

R16

Code No: 135AP

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**B. Tech III Year I Semester Examinations, November/December - 2018****ELECTROMAGNETIC THEORY AND TRANSMISSION LINES****(Electronics and Communication Engineering)****Time: 3 hours****Max. Marks: 75**

Note: This question paper contains two parts A and B. Part A is compulsory which carries 25 marks. Answer all questions in Part A. Part B consists of 5 Units. Answer any one full question from each unit. Each question carries 10 marks and may have a, b, c as sub questions.

PART - A**(25 Marks)**

- 1.a) Find the Electric Field due to an infinite line charge having a uniform charge density of ρ_L C/m., using Gauss's Law. [2]
- b) Define the term - Relaxation Time and estimate the same for a medium with $\sigma = 10^{-4}$ Ω/m , and dielectric constant of 81. [3]
- c) A copper wire carries a conduction current of 5 mA at 1 kHz. Find the amplitude of the associated displacement current. Take $\sigma_{Cu} = 5.8 \times 10^7 \Omega/m$. [2]
- d) Distinguish between the Magnetic Scalar Potential and Magnetic Vector Potential, and explain their significance. [3]
- e) Account for the phenomenon of Total Internal Reflection, and list out the conditions under which it is possible. [2]
- f) Define the term : Skin Depth, and estimate its value for Brass medium, having conductivity of $1.1 \times 10^7 \Omega/m$ at 1 MHz. [3]
- g) Sketch the typical equivalent circuit of a general lossy transmission line, listing out its primary and secondary constants. [2]
- h) What is the need for loading of transmission lines? What are the different methods of loading of transmission lines? [3]
- i) Explain the significance of Z_{max} and Z_{min} points along an rf transmission line. [2]
- j) Find the Quarter Wave Transformer parameters required, for matching a 60 ohm rf line to a load of 120 Ω at 600 MHz. Where should this be connected? [3]

PART - B**(50 Marks)**

- 2.a) State and derive the Maxwell's Equations for electrostatic fields, in both differential and integral forms.
 - b) Find the Potential and Electric Field due to a small electric dipole located on Z-axis. [5+5]
- OR**
- 3.a) Derive an expression for the capacitance of a spherical capacitor having concentric spheres of radii a and b ($a < b$). Hence evaluate the capacitance of a single spherical conductor of 4 cm diameter in air.
 - b) List out the relations between \vec{E} and potential in an electrostatic field, and hence show that the electrostatic field is a conservative field. [5+5]

- 4.a) State Biot-Savart's Law, and hence calculate the magnetic field due to a circular loop of radius R in $z=0$ plane, carrying a current I , at the points $(0, 0, h)$ and origin.
- b) Derive the continuity equation for time varying fields, and hence establish Maxwell's curl equation for time-varying magnetic field, explaining the concept of displacement current density. [5+5]

OR

- 5.a) State Ampere's Circuital Law, and hence evaluate the magnetic field for a long cylindrical conductor of diameter $2a$, carrying a dc current I , in the regions $\rho \leq a$, and $\rho \geq a$.
- b) State and derive the boundary conditions to be satisfied by the tangential components of electric and magnetic fields, at the surface of a perfect conductor. [5+5]

- 6.a) Define and distinguish between 'perpendicular' and 'parallel' polarizations, when a UPW travelling in air, is obliquely incident on a perfect dielectric, with neat sketches. Also write the related boundary conditions for tangential components of electric fields in both cases.
- b) For a UPW with $\vec{H} = 0.4 \cos(\omega t - 0.5x) \hat{z}$ A/m., find the dielectric constant, intrinsic impedance, direction of propagation and polarization, phase velocity and propagation constant, at 20 MHz. Also write the expression for \vec{E} . [5+5]

OR

- 7.a) Show that a Uniform Plane Wave is a TEM Wave.
- b) A 100 MHz UPW is normally incident from air onto another perfect dielectric medium with $\epsilon_r = 2.25$. Estimate the reflection and transmission coefficients for E and H fields, deriving the expressions used. [5+5]

- 8.a) Distinguish between the different types of distortions present in conventional transmission lines, and establish the condition for distortionlessness.
- b) A 75 ohm transmission line has a propagation constant of $0.05 + j5$ N per meter, at 50 MHz. Find its primary constants, assuming phase velocity as 60% of light velocity, and no distortion. [5+5]

OR

- 9.a) Explain the significance of infinite line, and hence obtain the general expression for the line characteristic impedance using the lossy line equivalent circuit.
- b) Establish the expressions for the propagation characteristics - α , β , γ , λ , v_p , Z_0 , for lossy distortionless transmission lines. [5+5]

- 10.a) Sketch the variations of input impedances of SC and OC lines with 5ℓ , and explain how a UHF line can be used as an inductance or a capacitance.
- b) A 50Ω rf line is connected to a load of $75 + j40$ ohms. Estimate the resultant reflection coefficient, VSWR, Z_{min} , Z_{max} . Also find its Input Impedance, if the line length is 0.5λ . [5+5]

OR

- 11.a) Explain the principle of impedance matching using a single stub tuner, and list out its limitations.
- b) Define the terms: Reflection Coefficient and VSWR and derive expressions for the same, as applicable to rf lines. [5+5]