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06EC64

Sixth Semester B.E. Degree Examination, December 2010
Antennas and Propagation

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions, selecting at least TWO questions from each part.***

PART – A

1 a. Explain the following parameters of antenna :
   i) Beam solid angle
   ii) Radiation intensity
   iii) Effective height
   iv) Band width. **(12 Marks)**

b. Find the relation between maximum effective aperture and directivity. **(04 Marks)**

c. An antenna has a field pattern given by $E(\theta) = \cos\theta \cos 2\theta$ for $0 \le \theta \le 90^\circ$. Find :
   i) The half – power beam width.
   ii) The beam width between first nulls. **(04 Marks)**

2 a. The radiation intensity of an antenna is given by $U = \cos^4\theta \sin^2\phi$ for $0 \le \theta \le \frac{\pi}{2}$ and $0 \le \phi \le 2\pi$. Find the directivity. **(05 Marks)**

b. Calculate the maximum power received at a distance of 0.5 km over a free space 1GHz circuit consisting of transmitting antenna with 25 dB gain and a receiving antenna gain of 20 dB. Assume the transmitting antenna input is 150 Watts. **(06 Marks)**

c. State and explain power theorem. **(04 Marks)**

d. Explain field and phase pattern. **(05 Marks)**

3 a. Derive an expression for total field in case of two isotropic points with same amplitude and opposite phase. Plot the relative field pattern when these two isotropic sources are spaced $\lambda/2$ apart. **(08 Marks)**

b. State and explain the principle of pattern multiplication. Calculate and plot the field pattern of an array of two non isotropic dissimilar sources for which the total field is given by $E = \cos\phi + \sin\phi \angle\psi$, where $\psi = \frac{\pi}{2}(\cos\phi + 1)$. Take source 1 as the reference as shown in Fig.Q.3(b). **(06 Marks)**

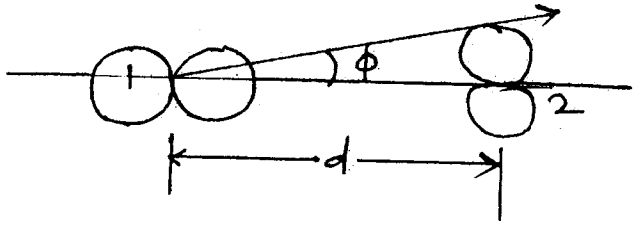

Fig.Q.3(b).

c. For a broadside array of n isotropic point source of equal amplitude and spacing, show that $\phi_0 = \cos^{-1}\left(\pm\frac{K\lambda}{nd}\right)$, where ϕ_0 gives the null directions. Find the null directions for an array of 4 isotropic point sources with $\lambda/2$ spacing. **(06 Marks)**

4 a. Derive the expression for the radiation resistance of short dipole. **(06 Marks)**

b. Show that the radiation resistance of a linear $\lambda/2$ antenna with sinusoidal current distribution is equal to 73 Ω. **(08 Marks)**

c. Obtain the field pattern for a dipole of length i) $\lambda/2$; ii) $3\lambda/2$. **(06 Marks)**

PART – B

5 a. Obtain the expression for the instantaneous electric field and magnetic field at a large distance r from a loop of any radius a. **(08 Marks)**

b. State and explain Babinet's principle. **(06 Marks)**

c. Explain microstrip antennas with neat sketches and mention its advantages. **(06 Marks)**

6 Write short notes on :

a. Log periodic antenna. **(05 Marks)**

b. Turnstile antenna. **(05 Marks)**

c. Embedded antennas. **(05 Marks)**

d. Antennas for ground penetrating radar. **(05 Marks)**

7 a. Describe the factors affecting ground wave propagation. **(06 Marks)**

b. Find the approximate formula for the field strength in VHF propagation and explain how it varies sinusolidally. **(10 Marks)**

c. A VHF communication is to be established at 90 MHz, with the transmitter power of 35 Watts. Calculate the LOS communication distance, if the heights of transmitter and receiver antennas are 40 m and 25 m respectively. **(04 Marks)**

8 a. Define the following as related to ionospheric propagation :

i) Virtual height

ii) Maximum usable frequency

iii) Skip distance. **(06 Marks)**

b. Derive the expression for refractive index of an ionospheric layer. **(08 Marks)**

c. An electromagnetic wave at frequency f is propagating through a lossy dielectric medium having conductivity σ, permittivity $E = E_0E_r$, and permeability $\mu = \mu_0$. Derive an expression for the attenuation per unit length of the medium, if $\frac{\sigma}{w\in} << 1$. Show that the attenuation is given by $60\pi\sigma/\sqrt{Er}$. **(06 Marks)**

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