



NATIONAL OPEN UNIVERSITY OF NIGERIA
PLOT 91, CADASTRAL ZONE, NNAMDI AZIKIWE EXPRESSWAY, JABI - ABUJA
FACULTY OF SCIENCES
DEPARTMENT OF PHYSICS
2025_1 EXAMINATION

COURSE CODE: PHY404
COURSE TITLE: ELECTRODYNAMICS III
CREDIT UNIT: 3
TIME ALLOWED: (3 HRS)
INSTRUCTION: *Answer question 1 and any other three questions*

QUESTION 1

- (a) List three types of polarization (3 marks)
- (b) An electromagnetic wave in free space has an electric field amplitude of $E_o = 80 \text{ v/m}$. Calculate the magnitude of the Poynting vector. (6 marks)
- (c) With an equation for the skin depth and explain the concept of skin effect (6 marks)
- (d) Using mathematical expression, define reflection and transmission coefficient. (10 marks)

QUESTION 2

- (a) An oscillating electric dipole radiates power P given by $P = \frac{P_o^2 \omega^4}{12\pi\epsilon_o l^3}$ where P_o is the dipole moment, ω the angular frequency, ϵ_o is the permittivity of free space, and c is the speed of light. Calculate the radiated power for $P_o = 3 \text{ C.m}$ and $\omega = 10^9 \text{ rad/s}$ (6 marks)
- (b) How can transmission line losses be minimized? (3 marks)
- (c) List 3 applications of waveguides. (6 marks)

QUESTION 3

- (a) For a series RLC circuit with $R = 10 \Omega$, $L = 2 \text{ mH}$, and $C = 5 \mu\text{F}$. Calculate the resonant frequency (6 marks)
- (b) Differentiate between wavelength (λ), frequency (f), and velocity (c) (9marks).

QUESTION 4

- (a) Define plane waves (3marks)
- (b) List 3 applications of plane waves. (6 marks)
- (c) Calculate the cutoff frequency for the TE₁₀ mode in a rectangular waveguide with dimensions $a = 4 \text{ cm}$ and $b = 1 \text{ cm}$. Assume the waveguide is air-filled (6marks)

QUESTION 5

- (a) For a lossless transmission line with a characteristic impedance of 50Ω and a load impedance of 100Ω , calculate the reflection coefficient at the load. (6 marks)
- (b) Mention six (6) properties of electromagnetic waves (9 marks)

QUESTION 6

- (a) Discuss three (3) ways in which electromagnetic waves can be propagated (9 marks)
- (b) A charge $q = 2 \mu\text{C}$ is moving with a velocity $v = 10^6 \text{ m/s}$ perpendicular to a magnetic field $B = 0.1 \text{ T}$. Calculate the magnitude of the force acting on the charge. (6 marks)