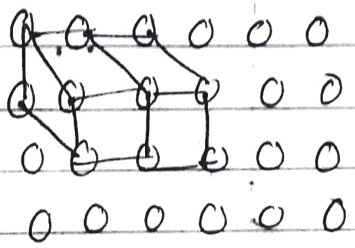
1, Sep, 2021

LECTURE - 2 (SOLID STATE)

LATTICE

1-D lattice - o o o o o o o o o o o

2-D lattice - 

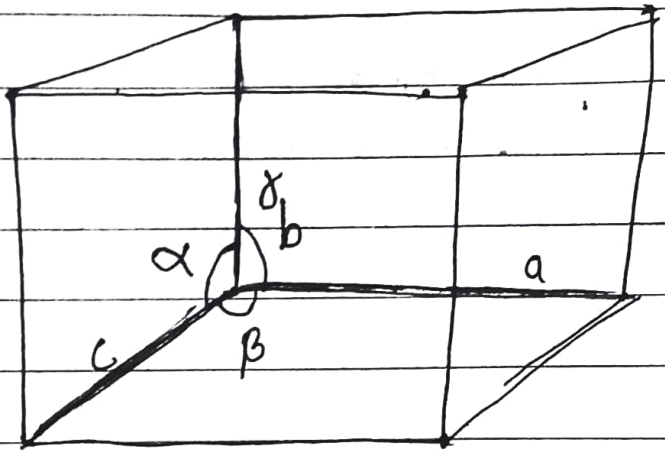
3D lattice 

SPACE LATTICE → It is an imagenary collection of infinite no of points with a regular and repeating geometry.

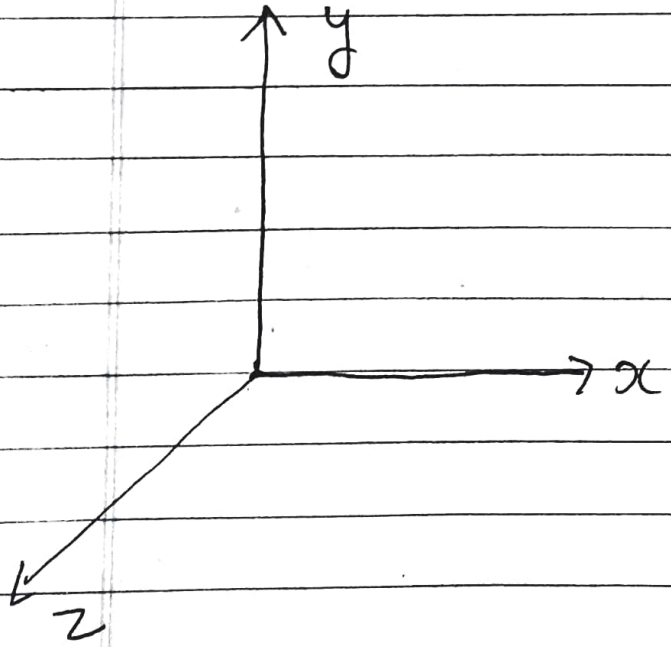
UNIT CELL → The smallest repeating unit of Space lattice is called unit cell.

Cell parameters define the geometry of unit cell.

The imagenary points are known as lattice points.



a → edge length along x
b → edge length along y
c → edge length along z



a, b and c represents the edge length of unit cell along three axis.

The plane may not be perpendicular to each other.

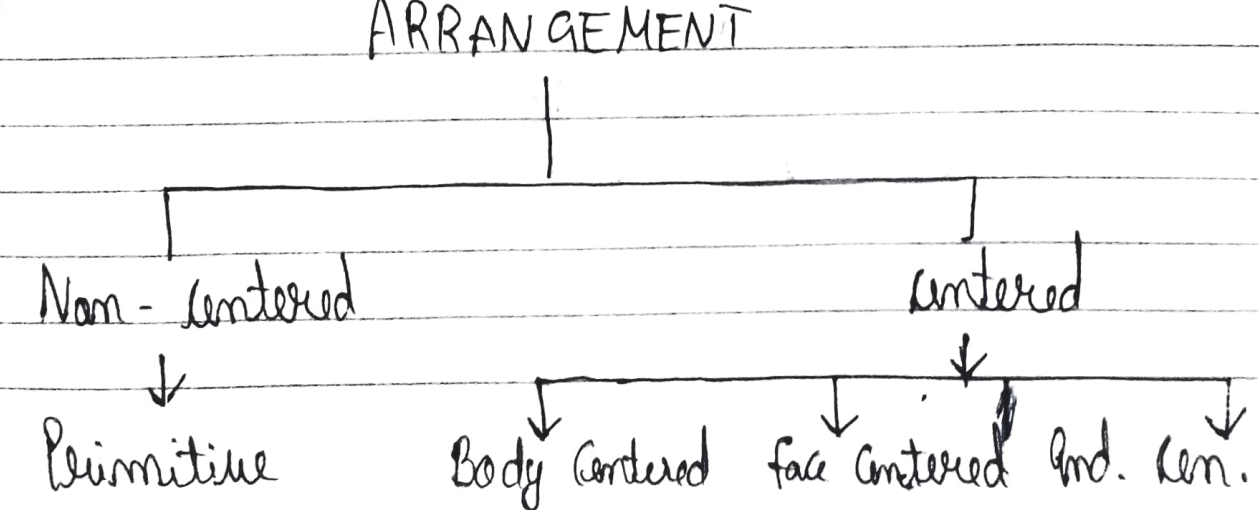
CELL PARAMETERS → SIX

⇒ a, b, c, α, β, γ

⇒ Geometry of the unit cell defines crystal system. There are a total of seven crystal systems.

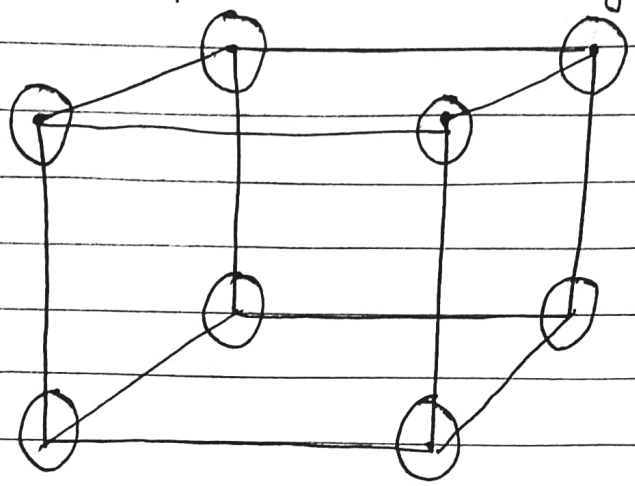
CUBIC CRYSTAL SYSTEM

⇒ There can be four types of arrangement for a given geometry of unit cell



1) PRIMITIVE ARRANGEMENT :→

⇒ when the constituents particles are present at the corners only, it is called primitive arrangement.

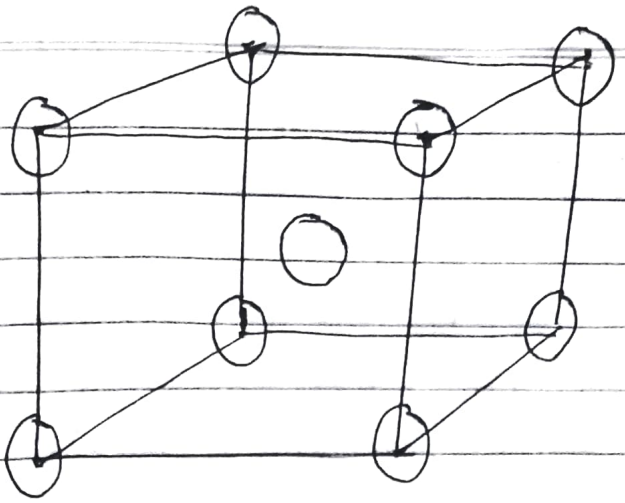


→ Primitive Crystal System

Arrangement Crystal System.

2) BODY CENTERED ARRANGEMENT :→

⇒ when the constituents particles are present at the corness as well as the center of the unit cell, it is called body centered arrangement.

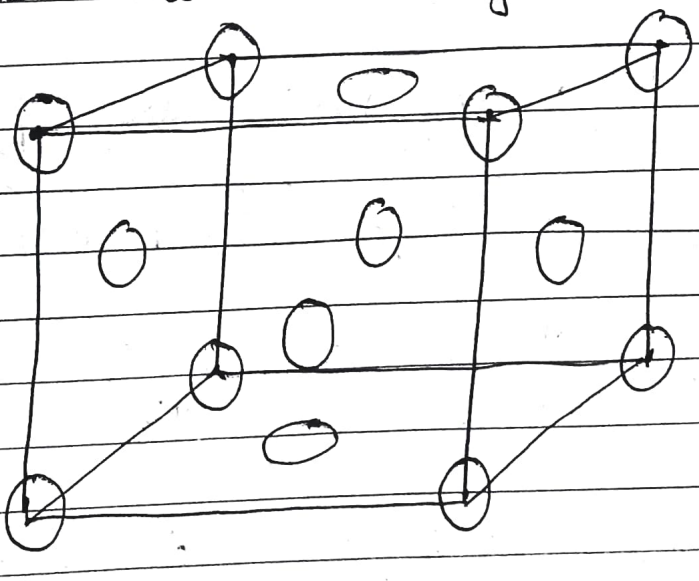


Body centered Cubic (BCC)

Arrangement.

3) Face CENTERED ARRANGEMENT :⇒

⇒ when the constituents particles are present at the corners as well as the center of the faces, it is called face centered arrangement.

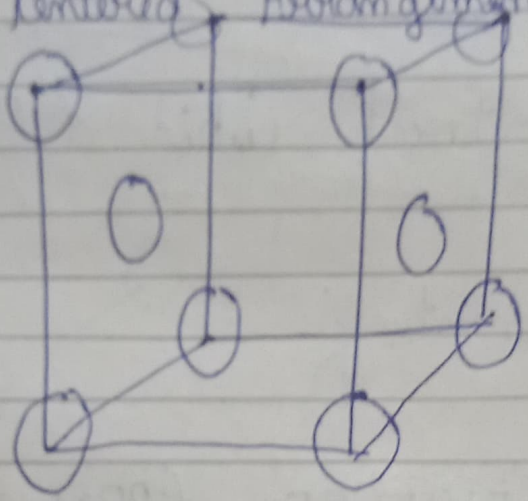


Face centered Arrangement

Cubic Crystal System.

END - CENTERED ARRANGEMENT

when the atoms are present at corners and at any two of parallel walls of unit cell is known as End - Centered Arrangement.



CELL BANK :⇒

IMPORTANT Points :→

⇒ Since 4 arrangements are possible within each crystal system, So 7 × 4 = 28 unit cells are possible theoretically.

⇒ Only 14 out of 28 can exist in nature (Symmetry Consideration)

⇒ These units cells are not equally distributed among the crystal System.

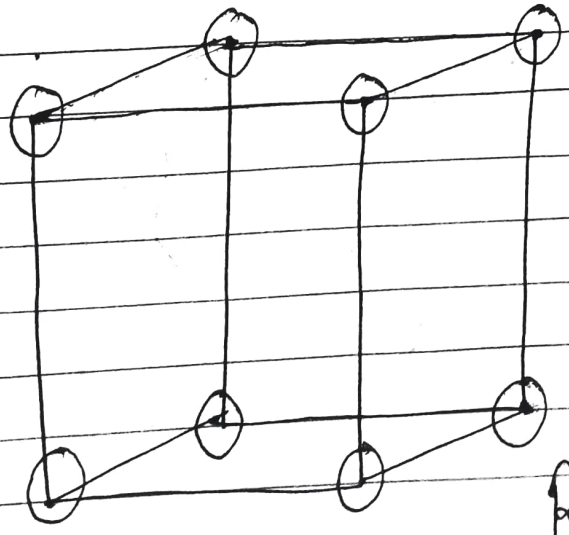
⇒ Constituents particles are considered to be solid sphere. Their shape can't be deformed by the application of stress. They may or may not make contact with each other but they never merge into one another.

⇒ Lattice points are located at the centre of the sphere.

RANK OF UNIT CELL :→

⇒ It is effective number of atoms per unit cell.

1) CORNER CUBIC SYSTEM

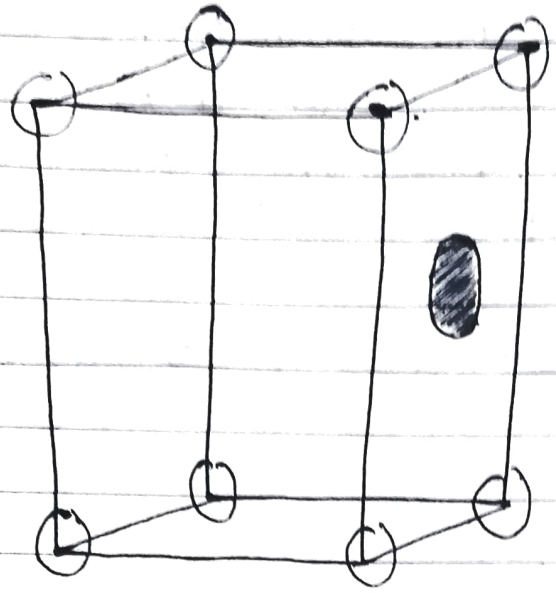


The corner atom is shared by eight cubes, therefore it's contribution in one unit cell is $\frac{1}{8}$.

$$\text{Rank} = \frac{n_c}{8}$$

n_c = atoms at corners.

ii) Face Centered Cubic System (FCC) :-

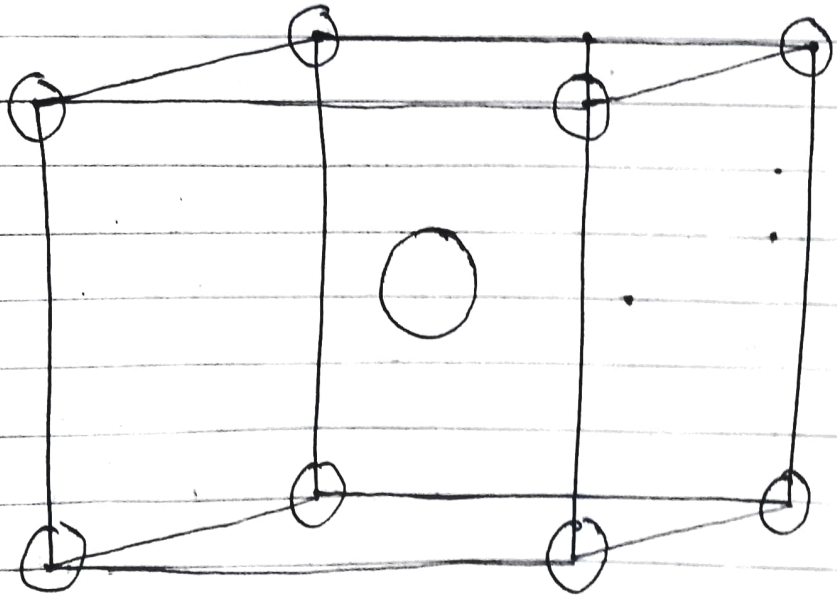


The face atoms are shared by two unit cells, Therefore it's contribution in one cube is $\frac{1}{2}$.

$$\text{Rank} = \frac{n_f}{2} + \frac{n_c}{8}$$

where n_f = atoms at faces
n_c = atoms at Corners

iii) Body Centered Cubic System (BCC) :-



⇒ The atoms inside the cube are called body atoms and they contribute their whole to the unit cell.

$$\text{Rank} = \frac{n_c}{8} + \frac{n_f}{2} + n_b$$

n_b = atoms of body Centered.

#NOTE The atoms on the edges are shared by 4 cubes Therefore it's contribution to one cube is $\frac{1}{4}$

$$\text{Rank} = \frac{n_c}{8} + \frac{n_f}{2} + n_b + \frac{n_e}{4}$$

Only applicable to cubic crystal System.