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 $E_o = 80\ v/m$. 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 $P_o = 3\ C.m$ and $\omega = 10^9\ rad/s$ (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 $R = 10\ \Omega, L = 2\ mH, and\ C = 5\ \mu F$. 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 $a = 4\ cm\ and\ b = 1\ cm$. Assume the waveguide is air-filled (6marks)

QUESTION 5
(a) For a lossless transmission line with a characteristic impedance of 50 Ω and a load impedance of 100 Ω, 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 $q = 2\ \mu C$ is moving with a velocity $v = 10^6\ m/s$ perpendicular to a magnetic field $B = 0.1\ T$. Calculate the magnitude of the force acting on the charge. (6 marks)