

M.SC. 2ND YEAR 1ST SEMESTER 2018

X-RAY CRYSTALLOGRAPHY I

Time: Two hours

Full marks: 40

Paper-PHY/TE/304

Question 1 is compulsory. Answer any three questions from rest.

1. (a) What is the characteristic symmetry of a cube?

(b) Write the basic symmetry elements in a crystal.

(c) If in a crystal, a mirror plane is combined perpendicularly to a rotation axis, which combinations will you obtain? Also prove any ONE equivalence that exists.

(d) Draw the stereographic projections of the following point groups and identify which of them has a centre of symmetry:

(i) $2/m$ (ii) 222 (iii) $3m$

2. (a) What is atomic scattering factor? Considering classical scattering of X-rays by a group of electrons confined within the volume of an atom, derive an expression for the atomic scattering factor and also plot its variation with the scattering angle.

(b) An unpolarized primary beam of intensity I_0 is scattered according to classical theory by a single electron. Show that the total scattered power (integral of intensity over area) is given by:

$$\frac{8\pi}{3} \left(\frac{e^4}{m^2 c^4} \right) I_0$$

where, symbols have their usual meaning.

3. (a) State the necessity of the concept of reciprocal lattice. Derive the relation of reciprocal lattice vector in terms of primitive translation vectors of the reciprocal lattice.
- (b) Establish the Weiss zone law. Do the following planes $(-1,1,0)$, $(-3,1,1)$ and $(-1,-3,2)$ belongs to the same zone? If so, what is the corresponding zone axis?
- (c) State and prove the Friedel's law. Calculate structure factor of the face-centered unit cell. (3+3+4)

4. (a) Find the relation for Fourier series representation of electron density in a crystal.
- (b) Find the expression for one-dimensional Patterson function. Explain how the positions of Patterson peaks are related to atomic coordinates in a crystal. (5 + 5)

5. Write short notes (2 x 5 =10)

(a) Miller-Bravais indices

(b) Auger effect