

Name : .....

Roll No. : .....

Invigilator's Signature : .....

**CS/B.TECH ( ECE-NEW)/SEM-4/EC-401/2012  
2012**

**ELECTROMAGNETIC THEORY & TRANSMISSION LINES**

Time Allotted : 3 Hours

Full Marks : 70

*The figures in the margin indicate full marks.*

*Candidates are required to give their answers in their own words  
as far as practicable.*

**GROUP – A**

**( Multiple Choice Type Questions )**

1. Choose the correct alternatives for any *ten* of the following :

10 × 1 = 10

i) The divergence of  $G = xa_x + ya_y + za_z$  at point

$P ( 2, 2, 2 )$  is

a) 1

b) 2

c) 3

d) 4.

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ii) The Stokes' theorem is

$$\text{a) } \int_1 H \cdot dL = \oint_S (\nabla \times H) \cdot dS$$

$$\text{b) } \int_1 H \cdot dL = \oint_S (\nabla \cdot H) \cdot dS$$

$$\text{c) } \int_1 H \cdot dL = \int_S (\nabla \times H) \cdot dS$$

$$\text{d) } \oint H \cdot dL = \int_S (\nabla \cdot H) \cdot dS$$

iii) Energy density in an electrostatic field  $E$  is

$$\text{a) } \frac{1}{2} (\epsilon E^2) \quad \text{b) } (\epsilon E^2)$$

$$\text{c) } 2 (\epsilon E^2) \quad \text{d) } \frac{1}{2} (\epsilon E).$$

iv) The electric field intensity due to sheet charge density is

$$\text{a) } E = \frac{\rho_s}{2 \epsilon_0} a_p \quad \text{b) } E = \frac{\rho_s}{2 \epsilon_0} a_n$$

$$\text{c) } E = \frac{\rho_s}{2 \epsilon_0} a_z \quad \text{d) } E = \frac{\rho_s}{2 \epsilon_0} a_\theta.$$

v) Yag-Uda antenna is one kind of

$$\text{a) } \text{array} \quad \text{b) } \text{reflector}$$

$$\text{c) } \text{dipole} \quad \text{d) } \text{none of these.}$$

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vi) Intrinsic impedance in free space is

- a) 0 ohm                                      b) 370 ohm  
c) 377 ohm                                      d) none of these.

vii) The condition for distortionless transmission line is

- a)  $RL = GC$                                       b)  $RG = LC$   
c)  $RC = LG$                                       d) none of these.

viii) The rate of energy flow is given by

- a) Maxwell equation  
b) Poynting vector  
c) Poisson equation  
d) Equation of continuity.

ix) Effective length of a half wave dipole is

- a)  $> \frac{\lambda}{2}$                                       b)  $< \frac{\lambda}{2}$   
c)  $0.55 \lambda$                                       d)  $0.6 \lambda$ .

x) Polarization refers to the orientation of the

- a) E-H fields                                      b) H-field  
c) Transverse E-field                                      d) E-field.

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xi) A transmission line is said to be distortionless if

- a)  $R/G = C/L$                       b)  $R/G = L/C$
- c)  $RG = LC$                       d)  $R/Y = L/Z$

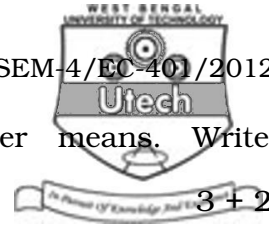
xii) Which one of the following is not a source of magnetostatic fields ?

- a) A d.c. current in a wire
- b) A permanent magnet
- c) An accelerated charge
- d) An electric field linearly changing with time.

**GROUP – B****( Short Answer Type Questions )**Answer any *three* of the following.                      3 × 5 = 15

2. State and prove Uniqueness theorem.
3. Starting from Ampere's circuit law establish the relation,  
 $\nabla \times H = J + \frac{\partial D}{\partial t}$ , where symbols have their usual meanings.
4. Establish the relation between reflection coefficient and VSWR.

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5. Explain what 'quarter-wave' transformer means. Write applications of such a transformer. 3 + 2
6. a) What are the characteristics of Smith chart ? 2  
 b) Define Reflection Coefficient and VSWR. What is their range of values ? 3

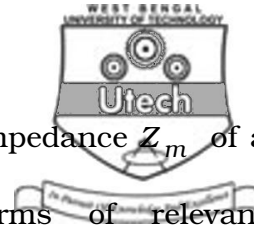
### GROUP – C

#### ( Long Answer Type Questions )

Answer any *three* of the following. 3 × 15 = 45

7. a) What do you mean by Electric Potential ? Derive the relation  $E = - \vec{\nabla} V$ . 4  
 b) Given the spherically symmetric potential field in free space,  $V = V_0 e^{-r/a}$ , find  $\rho_v$  at  $r = a$ . 3  
 c) Write and explain the point forms and integral forms of Maxwell's equation in time-varying EM field. 8
8. a) Write Maxwell's equations in differential vector form for time varying fields. 4  
 b) Define the following terms in relation to uniform plane wave propagation in a dielectric medium : 4 × 1  
 i) Propagation constant  
 ii) Phase velocity  
 iii) Wavelength  
 iv) Phase constant.  
 c) Prove that the electromagnetic power (  $P$  ) passing through free space is given by the expression  $P = E \times H \text{ W/m}^2$ . 7

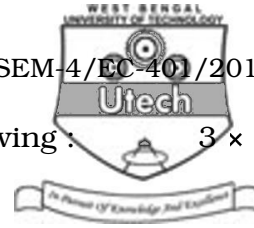
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9. a) Derive an expression for the input impedance  $Z_m$  of a lossless transmission line, in terms of relevant parameters, when the line is terminated into impedance  $Z_L$ . 5
- b) Show that for a lossless transmission line the input impedance of a line repeats over every  $\lambda/2$  distance. 5
- c) At a frequency of 80 MHz, a lossless transmission line has a characteristic impedance of  $300 \Omega$  and a wavelength of 2.5 m. Find the value of  $L$  and  $C$ . 5
10. a) Establish the boundary conditions for electric and magnetic field intensities and the interference between two dielectric media. 6
- b) Explain how these conditions will be modified, if one of the media is a perfect conductor. 5
- c) If  $x < 0$  defines region 1 and  $x > 0$  defines region 2, then find the electric field intensity in region 2  $\left( \epsilon_{r_2} = 5 \right)$ , if electric field intensity in region 1  $\left( \epsilon_{r_1} = 1 \right)$  is  $\vec{E}_1 = \left( 4\hat{u}_x + 1.5\hat{u}_y - 2\hat{u}_z \right) \text{ V/m}$ .

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11. Write short notes on any *three* of the following : 3 × 5

- a) Skin effect
- b) Smith chart
- c) Half-wave dipole antennas
- d) Yagi-Uda antenna.

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