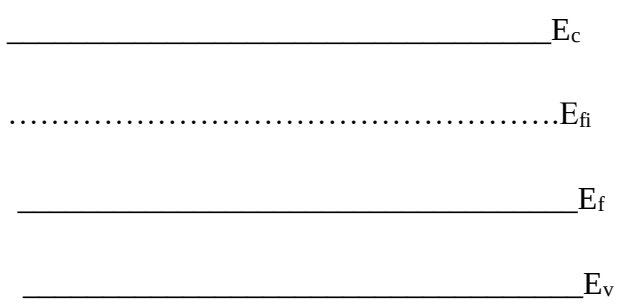
EEM Assignment - II

Solve all the questions in a separate answer sheet (Hand written) and submit it within given time.

Last Submission Date: 2079 - 09 - 21

1) What is the wavelength associated with a canon projectile of mass 100 kg traveling at a velocity 1000 ms^{-1}.
2) The value of constant in Richardson - Dushman equation for metal is 30. 1 amp $cm^{-2}\,{}^0K^{-2}$ and the value of minimum energy required for electron to escape the metal surface is 2. lev. Find the emission current density at 1000 ^0K. Given $K_B = 1.37 \times 10^{16}$ $ergs^0K^{-1}$.
3) The resistivity ρ of copper at 20°C is 1.69×10^{-8} ohm-m and density of free electrons, $n = 8.5 \times 10^{28} m^{-3}$. Calculate the mean free time of electron in copper lattice, (Given $m^* = 1.0lm$, where $m = 9.1 \times 10^{-31} Kg$)
4) Indium Antimonide has an electron mobility of $6m^2$ $volt^{-1}$ sec^{-1} and hole mobility of $0.2m^2$ $volt^{-1}$ sec^{-1}. The highest room temperature (300 ^0k) resistivity is 2×10^{-4} ohm-m. Assuming the material is Intrinsic, determine the intrinsic carrier density n_i, at room temperature.
5) All electron is confined to an infinite potential well of size 0.1 nm. Calculate the ground energy of the electron and radian frequency. How this electron can be put to the fifth energy level.
6) At which temperature, do you expect probability of finding electron at the energy state 0.25e V above Fermi level, will be 10%.
7) A semiconductor crystal is characterized by following energy band Diagram at 300 ^0K.



   i) Find the type of dopant and the doping level.

   ii) Calculate the conductivity of semiconductor at room temperature.

   iii) If it is desired that Fermi-Level is to be lowered to 0.3 eV below intrinsic Fermi level what type of dopant is to be used? Determine its doping level.

8) Find the resistivity of germanium at temperature of 300 ^0K. Given $\mu_n = 3900\ cm^2 / v - s$ $\mu_p = 1900\ cm^2 / v - s$ and $n_i = 2.5 \times 10^3$ atoms / cm^3
9) Derive the following expression for an intrinsic semiconductor $\rho_i = 1/B \exp [E_g / 2KT]$ Where ρ_i is the resistivity, E_g is the Energy Gap and B is a constant.
10) A Silicon wafer doped uniformly with 10^{16} Indium atoms per cm^3 is further doped with 2.1×10^{17} Antimony atoms per cm^3. Determine the position of the Fermi energy with respect to the Fermi energy E_{Fi} in intrinsic Silicon. The intrinsic concentration of Silicon is 1.45×10^{10} per cm^3 at room temperature. Draw energy band diagram for the above .

11) The drift mobility of electron is 43 $cm^2V^{-1}S^{-1}$ and the mean speed is $2x10^2$ m/s. Calculate the relaxation time and mean free path of electrons between collisions.) The density of states related effective masses of electrons and holes in silicon are approximately $1.08m_e$ and $0.56m_e$ respectively. The electron and hole drift mobility's at room temperature are 1350 and 450 $cm^2 V^{-1} S^{-1}$ respectively. Calculate intrinsic concentration and Intrinsic resistivity of silicon. Take the energy band gap for silicon as 1. 1eV.

12) Consider an electron confined to a region of size 0.1 nm, which is the typical dimension of an atom, what will be the uncertainty in its momentum and hence its kinetic energy?

13) Find the temperature at which there is 98% probability that a state 0.3 eV below the Fermi energy level will be occupied by an electron.

14) Find the resistance of pure silicon cubic crystal of 1 cm^3 at room temperature. What will be the resistance of the cube when it is doped with 1 Arsenic in 10^9 Si-atoms and 1 Boron atom per billion Si-atoms? Atomic concentration of Si is $5x10^{22}$ cm^{-3} and mobility's for electron and holes are 1350 and 450 $cm^2 v^{-1}s^{-1}$ respectively.

15) Calculate the mean free path and the mean free time between collision of an electron having drift mobility 43 $cm^2V^{-1}s^{-1}$ and mean speed $1.2x10^6$ ms^{-1} .