

Code No: 54011

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

B.Tech II Year II Semester Examinations, May - 2016

ELECTROMAGNETIC THEORY AND TRANSMISSION LINES

(Common to ECE, ETM)

Max. Marks: 75

Time: 3 hours

Answer any five questions  
All questions carry equal marks

- 1.a) State and explain Coulomb's law using vector form of Coulomb's force expression.
- b) Find the force on charge  $Q_1$ ,  $30\mu\text{C}$ , due to charge  $Q_2$ ,  $-200\mu\text{C}$ , where  $Q_1$  is at  $(0, 0, 2)$  m and  $Q_2$  is at  $(2, 1, 0)$  m. [7+8]
- 2.a) What is capacitance? Explain different types of capacitors.
- b) A parallel plate capacitance has 500 mm side plates of square shape separated by 10 mm distance. A sulfur slab of 6 mm thickness with  $\epsilon_r = 4$  is kept on the lower plate. Find the capacitance of the setup. If a voltage of 100 V is applied across the capacitor, calculate the voltage at both the regions of the capacitor between the plates. [7+8]
- 3.a) State and explain Biot and Savart's law and write the equation in terms of distributed current sources.
- b) Derive an expression for magnetic field strength due to current-carrying conductor of finite length placed along the y-axis at a point P in x-z plane and 'r' distance from the origin. Hence deduce expressions for H due to semi-finite length of the conductor. [7+8]
- 4.a) Write Maxwell's equation in point and integral form for good conductors and write for each equation equivalent word statements.
- b) Let  $\vec{H} = 2\cos(10^{10}t - \beta x)\vec{u}_z$  A/m,  $\mu = 3 \times 10^{-5}$  H/m,  $\epsilon = 1.2 \times 10^{-10}$  F/m and  $\sigma = 0$  everywhere, find the electric flux density ( $\vec{D}$ ). [7+8]
- 5.a) Derive the wave equation for a uniform plane wave traveling in a conducting medium.
- b) Determine the i) phase velocity of propagation, ii) attenuation constant, iii) phase constant and iv) intrinsic impedance for a forward traveling wave in a large block of copper at 1MHz ( $\sigma = 5.8 \times 10^7$ ,  $\epsilon_r = \mu_r = 1$ ). Also determine the skin depth. [7+8]
- 6.a) What is meant by surface impedance? Derive an expression for the surface impedance for a perfect conductor.
- b) Consider an oblique incidence at  $\theta_i = 10^\circ$  and find the transmission and reflection coefficients for perpendicular polarization of wave. [8+7]
- 7.a) A transmission line in which no distortion is present has the following parameters:  $Z_0 = 60\Omega$ ,  $\alpha = 20 \times 10^{-3}$  Np/m, and  $V = 0.7$ . Determine R, L, G and C and wavelength at 0.1 GHz.
- b) What is the difference between lumped parameters and distributed parameters? Discuss in detail. [8+7]

8.a) Derive the expression for the input impedance of a lossless line and hence evaluate open-circuit and short-circuit impedance.

b) Find the input impedance for a lossless line with characteristic impedance of  $75\Omega$  and termination impedance of  $45+j60\text{ ohm}$  with the following:

i)  $f = 50\text{M Hz}$ , length = 3 m

ii)  $f = 15\text{M Hz}$ , length = 5 m.

[7+8]

---ooOoo---