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14ECS12

First Semester M.Tech. Degree Examination, June/July 2018
Antenna Theory & Design

Time: 3 hrs. Max. Marks:100

Note: 1. ***Answer any FIVE full questions.***
2. ***Assume any missing data suitably.***

1 a. Define : (i) Normalized field patterns (ii) Beam efficiency (iii) Aperture efficiency (iv) Effective height of an antenna (v) Half power beam width. Also give the corresponding mathematical expressions. **(10 Marks)**

b. The radiation intensity of an antenna is given by, $U = \sin^3\theta$. Find the directivity and the HPBW. **(04 Marks)**

c. Derive the expression $\nabla^2\vec{A} + K^2\vec{A} = -\mu\vec{J}$ assuming Lorentt condition for solving the vector potential $\vec{A}$ for the electric current source $\vec{J}$. **(06 Marks)**

2 a. Obtain the expressions for radiation resistance, maximum directivity and effective aperture assuming the expression for average power density for an infinitesimal dipole. **(05 Marks)**

b. A circular loop antenna of radius 0.1 m and carrying a current of 5 A at 120 MHz in symmetrically placed at origin in the x-y plane. Calculate the (i) Power radiated by the antenna (ii) Magnitude of electric field at a distance of 1 km. **(05 Marks)**

c. With respect to point source, explain power patterns and power theorem. **(10 Marks)**

3 a. Consider a two element linear array of two infinitesimal dipoles located at $z_1 = -\frac{\lambda}{8}$ and $z_2 = \frac{\lambda}{8}$ and carrying currents $I_1 = e^{\frac{-j\pi}{4}}$, $I_2 = e^{\frac{j\pi}{4}}$. Calculate direction of the maxima and the nulls of the array factor. **(06 Marks)**

b. Given a linear uniform array of 16 elements with a separation of $\frac{\lambda}{4}$ between the elements. Compare the directivity of the array if it is,
(i) Broad side
(ii) Ordinary end fire.
(iii) Hansen wood yard end fire array. **(06 Marks)**

c. Write a note on feeding techniques for arrays. **(08 Marks)**

4 a. Design an Helix antenna to obtain a directivity of 12 dB at 8 GHz and calculate the HPBW, input resistance and the axial ratio of the helix designed. **(06 Marks)**

b. Discuss the principles of frequency independent antennas. **(06 Marks)**

c. What are the different types of reflector antennas and their applications? **(04 Marks)**

d. Compute the gain of a parabolic reflector antenna at 18 GHz whose focal length is 0.4 m and $f/D = 1.2$ D, where D is the aperature diameter, assuming an overall efficiency of 60%. **(04 Marks)**

5 a. With neat sketches and relevant equations, explain the working of patch antennas. Reason out their popularity. **(10 Marks)**

b. Discuss (i) Babinet principle. (ii) Lens antenna. **(10 Marks)**

6 Explain the design of a Dolph-Chebyshev array for the specification.
Number of elements = 4.
Boradside array element spacing = $\lambda/2$.
Side lobe levels = 25 dB below the main lobe. **(20 Marks)**

7 a. Bring out the principles of method of moments. **(06 Marks)**

b. Discuss how Pocklington integral equation could be solved. **(14 Marks)**

8 Write detailed notes on:

a. Geometrical optics and physical optics.

b. Wedge diffraction theory.

c. Equivalent current concepts.

d. Kirchoff's networking equations. **(20 Marks)**

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