Code No: 114CU

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JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

B.Tech II Year II Semester Examinations, November/December - 2015

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) Define Conservative field. Find whether the electrostatic field given by $\overline{E} = yz\hat{X} + xz\hat{Y} + xy\hat{Z}$ v/m. is conservative or not. [2]

b) Using the field expression due to an infinite sheet having charge density of ρ_s C/m^2, find the expression for the capacitance of a parallel plate capacitor. [3]

c) Explain the significance and utility of Scalar and Vector Magnetic Potentials. [2]

d) Define Biot-Savart Law, and List out the expressions for $\overline{H}$ due to line, surface and volume current distributions. [3]

e) List out all the mathematical relations between $\overline{E}$ and $\overline{H}$ for a Uniform Plane Wave propagating along $+\hat{Z}$ direction. [2]

f) Define the term 'Polarization' for a Uniform Plane wave, and state the conditions under which it can be classified as 'Circular Polarization'. [3]

g) Explain the concept of 'an infinite transmission line'. How can it be realized in practice ? [2]

h) What is the significance of 'Loading of Transmission Lines'. How is it implemented ? [3]

i) What types of circles constitute a Smith Chart? What does the centre of the Smith Chart represent ? [2]

j) Explain the significance and utility of $\lambda/4$ RF lines. [3]

Part - B

(50 Marks)

2.a) Establish the Gauss's Law in differential and integral forms. What is a Gaussian Surface ?

b) Find the field and potential in different regions due to a single shell of radius R, having a surface charge density of ρ_s C/m^2 in air, and sketch their variation with radial distance. [5+5]

OR

3.a) Derive the differential and integral relations between the electrostatic potential and static electric field.

b) A uniformly charged sphere of radius R has a volume charge density of ρ_v C/m^3 inside. Evaluate the resultant field and potential in different regions, and sketch their variation with r. [5+5]

4.a) Given $\overline{E} = 377 \sin(\omega t - 10x)\,\hat{Y}$ V/m, find the displacement current density and magnetic field in air region.

b) Define and explain the significance of Ampere's Force Law, listing out the relevant mathematical relations. [5+5]

OR

5.a) Derive the two Maxwell's divergence equations for time-varying fields in both integral and differential forms. How do they change for static case ?

b) State the boundary conditions to be satisfied by the normal components of electric and magnetic fields at the interface between air and a perfect conductor. [5+5]

6.a) Derive and explain the significance of 'Poynting Theorem', and list out the various Poynting Vector relations.

b) A 300 MHz Uniform Plane Wave is propagating through a lossless medium of $\varepsilon_r = 2.25$, $\mu_r = 1$. Find its propagation constant, velocity, wavelength and the intrinsic impedance of the medium. [5+5]

OR

7.a) What is a TEM wave ? Derive the relations for the reflection and transmission coefficients of electric and magnetic fields, if such a wave is normally incident from air onto another perfect dielectric.

b) Evaluate all the reflection and transmission coefficients for the above case, if the second medium has a dielectric constant of 2.56. [5+5]

8.a) Give the equivalent circuit of a lossy transmission line, and hence establish the transmission line equations for voltage and current in terms of load parameters, in hyperbolic functions.

b) Find the secondary constants and line velocity for a transmission line with R = 0.4 mΩ/m, L = 2 μH/m, G ≈ 0, C = 6 pF/m, at 4 kHz. What will be the attenuation in dB for 1 km long line. [5+5]

OR

9.a) A 50 ohm cable has $Z_{SC} = 1600 \angle 30^0\ \Omega$, $Z_{OC} = 225 \angle -30^0\ \Omega$ at 1 kHz. Find its primary and secondary constants.

b) List out the expressions for Z_{in} of a lossy cable, and hence find the input impedance of SC, OC, and match terminated lines. [5+5]

10.a) List out the sources of distortions in transmission lines, and hence establish the c condition for a line to be 'distortionless'.

b) A 60 Ω rf line delivers power to a load of (120 + j 60) Ω. Evaluate the complex reflection coefficient, VSWR, and the power delivered to the load, if the input power is 10 W. [5+5]

OR

11.a) Estimate the values of Z_{min} and Z_{max} along an RF transmission line, and explain their significance.

b) Explain the principle of 'Single Stub Matching' in UHF lines with neat schematics, listing out the relevant expressions. What types of stubs are used here, and Why ?

[5+5]

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