EC102: Electronic Devices and Circuits
Tutorial Sheet-1

1. The atomic number of silver is 47.Determine its orbital distribution of electrons.
[Ans: 2, 8, 18, 1]
2. What is the valency of gallium whose atomic number is 31?
[Ans: 3]
3. Antimony has atomic number of 51. How many valence electrons does it have?
[Ans: 5]
4. At room temperature ,copper has free-electron density of 8.4 x 10^{28} per m3.Find electron drift velocity in a copper conductor having a cross-section of 10^{-6} m^2, a length of 1.5 m and carrying a current of 5.4 A.
[Ans: 0.4mm/s]
5. Determine the intrinsic carrier concentration of germanium if its intrinsic resistivity at 300 K is 0.47 ohm-m .Given that the electron and hole mobilities are 0.39 m^2/Vs and 0.19 m^2/Vs, respectively.
[Ans: 2.3x1019/m^3]
6. A sample of silicon is doped with phosphorous to a density of 10^{21} /m^3 as well as with boron to a density of 5 x 10^{20}/m^3. Determine the conductivity of the silicon sample. Given that μ_n = 0.18 m^2/Vs.
[Ans: 14.4 S/m]
7. Determine the resistivity of a N-type germanium at 300 K with donor density of N_d=10^{20}/m^3, all donors are assumed ionized .Given that μ_n= 0.38 m2/Vs.
[Ans: 0.164 ohm-m]
8. Compute the mobility of free electrons in Al for which the density is 2.7 g/cm^3, atomic weight is 26.98 and resistivity is 3.44 x 10^{-6} ohm-cm .Assume that the Al has 3 valence electron / atom.
[Ans: 10.0cm^2/Vs]
9. What percentage of the electron leaving a tungsten filament at 2700K can surmount a barrier whose height is 1eV?
[Ans: 0.014]
10. The specific gravity of tungsten is 18.8 and atomic weight is 184 .Assume that there are 2 free electrons per atom .Calculate n and E_F.
[Ans: 8.95 eV]
11. A donor type impurity is added to the extent of 1 atom per 10^6 atom of an intrinsic semiconductor (Silicon). Calculate:
    a. Resulting donor atom concentration **[Ans: 5x 10^{16} per cm^3]**
    b. Resulting mobile electron concentration **[Ans: 5x 10^{16} per cm^3]**
    c. Resulting hole concentration **[Ans: 4.205x 10^3 per cm^3]**
    d. Conductivity of doped silicon sample **[Ans: 10.413 S/ ohm]**
    e. If silicon bar is 0.5cm long, cross sectional area of $(50e\text{-}4)^2$ cm^2. Find its resistivity. **[Ans: 1920 ohm]**

    The concentration of Si atoms = 5x 10^{22} cm^{-3} and n_i= 1.45 x $10^{10}$$cm^{-3}$
    μ_e=1300cm^2/Vs.

12. The resistivity of doped silicon material is 9x 10^{-3} ohm-m. the hall coefficient is $3.6x10^{-4}$ m^3 $coulomb^{-1}$. Assuming single carrier conduction. Find the mobility of the charged carrier. **[Ans: 0.04m^2/vs]**

13. The electron concentration in an n-type Si varies linearly from 10^{17} cm^{-3} at x = 0 to $6x10^{16}$ cm^{-3} at x = 2 μm. Electrons are supplied to keep their concentration constant with time. Calculate the current density if no electric field is present. D_n = 35 cm^2/S.

14. A Si bar Doped with 10^{17} cm^{-3} atoms of Sb has a length of 0.1 cm and an area of cross-section 100 μm^2. Determine the current when the voltage of 10 V is applied across the bar. Assume μ_n = 1000 cm^2/V-sec.

15. The Hall effect is used to determine the mobility of holes in a p type Si bar. Assume the bar resistivity $\rho = 3.2x10^5$ Ω-cm, the magnetic field B_z = 0.1 Wb/m^2 and d = W = 3 mm. The measured values of current I_x = 10 μA. and the Hall voltage V_H = 50 mV. Determine the hole mobility μ_p.