

ANTENNA ENGINEERING FOR MODERN COMMUNICATION
(ETC 1034)

Full Marks – 70.

Time – 3 Hrs.

The questions are of equal value

Answer any FIVE questions.

Answer should be brief and to the point.

1. Illustrate magnetic vector potential & retarded vector potential of a current element with suitable mathematical interpretation. Hence find the H-field and E-field radiation pattern & calculate the intrinsic impedance for a plane wave in space. Deduce the expression for radiation resistance of a short current element.
[4+7+3]
2. Explain the phenomenon of Antenna Radiation. With proper diagram explain the current distribution on a thin wire antenna for different length with respect to wave length. For the given pattern $\sin 2\theta$ find out the value of Directivity in dB. Suppose an antenna has $D = 4\text{dB}$, $R_{\text{rad}} = 40 \Omega$ and $R_{\text{diss}} = 10 \Omega$. Find antenna efficiency and maximum power gain in dB.
[4+4+2+4]
3. Write Friis transmission formula. A 50W transmitter at 900 MHz is radiating into free space using a linearly polarized 12dBi omni-directional antenna. Calculate the power density and the electric field intensity at a distance of 10 km from the antenna along the direction of the main beam. Define far and near field zones of antenna .
[5+5+4]
4. Derive an expression for the resultant field of an array of N isotropic source and obtain the condition for operating it as i) Broad side array ii) End fire array. Explain the concept of principle of pattern multiplication with an example. What do you mean by Grating lobes? What are the conditions for eliminating Grating lobes for Broad side array?
[8+2+4]

5. Describe the radiation mechanism of a microstrip antenna using 'Cavity Model' method. Show the various modes of excitation in rectangular microstrip antenna with suitable exhibits. What do you understand by Quality factor of microstrip antenna? How is it related to VSWR and bandwidth?

[5+4+3+3]

6. Design a rectangular microstrip antenna using a substrate (RT Duroid) with dielectric constant 2.2, height = 0.78 mm, so as to resonate at 5 GHz. What are the various types of feeds used in microstrip antenna? Give their equivalent circuit diagrams. Why 'effective length' term is coined against microstrip antenna? How does substrate thickness affect microstrip antenna?

[5+1+4+2+2]

7. Derive the expression of radiation resistance for a half-wave dipole antenna. What are the basic differences of dipole and monopole antenna? Discuss the effect of ground plane on monopole antenna.

[8+3+3]

8. Analyze Finite Difference Method of an in-homogeneously filled parallel plate capacitor. Determine the cut off frequency of modes in a rectangular waveguide. The rectangular waveguide is analyzed for the TE mode cut off (Consider the dimensions of the waveguide and order of discretization produces a small sized matrix which can be solved almost analytically). Analyze the transmission line using one dimensional FDTD method (Assume TEM-wave propagation along the x-direction in the transmission line).

[7+7]

9. Write short notes on (any two):

- (a) Antenna Polarization
- (b) Reciprocity Theorem for Antennas
- (c) Aperture Antenna
- (d) Smart Antenna Architecture

[7+7]