PG/IIS/PHS-202/14

M.Sc. 2nd Semester Examination, 2014

PHYSICS

PAPER – PHS-202(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

Write the answers to questions of each Group in separate books

GROUP – A

[*Marks* : 20]

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

(*a*) Evaluate the penetration depth of a super-conductor having super-electron density $4 \times 10^{28}\ m^{-3}$.

(*b*) Show that "the total magnetic flux threading a closed resistanceless circuit cannot change so long as the circuit remains resistanceless.

(*c*) Determine the frequency of the electro-magnetic waves radiated by a Josephson junction across which a dc voltage of 0·5 mV is applied.

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

(*a*) What is the basic difference between perfect conductor and superconductor (Draw necessary diagram).

(*b*) Draw energy level diagram and show tunneling for two identical superconductors are without and with applied bias. (Assume that the temperature is above OK).

(*c*) The optical index of refraction and the dielectric constant for water are 1·33 and 8·1 respectively. Determine the percentage of ionic polarizability.

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

(*a*) Discuss the frequency dependence of the dielectric constant of a dipolar system. Explain dielectric relaxation and dielectric loss in solids. $7 + 3$

(*b*) Discuss clearly first-order and second order transitions of superconductor to normal conductor. Explain DC Josephson effect. Show that supercurrent of a superconducting pair across the junction depends on the phase difference. $\left(2\frac{1}{2}+2\frac{1}{2}\right)+5$

GROUP – B

[*Marks* : 20]

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

1. Answer any *two* questions : 2×2

(*a*) Derive electric neutrality condition when a semiconductor in doped both with donor and acceptor impurity.

(*b*) A pure semiconductor has an energy gap of 1 eV. For temperature of OK and 300 K respectively, calculate the probability of an electron occupying a state near the bottom of conduction band.

(*c*) What is the origin of diode ideality factor ?

2. Answer any *two* questions : 3 × 2

(*a*) Find an expression of barrier potential for a symmetric junction under equilibrium condition.

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

(*c*) Find an expression of open circuit voltage in a solar cell.

3. (*a*) Find an expression of density of states in the conduction band of a semiconductor.

(*b*) Find the density of electrons in the conduction band for a non-degenerate semiconductor. 5 + 5

4. (*a*) What is meant by diffusion length ? Find an expression of diffusion length of hole when a *p-n* junction is forward biased.

(*b*) What is diffusion capacitance ? Find an expression of diffusion capacitance in *p-n* junction. 5 + 5