Total number of printed pages – 7

B. Tech

BSCP 2201

Fourth Semester Examination – 2008

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

1. Answer the following questions : 2×10

   (a) A linear accelerator is to be designed to accelerate protons to 50 Mev by using a radio frequency voltage source of 50MHz. Calculate the length of the last electrode.

P.T.O.

(b) Distinguish between the magnetic fields as applied in betatron and cyclotron.

(c) Construct a $(0\bar{1}1)$ plane within a cubic unit cell.

(d) Distinguish between the reflection of a light ray by a plane mirror and diffraction of x-ray beam by crystal plane.

(e) What is the difference between energy bands of diamond and semiconductor ?

(f) Show the accepter level in the band diagram of p-type materials.

(g) To what temperature must lead be cooled in a magnetic field of 20000 A / m for it to be superconductive ? The data given for lead are $T_C = 7.19K$ and $B_C(0) = 0.0803T$.

(h) What are the limitations of the new superconducting materials that have relatively high critical temperatures ?

(i) Give four examples of optoelectronic devices.

(j) Determine the maximum angle for which the light rays incident on the end of the pipe are subject to total internal reflection along the walls of the pipe. Assume that the material of the pipe has refractive index of 1.36 and that outside medium is air.

2. (a) Explain how direction indices of a crystal plane are found out. 3

(b) What happens to the output voltage of the voltage multiplier circuit used in Cockcroft-Walton accelerator if the capacitors used have high capacitance ? 2

(c) Calculate the highest order of x-ray diffraction that could be observed when 1.54 Å x-ray radiation is incident on a crystal having interplaner spacing distance of 2.0 Å. 2

(d) What is geometrical structure factor ? How does it affect the intensity maxima in a diffracted beam ? 3

3. (A) What is the principle of betatron ? Derive the betatron condition. 4

(b) Distinguish between laser light and ordinary light. 2

(c) Show that the [hkl] direction is perpendicular to the (hkl) plane. 4

4. (a) Explain how Kronig-Penney model of solids predicts the presence of allowed and forbidden energy bands in crystals. 6

(b) A laser beam has power of 5mW. The diameter of the mirror of the optical resonator is 1.5 mm. Calculate the area spread and intensity of the image if the laser emission occurs at 6500 Å and laser beam is focused using a lens of focal length 1.5m. 4

5. (a) Explain how and when, a material undergoes superconducting transition from normal state to superconducting state, entropy of the material decreases. 5

(b) Calculate the critical current density of certain wire of radius 1mm at 4.2K. The data given for the material are $T_c = 7.18K$ and $B_{oo} = 29.3 \times 10^{-3}T$ at 0K. 3

(c) Show the position of Fermi level in the band diagram of a n-type semiconductor. 2

(a) What do you mean by compound semiconductors ? Distinguish between n-type and p-type semiconductors. 2+4

(b) What is the working principle of a nuclear accelerator ? 2

(c) Write down an expression for London penetration depth with the used symbols explained. 2

7. (a) Explain briefly the BCS theory of superconductors. 5

(b) The maximum flux density in a betatron is 0.5T. Calculate the energy gained per revolution and final energy of an electron when radius of its path is 1 m and operating frequency is 60Hz. The average speed of the electron in the betatron is assumed to be 2.75×10^8 m/s. 4

(c) Define extrinsic semiconductors. 1

8. (a) Explain with necessary diagrams the functioning of a diode laser. 4

(b) In future, LED may overshadow the conventional incandescent lamps. Explain. 4

(c) The applied magnetic induction in a cyclotron is 25000 gauss. Calculate the frequency of the radio frequency source applied to accelerate α-particles. The mass of an α-particle may be taken as 4.04 amu. 2