Indian Institute of Technology Roorkee
Department of Metallurgical and Materials Engineering

MT-105 Electrical and Electronic Materials

Assignment 1

1. Calculate the following:
   - i. **Effective number of atoms** in SC, BCC, FCC, HCP unit cells
   - ii. **Relationship** between the size of the unit cell and atomic diameter in SC, BCC, FCC, HCP unit cells
   - iii. **Packing factors** of BCC, FCC, HCP unit cells
   - iv. **Packing factor** of a diamond cubic crystal structure
   - v. **Coordination numbers** of BCC, FCC, HCP crystal lattice
   - vi. **c/a ratio** for an ideal HCP unit cell
   - vii. **Volume of unit cell** of germanium in cubic meters, the atomic radius of Ge having Diamond Cubic structure being 1.223 A^{o}

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2. Show with the help of neat sketches the following:
   - i. **Planes** whose Miller indices are (111), (210), (010), $(0\,\bar{1}\,\bar{1})$, (002), (130), (212) and $(3\,\bar{1}\,2)$.
   - ii. **Directions** whose Miller indices are [111], [110], $[1\bar{1}0]$, [122], [301], [201] and $[2\bar{1}3]$.
   - iii. $[1\bar{2}10]$, $[01\bar{1}0]$, $[\bar{1}011]$ **directions** and $(1\bar{2}10)$, $(\bar{1}\bar{1}22)$, $(12\bar{3}0)$ **planes** (Miller Bravais Index) in HCP unit cell.
     In a cubic unit cell, the (hkl) & [hkl] are perpendicular to each other
   - iv. **Miller index** of the direction that is common to both planes (110) and (111) inside the unit cell of a cubic crystal.
   - v. 3 parallel planes of belonging to {111} inside a cubic unit cell (may be touching the UC).
   - vi. 6 direction <110> on any one {111}

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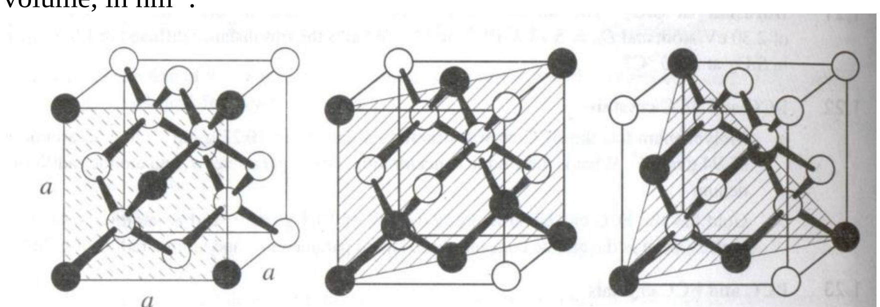
3. i. Given the Si lattice parameter a=0.543 nm. Calculate the number of Si atoms per unit volume, in nm^{-3}.



(100) plane (110) plane (111) plane

   ii. Calculate the number of atoms per m^{2} on the (100), (110), and (111) planes in the Si crystal as shown in above figure. Which plane has the maximum number of atoms per unit area?

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4. i Why single crystals are used for electronic applications? Explain methods of single crystal growth.
   - ii. How amorphous semiconductors are prepared? Give an example.
   - iii. Explain how the nonstoichiometeric, ZnO crystal with excess Zn at the interstitial sites contribute free electron for conduction.
