+3+2

Group—B

Answer Q. No. *1* and *2* and any *one* from the rest.

1. Answer any *two* questions: 2×2

(a) A semiconductor contains acceptor and hole concentration as $10^{22}/m^3$. Assume that the density of states in the valence band is $10^{25}/m^3$. Find the position of Fermi level at 300K.

(b) A sample of n type Si is brought into intimate contact with a metal $(\varnothing_m = 5\text{ ev})$. For semiconductor $\varnothing_s = 4.06$ ev and X = 4.05 ev. Find the barrier height from the semiconductor end and also the barrier height from the metal end ?

(c) Why fourth quadrant in I-V used as operating point of a solar cell ? How the efficiency of solar cell depends on band gap ? 1+1

2. Answer any *two* questions: 2×3

(a) Prove that Einstien relation is valid for holes in a p-n junction under equilibrium condition.

(b) Find an expression of ionisation energy of the donor atom in Germanium.

(c) Clearly distinguish linear recombination and quadratic recombination.

3. (a) What is electric neutriality condition for a semiconductor doped with donor impurity ?

(b) Find an expression of electron concentration in an n type semiconductor at extemly low temperature region.

(c) Find an expression of depletion temperature from impurity to intrinsic conductivity of a n type semiconductor. 1+7+2

4. (a) Find an expression of diffusion length of minority carriers in a p-n junction under bias.

(b) Explain the origin of diffusion capacitance in a p-n junction and hence find an expression of diffusion capacitance. 5+5

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