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10EC64

Sixth Semester B.E. Degree Examination, June / July 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 terms with respect to antenna:
i) Gain ii) Isotropic radiator iii) Beam area iv) Radiation resistance. **(08 Marks)**

b. Prove that maximum effective aperture for a $\frac{\lambda}{2}$ antenna is $0.13\lambda^2$. **(06 Marks)**

c. The effective apertures of transmitting and receiving antennas in a communication system are $8\lambda^2$ and $12\lambda^2$ respectively, with a separation of 1.5 km between them. The e.m. wave is travelling with a frequency of 6 MHz and the total I/P power is 25 KW. Find the power received by the receiving antenna. **(06 Marks)**

2 a. Derive an expression for power radiated from an isotropic point source with "sine squared power pattern". Also find directivity "D" and draw power pattern. **(06 Marks)**

b. Find the power radiated and directivity for the unidirectional point sources, having the following point sources power patterns:
i) $U = U_m \cos^2\theta \sin^3\phi, \quad 0 \le \theta \le \pi, \ 0 \le \phi \le \pi$
ii) $U = U_m \sin^2\theta \sin^3\phi, \quad 0 \le \theta \le \pi, \ 0 \le \phi \le \pi$ **(06 Marks)**

c. Eight point sources are spaced $\frac{\lambda}{6}$ apart. They have a phase difference of $\frac{\pi}{3}$ between adjacent elements. Obtain the field pattern. Also find BWFN and HPBW. **(08 Marks)**

3 a. Show that the radiation resistance of a half wave $\left(\frac{\lambda}{2}\right)$ dipole antenna is 73 Ω. **(06 Marks)**

b. Write an explanatory note on folded dipole antenna, giving neat figures. **(06 Marks)**

c. A magnetic field strength of 20 μA/m is required to be produced at a point 2.5 km from the antenna in the broadside plane, in free space. How much power is transmitted by,
i) a hertzian dipole, with $l = \frac{\lambda}{15}$.
ii) a half wave dipole and
iii) a monopole antenna. **(08 Marks)**

4 a. Discuss the features of a loop antenna. Derive an expression for the far field components of a loop antenna. **(10 Marks)**

b. Explain Babinet's principle with illustrations. Discuss features of complementary antennas, with neat figures. **(10 Marks)**

PART – B

5 a. With a neat figure, explain the working of Yagi-Uda antenna. Write the design formulae for different components, used in Yagi-Uda antenna. Also mention the applications of Yagi-Uda antennas. **(08 Marks)**

b. Determine :

i) The length L aperture 'a_H' and half angles in E and H planes for a pyramidal Horn antenna, for which $a_E = 10\ \lambda$. The horn is fed with a rectangular wave guide in TE_{10} mode. Let $\delta = \frac{\lambda}{12}$ in the E-plane and $\delta = \frac{\lambda}{6}$ in the H-plane.

ii) Calculate directivity 'D'. **(08 Marks)**

c. Write a note on Corner Reflector antenna. **(04 Marks)**

6 a. Write notes on:

i) Plasma antenna.

ii) Embedded antenna. **(08 Marks)**

b. With a neat sketch, explain the principle of lens antenna. **(06 Marks)**

c. A paraboloid reflector of 2 m diameter is used at 10 GHz. Calculate the beam width between first nulls (BWFN) HPBW and gain in dB. **(06 Marks)**

7 a. Discuss various forms of radio-wave propagation. **(08 Marks)**

b. Derive the expression for resultant electric field strength (E_R) at a point, due to space wave propagation. **(06 Marks)**

c. Derive the expression for 'Line of sight' distance (LOS) between transmitting and receiving antennas. **(06 Marks)**

8 a. A high frequency radio link is to be established between two points on the earth 350 km apart. The reflection region of the atmosphere is at a height of 250 km and has a critical frequency of 8 MHz. Calculate the maximum usable frequency (MUF), for the given path in case of flat earth. **(06 Marks)**

b. Define skip distance. Derive an expression for skip distance (D), for a flat earth. **(06 Marks)**

c. Define critical frequency. Find the critical frequency for a particular ionospheric layer with Nm = 9×10^6 /cm^3. Also find maximum usable frequency (MUF), if the angle of incidence $\angle i = 60^\circ$. **(08 Marks)**

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