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B. Tech
BSCP 2201

THIRD SEMESTER EXAMINATION – 2005

PHYSICS – II

Full Marks : 70

Time : 3 Hours

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

The figures in the right-hand margin indicate marks for the questions.

(Given : $h = 6.62 \times 10^{-34}$ J.s, $c = 3 \times 10^8$ m/s)

1. Answer **all** the following questions : 2×10
- (a) Nuclear particles obtained from nuclear accelerators are preferred to the particles directly emitted from radioactive nuclei, for study of nuclear reactions. Give two reasons substantiating the assertion.

P.T.O.

- (b) What is the function of the magnetic field in a cyclotron ?
- (c) The crystallographic axes in a cubic crystal are along X-, Y- and Z-axes. What are the Miller indices of the planes parallel to the ZX plane ?
- (d) Which factors determine the intensity of a scattered beam satisfying Bragg's law in crystal diffraction ?
- (e) How does the magnetic field in betatron differ from the magnetic field in cyclotron ?
- (f) Determine the wavelength λ emitted by an atom due to transition from an excited level E_2 to the ground state with energy E_1 , if $E_2 - E_1 = 2.46$ eV.
- (g) Why is population inversion referred to as "negative temperature" ?
- (h) Find out the 'coherence length' in a laser beam for which the 'coherence time' is 0.5 ns.

- (i) What is Fermi level ? Show the Fermi levels in a p-type and n-type semiconductor in a energy level diagram.
- (j) What is graded-index optical fibre ? Draw its refractive index profile.
2. (a) Why is a metastable level between stable energy levels necessary for laser emission ? 3
- (b) Why is a system with four allowed energy levels more suitable than a three level system for laser action ? 4
- (c) Why is 'optical feedback' necessary in a laser device ? How is it achieved ? 3
3. (a) Determine the acceptance angle for an optical fibre having core and cladding refractive indices 1.58 and 1.48 respectively. 2
- (b) Draw the block diagram of a FOCL and explain the working of each section. 4

- (c) Distinguish between active optical fibre sensor and passive optical fibre. Mention some of their uses. 4
4. (a) Describe the basic structure of a semiconductor laser and explain its working. 8
- (b) Mention the merits of semiconductor laser. 2
5. (a) What is Meissner effect? Classify superconductors on the basis of Meissner effect. 4
- (b) Write the expression showing the temperature dependence of critical magnetic field for a superconductor. Graphically show the variation. 2
- (c) Write the expression for change of entropy when a system undergoes phase transition from normal to superconducting state. Graphically show the variation of entropy with temperature for both normal and superconducting states. 4

6. (a) The maximum energy acquired by an ion in a cyclotron is 3 MeV. If the frequency of the r.f. oscillator is doubled, other parameters remaining the same, what would be the maximum attainable energy of the ion? 2
- (b) Describe the construction of a linear accelerator. Show that the velocities of the ion in the tubes are in the ratio $1 : \sqrt{2} : \sqrt{3} : \dots$ 6
- (c) Why is the cyclotron not suitable for accelerating electrons? 2
7. (a) How are Miller indices assigned to crystal planes? A plane intercepts the crystal axes at 3, 2, 5 units respectively. Find the Miller indices of the plane. 6
- (b) Explain why visible light cannot be used for the study of crystal structure? 2
- (c) Write the Laue conditions for crystal diffraction. 2

8. (a) Describe, with necessary principle, the working of a betatron. Mention its relative advantages. 7

(b) The lattice parameters of a cubic crystal are $\vec{a} = \hat{i}$, $\vec{b} = \hat{j} - \hat{i}$, $\vec{c} = 2\hat{i} + \hat{k}$. Find the reciprocal lattice vector \vec{A} . 3

