Assignment-1[1]
Definitions, Energy band Diagrams and Ohms Law

Prerequisite for solving the below problems is thorough understanding of Lecture notes-1. All the constants are given in table-1 of the lecture notes-1. Any missing data may be suitably assumed and stated.

$$n = \frac{dv}{AM} = \frac{A_0 dv \times 10^3}{A}$$

where d= density, kg/m^3; v=valence, free electrons per atom; A= atomic weight; M= weight of atom of unit weight, kg; A_0=Avogadro's number, molecules/mole.

1. For the ground state ($n = 1$) of the hydrogen atom, show that the radius is 0.53 Å.

2. A conducting line on an IC chip is 2.8 mm long and has a rectangular cross section $1 \times 4\ \mu m$. A current of $5mA$ produces a voltage drop of $100mV$ across the line. Determine the electron concentration given that the mobility is 500 $cm^2/V - s$.

3. A flat aluminum strip has a resistivity of $3.44 \times 10^{-8}\ (\Omega - m)$, a cross-sectional area of $2 \times 10^{-4}\ mm^2$, and a length of 5 mm. What is the voltage drop across the strip for a current of 50 mA.

4. For the aluminum strip described above in Prob.2, what current exists if the voltage across the strip is $30\mu V$?

5. The specific density of tungsten is $18.8 g/cm^3$, and its atomic weight is 184.0. Assume that there are two free electrons per atom. Calculate the concentration of free electrons. HINT: Use the equation mentioned above.

6. (a) Compute the conductivity of copper for $\mu = 34.8\ cm^2/V - s$ and density d=8.9 g/cm^3.
   (b) If an electric field is applied across such a copper bar with an intensity of 10 V/cm, find the average velocity of the free electrons.

7. Compute the mobility of the free electrons in aluminum for which the density is 2.7 g/cm^3 and the resistivity is $3.44 \times 10^{-6}\ \Omega - cm$. Assume that aluminum has three valence electrons per atom.

8. Calculate the Bohr radius (Å) and energy (eV) for n=1,2,3.

[1] **Due date: 27th August 2006, 3:30 pm. To be submitted in the Office.**