ECE 3317
Applied Electromagnetic Waves

Exam 1
Oct. 27, 2020

General Information:

The exam is open-book and open-notes. You are not allowed to use any device that has communication functionality (laptop, cell phone, ipad, etc.), except for the computer that you use during for the exam, and this must not be used to communicate in any way with anyone other than the instructor during the exam.

Remember, you are bound by the UH Academic Honesty Policy during the exam!

Instructions:

- Please make sure that you have your camera active at all times during the exam.
- Be prepared to share your screen with the instructor at any time if requested to do so.
- The exam will be in three parts (three problems). For each one, you will have 25 minutes to do the problem, and 5 minutes to scan your solution, convert it to a pdf file, and upload it on Blackboard. Each exam problem will be placed on Blackboard on a page called "Exam 1"at the time you are to begin on each part (2:30 pm, 3:00 pm, 3:30 pm). The upload links for the different parts of the exam will also be on this page.
- If you need to ask any questions, please chat in private with the instructor (not to everyone!)
- If you have any problems with the upload of one of the exam parts, please notify the instructor by private chat immediately and email your pdf file to the instructor (djackson@uh.edu).
- When you create your pdf file for each exam part (problem), please name your file using the following convention: **Exam 1 Part 1 Smith Mary.pdf**. Please name your file exactly as shown. Put spaces between each word of the file name as shown. Do not put hyphens or underscores between the different words. Capitalize only the first letter of each word in the file name as shown.

- Show all of your work. No credit will be given if the work required to obtain the solutions is not shown.
- Write neatly. You will not be given credit for work that is not easily legible.
- Leave answers in terms of the parameters given in the problem.
- Show units in all of your final answers.
- Circle your final answers.
- Double-check your answers. For simpler problems, partial credit may not be given.
- If you have any questions, ask the instructor. You will not be given credit for work that is based on a wrong assumption.
- Make sure you sign the academic honesty statement below.

Academic Honesty Statement

By taking this exam, you agree to abide by the UH Academic Honesty Policy during this exam. You understand and agree that the punishment for violating this policy will be most severe, including getting an F in the class and getting expelled from the University.

Problem 1 (30 pts)

Fields exists inside of a coaxial type of region that is described in cylindrical coordinates. The fields exists in the coaxial region $a < \rho < b$, $0 < \phi < 2\pi$, $0 < z < L$. This region is nonmagnetic ($\mu = \mu_0$) having a relative permittivity ε_r. The magnetic field in this region is given by

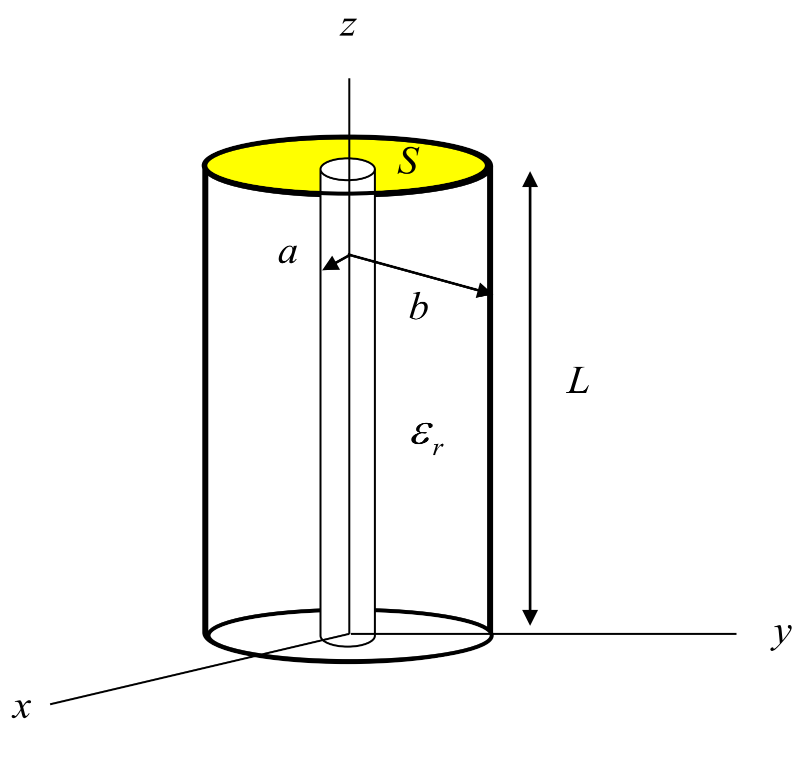
$$\underline{\mathscr{H}}(\rho,\phi,z,t) = \underline{\hat{\phi}}\left(\frac{1}{\rho}\right)\cos(kz)\cos\omega t \quad \text{[A/m]},$$

where $k = k_0\sqrt{\varepsilon_r}$ and $k_0 = \omega\sqrt{\mu_0\varepsilon_0}$.

a) Find the magnetic field vector in the phasor domain.

b) Find the electric field vector in the phasor domain.

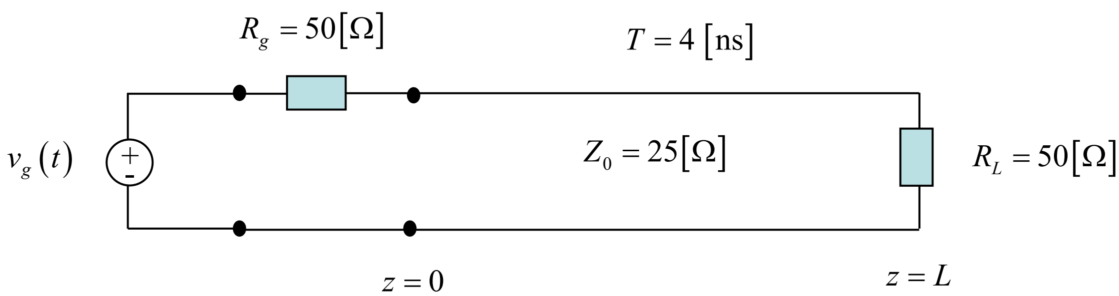
c) Find the complex power going through the surface *S* in the downward sense. The surface *S* is an annular region that lies in the $z = L$ plane and is defined by $a < \rho < b$ and $0 < \phi < 2\pi$. Also find the time-average power in watts and the reactive power in vars going downward though the surface *S*.

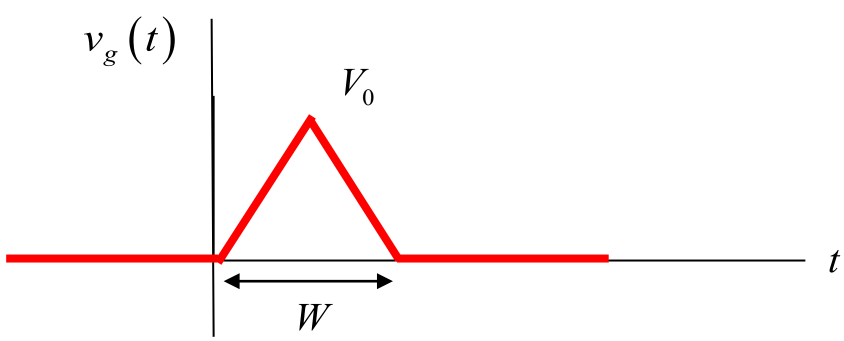


Problem 2 (35 pts)

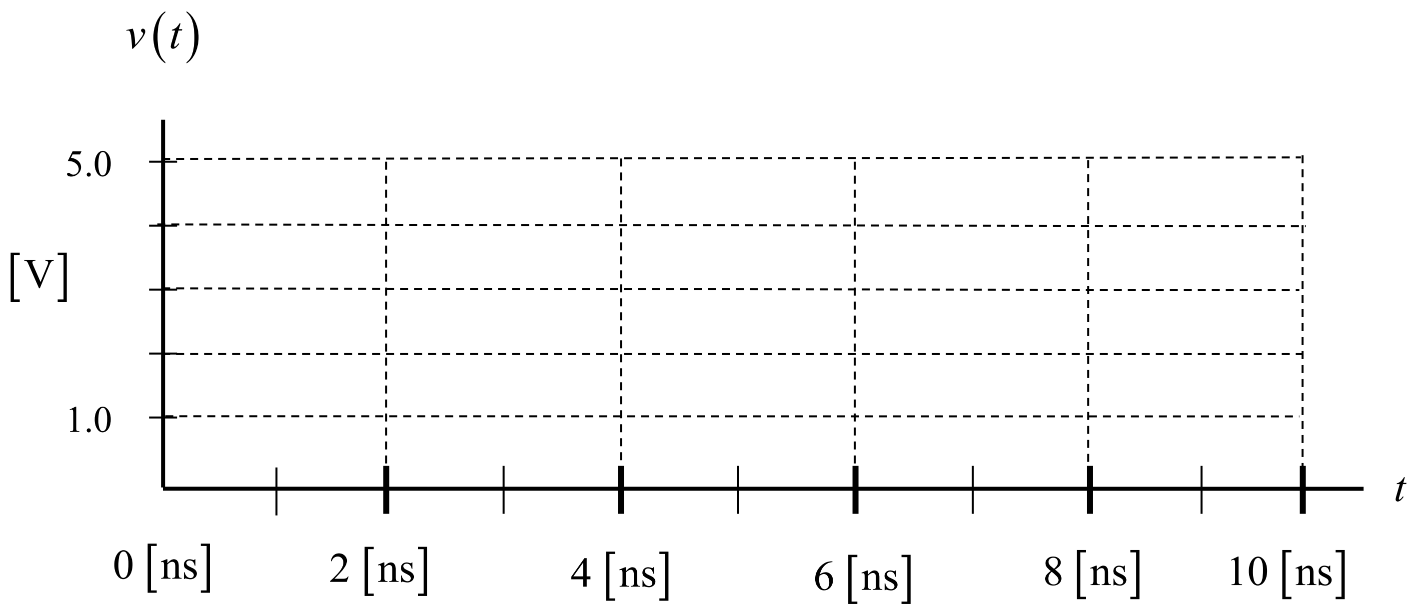
A voltage source is applied at the left end of a transmission line as shown below. A plot of the generator voltage $v_g(t)$ is shown below. The pulse peak is $V_0 = 9\,[V]$ and the width of the pulse is $W = 2\,[\text{ns}]$.

Plot the voltage $v(t)$ at a point halfway down the line ($z = L/2$). Plot to a time of 10 [ns]. Use the graph on the next page to make your plot. Label all voltage values on your plot.





Make your plot here:

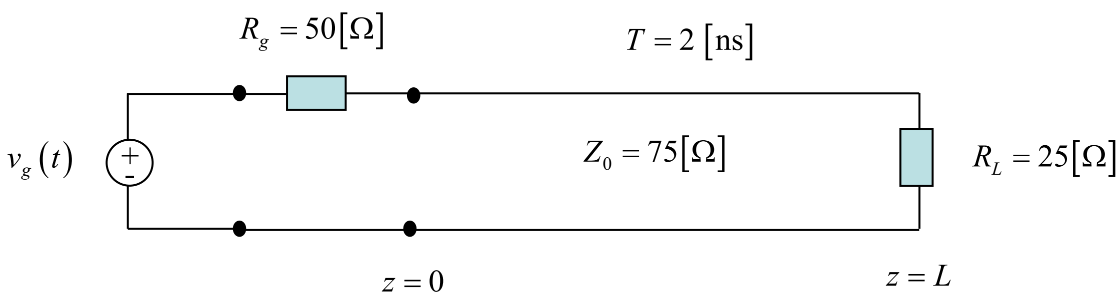


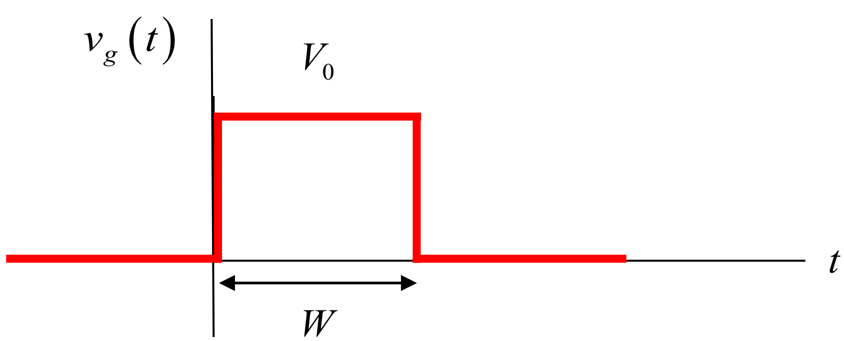
Problem 3 (35 pts)

A voltage source is applied at the left end of a transmission line as shown below. A plot of the generator voltage is shown below. The pulse width is $W = 2\,[\text{ns}]$ and the pulse voltage is $V_0 = 10\,[\text{V}]$.

a) Construct a bounce diagram for this problem that extends to a time of 8 [ns]. (Make your bounce diagram on the next page.)

b) Make an accurate "snapshot" plot of the voltage $v(z)$ on the line at $t = 2.5\,[\text{ns}]$. Make your plot on the graph that is given below on the next page. Label all voltage values on your plot. Also indicate which directions the wavefronts are moving in.





Make your bounce diagram here:

Make your plot here: