Bsc Physic Sem - IV

Paper 1 (Solid state physics, X-ray and Laser)

Question Bank

Unit 1

1. What are the symmetry operationsin crystals? Explain non-existence of five fold symmetry.
2. What are Miller indices? Explain the procedure to find Miller indices of a crystal plane. draw(100),(110),(111)and(222)planes.
3. Explain the crystal structure of NaCl.
4. What is packing fraction? Obtain its value for body centred cubic structure.
5. Explain the classification of crystal systems.
6. What are the fundamental symmetry operations shown by the crystal?, Determine the lattice constant of FCC lead crystal of radius 1.746Å.
7. What do you mean by packing fraction ? Derive the value of packing fraction of SC, BCCand FCC structure, find the value of voids in the structure.
8. Describe structure of diamond.
9. Explain symmetry operation in crystals.
10. What is Bravais lattice ? What are different Bravais lattices for cubic structure
11. Write the procedure to find Moller indices of plane in a crystal.
12. If the crystal plane has intercept 1a on X axis and parallel to Y and Z axis, find Millerindices of plane.

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Unit 2

1. Explain the construction and working of Bragg's spectrometer. Explain its use for the determination of wavelength of X-rays.
2. Obtain Bragg's condition for X- ray diffraction.
3. Define reciprocal lattice vectors and obtain the relation between translation vector in direct and reciprocal lattice.
4. Explain the construction of reciprocal lattice.
5. Explain Laue's theory of X-ray diffraction and obtain the Bragg's condition from Laue'sequations.
6. Define reciprocal lattice and describe its construction
7. The primitive vectors of a lattice are $\vec{a} = \hat{i}, b = \hat{i} - 2\hat{j}$ and $\vec{c} = 3\hat{k}$, find the primitive
8. vectors of reciprocal lattice.
9. Explain construction and working of a Bragg's X-ray spectrometer.

10. State and prove Bragg's condition for X-ray diffraction.
11. Explain in brief different methods of X-ray diffraction in crystallography.
12. A beam of X-rays of wavelength 0.819 A.U. incidents on an NaCl crystal at normal angle. If the lattice spacing of NaCl crystal is 0.282 nm, calculate the maximum orderof diffraction possible.
13. Explain Laue's method of X-ray diffraction.
14. Explain the determination of crystal structure by Bragg's method
15. Explain the significance of reciprocal lattice.
16. State the significance and properties of reciprocal lattice.
17. Explain the experimental determination of wavelength of X-rays using Bragg's spectrometer.

Unit 3

1. Explain construction and working of Collidge X-ray tube, give its characteristics.
2. What is Mosley law ? Explain its significance
3. Calculate the wavelength of radiation coming out of Co (Z = 27), if $K_{\square}$ radiation ofMo (Z = 2) has a wavelength of 0.75 Å.
4. Explain Duane and Hunt's law.
5. What are soft and hard X-rays ?
6. Show that absorption of X-ray by material follows the exponential law.
7. Calculate the minimum applied potential required to produce X-ray 2 Å wavelength
8. Determine the wavelength of $K_{\square}$ X-rays emitted by an element having z = 7a,a = 2.468×10^{15} s^{-1} and b = 1
9. Explain Auger effect.
10. State the applications of X-rays.
11. State Duane-Hunt law. Obtain an expression for the cut-off wavelength.
12. An X-ray tube operating at 40 kV emits continuous X-ray spectrum with a short wave-length limit $\square_{min}$ = 0.310 Å. Calculate Planck's constant.
13. What are X-rays? State their properties.
14. Calculate the maximum frequency of X-rays when a p.d. of 25 kV is applied.
15. Show that absorption of X-rays by a material follows exponential law.
16. Explain the construction and working of a Coolidge tube with a well-labelled diagram.
17. Explain characteristic X-ray spectra and draw the energy level diagram.

Unit 4

1. Explain construction and working of Ruby laser. State its drawback.
2. What are Einstein's coefficient A and B establish relation between them.
3. Find the intensity of a laser beam of 10 mW power and having a diameter of 1.3 mm. Assume the intensity to be uniform across the beam.
4. Explain construction and working of semiconductor laser.
5. Explain why three level pumping scheme is necessary for laser action ?
6. Explain the characteristics of Laser beam.
7. The coherence length of sodium line of wavelength 5890 Å is 2.5 cm. Calculate coherencetime and half width of spectral line. Given : $C = 3 \times 10^8$ m/s.
8. Calculate the ratio of population for two energy states at 300 K for radiation of LASERfrequency 4.7×10^{14} Hz. Given $h = 6.67 \times 10^{-34}$ Js, $K = 1.38 \times 10^{-23}$ Jk^{-1}.
9. Calculate the coherence length and coherence time for 20 waves of wavelength 6600 Å
10. Discuss population inversion in Laser.
11. Discuss the three level pumping for Laser action.
12. What is LASER? Discuss the spontaneous and stimulated emission process in a LASER
13. Explain the principle, construction and working of He-Ne laser. State the draw backs of He-Ne laser.
14. Explain the applications of Laser.
15. Calculate the energy of a photon of Laser beam of wavelength 6328 Å.