PHYS 565 Solid State Physics - Spring 2012

Instructor: Thushari Jayasekera - Email: tjayasekera@physics.siu.edu

Homework # 2 - Due 14th February 2012

---

1. Find the reciprocal lattices for the following Bravais lattices and sketch a picture for each of the reciprocal lattice.
   - A body-centered tetragonal
   - A body-centered orthorhombic
   - A face-centered orthorhombic

2. For a Orthorhombic Lattice system, show that the reciprocal lattice vector $G_{hkl}=h\mathbf{b}_1+k\mathbf{b}_2+l\mathbf{b}_3$ is perpendicular to the crystal plane (hkl).

   Also show that the distance between two adjacent planes is given by

   $$d_{hkl} = \frac{2\pi}{|G_{hkl}|}$$

   and verify that this distance is given by:

   $$d_{hkl} = \frac{1}{\sqrt{h^2 + k^2 + l^2}}$$

3. An orthorhombic lattice has primitive lattice vectors $\mathbf{a}_1$=a i , $\mathbf{a}_2$= b j and $\mathbf{a}_3$= c k. Find a set of fundamental reciprocal lattice vectors and use them to derive an expression for the separation of adjacent parallel lattice planes (Compare it with the result in the previous problem). Take a=3.17 Å, b=4.85 Å and c=2.13 Å, then find the separation of planes in each of the following sets: (100), (110), (011), and (111).

4. Write down a set of primitive vectors to describe the hexagonal 2D lattice. Find the Reciprocal lattice and sketch the form of the first Brillouin Zone (BZ).

   Search the existing literature to mark the high symmetric points in the first BZ.

5. Find the structure factor for a FCC lattice and comment on the possible X-Ray diffraction pattern for a monoatomic FCC lattice.