Department of Chemical Engineering, Indian Institute of Technology Delhi
CHL141: Introduction to Materials for Chemical Engineers
Semester I, 2015-2016

Minor-I

Date: 31/08/15 | Closed Book & Closed Notes | Marks: 15

1. What is the Bravais lattice formed by all points with cartesian coordinates (l, m, n) if
   a. [2 Marks] l, m and n are either all odd or all even.
   b. [2 Marks] The sum of l, m and n is required to be even.
   (Marks will be given only if the reason is provided).

2. [3+1+1 Marks] For a simple hexagonal Bravais lattice with unit vectors:

$$\vec{a}_1 = a\hat{i}, \quad \vec{a}_2 = \frac{a}{2}\hat{i} + \frac{\sqrt{3}a}{2}\hat{j}, \quad a_3 = c\hat{k}$$

find the reciprocal lattice and its lattice constants. What is angle between $\vec{a}_1$ and $\vec{b}_1$.

3. It is often convenient to represent fcc Bravais lattice as simple cubic with a cubic primitive cell of side 'a' and a four-point basis.
   a. [2 Marks] Write the vectors representing the four-point basis.
   b. [2 Marks] Show that the structure factor is then either 4 or 0 at all points of the simple cubic reciprocal lattice.
   c. [2 Marks] Determine the structure left, when all points with zero structure factors are removed. How the the structure related to fcc?

structure factor: $S_K = \sum_{j=1}^{n} \exp\left(i\vec{K} \cdot \vec{d}_j\right)$

END