UES012: Engineering Materials

Tutorial Solutions/answer key

Tutorial-2

Question No.	Formula used	Answer
7	LD=(No. of atoms along a direction)/(length of the line segment)	LD [100]=2.77 atoms /nm LD[110]=3.912 atoms/nm LD[111]=1.597 atoms/nm
8	LD=(No. of atoms along a direction)/(length of the line segment) For BCC, $\sqrt{3}a = 4r$	LD [100]=1.901 atoms/nm LD[110]=1.344 atoms/nm LD[111]=2.195 atoms/nm
9	PD = (Number of atoms on the plane) / (Area of the plane) For FCC, $\sqrt{2}a = 4r$	$PD(100) = \frac{4}{16r^2}$ $PD(110) = \frac{4}{\sqrt{2}\,16r^2}$ $PD(111) = \frac{4}{\sqrt{3}\,16r^2}$
10	PD = (Number of atoms on the plane) / (Area of the plane)	$PD(100) = 1.24\ atoms/nm^2$ $PD(110) = 17.16\ atoms/nm^2$ $PD(111) = 7.01\ atoms/nm^2$

Tutorial-3

Question No.	Formula used	Answer
6	$\rho = \frac{M}{V} = \frac{m \times N_e}{a^3}$	$a = 4.077$ Å
7	$\rho = \frac{M}{V} = \frac{m \times N_e}{a^3}$ $r = \frac{\sqrt{3}}{4}\ a$	ρ = 11.67 gm/cc

Tutorial-4

Question No.	Formula used	Answer
1	$\rho = \frac{A*n}{N*V}$	ρ = 2.211 gm/cc
2	$\rho = \frac{A*n}{N*V}$	ρ = 5.546 gm/cc
3	$d_{hkl} = \frac{a}{\sqrt{h^2 + k^2 + l^2}}$	5.63 Å
4	$d_{hkl} = \frac{a}{\sqrt{h^2 + k^2 + l^2}}$ $2d_{hkl}\ sin\theta\ =\ n\lambda$	$\lambda =\ 1.5236$ Å

5	$2d\ sin\theta\ =\ n\lambda$	$r =\ 1.45$ Å
6	$d_{hkl} = \frac{a}{\sqrt{h^2 + k^2 + l^2}}$ $2d_{hkl}\ sin\theta\ =\ n\lambda$	$a = 4.026$Å
7	$\frac{V_{BCC} - V_{HCP}}{V_{BCC}} \times 100\%$	3.2%
8	R= 0.414r (For octahedral voids) R= 0.225r (For tetrahedral voids) R= radius of largest interstitial void r = radius of iron atom For FCC, $\sqrt{2}a = 4r$	Largest one is for octahedral void. Diameter=1.103 nm
9	R= 0.414r (For octahedral voids) R= 0.225r (For tetrahedral voids)	Tetrahedral void at (0,1/2,1/4) R=0.225r Octahedral void at ()
10	$a = 2(R_a + R_c)$ Density of the unit cell = $\frac{Number\ of\ ions\ X\ Molecular\ weight}{Avegardros\ number\ X\ Volume}$ Ionic packing fraction $= \frac{number\ of\ ions \times volume\ of\ ions}{volume\ of\ unit\ cell} \times 100\ \%$	PD(100)=22.89 atoms/nm^2 2.4 g/cm^3 64%