ECE 604 Electromagnetic Field Theory

Fall 2019

Homework No. 8. Due Date: Nov 1, 2019.

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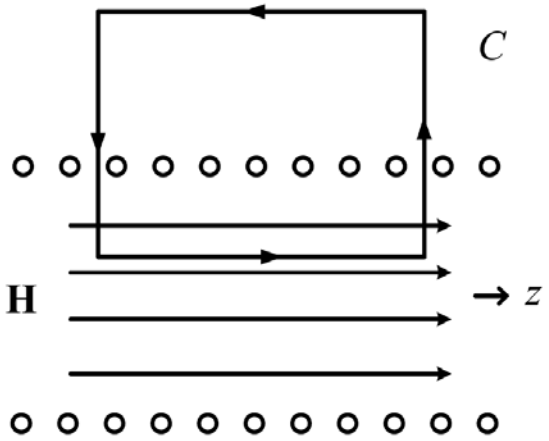
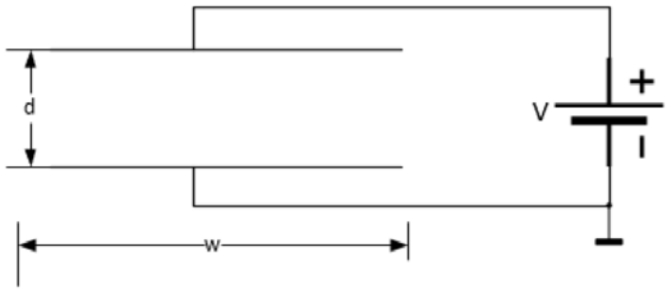
Read lecture notes 1-26.

1. Use the energy storage method:
(i) Find the inductance of the solenoid and show that it is the same as that obtained by the flux linkage method. (Hint: Ramo et al has a discussion of this.)



(ii) Find the capacitance of a parallel plate and show that it is the same as that obtained by solving the boundary value problem between the parallel plates, then followed by calculating the total charge stored in the plates.



2. (i) Since we know the complete field of a Hertzian dipole, both in the near field and the far field, find the complex Poynting vector $\mathbf{E}\times\mathbf{H}^*$ as a function of r. Explain the physical meanings of the real part of this vector, and its imaginary part.
(ii) Find the decay rates with respect to r for the real part and imaginary part.
(iii) Explain the decay rates. Which part decays faster, the real part or the imaginary part? Explain why.

3. (i) Show that in the far field, the ratio of $|\mathbf{E}|/|\mathbf{H}|=\eta$. Give the physical reason for this.

(ii) In Lecture 26, it was shown that

$$\mathbf{A}(\mathbf{r}) \cong \frac{\mu e^{-j\beta r}}{4\pi r}\mathbf{F}(\boldsymbol{\beta})$$

Explain why when we are in the far field, in the neighborhood of an observation around $\mathbf{r}$, the variation of the field is dominated by $e^{-j\beta r}$, and hence, why we can make a local plane wave approximation.

(iii) Find the radiation resistance of a short dipole (not Hertzian dipole) that is 0.2 wavelength long.