



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.



ii) The Stokes' theorem is

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

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

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

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

iii) Energy density in an electrostatic field E is

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

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

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

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

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

v) Yag-Uda antenna is one kind of

- a) array b) reflector
c) dipole d) none of these.



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) 0.55λ
- d) 0.6λ .

x) Polarization refers to the orientation of the

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



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 ?

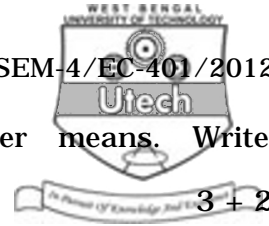
- a) A d.c. current in a wire
b) A permanent magnet
c) An accelerated charge
d) An electric field linearly changing with time.

GROUP - B

(Short Answer Type Questions)

Answer any *three* of the following. $3 \times 5 = 15$

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.



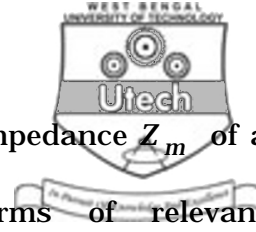
5. Explain what 'quarter-wave' transformer means. Write applications of such a transformer. 3 + 2
6. a) What are the characteristics of Smith chart ? 2
 b) Define Reflection Coefficient and VSWR. What is their range of values ? 3

GROUP - C

(Long Answer Type Questions)

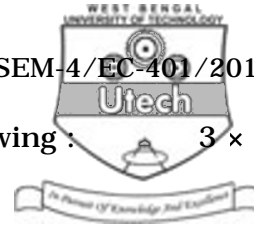
Answer any *three* of the following. 3 × 15 = 45

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 ρ_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 $P = E \times H W/m^2$. 7



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 300Ω 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 $\vec{E}_1 = \left(4\hat{u}_x + 1.5\hat{u}_y - 2\hat{u}_z \right) \text{ V/m}$.

4



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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