Code No: 135AP **R16**

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 $\sigma = 10^{-4}$ ℧/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 $\sigma_{Cu} = 5.8 \times 10^7$℧/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 1.1×10^7℧/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 $\overline{E}$ 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 $\overline{H} = 0.4 \cos(\omega t - 0.5 x)\, \hat{z}$ 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 $\overline{E}$. [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 $\in_r = 2.25$. 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, υ_p , Z_o, 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 + j 40 ohms. Estimate the resultant reflection coefficient, VSWR, Z_{min}, Z_{max}. Also find its Input Impedance, if the line length is $0.5\,\lambda$. [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]

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