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

Mid-term Examination

Date: March 27, 2015

Duration: 90 minutes

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

INTRODUCTIONS:

1. Each student can use his/her own note (one paper of A4 size). Other materials and devices are not allowed except calculators.
2. Answer all questions

Question 1 (10 Marks)

Let $\vec{A} = 2\hat{x} + 4\hat{y} + 3\hat{z}$ and $\vec{B} = \hat{x} - 6\hat{y} + 2\hat{z}$

a. Compute $\vec{A} \bullet \vec{B}$. (2 Marks)
b. Compute $\vec{A} \times \vec{B}$. (2 Marks)
c. Find the component of $\vec{A}$ along $\vec{B}$. (3 Marks)
d. Determine the unit vector which is perpendicular to both $\vec{A}$, $\vec{B}$. (3 Marks)

Question 2 (20 Marks)

We have two point charges Q_1 at (1,0,0) and Q_2 at (0,1,0). One current element $Id\vec{l} = \hat{x}$ [A] at (3,0,0). They have locations and/or direction in free space shown in Fig. 1.
a) Determine electric field at point A(1,1,0). (10 Marks)
b) Determine magnetic field at point B (3,1,0). (10 Marks) $\vec{A} \times \vec{B}$
Given: $\varepsilon_0 = 8.85\text{x}10^{-12}$ F/m, $\mu_0 = 4\pi\text{x}10^{-7}$ H/m

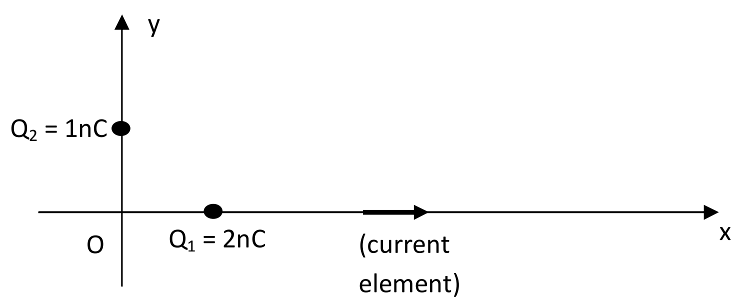

Fig. 1

Question 3 (20 Marks)

An infinite plane sheet of current lies in the z = 0 plane with uniform surface current densities of $2\,\hat{x}$ [A], and an infinite plane sheet of charge lies in the z = 10 plane with uniform charge density of 4 [C/m^2]. Find the resulting magnetic flux densities ($\vec{B}$) and displacement flux ($\vec{D}$) at (0,0,5) in free space. Given: $\varepsilon_0 = 8.85\text{x}10^{-12}$ F/m, $\mu_0 = 4\pi\text{x}10^{-7}$ H/m.

Question 4 (20 Marks)

Charge is distributed with uniform density ρ_o [C/m3] inside the sphere S_a which has the radius of a. Determine the displacement flux $\vec{D}$ at distance r of sphere S_r shown in Fig. 2. It is known that displacement flux $\vec{D}$ on the surface S_r is uniform in spherical coordinate system due to the symmetry. The surface area and the volume of S_r are $4\pi r^2$ and $4\pi r^3/3$, respectively. Give D with a = 1m and r = 2m.

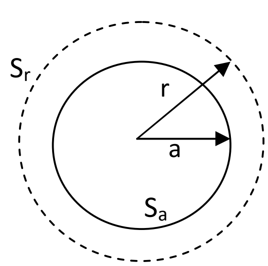

Fig. 2

Question 5 (20 Marks)

An infinite plane sheet of current density $\vec{J}_S = -J_S(t)\hat{x}$ (A/m) where $J_S(t)$ is as shown in Fig. 3, lies in the z = 0 plane in free space. Find and sketch

a. E_x versus t in the z = 300m plane. (10 Marks)
b. H_y versus t in the z = -600m plane. (10 Marks)

The phase velocity is given 3.10^8 m/s

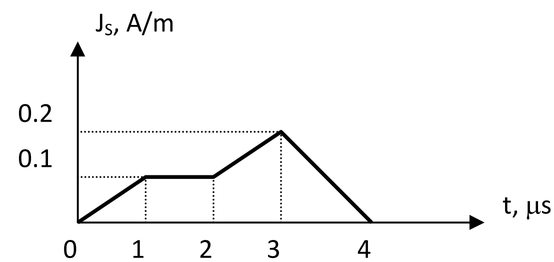

Fig. 3

Question 6 (10 Marks)

The electric field of a uniform plane wave in the free space is given by

$$\vec{E} = E_o \cos(12\pi \times 10^8 t + 4\pi x)\hat{y} \text{ (V/m)}$$

Find the followings:

a) velocity of the wave. (3 Marks)

b) the wavelength of the wave. (3 Marks)

c) Magnetic field $\vec{H}$. (4 Marks)