USN

06EC64

Sixth Semester B.E. Degree Examination, Dec.2013/Jan.2014
Antennas and Propagation

Time: 3 hrs. Max. Marks: 100

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

PART – A

1 a. Define the following:
i) Isotropic radiator ii) Directivity iii) Radiation intensity
iv) Beam width v) Radiation efficiency **(10 Marks)**

b. An antenna has a field pattern given by $E(\theta) = \cos^2\theta$ for $0 \le \theta \le 90°$. Find the beam area and the directivity. **(06 Marks)**

c. Calculate the maximum power received at a distance of 1 km over a free space for a radio link operating at 1 GHz frequency and consisting of transmitting antenna with 25 dB gain and a receiving antenna of 20 dB gain. Assume the transmitting antenna input is 200 Watts. **(04 Marks)**

2 a. For a $\frac{\lambda}{2}$ dipole antenna derive the maximum effective aperture and determine directivity. **(06 Marks)**

b. Derive an expression for total field in case of two isotropic point sources with same amplitude and opposite phase. Plot the relative field pattern when these two isotropic sources are spaced $\frac{\lambda}{2}$ apart. And also determine the directions of maximum field and nulls. **(08 Marks)**

c. Calculate the directivity for the sources having the following patterns:
i) $U = U_m \sin\theta \sin^2\phi$ ii) $U = U_m \cos\phi \sin^2\theta$
where $0 \le \theta \le \pi$ and $0 \le \phi \le \pi$ **(06 Marks)**

3 a. State and explain the principle of pattern multiplication. Plot the field pattern of an array of two non-isotropic dissimilar sources : $E_1 = \cos\phi$ and $E_2 = \sin\phi \angle\psi$, where $\psi = \frac{\pi}{2}(\cos\phi + 1)$, with reference to the source1 as shown in Fig. Q3 (a). **(06 Marks)**

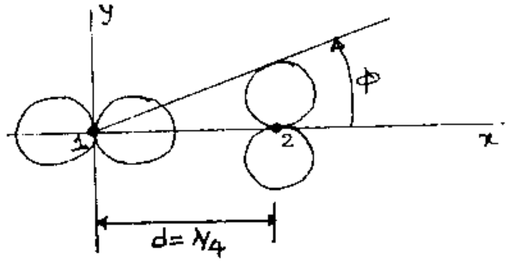

Fig. Q3 (a)

b. What is an array factor? Obtain the array factor for a linear array of n isotropic point sources of equal amplitude and same displacement. **(06 Marks)**

c. A linear array of four isotropic sources with equal displacement of $\frac{\lambda}{2}$ and same amplitude but a phase difference of $-d_r$. Plot the field pattern and determine half power beam width and directions of nulls. **(08 Marks)**

4 a. Derive an expression for the radiation resistance of a short electric dipole. **(08 Marks)**

b. Obtain the field pattern of thin linear antenna of length i) $L = \frac{\lambda}{2}$ ii) $L = \frac{3\lambda}{2}$. **(06 Marks)**

c. Write short notes on:
i) Rhombic antenna ii) Folded dipole antenna. **(06 Marks)**

PART – B

5 a. Considering the general case derive the far-field equations for loop antenna. **(08 Marks)**

b. State and explain the Babinet's principle. **(04 Marks)**

c. Write short notes on:
i) Patch antenna ii) Rectangular horn antenna. **(08 Marks)**

6 a. Discuss the features of helical antenna. Give the constructional details of helical antenna. **(08 Marks)**

b. Explain the corner reflector antennas. **(04 Marks)**

c. Write short notes on:
i) Log-periodic antennas ii) Antennas for ground penetrating radar. **(08 Marks)**

7 a. Explain the space wave propagation and obtain the expression for modified refractive index. **(10 Marks)**

b. Mention the conditions for sub-refraction, super refraction and duct propagation and draw a suitable diagram to depict these regions above the earth surface. **(06 Marks)**

c. An antenna located at the surface of the earth is used to receive the signals transmitted by another antenna located at a height of 60 m from the spherical surface of the earth (mean radius = 6370 km). Calculate the optical and radio horizons if $\frac{dN}{dh} = -39/km$. **(04 Marks)**

8 a. Define the following with respect to wave propagation: i) Critical frequency ii) Maximum usable frequency (MUF) iii) Virtual height iv) Skip distance **(06 Marks)**

b. Derive the expression for critical frequency in terms of maximum electron density, N_{max}. **(08 Marks)**

c. An electromagnetic wave at frequency f is propagating through a lossy medium having conductivity σ, permittivity $\epsilon = \epsilon_0 \epsilon_r$ and permeability $\mu = \mu_0$. Derive an expression for the attenuation per unit length of the medium. If $\sigma/(\omega \epsilon) << 1$. Show that the attenuation is given by $60\pi\sigma/\sqrt{\epsilon_r}$. **(06 Marks)**

* * * * *