*Total number of printed pages – 7*

**B. Tech**
**BSCP 2201**

# Fourth Semester Examination – 2007

## PHYSICS - II



**Full Marks – 70**

**Time – 3 Hours**

*Answer Question No. **1** which is compulsory and any **five** from the rest.*

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

Mass of electron = $9.11 \times 10^{-31}$ kg, Mass of proton = $1.67 \times 10^{-27}$ kg, Plank's constant = $6.63 \times 10^{-34}$ Js, Boltzmann constant = $1.38 \times 10^{-23}$ J/K

1. Answer the following questions : 2×10

   (a) What type of temperature coefficient of resistance does a pure semiconductor has ?

P.T.O.

(b) In a particular material, the forbidden energy gap between conduction band and valence band is of the order of 6 eV. To which type of material does this material belong to electrically ?

(c) What do you mean by planar density of atoms ?

(d) The lattice constant of a cubic crystal is 3.50 Å. Calculate the interplanar spacing of (011).

(e) Name an accelerator in which charged particle is accelerated by using only electric field.

(f) What is the difference between the magnetic fields as applied to cyclotron and betatron ?

(g) Write an expression for London's penetration depth at any temperature.

(h) What is Cooper pair in superconductivity ?

(i) What are the different types of electronic transitions occur when electromagnetic radiation of suitable frequencies is incident on the materials ?

(j) Show graphically the variation of refractive index of core of a graded index optical fiber with radius of the core.

2. (a) Write down all the steps to find out the Miller indices of an atomic plane. 4

(b) Let the electrons are ideally bound to the atoms as in the case of infinitely deep potential well. Using Kronig-Penney model derive an expression for the energy of an electron moving in the periodic potential. 3

(c) The critical temperature for mercury with isotopic mass 199.5 amu is 4.18 K. Calculate its critical temperature when its isotopic mass changes to 203.4 amu. 3

3. (a) What are the advantages of fiber optic communication system over the traditional copper cable communication systems ? 5

(b) Show that in simple cubic lattice, interplanar spacings of (101), (110) and (011) planes are in the ratio 1:1:1. 3

(c) Name few radio frequency accelerators. 2

4. (a) What are the difference between n-type semiconductors and p-type semiconductors ? 4

(b) Derive the London's equation in superconductivity. 4

(c) Show in a figure, the different parts of an optical fiber. 2

5. (a) Describe with necessary theory the working of a typical cyclotron. 4

(b) Derive the Bragg's law of x-ray diffraction. What are the differences between x-ray diffraction and reflection of visible light by mirrors? 2+2

(c) State the Bloch's theorem in one-dimension as applied to the periodic potential of atomic lattice. 2

6. (a) What are the factors which compelled scientists to construct nuclear accelerators? 3

(b) Plot the dispersion curve ($E$ vs $k = \frac{2\pi}{\lambda}$) of an electron moving in a one dimensional periodic potential. What are the inferences you draw from this plot regarding the band concepts of substances? 2+2

(c) Distinguish between type-I and type-II superconductors. 3

7. (a) A laser beam of wavelength 6800 Å has coherence time $4.5 \times 10^{-5}$ sec. Determine the temporal coherence length, spectral width and purity factor. 3

(b) Give few examples of applications of nuclear radiations obtained by using nuclear accelerators in processing of materials. 4

(c) Derive the Laue conditions of x-ray diffraction in vector form. 3

8. (a) How superconductivity concepts have been exploited technologically in the following fields : 1×4

(i) surface transportation

(ii) health science

(iii) distribution of electric power

(iv) defence.

(b) What is light emitting diode ? What are the different mechanisms responsible for emission of light in LED ? 1+3

(c) Protons in a cyclotron describe a circle of radius 40 cm just before emerging from the dees. The frequency of the applied alternating voltage is 15 MHz. Neglecting relativistic effects, find the speed of a proton on emergence. 2