Haldia Institute of Technology
Department of Applied Science

Assignment - V
Course: PH 101/PH 201
Module – 5: *Crystallography*

1. Define the terms unit cell, space lattice and basis.

2. What is atomic packing factor (APF) and lattice constant? Show that lattice constant is defined by $a = (nM_A / \rho N_A)^{1/3}$, where symbols have their usual meanings.

3. Sodium Chloride crystallizes in FCC structure. The density of NaCL is 2180 kg/m3. If the stomic weight of sodium and chlorine are 23 and 35.5 respectively. Calculate the distance between two adjacent atoms.

4. Find out the atomic packing factor of s.c., b.c.c. and f.c.c. lattice.

5. Describe Bragg's law and show that $2d_{hkl} \sin\theta = n\lambda$.

6. Calculate the number of atoms per unit cell of a crystal having lattice constant 0.29 nm. And density 7870 kg/m^3. Atomic weight of the crystal is 55.85 kg/mole.

7. Find the minimum radius of the sphere that can just fit into the void at (1/2, 1/2, 1/2) between the body centred atoms of a b.c.c. structure.

8. Assuming that lattice points of lattice parameter 'a' in a b.c.c. crystal are occupied by spherical atoms of radius r, i) calculate the free volume per unit cell, ii) determine the radius of the largest sphere that will fit into the voids produced by the lattice point atoms not occupying the full volume of the cell.

9. The unit cell of Al is f.c.c. crystal with lattice constant a = 0.405 nm., i) how many unit cells are there in an Al foil of 0.005 cm. thick and side of 25 $cm.^2$? ii) it weights is 0.0085 kg. How many atoms are present? iii) how many atoms are in each unit cell?

10. Show that for a s.c. lattice $d_{100} : d_{110} : d_{111} = \sqrt{6} : \sqrt{3} : \sqrt{2}$.

11. In a crystal a lattice plane cuts intercepts of length a, 2b, 3/2c. Find the Miller indices of the plane.

12. An electron initially at rest is accelerated through a potential difference of 5000 volts. Calculate i) the momentum ii) de Broglie wavelength iii) wave number and iv) Bragg's angle for 1^{st} order reflection from (111) planes which are 0.204 nm. apart.

13. Describe the various properties of X-rays.

14. Describe the origin of characteristic X rays.

15. Derive an expression for the minimum wavelength of continuous X-rays in terms of the applied voltage between the electrodes.

16. Give the applications of X-rays in various fields.

17. Define Moseley's law with diagram and give its importance.