Home Problem Set #14 Due : November 24, 2014

1. Complete the intermediate steps between (10.5) and (10.6).

2. Calculate the conductivity from the index of refraction and the damping constant for copper (0.14 and 3.35, respectively; measurement at room temperature and $\lambda = 0.6\ \mu$m).

3. Derive the Hagen-Rubens relation from (10.33). (*Hint*: In the IR region $\varepsilon_2^2 \gg \varepsilon_1^2$ can be used. Justify this approximation.)

4. The plasma frequency, ν_1, can be calculated for the alkali metals by assuming *one* free electron per atom, i.e., by substituting for N_f the number of atoms per unit volume (atomic density, Na). Calculate ν_1 for potassium and lithium.

5. Derive the equation (11.10a).

6. Calculate N_{eff} for sodium and potassium. For which of these two metals is the assumption of *one* free electron per atom justified?

7. Describe the damping mechanisms for free electrons and bound electrons.

8. Calculate the effective number of free electrons per cubic centimeter and per atom for silver from its optical constants (n= 0.05 and k =- 4.09 at 600 nm). (*Hint*: Use the free electron mass.) How many free electrons per atom would you expect? Does the result make sense? Why may we use the free electron theory for this wavelength?

9. Calculate the gap energy and the emitting wavelength of a GaAs laser that is operated at 100°C. Take the necessary data from the tables in Appendix 4 and Table 19.2.