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

# Final Examination

**Date:** May 29, 2014

**Duration:** 120 minutes

| **SUBJECT: Electromagnetic Theory** | |
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| Dean of School of Electrical Engineering<br>Signature:<br><br>Full name: Tran Van Su | Lecturer<br>Signature:<br><br>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 (15 Marks)**

Given $\vec{B} = (x\hat{x} + y\hat{y})$ Wb/m$^2$, find by evaluating $\vec{B} \bullet \Delta\vec{S}$ the approximate absolute value of the magnetic flux crossing from one side to the another side of an infinitesimal surface of area 0.0005 m$^2$ at point (1,1,1) for each of the orientations of the surface:

a. In the y = 2 plane (8 Marks)
b. Normal to the unit vector $\hat{z}$ (7 Marks)

**Question 2 (10 Marks)**

Two sinusoidally time-varying, linearly polarized vector fields are given at a point by

$$\vec{F}_1 = (C\hat{x} + C\hat{y} + \hat{z})\cos 2\pi \times 10^6 t$$

$$\vec{F}_2 = (C\hat{x} + \hat{y} - 2\hat{z})\sin 2\pi \times 10^6 t$$

where C is a constant

a. If C = 2, determine the polarization of the vector $\vec{F}_1 + \vec{F}_2$
b. Find the value(s) of C for which the tip of the vector $\vec{F}_1 + \vec{F}_2$ traces a circle with time

**Question 3 (20 Marks)**

The electric field associated with a uniform plane wave propagating in the +z direction in free space is given by

$\vec{E} = E_0 \cos(6\pi \times 10^7 t - 0.2\pi z)\vec{a}_x$ (A/m), Find the following:

a) The instantaneous power flow across a surface of area 2m$^2$ in the z = 0 plane at t = 0 (10 Marks)

b) The time-average power flow across a surface of area 2m$^2$ in the z = 0 plane. (Hint: Use Phasor). (10 Marks).

**Question 4 (20 Marks)**

A uniform plane wave propagating in a medium has

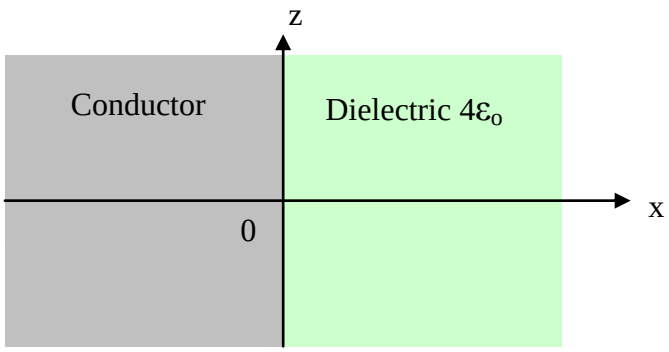
$$\vec{E} = 10e^{-\alpha z}\cos(10^8 t - \beta z)\hat{x} \text{ [V/m]}$$

If the medium is characterized by $\varepsilon_r = 1$, $\mu = 80\pi.10^{-7}$ (H/m), and $\sigma = 3$ [S/m]

a) The medium is considered as <u>good conductor</u>, find approximated values of α and β. (10 Marks)

b) Find magnetic field $\vec{H}(t,z)$ if the intrinsic impedance of the medium is $\overline{\eta} \approx \sqrt{\frac{\omega\mu}{\sigma}} e^{j\pi/4}$ (10 Marks)

**Question 5 (15 Marks)**

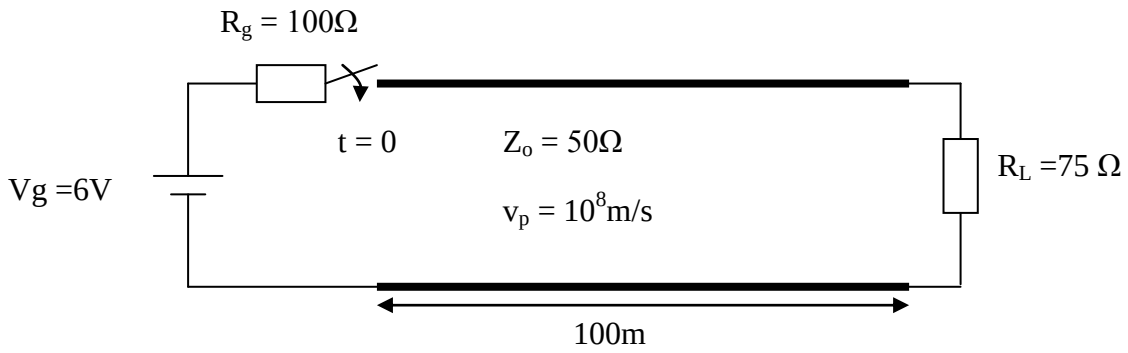



Region x $\leq$ 0 consists of a perfect conductor while region x $\geq$ 0 is a dielectric medium as shown in the Figure. If there is a surface charge of 5nC/m$^2$ on the conductor, determine $\vec{E}$ and $\vec{D}$ at

a) A(-31,2) (8 Marks)

b) B(10,2,5) (7 Marks)

**Question 6 (20 Marks)**




For the transmission line of the Figure above,

a) Sketch the bounce diagram of the voltage and give enough information on it (up to 4μs) . (5 Marks)

b) Sketch the bounce diagram of the current and give enough information on it (up to 4μs). (5 Marks)

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

**d)** Calculate steady state $V^+_{SS}$, $V^-_{SS}$, $I^+_{SS}$ and $I^-_{SS}$. (5 Marks)