Assignment 9
PHGN361

Homework due March 30

1. A gas of linear dielectric material of density ρ $atoms/m^3$ is exposed to an electric field in a parallel plate capacitor. Derive an expression for χ_e in terms of the polarizability α of an atom. The capacitance is measure to be C_0. Derive a relationship for α in terms of the measured capacitance (and its parameters). You have then succeeded in determining an atomic property from a macroscopic measurement of capacitance!

2. Problem 1.56

3. Read section 5.1, 5.2, 5.3.

4. Problem 5.10, 5.13, 5.18, 5.19, 5.20

5. Consider an operational-amplifier with feedback. The input signal, V_{in} is first amplified to an output voltage $V_{out} = AV_{in}$ where A is the gain of the amplifier. Now this output is modified by feeding back to the input the output voltage. Let the output be added or subtracted with the input signal before going back through the amplifier. What is the equation that describes this process for positive and for negative feedback. Try to write it down without looking up the answer. Solve the equation for ratio V_{out}/V_{in}. For small A write this expression as series expansion (perturbation series)in A. You don't have to start with a particular configuration of an op-amp with resistors. I want you to start with a schematic of the system. The amplifier is a triangle with a input line going in and an output line going out. The input line has a circle in it that allow another line to come into the circle to add or subtract a signal. A line then goes from the output line back to the circle at the input line so that that signal adds to the input signal. An input Vin goes through the amp to generate Vout = A Vin where A is the gain. Now put feedback into this equation.