ELIZADE UNIVERSITY

ILARA-MOKIN

ONDO STATE

FACULTY: Basic and Applied Sciences
DEPARTMENT: Physical and Chemical Sciences
FIRST SEMESTER EXAMINATIONS
2018/2019 ACADEMIC SESSION

COURSE CODE: PHY 403

COURSE TITLE: ELECTROMAGNETIC THEORY 11

DURATION: 2 HOURS

HOD's SIGNATURE

TOTAL MARKS:

Matriculation Number: _____

INSTRUCTIONS:

1. Write your matriculation number in the space provided above and also on the cover page of the exam booklet.
2. This question paper consists of 2 pages with printing on both sides.
3. Answer all questions in the examination booklet provided.
4. More marks are awarded for problem solving method used to solving problems than for the final numerical answer.
5. Box your final answers.
6. **Attempt any 4 of the 6 questions**

1a(i) Give three properties of electromagnetic waves and three applications of Maxwell's equations.

(ii) Write the Maxwell's equations in (a) Point form and (b) Integral form in free space set.

b. Show that for an Electromagnetics wave travelling in vacuum

(i) There is a definite ratio between the magnitudes of E and B

(ii) The speed, $V = 1/\sqrt{\epsilon_0 \mu_0}$

2a(i) Starting from Maxwell equations in a vacuum show that

$$\nabla^2 E - \frac{1}{c^2}\frac{\partial^2 E}{\partial t^2} = 0 \text{ (wave equation)}$$

(ii) What is Polarization and Magnetization effect in Macroscopic media and state their respective effect on electric and magnetic field

b. In free space, $E_{(z,t)} = 10^5 \sin(wt - \beta z) a_y$ V/m . Obtain $H_{(z,t)}$

3a(i) State snell's Law as applicable to an electromagnetic wave

(ii) Write short note on (a) Parallel polarization (b) perpendicular polarization

b.) An electromagnetic wave travels in free space with the electric field component
$$E_s = 200 e^{j(0.766y+0.5z)ax} \text{ V}/m .$$

Determine (i) ω and λ (ii) The magnetic field component. (iii) The time average power in the wave.

4a(i) Explain briefly what is meant by Poynting Vector.

(ii) Starting from the Maxwell's equations obtain the expression for the poynting Vector of a region with conductivity σ .

(b) Given that $A = 20Cos(10^6 t - 20x + 30^0)$ and $B_s = \left(\frac{40}{j}\right)_{ax} + 30e^{\frac{j2\pi x}{3}}$ ay

Express A in phasor form and B_s in instantaneous form.

5 (a) (i) Define attenuation constant α and state its unit.

(ii) What is the skin depth and show that the skin depth is
$$\delta = \frac{1}{\sqrt{\pi f \mu \sigma}}$$

(b) State the Maxwell's equation in a linear, isotropic, homogeneous, lossy dielectric medium that is charge free ($\rho_v = 0$) , and hence show that
$$\nabla^2 H_s - \gamma^2 H_s = 0 \text{ (Helmholtz's equation)}$$

6 a. What is meant by Electromagnetic Spectrum

b.(i) What is a Lossy material

(ii) Write the expression for the wavelength in a lossy material (iii) A radiation has a frequency of 1000MHz . Find its wavelength in medium of relative permittivity 82 and resistivity 1.8 Ωm.