Arab Academy for Science & Technology & Maritime Transport
(AASTMT – Cairo Branch)
College of Engineering & technology
Electronics & Communication Engineering Department

Course : Solid State Electronics
Course Code : EC210

Sheet #1

Physical Constants:

Charge of electron (e) =1.6x10^{-19} C
Mass of electron (m_e) = 9.1x10^{-31} kg
Mass of proton (m_p) = 1.672x10^{-27} kg
Avogadro's number (N_A) = 6.02x10^{23} atoms/mole
Plank's constant (h) = 6.63x10^{-34} J.s
Speed of light (C) = 3x10^{8} m/s

Put (T) for the true statement or (F) for the false statement:

1. The material that has crystalline subsections which are disoriented relative to each other is an amorphous material.
2. The bond that occurs between atoms due to the sharing of valence electrons between the atoms is a metallic bond.
3. In Sodium Chloride (NaCl), atoms are bonded by an ionic bond.
4. In Silicon, atoms are bonded by a metallic bond.
5. In Copper, atoms are bonded by a covalent bond.

Choose the correct answer justifying your choice:

1. The bond that occurs between different atoms due to the transfer of valence electrons from one atom to another is a ……..bond.
   (a) ionic (b) covalent (c) metallic (d) molecular

2. The bond that occur between atoms due to electrostatic force between free electrons and positive ions is a ……..bond.
   (a) ionic (b) covalent (c) metallic (d) molecular

3. In semiconductor materials, atoms are usually bonded by a ……..bond.
   (a) ionic (b) covalent (c) metallic (d) molecular

4. The material that has arranged atoms in 3D array is ……. material.
   (a) crystalline (b) poly-crystalline (c) amorphous (d) non-crystalline

5. The material that has no recognizable long-range order is a …… material.
   (a) crystalline (b) poly-crystalline (c) semiconductor (d) non-crystalline

6. In a simple cubic structure, there are …….. atoms per unit cell.
   (a) 1 (b) 2 (c) 4 (d) 8

7. In a body-centered cubic structure, there are …….. atoms per unit cell.
   (a) 1 (b) 2 (c) 4 (d) 8

8. In a face-centered cubic structure, there are …….. atoms per unit cell.
   (a) 1 (b) 2 (c) 4 (d) 8

9. In a diamond structure, there are …….. atoms per unit cell.
   (a) 1 (b) 2 (c) 4 (d) 8

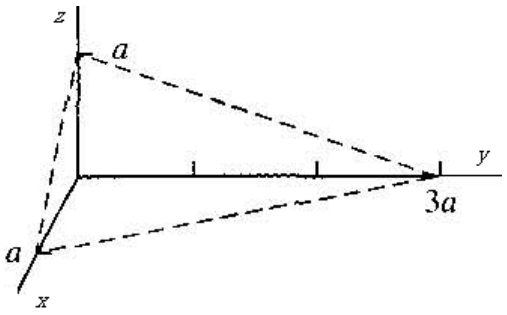
10. Silicon atoms are arranged in a ……..... lattice structure.
   (a) diamond (b) zencblende (c) simple cubic (d) face-centered cubic.

11. Gallium Arsenide (GaAs) crystallizes in a ……..... lattice structure.
   (a) diamond (b) zencblende (c) simple cubic (d) face-centered cubic.

12. The energy gap (E_g) of an insulator material is usually:
   (a) zero (b) greater than 4 eV (c) less than 2 eV (d) negative

13. The [110] direction in a cubic unit cell is parallel to ……. of the unit cell
   (a) an edge (b) a body diagonal
   (c) a face diagonal
   (d) the normal of a face

14. The Miller indices for the plane shown in the figure are denoted by
   (a) (113) (b) (313) (c) (131)
   (d) (101) (e) (133)



Solve the following Problems:

[1] Copper has a F.C.C structure and its atomic radius is 1.278 A^0. Calculate its density. Atomic weight of Copper = 63.54 g/mole.

[2] Calculate the densities of Ge where the lattice constants is 5.66 A^o and the atomic weight of Ge is 72.59 g/mole.

[3] Show that for the closest packing of spheres, the atomic packing factor of the face-centered cubic (FCC), body-centered cubic (BCC), Simple Cubic (SC) and diamond lattices are approximately in the ratio of: 1.4 : 1.3 : 1 : 0.65 .

[4] Draw the (110) and (111) planes and the [110] and [111] directions in a simple cubic crystal.

[5] Given the following families of planes: {201},{150}, and{312}:
   a) Write down all possible combination of planes for each family.
   b) Draw one plane for each family.

[6] Write down the Miller indices for each of the following planes.