MECH 2322: MID TERM: SP 2021: Point-85

I. Determine the types of bonding between the elements below 10

Elements	Pick any of the bonding below	Bonding Types (Pick from left column)
NaCl	Ionic Bonding Covalent Bonding Metal Bonding	Ionic
SiC		Covalent
Aluminum		Metal
CH_4		Covalent
H_2		Covalent

II. **Multiple Choice Questions** 10

1. APF stands for
   a. Applied Physics Forum
   b. Atomic Packing Factor
   c. Asymmetric Potentiality Factor
   d. None of the above
2. Which of the following crystal system has the lowest packing density?
   a. BCC
   b. HCP
   c. FCC
   d. SCC
3. Among the Bonding types below which one is the weakest?
   a. Ionic
   b. Hydrogen
   c. Covalent
   d. Metallic
4. Determine the correct order for the brittleness of the following material
   a. Glass>Metal>Plastic
   b. Metal>Glass>Plastic
   c. Metal<Plastic<Concrete
   d. None of the above

III. Short Questions

1. Draw (hand Sketch) the electron configuration and show valence electrons for the following elements- (10)
   a. Na
   b. Fe
   c. Si

2. Write the elaborations of the following terms (5)
   a. BCC
   b. HCP
   c. XRD

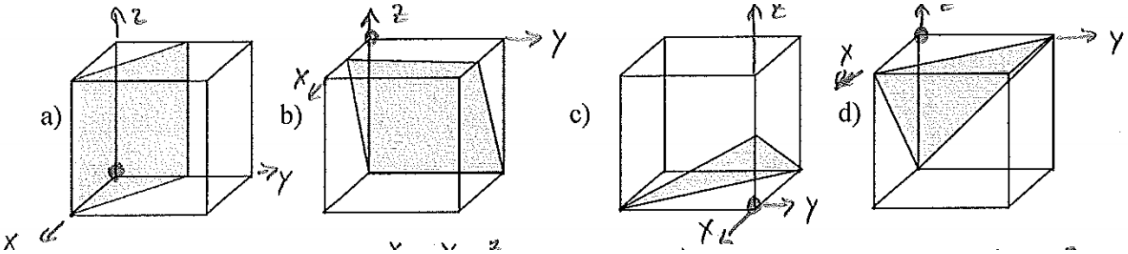
3. Write the Definition of the following terms in your own words- (10)
    a. Lattice Parameter

    b. Unit cell

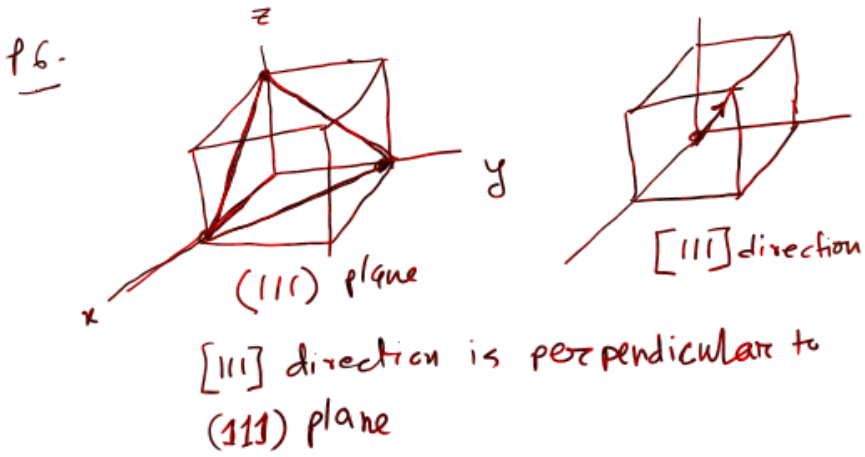
    c. Miller Indices

4. Calculate the density of the material given that its atomic weight is 141 g/mol with BCC crystal structure and lattice parameter of 0.35 nm. (10)

5. Determine Miller indices for the following planes. (be sure to redraw the cubes and identify the axis) SHOW YOUR WORKS IN HAND SKETCH. (10)



6. Show [111] direction and (111) plane in a cube and determine the angle between the direction and the plane. (10)



7. Using Table 3.1 for Copper compute the interplanar spacing for the (110) and (221) sets of planes (10)

Table 3.1 Atomic Radii and Crystal Structures for 16 Metals

Metal	*Crystal Structure*[a]	*Atomic Radius*[b] *(nm)*	*Metal*	*Crystal Structure*	*Atomic Radius (nm)*
Aluminum	FCC	0.1431	Molybdenum	BCC	0.1363
Cadmium	HCP	0.1490	Nickel	FCC	0.1246
Chromium	BCC	0.1249	Platinum	FCC	0.1387
Cobalt	HCP	0.1253	Silver	FCC	0.1445
Copper	FCC	0.1278	Tantalum	BCC	0.1430
Gold	FCC	0.1442	Titanium (α)	HCP	0.1445
Iron (α)	BCC	0.1241	Tungsten	BCC	0.1371
Lead	FCC	0.1750	Zinc	HCP	0.1332

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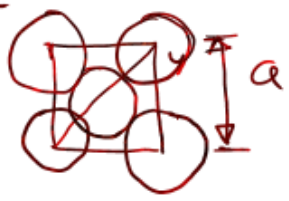
Atomic radius of copper. $R = 0.1278$ nm

crystal structure : Fcc



For Fcc → $a = 2\sqrt{2}R$

$= 2\sqrt{2} \times 0.1278$

$= 0.361$ nm

For (110) planes → $h = 1, k = 1, l = 0$

$$d_{110} = \frac{a}{\sqrt{h^2+k^2+l^2}} = \frac{0.361}{\sqrt{1^2+1^2+0^2}} = 0.255 \text{ nm}$$

$$d_{221} = \frac{a}{\sqrt{2^2+2^2+1^2}} = 0.120 \text{ nm}$$

∴ (221) planes are closer