

Engineering Materials (UES012)
School of Physics and Materials Science
Tutorial Sheet No 3-4

1. Draw the following crystallographic planes in cubic unit cell:
(a) (101) (b) ($\bar{1}\bar{1}0$) (c) (221) (d) (210) (e) (0 $\bar{1}2$)
2. Draw the following crystallographic planes in HCP; Check whether the symmetry exists.
(a) (01 $\bar{1}0$) (b) ($\bar{1}0\bar{1}0$) (c) ($\bar{1}2\bar{1}0$) (d) (10 $\bar{1}2$) (e) (01 $\bar{1}\bar{1}$)
3. Draw cubic unit cell and show the following planes in it
(a) (21 $\bar{2}$) (b) ($\bar{1}20$) (c) (12 $\bar{2}$) (d) (20 $\bar{3}$) (e) ($\bar{3}1\bar{2}$) (f) (2 $\bar{2}3$)
4. Draw the following directions in cubic unit cell
(a) [$\bar{1}\bar{1}\bar{1}$] (b) [$\bar{1}\bar{1}3$] (c) [$\bar{1}\bar{1}0$] (d) [110] (e) [101] (f) [102]
5. Draw the hexagonal unit cell and show the following planes in it:
(a) (1 $\bar{2}12$) (b) ($\bar{1}100$) (c) (1 $\bar{1}01$) (d) ($\bar{2}111$) (e) (12 $\bar{1}0$)
6. Compute and compare the linear densities for [100], [110] and [111] for copper. Given $a = 0.3615$ nm.
7. Calculate the linear atomic density in the [110] direction in the copper crystal lattice in atoms per square millimeter. The lattice constant of copper is 0.361 nm.
8. A metal crystallizes in the FCC structure. Calculate the linear atomic density along [110] and [111] direction. Assume lattice constant $a = 0.3923$ nm.
9. Compute the planar density for the BCC (100), (111) and (110) planes in terms of atomic radius r .
10. Calculate the planar density for (110) plane of BCC iron lattice in atoms per square millimeter. The lattice constant of iron is 0.287 nm.
11. From an X-Ray powder diffraction of a pure element, peaks at the following 2θ values in degrees were obtained 38.7, 45.4, 65.7, 78.8, 83.0, 99.6, 112.5, 117.0, 138.1, and 164.2. Copper K_α radiation was used. Find the lattice parameter and the crystal structure.
12. A BCC crystal is used to measure the wavelength of some X-rays. The Bragg angle for reflection from (110) plane is 20.2° . What is the wavelength? The lattice parameter of the crystal is 3.15 Å.
13. Determine the Miller indices of cubic crystal plane that intersects the position coordinates $(1, 1/4, 0)$, $(1, 1, 1/2)$, and $(3/4, 1, 1/4)$.
14. NaCl has the FCC lattice with $a = 5.63$ Å. What is the spacing of {100} plane?
15. Gold has atomic weight 197 and the density 19.3 gm/cc. What is the spacing between atoms in solid gold?

16. Compare packing fraction for SC and FCC lattice.
17. In powder diffraction pattern for lead with radiation of $\lambda = 1.54 \text{ \AA}$ the (220) Bragg reflection angle is $\theta = 32^\circ$. What is the radius of atom?