Háskóli Íslands
Verkfræðideild
Rafmagns- og tölvuverkfræði

Haust 2001

08.33.40 Hlutjónað rafgas

Dæmablað 4

Skilafrestur 3. október 2001 kl. 14:00

1. (15) Dæmi 4.3 í Lieberman og Lichtenberg

2. **rf afhleðsla**

   (15) A one-dimensional slab model of an rf discharge between two parallel perfectly conducting electrodes of area A consist of a uniform plasma slab ($n_\mathrm{e} = n_\mathrm{i} = n_0$) of thickness d with two sheaths, each of thickness s, one near each electrode. An rf voltage source is connected across the electrodes, such that an rf current $I(t) = I_0 \cos \omega t$ flows across the plates. You may neglect ion motions and assume that $\omega_\mathrm{p} \gg \omega, \nu_\mathrm{m}$, where ω_p is the plasma frequency and ν_m is the electron-neutral momentum transfer frequency. Writing the voltage across the plates in the form $V(t) = \mathrm{Re}[V_0 \exp(j\omega t)]$, then we can introduce

   $$V_0 = I_0 Z = I_0(R + jX)$$

   where Z, R, and X are impedance, resistance, and reactance of the discharge, respectively. (V_0 and Z are complex numbers; I_0, R, and X are real numbers.)

   (a) Find R and X for this discharge model. Sketch R and X versus ω for $0 \leq \omega \leq \omega_\mathrm{p}$.

   (b) Find the real power

   $$P = \frac{1}{2}\mathrm{Re}(V_0^* I_0)$$

   flowing into the discharge, and find the frequency ω_res for which $X = 0$ (the series resonance frequency).