USN 4SF11EC040

10EC64

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. Define directivity. Obtain the relationship between directivity and beam area to show that smaller the beam area, larger is the directivity. **(07 Marks)**

b. Define antenna aperture. Derive the relationship between aperture and beam area. **(06 Marks)**

c. Show that maximum effective aperture of a short electric dipole is equal to $0.119\,\lambda^2$. **(07 Marks)**

2 a. Find the power radiated and the directivity for the following:

i) $U = U_m \sin^2\theta \sin^3\phi \qquad 0 \le \theta \le \pi \qquad 0 \le \phi \le \pi$

ii) $U = U_m \cos^n\theta \qquad 0 \le \theta \le \pi/2 \qquad 0 \le \phi \le 2\pi$ **(08 Marks)**

b. Obtain the relative field pattern for two isotropic point sources of same amplitude but opposite phase, spaced $\frac{\lambda}{2}$ apart. **(08 Marks)**

c. State and explain power theorem. **(04 Marks)**

3 a. Derive the equation for radiation resistance of a short electric dipole. **(08 Marks)**

b. Explain the following : i) Folded dipole, ii) Rhombic antenna. **(08 Marks)**

c. A half wave dipole radiating in free space is driven by a current of 0.5 amperes at the terminals. Calculate E and H field at a distance 1 km from the antenna at angles of 45° and 90°. **(04 Marks)**

4 a. Obtain the radiation resistance of a small loop antenna. **(07 Marks)**

b. Write short notes on: i) Slot antenna, (ii) Patch antenna. **(08 Marks)**

c. Find the radiation efficiency of a 1 meter diameter loop of 10 mm diameter copper wire at (i) 1MHz, (ii) 10 MHz. **(05 Marks)**

PART – B

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

b. Write short notes on: i) Lens antenna; ii) Log periodic antenna **(08 Marks)**

c. Design a Yagi-Uda six element antenna for operation at 500 MHz with a folded dipole field. What are the lengths of (i) reflector element, (ii) driven element, (iii) four director element? What is the spacing between reflector and driven element? **(04 Marks)**

6 a. Derive an expression for resultant field intensity in the case of a space wave propagation. **(10 Marks)**

b. Evaluate the roughness factors for the earth at 10 MHz, if $\sigma = 5$, for 'θ' equal to (i) 30°, (ii) 45°, (iii) 60°. **(05 Marks)**

c. A transmitting antenna of 100 m height radiates 40 kW at 100 MHz uniformly in azimuth plane. Calculate maximum LOS range and strength of the received signal at 16 m high, receiving antenna at a distance of 10 km. At what distance would the signal strength reduce to 1 mV/m? **(05 Marks)**

7 a. Explain the structure of ionosphere. Derive an expression for refractive index of ionospheric layer. **(10 Marks)**

b. Define the following with respect to ionospheric propagation:
   i) Critical frequency
   ii) Virtual height **(06 Marks)**

c. Obtain the relationship between maximum usable frequency (MUF) and skip distance. **(04 Marks)**

8 Write short notes on:
a. Principle of pattern multiplication
b. Scanning array
c. Embedded antennas
d. Ground wave propagation **(20 Marks)**

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