THE INTERNATIONAL UNIVERSITY (IU) – VIETNAM NATIONAL UNIVERSITY - HCMC

FINAL EXAMINATION – CLASS

Student Name:_____ **Student ID:**_____

Date: August 2016

Duration: 90 minutes

SUBJECT: PHYSICS 3	
Chair of Department of Physics: Signature: Full name: Phan Bảo Ngọc	Lecturer: Signature: Full name: Dương Hoài Nghĩa

INSTRUCTIONS: This is a closed book examination. Use of cell phones, laptops, dictionaries is not allowed.

1) Three identical wires lie parallel to each other, separated by distances of a, so that in cross-section their centres form an equilateral triangle, as shown in Fig. 1. All three wires carry parallel currents I. Find the magnitude and direction of the force per unit length on the top wire due to the currents in the other two wires. (*25 marks*)

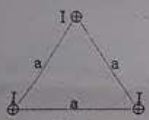


Fig. 1

Fig. 2

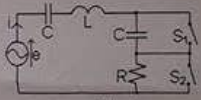


Fig. 3

2) In Fig.2, the current in the infinitely long wire is $i = 100\sin(1000t)$A, the rectangle has resistance $R = 0.1\Omega$. Find the value of the induced current in the rectangle. Where d = b = 2m, a = 1m. (*25 marks*)

3) Consider the circuit in Fig.3 with $e(t) = 12\sin(120\pi t)$ V. When S_1 and S_2 are open, i leads e by 30°. When S_1 is closed and S_2 is open, i lags e by 30°. When S_1 and S_2 are closed, i has amplitude 0.5A. What are R, L and C? (*25 marks*)

4) A plane electromagnetic wave, with frequency f = 100MHz, travels in vacuum in the positive direction of an x axis. The electric field, of amplitude $E_m = 100$V/m, oscillates parallel to the y axis.

a) Find the wave length λ and the angular wave number k of the wave. (*10 marks*)

b) Find the amplitude B_m of the magnetic field component. Parallel to which axis does the magnetic field oscillate? (*10 marks*)

c) Find the Poynting vector of the wave? (*5 marks*)

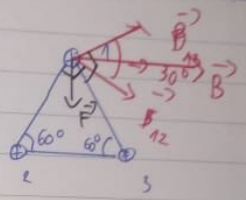
Ampère's law	Magnetic force	Faraday's law	Poynting vector	Speed of wave	Some constants
$\oint_{\text{closed path}} \vec{B}.d\vec{s} = \mu_0 i$	$\vec{F}_B = i\vec{L} \times \vec{B}$	$e = -\frac{d\Phi_B}{dt}$	$\vec{S} = \frac{1}{\mu_0}\vec{E} \times \vec{B}$	$\frac{E}{B} = \frac{\omega}{k} = c$	$\varepsilon_0 = 8.85 \times 10^{-12}$ C²/Nm² $\mu_0 = 1.26 \times 10^{-6}$ Tm/A $c = 3 \times 10^8$ m/s

END OF QUESTION PAPER

August 2016

10

$\vec{F_1} = \vec{F_{13}} + \vec{F_{12}}$ $\quad \vec{B_1} = \vec{B_{13}} + \vec{B_{12}}$



Bây giờ tưởng tượng một sợi dây:

↳ Từ trường $\vec{B}$ chạy vòng tròn

Nhưng, tại 1 điểm bất kỳ trong vòng tròn.

↳ $\vec{B}$ tiếp tuyến tại điểm.

Nếu ta nối dây điện (tâm) tới $\vec{B}$ ⇒ góc 90° — Áp dụng vào.

Từ đó, ta biết được góc giữa $\vec{B_{12}}$ và $\vec{B_{13}} = 30°$

$\vec{B_1} = \vec{B_{13}} + \vec{B_{12}}$ ⇒ $|\vec{B_1}| = \sqrt{B_{12}^2 + B_{13}^2 + 2 B_{12} B_{13} \cos 30°}$

$= 1.73 B_{12}$

$\left(B_{12} = B_{13} = \frac{\mu_0 I}{2\pi a}\right)$ (1)

Force per unit length: $F = iB = I \times 1.73 \times B_{12}$

$= 1.73 \times \frac{\mu_0 I^2}{2\pi a}$

Direction of Force: straight down

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(1) and (3) $\Rightarrow \tan 30^\circ = \frac{24}{R} \Rightarrow R = 24\sqrt{3}\ (\Omega)$ (4)

From (1), (3) and (4) $\Rightarrow L = 0.19\ H;\ C = 35.26\ \mu F$

4)

a) $f = \frac{c}{\lambda} \Rightarrow \lambda = \frac{c}{f} = \frac{3\times10^8}{100\times10^6} = 3\ (m)$

$K = \frac{\omega}{c} = \frac{2\pi f}{c} = \frac{2\pi}{\lambda} = \frac{2}{3}\pi$

b) $\frac{E}{B} = c \Rightarrow B = \frac{E}{c} = \frac{100}{3\times10^8} = \frac{1}{3}\times10^{-6}\ (T)$

EM travels along x-axis, E field // to y-axis $\Rightarrow$ B field // to z axis

c)

$\vec{S} = \frac{1}{\mu_0}\vec{E}\times\vec{B} \Rightarrow S = \frac{1}{\mu_0 c}E^2 = \frac{100^2}{\mu_0 c} = 26.54$

$\vec{E} = 100\sin(2\times10^8\pi t)\,\vec{j}$

$\hookrightarrow \vec{B} = \frac{1}{3}\times10^{-6}\sin(2\times10^8\pi t)\,\vec{k}$

$\vec{S} = \frac{1}{\mu_0}\vec{E}\times\vec{B} = 26.52\sin^2(2\times10^8\pi t)\,\vec{i}$

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2| $B = \frac{\mu_0 i}{2\pi r}$, $\Phi_B = \int_a^b B\,dA = \int_a^b \frac{\mu_0 i d}{2\pi r}\,dr = \frac{\mu_0 i d}{2\pi}\int_a^b \frac{1}{r}\,dr$

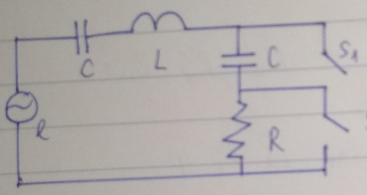
$= \frac{\mu_0 i d}{2\pi} \ln\frac{b}{a}$

$\mathcal{E} = \frac{d\Phi_B}{dt} = \frac{\mu_0 d}{2\pi} \ln\frac{b}{a} \frac{di}{dt} = \frac{\mu_0 d}{2\pi} \ln\frac{b}{a}\, 100\times 1000 \cos(1000t)$

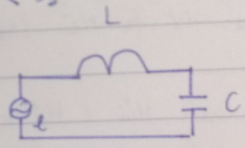
$= 0.0277 \cos(1000t)$

$\Rightarrow i = \frac{\mathcal{E}}{R} = 0.277\cos(1000t)$

3| $e(t) = 12\sin(120\pi t)$

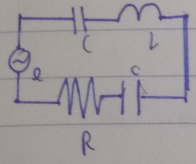


* When S_1, S_2 are closed → Đây là mạch LC



$0.5 = i = \frac{12}{\left|120\pi L - \frac{1}{120\pi C}\right|}$ (1) → Vì chưa biết $120\pi L - \frac{1}{120\pi C} > 0$ hay < 0

* When S_1, S_2 open:

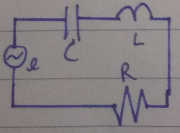


↳ Mạch RLC (2 cuộn dây)

i lead e 30°

$\Rightarrow \tan -30° = \frac{120\pi L - \frac{2}{120\pi C}}{R}$ (2)

* When S_1 closed, S_2 open: Mạch RLC (1 C)



i lags e 30°

$\Rightarrow \tan 30° = \frac{120\pi L - \frac{1}{120\pi C}}{R}$ (3) → Dựa vào đây ta biết $120\pi L > \frac{1}{120\pi C}$