

Code No: R09220404

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY, HYDERABAD
B.Tech II Year II Semester Examinations, May-2013
Electromagnetic Theory and Transmission Lines
 (Common to ECE, ETM)

Time: 3 hours

Max. Marks: 75

Answer any five questions
 All questions carry equal marks

- 1.a) A cube of 2 cm. side is centered at the origin, with its sides parallel to the axes, and contains a field of $3x^2 \hat{U}_x$ V/m. Find the total charge contained in the cube, and the flux coming out of one face of the cube.
- b) Find the potential and sketch its variation with radial distance, for a spherical shell of radius $a = 3$ cm, having a surface charge density of ρ_s C/m². [15]
- 2.a) Distinguish between the Conduction and Convection currents. Establish the current continuity equation, and hence calculate the relaxation time for Brass material, having a conductivity of 1.1×10^7 mhos/m at 10 MHz.
- b) Find the capacitance of a 50 cm. long coaxial cable, having conductors of 4 cm and 2 cm diameters, separated by a medium of relative permittivity 2.56. Also find the stored energy and field at a radius of 1.5 cm in the dielectric when 10 V is applied. [15]
- 3.a) Define Ampere's Circuital Law in point and integral forms for static fields.
- b) Establish the fields in the different regions of a coaxial cable carrying a current I , and sketch their variation with radial distance. Is this cable a shield cable? [15]
- 4.a) Define and derive the Maxwell's curl equation involving Faraday's Law. Explain the concept of displacement current.
- b) If $\vec{H} = 10 \cos(10^8 t - z) \hat{Y}$ mA/m, find the corresponding electric field in air, and the displacement current density. [15]
- 5.a) Define a Uniform Plane Wave and establish the wave equations for a conducting medium.
- b) A lossy dielectric has intrinsic impedance of $250 \angle 30^\circ$ ohms, and $\vec{E} = 2 e^{-\alpha x} \cos(\omega t - 0.5x) \hat{Z}$ V/m. Find the loss tangent, propagation constant, skin depth, polarization and direction of propagation. [15]
- 6.a) With neat sketches, define and distinguish between vertical and horizontal polarizations, when a uniform plane wave is obliquely incident on a perfect dielectric from air, with relevant schematics.
- b) A Uniform plane wave is normally incident from free space onto a non-magnetic medium of $\epsilon_r = 2.56$, $\sigma = 0$. Determine the reflection and transmission coefficients for E and H fields, and find the VSWR. [15]

7.a) Draw the equivalent circuit of lossy and lossless transmission lines, and account for the different types of distortions present in such lines. How can these distortions be avoided?

b) A 50 ohm transmission line operates at 10 MHz, with a velocity of 2×10^8 m/sec. If the load impedance is $60 + j 10$ ohms, determine its input impedance for a line length of 10 m and 5 m. [15]

8.a) Establish the relations for Z_{sc} and Z_{oc} of rf lines, and sketch their variation with $(\beta \ell)$.

b) A 60 ohm lossless line is 30 m long and is terminated with a load of $75 + j 50$ ohms at 3 MHz. Find its reflection coefficient, VSWR, Z_{MAX} and Z_{MIN} , if the line velocity is 60% of the velocity of light. [15]

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