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

Final Examination

Date: May 29, 2015

Duration: 120 minutes

SUBJECT: Electromagnetic Theory	
Dean of School of Electrical Engineering Signature: Full name: Tran Van Su	Lecturer Signature: Full name: Tran Van Su

INTRODUCTIONS:

1. One sheet, A4-size paper, with your own hand-writing characters is allowed (Books are prohibited)
2. Laptop and communications devices are not allowed except calculators
3. Answer all questions

Question 1 (10 Marks)

A square loop lies in the xy-plane forming the closed path C connecting the points (0,0,0), (2,0,0), (2,2,0), (0,2,0), and (0,0,0), in that order. A magnetic field **B** exists in the region. From considerations of Lenz's law, determine whether the induced emf around the closed path C at t = 0 is positive, negative, or zero for each the following magnetic fields, where B_0 is a positive constant:

a. $\vec{B} = B_O \sin(3\pi t + \pi/4)\hat{z}$ [Wb/m^2] (5 Marks)

b. $\vec{B} = B_O e^{-2t^2}\hat{z}$ [Wb/m^2] (5 Marks)

Question 2 (20 Marks)

An infinite plane sheet lying in the z = 0 plane in free space ($v_p = 3.10^8$m/s, $\eta_o = 120\pi\ \Omega$) carries a surface current of density $\vec{J}_S = -J_S\vec{a}_x$, where $J_S(t)$ is shown in Fig.1. Find and plot the waveform of:

a. E_x versus t in the z = 300m plane (10 Marks)

b. H_y versus t for z = 600m (10 Marks)

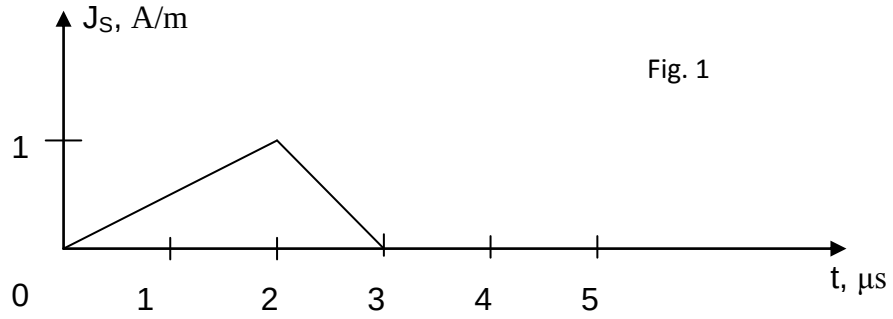

Fig. 1

Question 3 (20 Marks)

Two sinusoidally time-varying vector fields are given by

$$\vec{F}_1 = \cos(6\pi \times 10^8 t - 2\pi z)\hat{x}$$
$$\vec{F}_2 = \cos(6\pi \times 10^8 t - 4\pi z)\hat{y}$$

Find the polarization of the sum of two given vectors at points (1, 1, 0) and (2, 2, ¼).

Quesstion 4 (20 Marks)

The parameters of the medium is given as follows:

$\sigma = 10^{-4}$ S/m, $\varepsilon = 4\varepsilon_0$, $\mu = \mu_0$, and f = 10^6 Hz, $\varepsilon_0 = 8.85\text{x}10^{-12}$ F/m, $\mu_0 = 4\pi\text{x}10^{-7}$ H/m.

a. Compute the propagation constant and intrinsic impedance. (5 Marks)
b. If the magnitude of the magnetic field is E_0. What is the magnitude of the magnetic field? (5 Marks)

c. What is the phase difference between electric and magnetic fields? (5 Marks)

d. Complete the expression of the electric field

$$\vec{E} = E_0\ ?\cos(?t - ?z)\hat{x}$$ (3 Marks)

(Hint: Replace the question marks by proper values or functions)

e. From the result in (d), Give the expression for magnetic field if the propagation direction is $\hat{z}$. (2 Marks)

Question 5 (10 Marks)

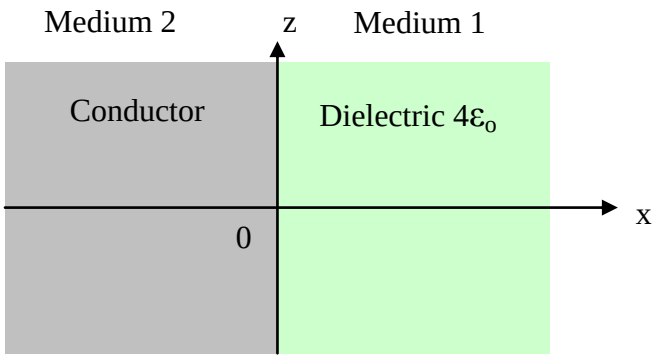

Fig. 2

Region x ≤ 0 consists of a perfect conductor while region x ≥ 0 is a dielectric medium as shown in the Fig. 2. If there is a surface charge of 5nC/m^2 on the boundary of the conductor and dielectric medium, determine

a. The tangent components of $\vec{E}$ and $\vec{D}$ at the boundary.
b. The normal components of $\vec{E}$ and $\vec{D}$ at the boundary.

Question 6 (20 Marks)

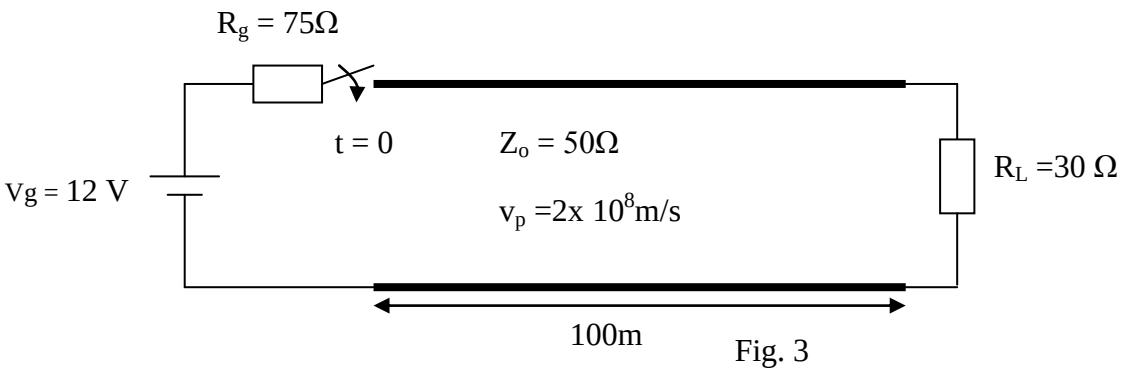

Fig. 3

For the transmission line in Fig.3,

a) Compute voltage reflection coefficients at the load and the source. (5 Marks)

b) Sketch the bounce diagram of the voltage and note information on the diagram (up to 8μs). (5 Marks)

c) Sketch the bounce diagram of the current and note information on the diagram (up to 8μs). (5 Marks)

d) Calculate steady state V_{SS} and I_{SS}. (5 Marks)