

Code No: 114CU

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

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

ELECTROMAGNETIC THEORY AND TRANSMISSION LINES

(Common to ECE, ETM)

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) How can materials be classified in terms of their conductivity? [2]
- b) Give an expression for convection current density. Also state the point form of Ohm's Law. [3]
- c) State Maxwell's equations for a lossless or non conducting medium. [2]
- d) State the Ampere's Force Law. Give magnetic force for arbitrary geometries. [3]
- e) Give an expression for intrinsic impedance in phasor form. What are its magnitude and phase components? [2]
- f) Explain in brief significance of loss tangent. [3]
- g) List any four types of transmission lines. [2]
- h) How does group velocity vary when compared to phase velocity? [3]
- i) What are the two families of circles that constitute the Smith Chart? [2]
- j) What are the advantages and disadvantages of a Single Stub? [3]

**PART - B****(50 Marks)**

- 2.a) State Coulomb's Law. Find the force on charge  $Q_1$ ,  $30 \mu\text{C}$  due to a 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.
- b) Derive the relation between electric field,  $E$  and Scalar potential,  $V$ . Find the electric field at  $(2,3,1)$  if the potential distribution is of the form  $3x^2y + y^2x + 3z$ . [5+5]

**OR**

- 3.a) Discuss the Maxwell's equations for electrostatic fields.
- b) Obtain the expression of Gauss's Law for infinite surface charge. Also state any two limitations of Gauss's Law. [5+5]

- 4.a) State the important properties of magnetic lines of forces.
- b) Show that the magnetic field due to a finite current element along  $z$ -axis at a point  $P$  "r" distance away from  $y$ -axis is given by  $\vec{H} = \frac{1}{4\pi r} (\sin \alpha_1 - \sin \alpha_2) a\phi$ , where

"I" is the current through the conductor,  $\alpha_1, \alpha_2$  are the angles made by the tips of the conductor element at  $P$ . [5+5]

**OR**

5.a) What are boundary conditions? State the boundary conditions at the interface of dielectric and perfect conductor.

b) A certain material has  $\sigma = 0$  and  $\epsilon_r = 1$ , if  $\vec{H} = 4 \sin(10^6 t - 0.01z) \vec{a}_y \text{ A/m}$ . Use Maxwell's equations to find  $\mu_r$ . [5+5]

6.a) Derive the relation between  $\vec{E}$  and  $\vec{H}$  in a Uniform plane wave.

b) What are the wave equations for a lossless medium and a conducting medium for sinusoidal variations? [5+5]

OR

7.a) Write short notes on normal incidence of a plane wave on a perfect dielectric.

b) A plane wave travelling in air is normally incident on a material with  $\epsilon_r = 4$  and  $\mu_r = 1$ . Find the reflection and transmission coefficients. [5+5]

8.a) Derive the expression for voltage and current at any point on the transmission line in terms of characteristics impedance.

b) Discuss the parameters that characterize a lossless and low loss transmission line. [5+5]

OR

9.a) What is distortion? State the conditions that characterize a distortion less line.

b) The propagation constant of a lossy transmission line is  $(1+j2)\text{m}^{-1}$  and its characteristic impedance is  $20 \Omega$  at  $\omega = 1\text{M rad/s}$ . Find  $L$ ,  $C$ ,  $R$  and  $G$  for the line. [5+5]

10.a) What are the applications of transmission lines?

b) How can ultra high frequency transmission lines be used as circuit Elements? [5+5]

OR

11.a) What are the applications of Smit Chart.

b) One end of a lossless transmission line having the characteristic impedance of  $75 \Omega$  and length of  $1 \text{ cm}$  is short circuited. At  $3 \text{ GHz}$ , What is the input impedance at the other end of the transmission line? [5+5]

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