CS/B.TECH/ECE/NEW/SEM-4/EC-401/2013

2013

ELECTROMAGNETIC THEORY AND 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 : $10 \times 1 = 10$

   i) The point P(1, 3, 5) in the Cartesian co-ordinate system is P (... ... ...) in the Cylindrical co-ordinate system

   a) 3·16, 71·565°, 5

   b) 3·162, 5, 71·565°

   c) 5·916, 32·11°, 3·162

   d) 5·916, 3·162, 32·11°

ii) Which of the following is zero ?

a) grad div   b) curl grad

c) div grad   d) curl curl.

iii) The unit of electric field intensity is

a) Volt   b) Volt/m

c) Coulomb/m   d) Weber/m.

iv) On a perfect conductor surface

a) The tangential component of E and normal component of B are zero

b) The tangential component of H is equal to the surface current density

c) The normal component of D is the surface charge density

d) All of these.

v) The rate of energy flow is given by

a) Maxwell Equation

b) Poynting Vector

c) Poisson Equation

d) Equation of Continuity.

vi) The characteristic impedance of a transmission line is

a) directly proportional to its length

b) inversely proportional to its length

c) independent of its length

d) directly proportional to square root of its length.

vii) For a line of characteristic impedance Z_0, terminated by a load impedance $Z = Z_0/3$, the reflection coefficient is

a) 1/3   b) 2/3

c) – 1/3   d) – 1/2.

viii) Reflector in Yagi-Uda antenna is

a) active element   b) driven element

c) identical to dipole   d) parasitic element.

ix) A short-circuited transmission line stub is preferred in stub-matching than an open-ended stub because

a) Short-circuited stub does not radiate

b) It is easy to maintain short-circuit

c) Length of short-circuit stub is less

d) none of these.

x) If E_0 and B_0 be the amplitude of electric field and magnetic field associated with an electromagnetic wave propagating in space. then E_0 / B_0 is

a) $\sqrt{\dfrac{\mu_0}{\varepsilon_0}}$ b) $\sqrt{\dfrac{\varepsilon_0}{\mu_0}}$

c) $\sqrt{\mu_0 \varepsilon_0}$ d) $\dfrac{1}{\sqrt{\mu_0 \varepsilon_0}}$.

xi) Voltage standing wave ratio of a matched transmission line is

a) Zero   b) Infinity

c) Unity   d) None of these.

xii) Poynting vector for e.m. wave has unit

a) W/m b) W/m^2

c) W^2/m d) $(W/m)^2$.

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

2. Find the directional derivative of $\phi = x^2 yz + 4xz^2$ at $(1, -2, -1)$ in the direction $2i - j - 2k$.

3. a) What is divergence theorem ?

   b) Prove that $\nabla \cdot (\phi A) = (\nabla \phi) = (\nabla \phi) \cdot A + \phi (\nabla \cdot A)$.

   $2 + 3$

4. What are the transmission line parameters ? Mention the different modes of transmission lines. $2 + 3$

5. a) Write down the Maxwell's equations in integral form

   b) What is the relation between decibel and neper ? $4 + 1$

6. Derive the relation between antenna aperture and effective height of an antenna.

GROUP – C
(Long Answer Type Questions)
Answer any *three* of the following. $3 \times 15 = 45$

7. a) In the cylindrical region $0 < r < 0.5m$, $J = 4.5 \, e^{-2r} \, a_z$ Amp/m^2. Determine $H = H_\varphi A_\varphi$ everywhere.

   b) Prove that Curl $H = J$

   c) An magnetic field intensity due to a current source is given by $H = y \cos(ax) \, a_x (y + e^x) a_z$. Describe the current density over the YZ plane. $5 + 5 + 5$

8. a) What is 'Biot-Savart's law in magnetostatics ?

   b) If a infinite long wire of negligible cross section is carrying current I. Find the magnetic field intensity at a distance r from the wire.

   c) What is Magnetic vector potential ?

d) Using integral form of Ampere's circuit law find the magnetic field intensity inside the infinite long straight wire carrying steady current I. $\qquad$ 2 + 5 + 3 + 5

9. a) Explain directivity of an antenna with an example. 3

b) Give the relation between directivity and gain of an antenna. What is the limit of efficiency factor of an antenna ? 3

c) What are half power beam width (HPBW) and beam width between flint nulls (BWFN) ? 5

d) Define radiation resistance of folded dipole antenna. Why is it beneficial for our TV reception antenna ? 4

10. a) Differentiate between a plane wave and a uniform plane wave.

b) Explain the 'quarter-wave transformer' technique of matching.

c) A distorionless transmission line has $Z_0 = 50$ Ohm and a phase constant of 3rd/m at 10 MHz. Find the inductance and the capacitance of this line.

d) A lossless, half wavelength line has $Z_0 = 50$ Ohm. and is terminated in a load resistance of 100 Ohm. Determine

(i) Reflection coefficient

(ii) VSWR

(iii) Z_{min}

(iv) Z_{max}. $\qquad$ 2 + 5 + 3 + 5

11. Write short notes on any *three* of the following : 3 × 5 = 15

a) Gradient of a scalar field

b) Boundary conditions for electric and magnetic fields

c) Distortionless transmission line

d) Use of transmission line as circuit element

e) Basic antenna elements.