Solution: Tutorial 9 (Physics 2-15B11PH211)

Solution 1.

Family of planes :-

$\{100\}$ means family of planes $(\bar{1}00)$ $(\bar{1}00)$
(010) $(0\bar{1}0)$
(001) $(00\bar{1})$

Solution 2.

$OA : OB : OC = 3\mathring{A} : 4\mathring{A} : 3\mathring{A}$

$\frac{c}{a} = 1.5$

for tetragonal , $a = b \neq c$

$\therefore$ $b = a$, $c = 1.5a$

$h : k : l = \dfrac{a}{OA} : \dfrac{b}{OB} : \dfrac{c}{OC}$

$= \dfrac{a}{3\mathring{A}} : \dfrac{a}{4\mathring{A}} : \dfrac{1.5a}{3\mathring{A}} = \dfrac{1}{3} : \dfrac{1}{4} : \dfrac{1}{2}$

$= 4 : 3 : 6$

$\boxed{(hkl) \equiv (436)}$ Ans

Solution 3.

$OA : OB : OC = 1\mathring{A} : 2\mathring{A} : \infty$

$h : k : l = \dfrac{a}{OA} : \dfrac{b}{OB} : \dfrac{c}{OC}$

$= \dfrac{3}{1\mathring{A}} : \dfrac{2}{2\mathring{A}} : \dfrac{1}{\infty}$
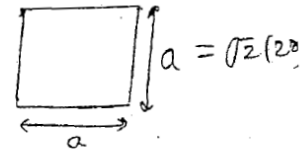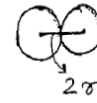
$= 3 : 1 : 0$

$\boxed{(hkl) \equiv (310)}$ Ans

Solution 4.

$$2r = 3.5$$

$$1\,mm^2\ Area$$

for fcc,
$$a = \sqrt{2}\,(2r)$$
$$= 1.414\,(3.5)$$
$$= 4.94\ \mathring{A}$$

(100):- Area of square $= a^2 = (4.94)^2\ \mathring{A}^2$

No. of atoms in this area $= 2$

$$1\mathring{A} = 10^{-7}mm$$

In. $(4.94)^2 \times 10^{-14}\ mm^2$ Area $= 2$ atoms.

$$1\ mm^2\ \ Area = \frac{2 \times 10^{14}}{(4.94)^2}$$

$$= 8.16 \times 10^{12}\ atoms$$

Solution 5.

Fe :
$$a = 2.87\ \mathring{A}$$
$$\rho = 7870\ kg/m^3$$
$$m_A = 55.85$$

n= no of atoms per unit cell

$$a^3 = \frac{n M_A}{N_A\,\rho_m} \quad\Rightarrow\quad n = \frac{a^3\,N_A\,\rho_m}{M_A}$$

$$n = \frac{(2.87)^2 \times 6.023 \times 10^{23} \times 7870}{55.85}$$

$$n = 2.0063$$

$$\boxed{n \simeq 2}\ \text{for bcc},$$

$$n = 1 \rightarrow S.C.$$
$$n = 2 \rightarrow bcc$$
$$n = 4 \rightarrow fcc$$
$$= 8 \rightarrow dc.$$

Solution 6. Please refer lecture slides.

Solution 7.

bcc, Reflection of (110) $\longrightarrow$ 20.2°

$$a = 3.15 \text{ Å} \quad , \quad \lambda = ?$$

$$2 d_{110} \sin \theta_B = \lambda$$

$$\lambda = 2 \times \frac{3.15}{\sqrt{2}} \times 0.34 \text{ Å} \qquad \left[d_{110} = \frac{a}{\sqrt{2}} \right]$$

$$\boxed{\lambda = 1.538 \text{ Å}}$$