PHY4905 Spring 2013

Homework D

Instructor: Yoonseok Lee

Submit only HW's. EX's are additional problems that I encourage you to work on.

(**a**.**b**) means problem number **b** of chapter **a** in *Introduction to Solid State Physics* (8th ed.) by Kittel.

Use SI unit.

Due February 18

HW 1: (6.5) (10 pt)

HW 2: (6.6) (10 pt)

HW 3: (6.9) (10 pt)

HW 4: One can write the Drude conductivity (σ) in a slightly different form introducing a new quantity called mobility:

$$\sigma = \mu_e n e,$$

where μ_e is electron mobility, and n and e carry the conventional definition. In general mobility is defined as the ration of the drift velocity to the driving field, $\mu = \frac{v}{f}$.

(a) Using the general definition and the equation of motion for an electron with scattering derived in class, verify that

$$\mu_e = \frac{e}{m}\tau.$$

(b) Electrical current of 6.4 mA is passed through a 10 mm cube of germanium when 10 mV is applied between two parallel faces. Assuming that the charge carriers are electrons that have a mobility of 0.39 $m^2V^{-1}sec^{-1}$, calculate the density of carriers. What is the relaxation time τ if the electron effective mass is $0.12m_e$? (10 pt)

HW 5: Measurements on sodium have provided the following data: resistivity 4.7×10^{-8} Ωm, Hall coefficient -2.5×10^{10} m^3C^{-1}. Calculate the density of electron and the electron mobility. Use electron bare mass. (10 pt)

HW 6: Electrical conductivity of silver at room temperature is 6.3×10^7 $\Omega^{-1}m^{-1}$. A piece of silver rod of 0.5 cm diameter and 50 cm-long was annealed to achieve the residual resistance ratio 2500. What is the thermal conductance of this wire at 4 K? (10 pt)