INDIAN INSTITUTE OF SPACE SCIENCE AND TECHNOLOGY

AV212 Semiconductor Devices

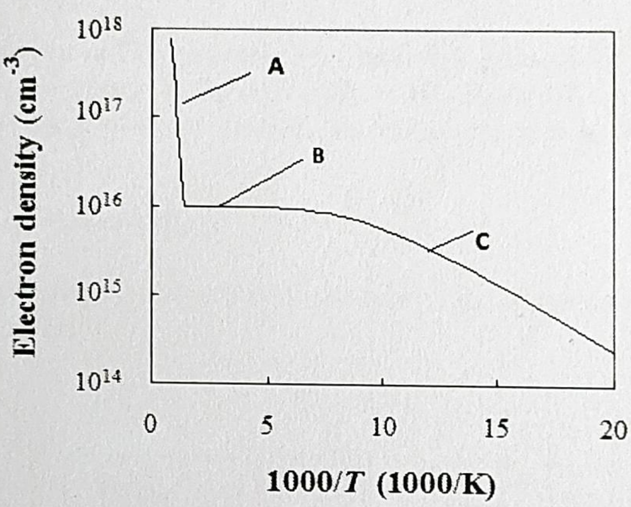
Department of Avionics

Quiz #2 (21/10/2022)

Semester: III **Maximum Marks: 30**

Answer ALL questions

1. Silicon shows a higher intrinsic carrier concentration compared to GaAs at a given temperature. With relevant equation and diagram explain the reason for this. **[3]**
2. Assume that 10^{19} electron hole pairs per cm^3 per second are generated optically by shining a laser beam (Type A) on a Silicon sample with $n_0=10^{14}/cm^3$. The life time of electron and hole is 2×10^{-6} second. Calculate the equilibrium hole concentration. Calculate the steady state hole concentration.
   Now assume that a new laser beam (Type B) of wavelength 1700nm is shone on the Silicon sample. How many additional electron hole pairs are now generated due to the shining of Type B laser beam? **[7]**
3. The carrier concentration versus inverse temperature for Silicon doped with 10^{16} donors per cm^3 is shown below.



   Simply mention what are the names of A, B and C.
   Describe with band diagram, the origin of behavior for the region marked A. **[5]**
4. Show graphically the DOS and Fermi probability function for an p-type semiconductor. Assume equal effective mass for electron and hole.
   Plot them as a function of energy on the same graph. Illustrate how to calculate the carrier densities in conduction and valence bands. **[6]**
5. Mention the two scattering mechanisms that influence the electron and hole mobility. Plot the temperature dependence of mobility with both these scattering present. Write down the net mobility when both the scattering mechanisms are present. Which scattering mechanism dominates in lightly doped semiconductors? **[4]**
6. Consider a GaAs sample at T=300K with doping concentration of $N_A=10^{14}/cm^3$ and $N_D=10^{16}/cm^3$. Assume that the dopants are completely ionized, and the electron and hole mobilities are 8500 and 400 respectively. Calculate the drift current density if the applied electric field is E=10 V/cm. Also, calculate the respective hole and electron Diffusion coefficients **[5]**