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(c) Explain the Poynting theorem for the conservation of energy in an electromagnetic field and discuss the physical significance of each term in resulting equation. (6+3+6)

9. (a) Derive an expression for the input impedance $Z_{in}$ of a lossless transmission line, in terms of relevant parameters, when the line is terminated into impedance $Z_L$.
(b) Plot the variation of the input impedance with $\beta l$ when the line is shorted and open.
(c) Show that for a lossless transmission line the input impedance of a line repeat over every $\lambda/2$ distance. (7+5+3)

10. (a) What do you understand by the term radiation resistance of an antenna? Find out an expression of the radiation resistance of a Hertzian-dipole antenna with uniform current distribution.
(b) A magnetic field strength of 5μA/m is required at a point on, $\theta = \lambda/2$, 2Km from an antenna in air. Neglecting the ohmic loss how much power must the antenna transmit if it is a Hertzian-dipole of length $\lambda/25$?
(c) Write the applications of loop antenna and Yagi-Uda antenna. (8+4+3)

11. Write short notes on any three of the following:
(a) Uniqueness theorem
(b) Solenoidal and Conservative field
(c) Single Stub Matching
(d) Boundary condition of Electric and Magnetic field
(e) Antenna Radiation Parameters



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CS/B.Tech/Even/ECE/4th Sem/EC-401/2014

# 2014
# Electromagnetic Theory & Transmission Lines

*Time Allotted : 3 Hours* *Full Marks : 70*

*The figure 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 all the following: 10x1=10

i) 1 Neper is equal to
a) 8.686 dB b) 8.684
c) 7.686 d) 6.6686

ii) 1 dB is defined as
a) $10\log_{10}\left(\frac{P_1}{P_2}\right)$ b) $10\log_{10}\left(\frac{P_2}{P_1}\right)$
c) $20\log_{10}\left(\frac{P_1}{P_2}\right)$ d) $\log_{10}\left(\frac{P_1}{P_2}\right)$

iii) In spherical coordinates, $\theta$ varies between
a) 0 and $\pi$ b) $\pi$ and 0
c) 0 and $2\pi$ d) $\pi$ and $2\pi$

iv) The wavelength of an EM wave depends on its
a) Velocity b) frequency
c) wavelength d) microwave device



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v) The force magnitude between $Q_1$= 1C and $Q_2$ = 1C when they are separated by 1 m in free space is

a) $9 \times 10^9$N  b) $8.854 \times 10^{-12}$ N

c) $\frac{1}{36\pi} \times 10^{-9}$N  d) $9 \times 1^{-9}$N

vi) Laplace's equation has

a) Two solutions  b) infinite solutions

c) no solution  d) only one solution

vii) If the voltage applied across a capacitor is increased, the capacitance value

a) Increases  b) decreases

c) remains constant  d) becomes infinity

viii) The unit of electric flux is

a) coulomb  b) coulomb/m  c) weber  d) tesla

ix) Poynting vector gives

a) rate of energy flow  b) direction of polarization

c) electric field  d) magnetic field

x) For a uniform plane wave in the x-direction

a) $E_x = 0$  b) $H_x = 0$

c) $E_x = 0$ and $H_x = 0$  d) $E_z = 0$

xi) If reflection coefficient in a transmission line for a given load is 0.5 + j0.5, VSWR is

a) 1  b) $\alpha$  c) 2  d) $-\alpha$

xii) Radiation resistance of half wave dipole is

a) 73 $\Omega$  b) 36 $\Omega$

c) $80\pi^2\left(\frac{dl}{\lambda}\right)^2 \Omega$  d) 292 $\Omega$

xiii) If the maximum directive gain of an antenna is 2, its directivity is

a) 4  b) 2  c) 1  d) 6



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## Group - B
## (Short Answer Type Question)

Answer any *three* of the following  3x5=15

2. For a vector field A show that $\nabla . \nabla \times A = 0$  (5)
3. State and explain boundary conditions.  (5)
4. What is Faraday's Law? Write down the four Maxwell's equation and explain their significance?  2+3
5. a) What is radiation resistance of an antenna?

   b) Define directivity of an antenna and what is the minimum value of Directivity?  2+ (2+ 1)
6. Electric field components of a propagating electromagnetic wave in free space are given as
   $E_x = E_z$ and $E_y = E_0 \cos(\omega t - \beta z)$.
   Determine the field components of the magnetic field.  (5)

## GROUP-C
## (Long Answer Type Questions)

Answer any *three* of the following  3x15=45

7. (a) State & Prove Gauss's law.

   (b) Derive an expression for the electric field intensity due to infinite length line charge along the z-axis at an arbitrary point Q(x,y,z).

   (c) If the electric field intensity is given by $E = (xa_x + ya_y + za_z)$ V/m, the calculate the potential difference between A(2,0,0) and B(1,2,3).  (4+7+4)
8. (a) Derive the expressions of the electric and magnetic fields of an electromagnetic wave propagating in a lossy dielectric medium.

   (b) What do you understand by the term loss tangent and what is its physical significance?



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