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EC–702

B. E. (Seventh Semester)
EXAMINATION, Dec., 2011

(Electronics & Communication Engg. Branch)

ANTENNA AND WAVE PROPAGATION

(EC – 702)

Time : Three Hours

Maximum Marks : 100

Minimum Pass Marks : 35

Note : Attempt any *five* questions. Assume suitable data if any missing.

1. (a) The vector magnetic potential of a particular wave travelling in free space is given by : 9

$$A = a_x A_x \sin(\omega t - \beta_0 z)$$

Find the expression for the electric and magnetic fields of the wave.

(b) Determine the radiation resistance of a dipole antenna of 1/12 wavelength long. 3

(c) Show that a Hertzian dipole of length h radiates a total power of $0 \cdot 439 (I_0 h)^2$ W at 10 MHz. 8

2. (a) An antenna having directivity of 90 is operating at a wavelength of 2 m. Calculate the maximum effective aperture of the antenna. 6

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(b) Evaluate the radiation resistance of a single turn circular loop with a circumference of a quarter of a wavelength. 7

(c) Find the electron density required in an ionospheric layer to return a 10 MHz signal incident on the bottom of the layer at an angle of 30 degree to the normal. 7

3. (a) A portable TV microwave relay link operates at 7 GHz between two points 20 km apart with both the transmitter and receiver using 1 m diameter paraboloid antenna, the effective area which can be assumed to be half of the aperture area. Given that the transmitter power is 500 mW, calculate the received power. 10

(b) A transmitting antenna at a height of 100 m above a smooth perfectly conducting flat earth sends a signal to a receiving antenna at a height 25 m and ground range d. If the transmission is at 150 MHz and the ground reflection is –1, find the maximum distance from the transmitter at which the received signal can be greater than free space value. 10

4. Find the normalized far field E-plane radiation pattern for an antenna of aperture $|x| \leq L/2$ having a triangular electric field distribution $E(x) = 1 - 2x/L$. 20

5. Two half wave dipoles are spaced half a wavelength apart and excited with currents of equal magnitude but in anti-phases. The self-impedance of each dipole is $(73 + j\,42{\cdot}5)$ ohms and the mutual impedance is $(-12 - j\,3)$ ohms. Find the input impedance of each dipole and the gain of the array formed by these two dipoles with respect to an isotropic radiator. 20

6. (a) Design a four elements, Chebyshev broad side array of isotropic elements spaced $\lambda/2$ apart, that has an array factor with all the side lobes 25 dB below the main lobe. 13

(b) An array antenna consists of two elements with uniform in phase excitation and an elements spacing of 2λ. Determine the number and the directions of maxima and nulls in the array factor. 7

7. (a) Explain the bending of radio waves in troposphere. Obtain the expression of radius of curvature of ray path in terms of rate of change of permittivity with height. 11

(b) Write in short on "Continuous sources". 9

8. Design a broadside five elements, -40 dB side lobe level Taylor distribution array of isotropic sources. The elements are placed along the x-axis with a spacing of $\lambda/4$ between them. Determine : 20

(a) The excitation coefficients of each element

(b) Array factor.