USN | | | | | | | | | | 10TE63

Sixth Semester B.E. Degree Examination, Dec.2017/Jan.2018

Antennas and Propagation

Time: 3 hrs. Max. Marks:100

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

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages. 2. Any revealing of identification, appeal to evaluator and /or equations written eg. 42+8 = 50, will be treated as malpractice.

PART – A

1 a. Derive the relationship between directivity and effective aperture of an antenna and hence show that the effective aperture of a hypothetical, idealized isotropic antenna is equal to $0.0796\ \lambda^2$. **(10 Marks)**

b. Two spacecrafts A and B are separated by a distance of 100 mm. Each has an antenna of directivity D = 1000 operating at 2.5 GHz. If spacecraft A's receiver requires 20 dB over 1 pW, what transmitter power is required on space craft B to achieve this signal level? **(06 Marks)**

c. The radiation resistance of an antenna is 75 Ω, and loss resistance is 10 Ω. Find the directivity if power gain is 15. **(04 Marks)**

2 a. Compute the resultant radiation pattern for an array of two isotropic point sources placed $\lambda/2$ distance apart and fed with power of equal magnitude and phase. Mention the type of resultant array and its applications. Also find HPBW and FNBW. **(10 Marks)**

b. Prove that the width of main lobe of a uniform end-fire array is broader than that of a uniform broadside array. **(07 Marks)**

c. State and explain the principle of pattern multiplication. **(03 Marks)**

3 a. Show that the radiation resistance of a short electric dipole with uniform current is given by $R_r = \dfrac{80\pi^2\ell^2}{\lambda^2}$ where ℓ = length of dipole and λ = wavelength of operation. **(10 Marks)**

b. For a short dipole of length $\lambda/15$, find the efficiency and radiation resistance if the loss resistance is 1 Ω. Also find the effective aperture. **(05 Marks)**

c. What are folded dipoles? Mention its advantages over ordinary dipoles. **(05 Marks)**

4 a. Derive an expression for radiation resistance of loop antenna with usual notations. **(10 Marks)**

b. State and explain Babinet's principle as applicable to complementary linear antennas with appropriate diagrams and illustrations. **(10 Marks)**

PART – B

5 a. The radius of a circular loop antenna is $0.02\ \lambda$. How many turns of the antenna will give a radiation resistance of 35 Ω? **(05 Marks)**

b. Determine the length L, H-plane aperture and flare angles θ_E and θ_H (in the E and H planes, respectively) of a pyramidal horn antenna for which the E-plane aperture $a_E = 10\ \lambda$. The horn is fed by a rectangular waveguide with TE_{10} mode. Let $\delta = 0.2\ \lambda$ in the E-plane and $0.375\ \lambda$ in the H-plane. What are the beam widths? What is the directivity? **(07 Marks)**

c. Give a comparison between the far field components of a small loop antenna and a short dipole by deriving the former case. **(08 Marks)**

6 a. Describe the practical design considerations for a helical antenna along with its geometrical features. **(10 Marks)**

b. Write short notes on:

i) Plasma antenna

ii) Antennas for ground penetrating radar (GPRS). **(10 Marks)**

7 a. What is radio horizon? Derive an expression for the radio horizon. Also find the maximum range of tropospheric propagation given the transmitter antenna height is 100 feet and the receiver antenna height is 50 feet. **(12 Marks)**

b. An antenna located at the surface of the earth is used to receive the signals transmitted by another antenna located at a height of 80 m from the spherical surface of the earth (mean radius is 6370 km). Calculate both optical horizon and radio horizon if $\frac{dN}{dh} = -39/\text{km}$. **(06 Marks)**

c. Define diffraction. **(02 Marks)**

8 a. Explain the following terms:

i) MUF, LUF, OF

ii) Critical frequency

iii) Skip distance

iv) Virtual height **(10 Marks)**

b. Give the structural details of the ionosphere along with neat sketches and interpretations. **(10 Marks)**

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