Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2015/2016

COURSE NAME	:	ELECTROMAGNETISM
COURSE CODE	:	BWC 21103
PROGRAMME CODE	:	BWC
EXAMINATION DATE	:	JUNE / JULY 2016
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWERS **ALL** QUESTIONS

THIS QUESTION PAPER CONSISTS OF **SIX (6)** PAGES

Q1 (a) Define the following terms and for each of the term suggest ONE (1) application of it that being used in daily life.

(i) Vector.
(ii) Scalar.

(4 marks)

(b) Given vector $\bar{A} = \bar{a}_x + 3\bar{a}_z$ and $\bar{B} = 5\bar{a}_x + 2\bar{a}_y - 6\bar{a}_z$, determine

(i) |**A**+**B**|.
(ii) 5**A** – **B**.
(iii) The component of **A** along $\mathbf{a}_y$.
(iv) A unit vector parallel to 3**A** + **B**.

(8 marks)

(c) The three fields are given by:

$$\bar{A} = 2\bar{a}_x - \bar{a}_z$$
$$\bar{B} = 2\bar{a}_x - \bar{a}_y + 2\bar{a}_z$$
$$\bar{C} = 2\bar{a}_x - 3\bar{a}_y + \bar{a}_z$$

Evaluate the scalar and vector triple product.

(8 marks)

Q2 (a) Point B (33, π/4, -6) is given in cylindrical coordinate system. Express point B in spherical coordinate system.

(4 marks)

(b) The spherical strip shown in **Figure Q2(b)** is a section of sphere of radius 3 cm. Find the area of the strip.

(6 marks)

(c) Verify Stoke's theorem for a vector field, $\vec{F} = r^2 \cos\varphi \hat{a}_r + z \sin\varphi \ \hat{a}_z$ around the path L defined by $0 \leq r \leq 3$, $0 \leq \varphi \leq 45°$ and z = 0 as shown in **Figure Q2(c)**.

(10 marks)

Q3 (a) Give a definition of electric field intensity.

(2 marks)

(b) Consider two finite uniform line charges of 7 nC/m and -10 nC/m lie along x and y axes in free space. If there is a point charge, 3 nC at the location of (1, -2, 3),

(Assume the unit of length is meter)

(i) analyze total electric field intensity due to both line charges,
(ii) determine the force exert on the point charge.

(10 marks)

(c) Simply describe electric flux density generation, $\vec{D}$ in the region between a pair of charged conductor spheres and prove that the magnitude and direction of $\vec{D}$ are not functions of the dielectric between the spheres.

(4 marks)

(d) Given a 50 μC point charge locates at the origin, solve the total electric flux passing through the closed surface defined by r = 25 cm and z = ±25 cm.

(4 marks)

Q4 (a) Bio-Savart and Ampere's Law are the two laws that can generate magnetism based on moving charges. Point out the major different between the two laws and compare the analytical mechanism of each law by giving an example of moving charges through straight conducting wire.

(12 marks)

(b) Consider **Figure Q4(b)** has a square loop of wire in the $z = 0$ plane carrying 2 mA in the field of an infinite filament on the y axis, as shown. Analyze the total force of the loop.

(8 marks)

Q5 (a) Given the Stoke's theorem

$$\oint_L \overline{H} \bullet d\overline{L} = \int_S \left(\nabla \times \overline{H}\right) \bullet d\overline{S}$$

Evaluate the left hand side of the Stoke's theorem for the field $\overline{H} = 6xy\bar{a}_x - 3y^2\bar{a}_y$ (Am^{-1}) and the rectangular path around the region, $2 \leq x \leq 5$, $-1 \leq y \leq 1$, $z = 0$. Assume that the positive direction of $d\bar{S}$ is $\bar{a}_z$.

(8 marks)

(b) A tightly wound rectangular coil having N turns is rotating in a uniform magnetic field, as shown in **Figure Q5(b)**.

Determine the induced emf in the coil using

(i) the concept of motional emf,
(ii) Faraday's law of induction.

(6 marks)

(c) If the magnetic flux density in **Q5(b)** varies as $B_m \sin \omega t$, determine the induced emf using

(i) the concepts of motional and transformer emfs.
(ii) Faraday's law of induction,

(6 marks)

-END OF QUESTION-

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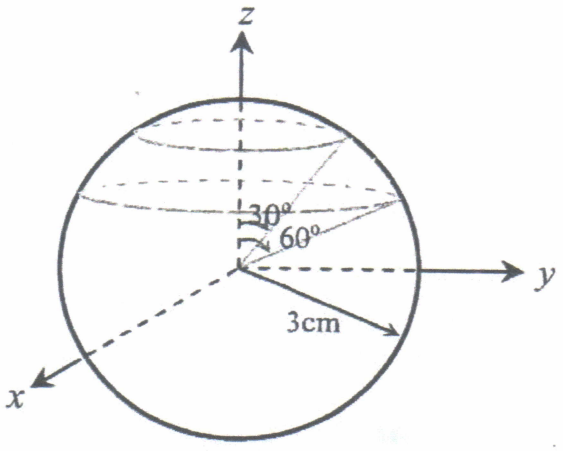

Figure Q2(b)

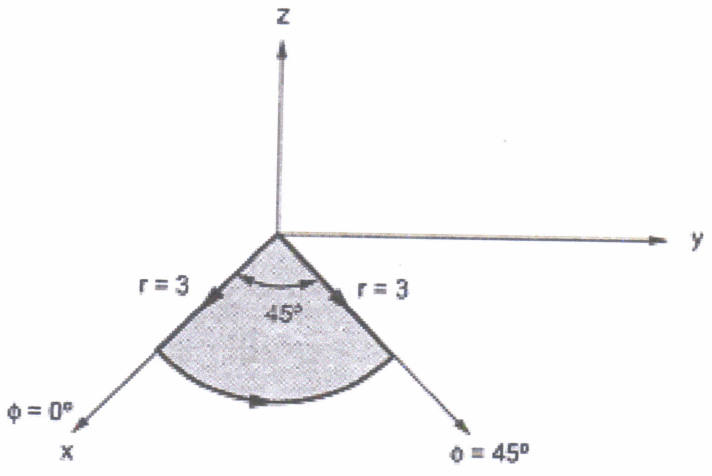

Figure Q2(c)

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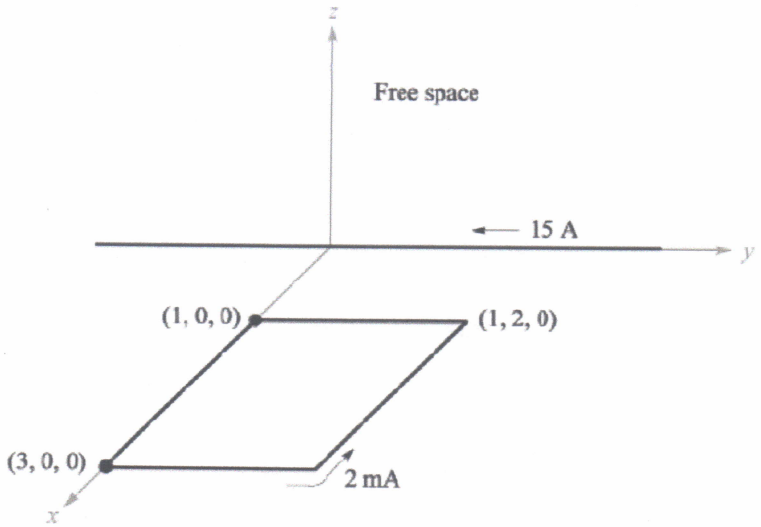

Figure Q4(b)

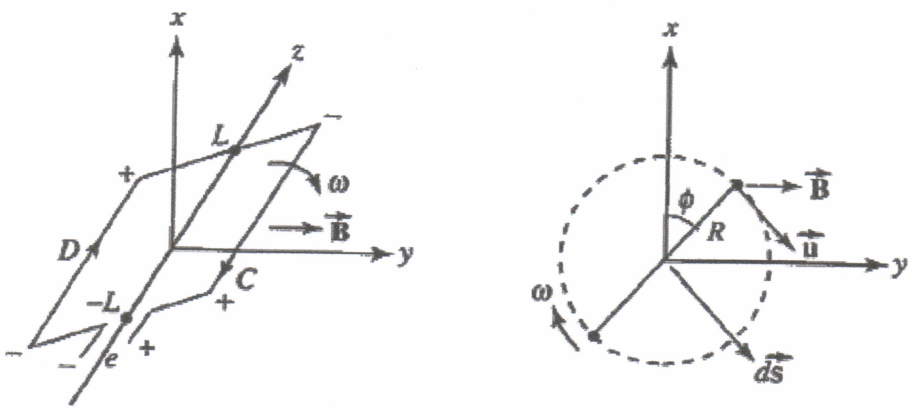

Figure Q5(b)