NATIONAL OPEN UNIVERSITY OF NIGERIA
PLOT 91, CADASTRAL ZONE, NNAMDI AZIKIWE EXPRESSWAY, JABI - ABUJA
FACULTY OF SCIENCES

DEPARTMENT OF PURE AND APPLIED SCIENCE

2021_2 EXAMINATIONS

COURSE CODE: **PHY404**

COURSE TITLE: **ELECTRODYNAMICS III**
CREDIT UNIT: **3**
TIME ALLOWED: **(2½ HRS)**

INSTRUCTION: ***Answer question 1 and any other four questions***

CONSTANTS

Permittivity of free space, $\varepsilon_o = 8.85 \times 10^{-12}$ Fm^{-1}

Permeability of free space, $\mu_0 = 4\pi \times 10^{-7}$ Hm^{-1}

Velocity of light in vacuum, $c = 3.00 \times 10^{8}$

QUESTION 1

Distinguish between group velocity and phase velocity.**2 marks**

b. Write the simple differential equation of Resonant Circuit.**3 marks**

c. Obtain expressions for reflection and transmission coefficients in term of Poynting vector.

2 marks

d. Differentiate between Polarized and unpolarized wave.**2 marks**

e. Show the that the refractive index of a dispersive medium varies with frequency where n= $\sqrt{\varepsilon_r \mu_r}$**5 marks**

f. From Maxwell's equation show the wave equation of Electric and magnetic field can be given as $\nabla^2 E = \frac{1}{c^2}\frac{d^2E}{dt^2}$ and $\nabla^2 B = \frac{1}{c^2}\frac{d^2B}{dt^2}$**6 marks**

QUESTION 2

ai. What is an isotropic medium? **2 marks**

aii. Give examples of isotropic medium **2 marks**

b. Starting from Maxwell's equations, obtain wave equation for Electric field in an insulating

medium. **5 marks**

c. Give two examples of an isotropic medium. **3 marks**

QUESTION 3

a. Explain the resonance in term of LRC circuit.**4 marks**

b. The aerial circuit of a radio set is equipped with a turning coil of inductance 1.4 mH. What turning capacitor must be used to tune to the CNN long wave station (250 GHz).**5 marks**

c. Mention some the boundary conditions for transmission of wave in a pair of parallel conducting plane. **3 marks**

QUESTION 4

a. A rectangular air –filled waveguide has a cross section of $4cm \times 10cm$. What is the minimum frequency propagated in the waveguide. **5 marks**

b. Show that the natural frequency w, of resonant circuit is **7 marks**

QUESTION 5

a. Define (i) resonance (ii) resonant circuit **2Marks each**

b. (i) What is the equation of motion for an oscillating circuit where no external force is applied? **3 marks**

(ii) Use the equation to determine the natural angular frequency of the system. **5 marks**

QUESTION 6

(a) Put down the electric field components for transverse electric (TE) wave. **4 marks**

(b) What is the retarded potential expression mathematically? **1 mark**

(c) How is the retarded potential, A related to the magnetic field, B? **1 mark**

(d) What are the retarded potential components and its corresponding magnetic field components in spherical coordinate? **6 marks**