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B. Tech
BSCP 2201

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 Fermienergy ?

- (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. $T_c = 5.7\text{K}$, density = 7.3g/cm^3 , atomic mass = 118.7 amu, effective mass of electron = $17.29 \times 10^{-31}\text{Kg}$ 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 $25\ \mu\text{m}$. 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 $3.4\ \text{\AA}$. 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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