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10EC64

Sixth Semester B.E. Degree Examination, Dec.2016/Jan.2017
Antennas and Propagation

Time: 3 hrs. Max. Marks:100

Note: *1. Answer any FIVE full questions, selecting atleast TWO questions from each part.*
2. Draw diagram wherever necessary.

PART – A

1 a. Obtain relation between directivity and beam width and also write equation for estimating directivity. **(05 Marks)**

b. A parabolic reflector antenna is circular in cross – section with a diameter 1.22 m. If the maximum effective aperture equals 55% of the physical aperture, calculate gain of antenna in dB at 20 GHz. **(07 Marks)**

c. Show that the maximum effective aperture of a $\lambda/2$ dipole is $\frac{30}{73\pi}\lambda^2$ and also obtain radiation resistance of $\lambda/2$ dipole is 73Ω. **(08 Marks)**

2 a. Derive Hansen–Woodyard condition for 'n' element end fire array for enhancing directivity. **(08 Marks)**

b. A linear uniform array of isotropic antennas satisfy the following parameter, obtain the field pattern and find BWFN and HPBW $\eta = 4$; $\delta = 0$; $d = \lambda/2$. **(07 Marks)**

c. Explain in detail pattern multiplication method in array synthesis. **(05 Marks)**

3 a. Derive an expression for power radiated by current element and radiation resistance of short dipole. **(09 Marks)**

b. Obtain an expression for field of dipole in general ($\ell \geq \lambda/4$) for thin linear antenna. **(06 Marks)**

c. A half wave dipole in free space is radiating with a current of 1A(rms) at the antenna terminals. Find the angle θ for maximum field strength and determine the field strength and power density at a point 1 mile from the antenna at the corresponding angle. **(05 Marks)**

4 a. Obtain expression for radiation resistance of loop antenna. **(08 Marks)**

b. The multiturn rod antenna of a broadcast receiver has 10 turns of 1 mm diameter copper wire wound on a ferrite rod 1 cm in diameter and 10cm long. For the ferrite rod $\mu_r = \mu_r' - \mu_r'' = 250 - j2.5$. Take the effective relative permittivity of ferrite rod $\mu_{er} = 50$. At 1 MHz find : i) the radiation efficiency ii) the Q factor iii) Half power bandwidth. **(06 Marks)**

c. The diameter of a circular loop antenna is 0.04 λ. How many turns of antenna will give a radiation resistance of 36 Ω? **(06 Marks)**

PART – B

5 a. Explain the radiation mechanism of microstrip patch antenna and its characteristics. **(06 Marks)**

b. Determine length ρ of the horn, H – plane aperture and flare angles θ_E and θ_H in (E and H plane) of a pyramidal horn for which E – plane aperture is 10λ. The horn is fed with a rectangular waveguide with TE_{10} mode. Let $\delta = 0.2\ \lambda$ in E plane and $0.375\ \lambda$ in H plane. Calculate beam width and directivity. **(08 Marks)**

c. Explain the basic concepts of reflector antenna and concepts involved in plane and corner reflector. **(06 Marks)**

6 a. Explain with suitable sketches perpendicular mode of radiation in helical antenna and obtain an expression for axial ratio and pitch angle. **(05 Marks)**

b. Write a short note on :
   i) Sleeve antenna
   ii) plasma antenna
   iii) embedded antennas. **(09 Marks)**

c. Explain in brief antenna for satellite communication. What are different design consideration for the same? **(06 Marks)**

7 a. Derive relation between radius of curvature of earth and the change in refractive index with height. **(08 Marks)**

b. Obtain an expression for field strength at receiving antenna for the wave propagation in free space. **(07 Marks)**

c. If a transmitting aerial is located at the top of a tower 200 m above the surface of the earth. Determine the maximum distance at which an air craft flying at an altitude 3000m will be able to receive signal form the transmitter. Assume that only LOS propagation involved. If the transmitting aerial has a power gain of 13 dB in direction of aircraft and the power radiated is 400 watts, determine the electric field strength of signal at the air craft. Assume an earth of 6350 kms radius. **(05 Marks)**

8 a. Explain what will happen if a radio wave with a frequency greater than the critical frequency is propagated to the ionosphere? Will it return back? Obtain the condition such that such a wave return back to the earth. **(07 Marks)**

b. Define the following :
   i) optimum working frequency
   ii) maximum usable frequency. **(06 Marks)**

c. In ionospheric propagation, consider that the reflection takes place at height of 300 km and that the maximum density in ionosphere corresponds to refractive index of 0.8 at 15 MHz frequency. Determine ground range for curved earth for which given frequency is MUF. **(07 Marks)**

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