

Physics 106c: Electrodynamics

Problem Set 6

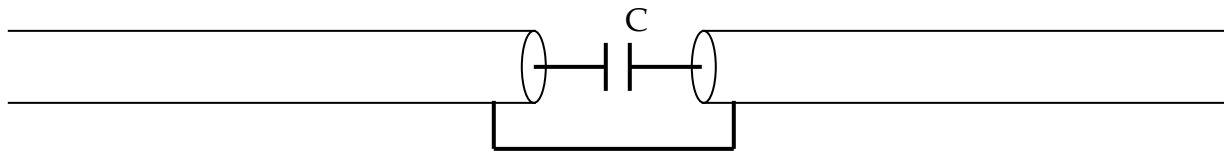
Due: 4pm Friday, May 18, 2012

Remember: Late homework will be granted 50% credit up to one week late, unless you have a note from the Dean or a health official.

Reading: Griffiths Chapter 10.

Problems:

1. An infinitely long coax consists of two semi-infinite sections which have 50 ohm characteristic impedances separated by an intermediate section which is 10 cm long and has a characteristic impedance of 93 ohms. Calculate the energy transmission coefficient of this coax as a function of frequency assuming waves are incident from one direction. Assume the wave velocity in all the coaxes is the same, $0.7c$. Describe your results in physical terms.
2. A joint between two long coaxial cables is produced by connecting a small discrete capacitor C between the inner conductors. The outer conductors of the cables are connected by a short wire of negligible resistance and inductance. The two coaxes have the same characteristic impedances. The drawing below depicts the situation:



A sinusoidal wave of frequency ω is incident upon this junction from the left.

- a) Find the complex reflection and transmission coefficients as a function of frequency.
- b) Assuming the coaxes have 50 ohm characteristic impedances, find the phase angle between the incident and reflected waves at $\omega/2\pi = 3$ GHz, assuming $C = 1$ picroFarad.

3. A long coax is terminated with a 100 picofarad capacitor. The characteristic impedance of the coax is 50 ohms. A square voltage pulse, 1 volt high and 20 ns wide is sent down the coax toward the terminating capacitor. Calculate, numerically if necessary, the shape of the reflected pulse. You may wish to use Fourier analysis for this problem.

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4. Consider a hollow waveguide with a right-triangle cross-section. Determine the spectrum of transverse electric (TE) modes which propagate down this guide. In other words, find the ω vs. k relations and cut-off frequencies for the propagating TE modes.

