



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

DEPARTMENT OF PURE AND APPLIED SCIENCE

2019\_1 SEMESTER EXAMINATION

**COURSE CODE:** PHY 404  
**COURSE TITLE:** ELECTRODYNAMICS III  
**CREDIT UNIT** 3  
**TIME ALLOWED** (2½ HRS)

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

### QUESTION 1

- What is an electric dipole (2marks)
- How is resonance achieved in the tuning of a radio set? (3marks)
- What is an isotropic medium (2marks)
- Show that the refractive index of an isotropic medium is given by  $n = \sqrt{(\epsilon_r \mu_r)}$  where  $\epsilon_r$  and  $\mu_r$  are relative permittivity and relative permeability respectively (5marks)
- Differentiate between Skin depth and Skin effect (4marks)
- Determine the skin depth when the frequency is 60 megahertz. (4marks)  
 $\mu_0 = 4\pi \times 10^{-7}$ ,  $\sigma = 5.9 \times 10^7$
- What is a wave guide? (2marks)

### QUESTION 2

- Explain how radio waves are generated from oscillating dipoles (5marks)
- The aerial circuit of a radio set has a tuning coil of inductance 1.5mH. What capacitance must be used with this to tune to a station of frequency 100 kilohertz. (4marks)  
What effects are noticed when a wave is incident on a boundary between two media? (3marks)

### QUESTION 3

- Write the simple differential equation of a resonant circuit. (1 mark)

- b. Show that the square of the natural frequency  $\omega$  of a resonant circuit is given by  $\omega^2 = 1/LC$  (5marks)
- c. An RLC circuit has a resistor 550 ohms connected to an inductor 0.2H and to a capacitor  $1\mu F$ . If the frequency of the source is  $(1000/\pi)$  Hz, find the impedance and current in the circuit. (6marks)

#### QUESTION 4

- a. State four Maxwell's equations outside a region of changing charge and current distribution (2marks)
- b. Show that the wave equations for magnetic field and electric field are given as  $\nabla^2 E = 1/C^2 d^2 E/dt^2$  and  $\nabla^2 B = 1/C^2 (d^2 B/dt^2)$  (10marks)

#### QUESTION 5

- a. Why is a pair of parallel conducting planes preferable to parallel transmission lines and coaxial cable (1mark)
- b. Mention two boundary conditions which a pair of perfectly conducting planes must have (3marks)
- c. Show mathematically that both voltage and current propagate as waves along transmission lines. (8marks)

#### QUESTION 6

- a. What is Poynting Vector? (1mark)
- b. Define reflection coefficient and transmission coefficient (2marks)
- c. If the refractive index for a liquid is 6 for waves of frequency 250Hz, calculate the reflection and the transmission coefficients (6marks)
- d. Explain the relationship between the refractive index and the energy reflected and transmitted in question 6C. (3marks)