UNIVERSITY OF RUHUNA

Faculty of Engineering

End-Semester 3. Examination in Engineering: July2016

Module Number: EE3302

Module Name: Engineering Electromagnetism

[Three Hours]

[Answer **all questions**, each question carries tenmarks]

(Permittivity of free space $\xi_0 = 10^{-9}/(36\pi)$ F/m and Permeability of free space $\mu_0 = 4\pi\times10^{-7}$ H/m)

Q1. The magnetic field component of a plane wave in a lossless dielectric ($\mu_r = 1$) is $\bar{H} = 30\sin(2\pi\times10^8 t - 5x)\,\bar{a}_x\ mA/m.$

a) Find relative permittivity (ξ_r) of the medium. [1 Mark]
b) Calculate the wave length and wave velocity of the signal. [2 Marks]
c) Determined the wave impedance. [1 Mark]
d) Determined the polarization of the wave. [2 Marks]
e) Find the corresponding electric field component. [2 Marks]
f) Find the displacement current density. [2 Marks]

Q2. The magnetic circuit of Fig.Q2 has current of 10 A in the coil of 2000 turns. Assume that all branches have the same cross section of 2 $cm^2$and that material of the core is iron with μ_r=1500.

a) Draw the magnetic circuit.
b) Calculate the reluctance of the iron core.
c) Calculate magnetic flux on iron core. [10 Marks]

Q3. a) What is electromagnetic compatibility? [1 Mark]
b) What is electromagnetic interference? [1 Mark]
c) Explain that how to assure electromagnetic compatibility. [2 Marks]
d) explain electromagnetics controls? [2 Marks]
f) Discuss that what are the critical factors to be considered during the maintenance procedures and expansion stage of the systems. [2 Marks]

Q4. a) What do you meant by directive gain ?

b) What do you meant by effective area of the antenna?

c) A magnetic field strength of 5 μA/m is required at a point on $\theta = \pi/2$, which is 2 km from an antenna in air. Neglecting ohomic loss, how much power must the antenna transmit if it is a hertzian dipole of length $\lambda/25$

d) A magnetic field strength of 5 μA/m is required at a point on $\theta = \pi/2$, which is 2 km from an antenna in air. Neglecting ohomicloss, how much power must the antenna transmit if it is a half wave dipole? [10 Marks]

Q5. Answer all MCQ given below and each question carries 1 mark.

a) Which of these is correct

i) $\bar{A} \times \bar{A} = |\bar{A}|^2$.

ii) $\bar{A} \times \bar{B} + \bar{B} \times \bar{A} = 0$.

iii) $\bar{a}_x . \bar{a}_y = \bar{a}_z$.

iv) $\bar{a}_k = \bar{a}_x - \bar{a}_y$.

b) By saying that the electrostatic field is conservative, we do not meant that

i) It is the gradient of a scalar potential.

ii) Its curl is identically zero.

iii) the work done in a closed path inside the field is zero.

iv) potential difference between any two point is zero.

c) A potential field is given $V = 3x^2y - yz$. Which of following is not true ?

i) A unit normal to the equipotential surface V = - 8 at P is - 0.83 $\bar{a}_x$ + 0.55 $\bar{a}_y$ + 0.07 $\bar{a}_z$.

ii) $x^2y = 1$ is an equipotential line on the xy-plane.

iii) The electric field at point P is 12 $\bar{a}_x$ - 8 $\bar{a}_y$ - $\bar{a}_z$ V/m.

iv) At point (1, 0, -1), V and **E** vanish.

d) Which of these is not valid at point (0, 4, 0)

i) $\bar{a}_\phi = -\bar{a}_x$

ii) $\bar{a}_\theta = -\bar{a}_z$

iii) $\bar{a}_r = 4\bar{a}_y$

iv) $\bar{a}_\rho = \bar{a}_y$

e) Which of following potentials does not satisfy laplace'sequation ?

i) $V = \rho \cos \varphi + 10$

ii) $V = 10xy$

iii) $V = r\cos \varphi$

iv) $V = 10/r$

f) Two conducting plates are inclined at an angle 30^0 to each other with a point charge between them. The number of image charges is
   i) 12.
   ii) 11.
   iii) 13.
   iv) 10.

g) The z-axis carries filamentary current of 10π along a_z. Which of these is incorrect
   i) $\bar{H} = -\bar{a}_x$ A/m at (0, 5, 0)
   ii) $\bar{H} = -\bar{a}_x$ A/m at (5,π/4, 0)
   iii) $\bar{H} = -0.8\,\bar{a}_x - 0.6\,\bar{a}_y$ at (-3, 4, 0)
   iv) $\bar{H} = -\bar{a}_\varphi$ at (5,3π/2, 0)

h) If $\bar{E}_s = 10\,e^{j4x}$, which of these is not a correct representation of $\bar{E}$?
   i) $\mathrm{Re}(\bar{E}_s e^{j\omega t})$
   ii) $\mathrm{Re}(\bar{E}_s e^{-j\omega t})$
   iii) $\mathrm{Im}(\bar{E}_s e^{j\omega t})$
   iv) $10\cos(\omega t + j4x)\,\bar{a}_y$

i) The concept of displacement current was a major contribution attributed to
   i) Faraday.
   ii) Lenz.
   iii) Maxwell.
   iv) Lorentz.

j) Given that $\bar{H} = 0.5e^{-0.1x}\sin(10^6 t - 2x)\,\bar{a}_z$ A/m, which of these statements are incorrect
   i) $\alpha = 0.1$ Nm/m
   ii) $\beta = -2$ rad
   iii) $\omega = 10^6$rad/s
   iv) The wave traveling along $\bar{a}_x$ [10 Marks]

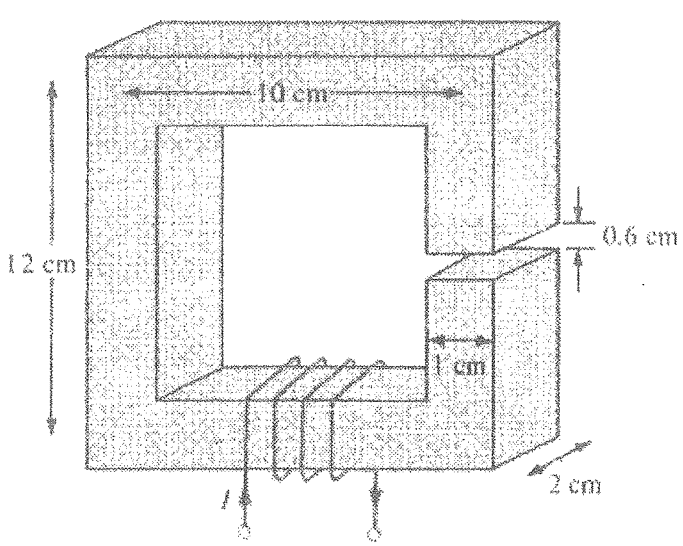

Fig. Q2