Tutorial Sheet-9, L30-L34 15B11PH211 (EVEN-2020)

1. Classify the following unit cells into proper systems: CO1
   i. a =7.309 Å, b=7.522 Å, c=7.678 Å & α=88.81^0, β = 90.92^0, γ = 90.93^0
   ii. a =b =2.507 Å, c =4.069 Å & α= β = 90^0, γ = 120^0
   iii. a = b = c =3.182 Å & α= β= γ = 90^0
2. Find out total number of NaCl molecules per unit cell. CO2
3. Copper has density of 8.89 g/cm^3. Assuming structure is *fcc* and atomic weight is 63.5 g/mol. Find the atomic radius of Cu. CO2
4. A plane makes intercepts if 1, 2, and 0.5 Å on the crystallographic axes of an orthorhombic crystal with *a: b: c* = 3:2:1. Determine the Miller indices of this plane and also illustrate this plane by drawing a proper unit cell. CO2
5. Show that for a simple cubic lattice $\frac{1}{d_{100}}:\frac{1}{d_{110}}:\frac{1}{d_{111}} = 1:\sqrt{2}:\sqrt{3}$, where d_{hkl} is the inter-planer spacing. CO2
6. Estimate the planar density of (111) and (110) planes for *fcc* unit cell.
7. The plane having Miller indices (110) shows a first order diffraction pattern for angle of incidence θ = 45^0, in a diffraction experiment. Estimate the wavelength for which this diffraction pattern is observed. The crystal has a cubic unit cell of edge 5 Å. CO3
8. Find the drift velocity of the free electrons in a copper wire whose cross-sectional area is 1.0 mm^2 when the wire carries a current of 1.0 A. Assume that each copper atom contributes one electron to the electron gas and density of copper is 8.94 g/cm^3. CO3
9. Find the magnitude of the electric field intensity in a sample of Silver (conductivity 6.17 x 10^{7}mho /m and mobility 0.0056 m^2/V.s) for following situations if CO3
   a) drift velocity is 1 mm/s;
   b) the current density is 10^7 A/m^2;
   c) a total current of 80 A is flowing through a cube shaped sample of dimension 3 mm;
   d) a potential difference of 50 mV across opposite faces of cubic sample of length 5 cm.
10. The resistivity of a metal at temperature 20^{0}C is 1.69 x 10^{-8} Ω.m and concentration of free electrons n = 8.5 x 10^{28} m^3. Calculate root mean square velocity, relaxation time, mean free path, mobility and electrical conductivity on the basis of free electron theory. If an electric field of 1volt/cm is applied to the copper wire, calculate the drift velocity and compare it with root mean square velocity. Discuss this dissimilarity in velocities. CO4