THE INTERNATINONAL UNIVERSITY (IU) – VIETNAM NATIONAL UNIVERSITY – HCMC

**Final Examination**

**Date:** May 21, 2012

**Duration:** 120 minutes

| **SUBJECT: Electromagnetic Theory** | |
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| Dean of School of Electrical Engineering<br>Signature:<br><br>Full name: Trần Văn Sư | Lecturer: Tran Van Su, M.Eng.<br>Signature:<br><br>Full name: Trần Văn Sư |

**INTRODUCTIONS:**

1. One sheet of notes is allowed
2. Laptop and communications devices are not allowed
3. Answer all questions

**Question 1 (15 Marks)**

The time variation for z = 0 of a function g(z, t) representing a traveling wave propagating in the – z-direction with velocity 200 [m/s] is shown in Fig. 1. Find the value of the function for each of the following cases:

a. z = 400m, t = 0.4s (8 Marks)
b. z = - 300m, t = 6s (7 marks)

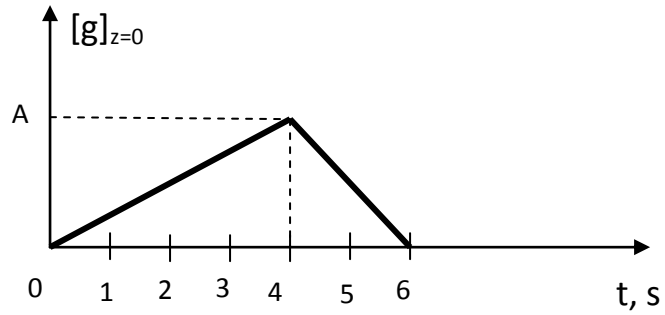


Fig. 1

**Question 2 (10 Marks)**

For a sinusoidally time-varying uniform plane wave propagating in free space, find the following:

a. The frequency f, if the phase of the field at a point is observed to change 2.5π rad in 0.2μs. (4 Marks)
b. The wavelength λ, if the phase of the field at a particular value of time is observed to change by 0.08π in a distance of 1.5 m along the direction of propagation of the wave. (3 Marks)
c. The frequency f, if the wavelength is 50m. (3 Marks)

**Question 3 (25 Marks)**

A lossy dielectric (with $\mu = \mu_o$) has an intrinsic impedance $200\angle 30^o$ (Ω) at a particular radian frequency ω. If, at that frequency, the plane wave propagating through the dielectric has the magnetic components

$$\vec{H} = 10e^{-\alpha x}cos\left(\omega t - \frac{1}{2}x\right)\hat{y}\ \text{(A/m)}$$

a. Determine the direction of electric field and propagation constant β. (5 Marks)
b. Write the expression of the electric field (similar to the magnetic field). (15 Marks)
c. Determine α if $\frac{\sigma}{\omega\varepsilon} = \sqrt{3}$. (5 Marks)

**Question 4 (15 Marks)**

The region z > 0 is a perfect dielectric of pemittivity $3\varepsilon_o$ and the region z < 0 is a perfect dielectric of permittivity $2\varepsilon_o$. Consider the field components at point 1 on the +z-side of the boundary to be denoted by subscript 1 and the field components at the adjacent point 2 on the –z-side of the boundary to be denoted by subscript 2. If $\vec{E}_1 = E_O(\hat{y} + \hat{z})$, find the following

a. $\frac{E_{z2}}{E_{z1}}$ (5 Marks)

b. $\frac{E_2}{E_1}$ (5 Marks)

c. $\frac{D_1}{D_2}$ (5 Marks)

**Question 5 (25 Marks)**

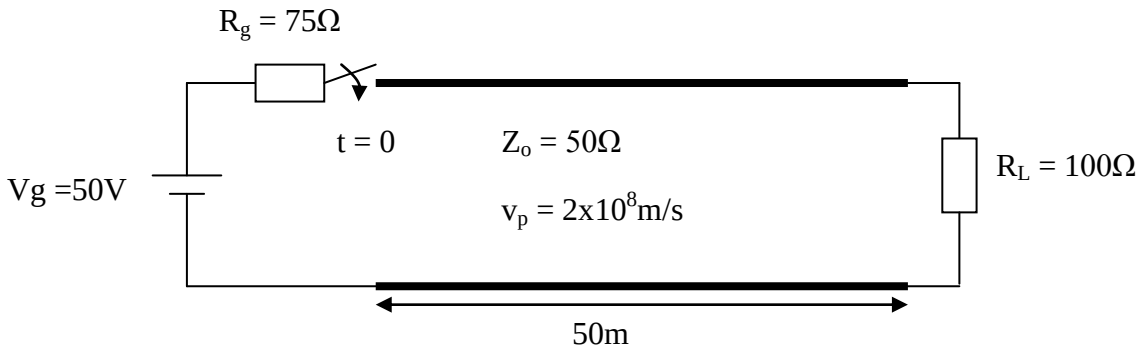


Fig. 2

In the system shown in Fig. 2, the switch S is closed at t = 0.

a. Determine the series inductance (L) and shunt capacitance (C) per unit length of the transmission line in Fig. 2. (5 Marks)
b. Plot Bounce-diagram of voltages and currents. (10 Marks)
c. Find $V_{SS}^{+}$ and $V_{SS}^{-}$. (5 Marks)
d. Determine $R_L$ to obtain V(l = 25m, t = 0.4μs) = 30V. (5 Marks)

**Question 6 (10 Marks)**

Region 1 (z < 0) in free space, wherea region 2 (z > 0) is a material medium characterized by σ = $10^{-3}$S/m, ε = 4ε$_o$, and μ = μ$_o$. We have the electric field incident on the interface z = 0 from region 1. The frequency of the plane wave is f = 2x$10^5$ Hz. Determine the reflected and transmitted coefficients for electric field.