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INTERNATIONAL COLLEGE PENANG (507232-U)
LAUREATE INTERNATIONAL UNIVERSITIES

FINAL
Examination Paper

(COVER PAGE)

Session	:	January 2013
Programme	:	DIPLOMA IN ELECTRICAL AND ELECTRONIC ENGINEERING
Course	:	**EEE2104 : ELECTROMAGNETIC FIELD THEORY**
Date of Examination	:	5 March 2013
Time	:	11a.m. – 1p.m. Reading Time : Nil
Duration	:	2 Hours
Special Instructions	:	

This paper consists of **SIX (6)** questions. Answer any **FOUR (4)** questions in the answer booklet provided. All questions carry equal marks.

Materials permitted :

Non Programmable Scientific Calculator

Materials provided :

Examiner(s)	:	**Chai Yoon Yik**
Moderator	:	**Liong Han Wen**

This paper consists of 4 printed pages, including the cover page.

INTI INTERNATIONAL COLLEGE PENANG

DIPLOMA IN ELECTRICAL AND ELECTRONIC ENGINEERING PROGRAMME

EEE 2104 : ELECTROMAGNETIC FIELD THEORY

FINAL EXAMINATION : January 2013 SESSION

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Question 1

(a) Define Coloumb's Law. [4]

(b) Two point charges $Q_1 = 8\mu C$ and $Q_2 = 10\mu C$ located at $P_1(2,5,8)$ and $P_2(6,15,8)$ respectively. What is the electric force acting on Q_1 and electric field intensity at P_1. [10].

(c) If a third point charge $Q_3 = 12\mu C$ is inserted into the system at $P_3(4,9,8)$, find the total potential energy stored in the system. [11]

Question 2

(a) Two uniform line charges of 8 nC/m each are located at x = 1, z = 2 and at x = -1, y = 2 in a free space. If the potential at the origin is 100V, find the potential difference between P(4,1,3) and origin. [12]

(b) A point charge $Q = 3\mu C$ located at $(4,\pi,0)$. What is the total work done to shift the point charge to $(2,\pi/2,2)$ in the region with $\overline{E} = (10^5/\rho)\overline{a}_\rho + 10^5 z\overline{a}_z$? Will the total potential energy of the point charge change after the shifting? Explain. [13]

Question 3

(a) A point charge of 12 nC is located at (0,0,0) together with two uniform line charges of 80nC/m located on the x = 0 plane at y = −1m and y=−5m.

(i) Find $\overline{D}$ at P(0,−3, 2). [4]

(ii) How much electric flux crosses the plane y = −3 and in what direction? [3]

(iii)How much electric flux leaves the surface of a sphere, 4m in radius, centered at C(0,−3, 0)? [5]

(b) A parallel-plate capacitor has a separation d = 5mm with free space in between the plates. If the applied voltage between the plates is 10kV, will the air breakdown if a piece of glass with thickness of 2mm is inserted into the capacitor and touching one of the conductor plate? Assume the air dielectric strength is 3MV/m and glass relative permittivity is 6.5.

[13]

Question 4

(a) A core with three legs is shown in Figure Q4(a). Its depth is 5 cm, and there are 200 turns on the leftmost leg. The relative permeability of the core is 1500. Assume a 4% increase in the effective area of the air gap due to fringing effects. Calculate the flux density in the left, center, and right leg of the core? [10]

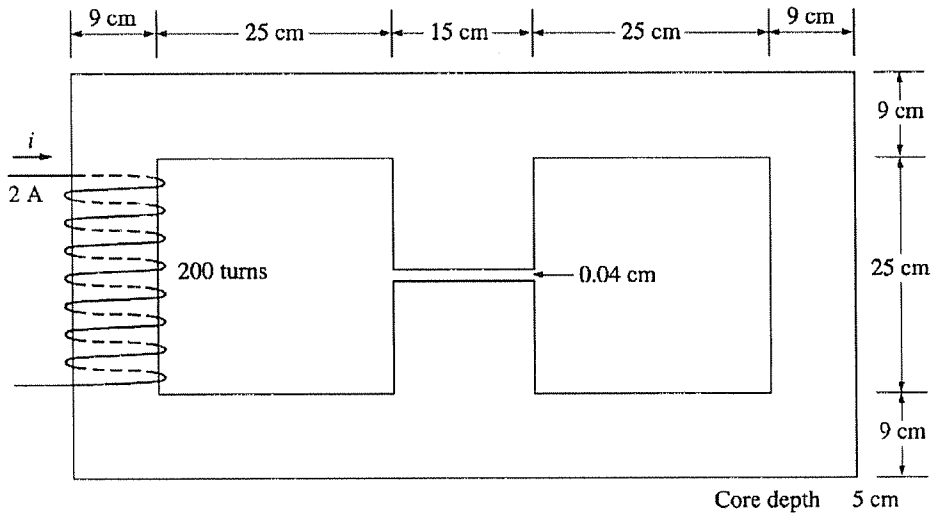

Figure Q4(a)

(b) A xy-plane serves as the interface between two different media. Medium #1 ($z < 0$) is filled with a material has $\mu_{r1} = 4$, and medium #2 ($z > 0$) is filled with a material has $\mu_{r2} = 6$. If the interface is current free and $\overline{B}_2 = 5\overline{a}_x + 8\overline{a}_z$ mWb/m^2, find $\overline{H}_1$ and $\overline{B}_1$. [9]

(c) Describe the various properties of ferromagnetic materials. List THREE (3) examples of ferromagnetics magnetic material. [6]

Question 5

(a) A sheet current $\overline{K} = 10\overline{a}_z$ A/m lies in the y = 0 plane. What should be the magnitude and direction of the current in an infinite filament located at x = 4, y = 5 to produce $\overline{H} = 0$ at (2,2,2). [7]

(b) When there is $\overline{\mathrm{H}} = \mathbf{300\cos}(3\times10^8\mathrm{t} - \mathrm{y})\overline{\mathrm{a}}_z$ A/m in free space, find the emf developed in a closed square path having corners at (0,0,0), (1,0,0), (1,1,0), and (0,1,0). Determine the magnitude and direction of the current flows in the loop if the conductor resistance per unit length is 0.5Ω/m? [13]

(c) Determine the magnetic field intensity and magnetic flux density in a magnetic material with $\mu_r = 2.4$ and magnetization $\overline{M} = 0.7\overline{a}_z A/m$. What is the magnetic susceptibility of the material. [5]

Question 6

(a) List down the FOUR (4) Maxwell's equations for a time harmonic field. [4]

(b) When there is an electric field, $E = 7\sin\left(8\times10^8 t\right)\mu V/m$ passing through a rod with conductivity of 10^{-3}S/m and relative permittivity of 4, calculate the conduction and displacement current density in the rod. [4]

(c) A rectangular loop of wire in free space with four corner points at A(1, 0, 1), B(3, 0, 1), C(3, 0, 4) and D(1, 0, 4) respectively. The wire carries a current of 6 A, flowing in the $\overline{a}_z$ direction from B to C. A filamentary current of 15 A flows along the entire z axis in the $\overline{a}_z$ direction. Find the total force acting on the loop. [8]

(d) Write an expression for the $\overline{H}$ of a traveling electromagnetic wave if it has a $\overline{E}$ field in the free space given as

$$\overline{E} = 60\pi\cos(\omega t + 30x)\,\overline{a}_z\ V/m$$

Determine:

(i) Wavelength of the wave

(ii) Frequency of the wave [9]

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