MOTILAL NEHRU NATIONAL INSTITUTE OF TECHNOLOGY, ALLAHABAD
Electronics and Communication Engineering Department
B.Tech. 3rd Year (Semester-V)
End Semester Examination 2016-17
Antenna and Wave Propagation (EC-1503)

M.M: 60 | Time: 3 Hours

Note: Attempt all question. Symbols and notations carry their usual meaning.

1. Attempt any two of the following: 6×2=12

(a) Describe ground wave propagation. What is the angle of tilt? How does it affect the field strength at a distance from the transmitter? 6

(b) What is significance of Virtual height in sky wave propagation? Find the skip distance for waves of frequency 4.6×10^6 Hz at a time when the maximum ionization in the E region has a value of 1.0×10^{11} e/m^3 at a height of 110km. 6

(c) Bring out the important differences between ground wave propagation and space wave propagation. A television transmitter antenna has a height of 169m and the receiving antenna has a height of 16m. What is the maximum distance through which the TV signal could be received by space propagation? 6

2. Attempt any two of the following: 6×2=12

(a) Write short notes on the following: 6

(i) Patch Antenna

(ii) Horn Antenna

(b) Explain applications of helical antenna. A helical antenna of 4 turns is operated in the normal mode at a frequency of 880 MHz and is used as an antenna for a wireless cellular telephone. The length L of the helical antenna is 5.7 cm and the diameter of each turn is 0.5 cm. Determine the: 6

(i) Spacing S (*in* λ_0) between the turns.

(ii) Axial ratio of the helix.

(c) Explain properties of frequency dependent antenna. Design a LPDA, to cover all the VHF range i.e. 54 MHz to 216 MHz. The desired directivity is 8 dB (σ= 0.157 and τ = 0.865). The elements should be made of aluminum tubing with 8.30 m length and 1.9 cm outside diameter for the largest element. Also, calculate number of element and total length of array. 6

3. Attempt any two of the following: 6×2=12

(a) (i) Explain the Yagi-Uda antenna with its design considerations. What is the effect of many directors? 6

(ii) Explain the V-antenna with its applications. Also, explain unidirectional and bidirectional radiation pattern of V antenna.

(b) Explain the Rhombic antenna with its radiation pattern. What are the advantages and disadvantages of Rhombic antenna? Obtain alignment design parameters of Rhombic antenna to operate at 30MHz when the required elevation angle is 30°. 6

(c) Defines the effective area of Antenna. The transmitting and receiving antennas are separated by a distance of 200 λ and have directive gains of 25 and 18 dB, 6

4. Attempt any two of the following: 2×5=10

(a) What is the necessity of an Array? Show that the peaks of the array factor of an N-element uniform array are given by the solution of the equation 5

$$N\tan\left(\frac{\psi}{2}\right) = \tan\left(\frac{N\psi}{2}\right)$$

(b) Calculate the directions of the maxima and the nulls of the array factor of an array of two infinitesimal dipoles oriented along the z direction, kept at $z_1 = -0.125\lambda$ and $z_2 = 0.125\lambda$, and carrying current $I_1 = e^{-j\pi/4}$ and $I_2 = e^{j\pi/4}$, respectively. 5

(c) Design a two-element uniform array of isotropic sources, positioned along the z-axis a distance $\lambda/4$ apart, so that its only maximum occurs along $\theta_0 = 0^\circ$. Assuming ordinary end-fire conditions, find the (i) relative phase excitation of each element (ii) array factor of the array. 5

5. Attempt any two of the following: 2×5=10

(a) Write the expressions for the magnetic field and electric field radiated by half wave dipole and monopole antenna. Also, determine directivity of the half wave dipole and monopole antenna.

(b) A 6 cm long z-directed dipole carries a current of 1A at 2.4 GHz. Calculate the electric and magnetic field strengths at a distance of 50cm along $\theta = 60^\circ$. 5

(c) The E-field pattern of an antenna, independent of φ, varies as follows: 5

$$E = \begin{cases} 1 & 0^\circ \le \theta \le 45^\circ \\ 0 & 45^\circ < \theta \le 90^\circ \\ \frac{1}{2} & 90^\circ < \theta \le 180^\circ \end{cases}$$

(i) What is the directivity of this antenna?

(ii) What is the radiation resistance of the antenna at 200 m from it if the field is equal to 10 V/m (rms) for $\theta = 0^\circ$ at that distance and the terminal current is 5 A (rms)?