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

Mid-term Examination

Date: March 25, 2014

Duration: 90 minutes

SUBJECT: Electromagnetic Theory	
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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 $\vec{E} = 3\hat{y} + 4\hat{z}$ and $\vec{F} = 4\hat{x} - 10\hat{y} + 5\hat{z}$

a. Find the component of $\vec{E}$ along $\vec{F}$.
b. Determine a unit vector perpendicular to both $\vec{E}$ and $\vec{F}$.

Question 2 (10 Marks)

An infinitestimal length 10^{-3}m of wire is located at the point (1,1,1) and carrying current 4[A] in the direction of the unit vector $\vec{a}_x$. Find the magnetic flux density $\vec{B}$ due to the current element at the point (2,2,2). Given $\mu_o = 4\pi.10^{-7}$ H/m.

Question 3 (15 Marks)

An infinitely long line charge of 8 [nC/m] is lying along the z-axis in free space.

a. Find displacement flux **D** at (0,3,0) .
b. Find the total displacement flux leaving a 5-m length of the line charge (Hint: Use Gauss'law)

Question 4 (15 Marks)

Infinite plane sheets of current lie in the x = 0, y = 0, and z = 0 planes with uniform surface current densities - $J_{so}\hat{z}$, 2 $J_{so}\hat{x}$, and $-J_{so}\hat{y}$ (A/m), respectively. Find the resulting magnetic flux densities $(\vec{B})$ at (1,1,1) in free space. Given $\varepsilon_o = 8.85\text{x}10^{-12}$ F/m.

Question 5 (10 Marks)

Given $\vec{B} = B_0(\sin\omega t\hat{x} - \cos\omega t\hat{y})Wb/m^2$, find the induced emf around the closed triangular path from (1,0,0) to (0,1,0) to (0,0,1) to (1,0,0)

Question 6 (15 Marks)

Use divergence theorem to find a total charge located within the box that is formed by the planes x = 0 and 1, y = 0 and 2, and z = 0 and 3 if the displacement flux $\vec{D} = 2xy\hat{x} + x^2\hat{y}$ [C/m^2]

Question 7 (15 Marks)

The fields are defined as $\vec{E}(z,t) = E_x\hat{x}$ and $\vec{H}(z,t) = H_y\hat{y}$ in free space

a. Show that $\dfrac{\partial E_x}{\partial z} = \mu_o \dfrac{\partial H_y}{\partial t}$
b. Show that $\dfrac{\partial H_y}{\partial z} = \varepsilon_o \dfrac{\partial E_x}{\partial t}$

c. Show that $\frac{\partial^2 E_x}{\partial z^2} = \mu_o \varepsilon_o \frac{\partial^2 E_x}{\partial t^2}$. (Hint: equations in a and b are taken one more derivative $\frac{\partial}{\partial z}$)

Question 8 (10 Marks)

Using Stokes's theorem, find the absolute value of the line integral of the vector field $2x\hat{y} + 3y\hat{z}$ around each of the following closed paths:

a. The perimeter of a square of side 1m lying in the xy-plane

b. A circular path of radius 1m lying in the xy-plane.