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10EC64

Sixth Semester B.E. Degree Examination, Dec.2014/Jan.2015
Antennas and Propagation

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. With the help of Maxwell's equation, explain how radiation and reception of EM takes place? **(06 Marks)**

b. Explain the following terms as related to antenna system:
i) Directivity; ii) HPBW; iii) Effective length; iv) Beam efficiency. **(08 Marks)**

c. Show that the directivity for unidirectional operation is $2(n + 1)$ for an intensity variation of $u = u_m \cos^n\theta$. **(06 Marks)**

2 a. With a neat diagram, obtain an expression for maximum effective aperture of a $\lambda/2$ dipole. **(07 Marks)**

b. Derive relationship between maximum effective aperture and directivity of an antenna. **(08 Marks)**

c. Find the maximum power received at a distance of 0.75km over free space 110 Mhz circuit consisting of a transmitting antenna of 30dB gain and a receiving antenna of 25dB gain, if the power i/p to the transmitting antenna is 120 watts. **(05 Marks)**

3 a. Starting from fundamentals derive the equation for radiation resistance of Hertzian dipole. **(08 Marks)**

b. A dipole antenna of length 5cm is operated at a frequency of 100MHz with terminal current, $I_0 = 120$mA. At time, $t = 1$ sec, $\theta = 45°$ and $r = 3$m. Find: i) E_r; ii) E_θ and iii) H_ϕ. **(08 Marks)**

c. Calculate the radiation resistance of a dipole of length = $\lambda/5$. (Assume triangular current distribution). **(04 Marks)**

4 a. Derive the far field expressions for small loop antenna. **(08 Marks)**

b. Derive an expression and draw the field pattern for an array of two isotropic point sources with equal amplitude and opposite phase. Take $d = \lambda/2$. **(08 Marks)**

c. Find half power beam width and directivity of a linear broadside array of four isotropic point sources of equal strength with $d = \lambda/2$? **(04 Marks)**

PART – B

5 a. Write explanatory note on: i) Folded – dipole antenna; ii) Yagi-uda antenna. **(10 Marks)**

b. Find the length, L, H-plane aperture and flare angles θ_E and θ_H of a pyramidal horn for which E-plane aperture is 10λ. Horn is fed by a rectangular waveguide with TE_{10} mode. Assume $\delta = 0.2\lambda$ in E-plane and 0.375λ in H-plane. Also find E-plane, H-plane beam widths and directivity. **(06 Marks)**

c. A dish antenna operating at a frequency of 1.43 GHz has a diameter of 64mts and is fed by a directional antenna. Calculate HPBW, BWFN and gain with respect to $\lambda/2$ dipole with even illumination. **(04 Marks)**

6 a. Write short notes on: i) Parabolic reflectors; ii) Log – periodic antenna. **(12 Marks)**

b. Determine the cut-off frequencies and bandpass of a log periodic dipole array with a design factor of 0.7. Ten dipoles are used in the structure, the smallest having a dimension L/2 equal to 0.3m. **(08 Marks)**

7 a. Define a wave tilt of a surface wave propagation. Also, prove that

$$\text{Wave tilt, } \alpha = \tan^{-1}\frac{E_n}{E_v} = \tan^{-1}\left[\frac{1}{\sqrt{\epsilon_r}}.\frac{1}{\left[1+x^2\right]^{1/4}}\right].$$ **(10 Marks)**

b. Derive the expression for resultant field strength at a point due to space wave propagation. **(05 Marks)**

c. For a VHF communication link, a 35 watt transmitter is operating at 90MHz. Determine the distance upto which LOS would be possible given that height of the transmitting and receiving antenna are 40m and 25m respectively. Evaluate the field strength at the receiving point. **(05 Marks)**

8 a. Define the following: i) MUF; ii) Critical frequency; iii) Virtual height; iv) Skip distance. **(08 Marks)**

b. Calculate the value of the operating frequency of the ionosphere layer specified by refractive index of 0.85 and an electron density 5×10^5 electrons/m^3. Calculate the critical frequency and MUF of the system with $\theta_i = 30^o$. **(06 Marks)**

c. Calculate the critical frequencies for f_1, f_2 and E layers, for which, the maximum ionic densities are 2.3×10^6, 3.5×10^6 and 1.7×10^6 elections/cm^3 respectively. **(06 Marks)**

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