ELEC 321/4-H	INTRODUCTION TO SEMICONDUCTOR MATERIALS AND DEVICES	Winter 2018
Homework due on February 27th 2018 No late homework will be accepted		

Homework #3

1. The *E* versus *k* diagram for a particular allowed energy band is shown in Fig. 1. Determine the sign of the effective mass.

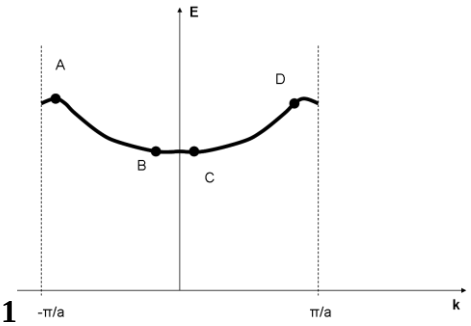

Fig.1

2. The energy band diagram for Silicon is shown in Fig. 2. The minimum energy in the conduction band is in the [100] direction. The energy in this direction near the minimum value can be approximated by

$$E=E_0-E_1.cos[\alpha(k-k_0)]$$

where k_0 is the value of k at minimum energy. Determine the effective mass of the particle at $k=k_0$ in terms of equation parameters.

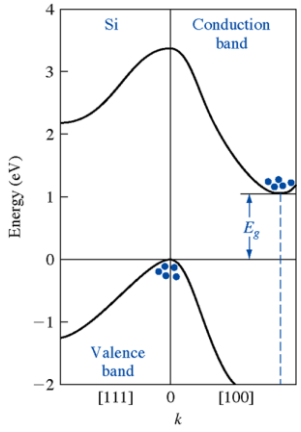

Fig. 2

3. Determine the total number of energy states in GaAs between E_V and E_V-kT at T=300 K. Consult Table B.4 of your textbook for any missing information.

4. Determine the probability that an energy level is occupied by an electron if the state is above the Fermi level by (a) kT, (b) 5kT, and (c) 10kT. k is the Boltzmann constant.

5. Consider the bandgap of Silicon at T=300 K (i.e. E_g=1.12 eV). (a) If E_C-E_F=0.3 eV, determine the probability that an energy state at $E=E_C$ is occupied by an electron and the probability that an energy state $E=E_V$ is empty. (b) Repeat part (a) if E_F-E_V=0.4 eV.

6. Calculate the temperature at which there is a 10^{-6} probability that an energy state 0.55 eV above the Fermi energy level is occupied by an electron.