Total number of printed pages – 7

Third 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.

(Given : Plank's constant = 6.62×10^{-34} Js,
$c = 3 \times 10^{8}$ m/s).

1. Answer the following questions : 2×10

    (a) The speed of a charged particle in the
         first tube of a linear accelerator is

P.T.O.

1.0 cm/s. What is the speed of the particle when it is in the fourth tube ?

(b) Mention the factors which force scientists to construct nuclear particle colliders.

(c) Write the Miller indices of a plane in a cubic crystal, which makes equal intercepts on the crystal axes.

(d) Calculate the geometrical structure factor of a primitive unit cell.

(e) What is the basic physical principle responsible for the presence of energy bands rather than specific energy levels in a solid ?

(f) In a fermionic system in the ground state, what is the probability of any particle having energy less than the Fermi energy ?

(g) Mention few properties of Cooper pair.

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

(i) What is difference between laser light and ordinary light ?

(j) Draw the refractive index profile of a graded index optical fiber.

2. (a) Derive the Bragg's law of x-ray diffraction. What are the difference between

x-ray diffraction by crystals and reflection of visible light by mirrors ? 3+2

(b) Calculate the London penetration depth at 2.5 K in superconducting state of a material from the following data. $T_c = 5.7$ K, density = 7.3g/cm^3, atomic mass = 118.7 amu, effective mass of electron = 17.29×10^{-31} Kg 3+2

3. (a) Prove that every reciprocal lattice vector is normal to certain crystal plane in direct lattice. 6

(b) Explain by giving examples, how nuclear radiation is useful in medical science. 4

4. (a) Define atomic form factor, scattering amplitude and geometrical structure factor. Give their significance. 5

(b) The refractive indices of core and cladding of a step index fiber are 1.48 and 1.47 respectively. The core radius is 25 μm .Assume the guided ray is traveling at steepest angle with respect to fiber axis. Calculate the number of reflections per meter. 5

5. (a) Explain how Kronig-Penney model predicts the presence of allowed and forbidden energy bands in crystals. 7

(b) The interplanar spacing in certain crystal is 3.4 Å. The first order maximum occurs

at diffraction angle 20°. Find the wavelength of the incident radiation. 3

6. (a) Give the construction and working of LED. What are the merits of LED over incandescent lamp ? 5

   (b) What do you mean by nuclear accelerator ? Distinguish between d.c. and r.f. accelerators. Give two examples from each.

   5

7. (a) Mention at least 10 number of modern day applications of the superconductivity phenomenon. 5

   (b) Describe with necessary theory the working of a betatron. What are its limitations ? 5

8. (a) What are the basic components of a typical nuclear accelerator ? 4

   (b) Draw the block diagram of a FOCL and explain the working of each section. 6

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