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06EC64

Sixth Semester B.E. Degree Examination, Dec.2015/Jan.2016

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. What is an antenna? Write and explain the basic radiation equation. Explain with neat diagram, how a free space wave can be launched by a transmission line opened out in a tapered fashion. **(06 Marks)**

b. Briefly explain the following with respect to an antenna:
i) Radiation resistance ii) Polarization
iii) Antenna temperature iv) Beam area **(04 Marks)**

c. Clearly mention the difference between
i) Power density and radiation intensity
ii) Power pattern and field pattern
iii) Effective Aperture and physical Aperture
iv) Half Power Beam Width (HPBW) and Beam Width between first Nulls (FNBW).
v) Directivity and gain **(10 Marks)**

2 a. For the uni-directional pattern $U(\theta) = U_m \sin\theta \sin^2\phi$, find directivity by,
i) approximate method
ii) accurate method **(08 Marks)**

b. State and explain power theorem. Find the directivity of a source with sine squared pattern $U = U_m \sin^2\theta$. **(06 Marks)**

c. Explain field patterns and phase patterns. **(06 Marks)**

3 a. Obtain the expression for far-field and draw the normalized field pattern for an array of two isotropic point sources of:
i) Equal amplitude and phase that are $\lambda/2$ apart, taking the centre point of the array as reference for phase.
ii) Equal amplitude and opposite phase that are $\lambda/2$ apart, taking the centre point of the array as reference for phase. **(08 Marks)**

b. Derive the expression for normalized total field E, for a linear array of 'n' isotropic point sources of equal amplitude and spacing. Find beam width between First null (FNBW) if sources are fed in-phase ($\delta = 0$) for an array of 20 elements with spacing between sources, $d = \lambda/2$. **(06 Marks)**

c. State and explain the principle of pattern multiplication with an example. **(06 Marks)**

4 a. Starting from the concepts of Magneric Vector and electric Scalar potentials, derive the expression for field components of short dipole. **(10 Marks)**

b. A dipole antenna of length 5 cm is operated at a frequency of 100 MHz with terminal current $I0 = 120$ mA at time $t = 1$ sec, angle $\theta = 45°$ and distance $r = 3$ m, find (i) E_r, (ii) E_θ and (iii) H_ϕ. **(10 Marks)**

PART – B

5 a. Derive far-field equations of small loop. Compare far-fields of small loop and short dipole. **(08 Marks)**

b. Derive the equation for impedance of a slot antenna in terms of the impedance of the complementary dipole antenna. **(08 Marks)**

c. Find the complementary slot impedance when the dipole impedance is $Z_d = (73 + j42.5)\Omega$. **(04 Marks)**

6 a. With neat diagram, explain the construction and operation of yagi-uda antenna. **(07 Marks)**

b. With neat diagram, explain the construction, feed, relative pattern of turnstile antenna. **(08 Marks)**

c. Compare corner reflector and parabolic reflector. **(05 Marks)**

7 a. For normal refraction of tropospheric waves, derive the relation between the radius of curvature of the path and the change of dielectric constant with height. **(07 Marks)**

b. Explain the phenomenon of tropospheric scattering and how it can be used to establish communication link over a distance much beyond the radio horizon. **(06 Marks)**

c. An antenna located at the surface of the earth is used to receive signals transmitted by another antenna located at a height of 80 m from the spherical surface of the earth (mean radius 6370 km) calculate the optical and radio horizons if $\frac{dN}{dh} = -39/\text{km}$. [Take effective radius $= \left(\frac{4}{3} \times 6370\right) = 8493$ km). **(07 Marks)**

8 a. Explain characteristics of different ionized layers in ionospheric propagation. **(06 Marks)**

b. Define the following:

i) Critical frequency (f_c)

ii) Maximum usable frequency (f_{muf})

iii) Virtual height

iv) Skip distance

Obtain expression for skip distance in terms of f_c and f_{muf}. **(10 Marks)**

c. Calculate the critical frequency of the medium in which the wave reflects if the maximum electron density is (1.44×10^6) electrons/cm^3. **(04 Marks)**

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