NAME: VIVEK VISHWAKARMA ROLL No.: 36 SUBJECT: EAA CLASS: TE-ET 2

BATCH: E

EXPERIMENT 1

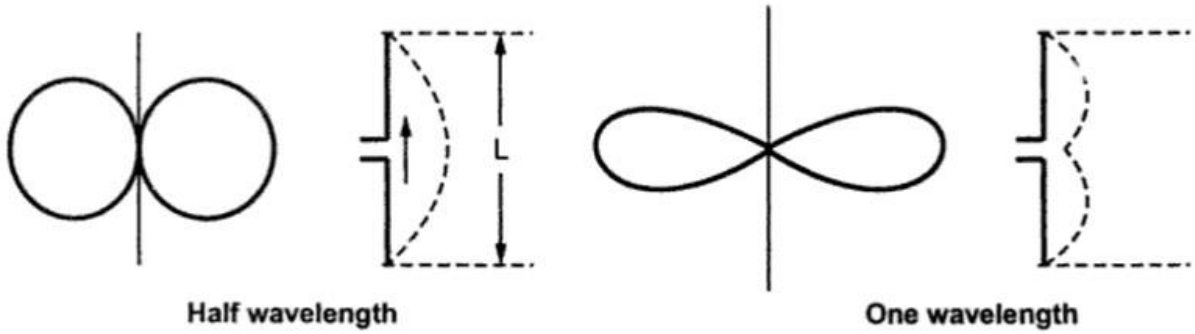
AIM: To study different antenna parameters. (Characteristics)

THOERY:

Antenna is an essential component in a Wireless Communication system. The characteristics of a typical wireless communication system are dependent on the characteristics of the antenna used in the system. For example, the operational characteristics of a communication system find back its roots to the directional characteristics of the antenna. Irrespective of the application that an antenna is used in, all the antennas are associated with a few fundamental parameters.

These parameters are sometimes also called as Properties of Antenna or Characteristics of Antenna. Certain basic characteristics of antenna are listed below:

Antenna Radiation Pattern: A practical antenna cannot radiate energy in all directions with equal strength. Radiation from an antenna is usually found to be maximum in one direction whereas it is minimum or almost zero in other directions. Field Strength is the quantity that is used to represent the radiation pattern of an antenna. It is usually measured at a point located at a particular distance from the antenna. You can measure field strength by calculating voltage at two different points on an electric line and dividing the result with the distance between the two points. Hence, the units of field strength are volts per meter. Graphically speaking, the field of strength is plotted as a three-dimensional graph as it is the measure of the electromagnetic field strength at equidistant points from the antenna. If the graph of radiation of antenna is just a function of direction, then it is simply called as Radiation Pattern. But if it is expressed in terms of the electric field strength in V/m, then it is called Field Strength (or Radiation) Pattern. The following image shows the Field Radiation Pattern for Dipole Antennas with half wavelength and one wavelength.



Sometimes, the radiation of the antenna is also a function of the power per unit solid angle. This graph is called as Power Radiation Pattern.

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Radiation intensity: The radiation intensity of an antenna is the power per unit solid angle. It is represented by U and is independent to distance from the antenna. Units of radiation intensity are Watts per steradian (W/Sr).

Directivity and Gain: Ideally, an antenna which radiates energy in all directions equally i.e. an omnidirectional antenna is called as Isotropic Antenna. This is just a hypothetical situation and an isotropic antenna doesn't exist in practice. But in isotropic antenna, power density is same at all points on the sphere of radiation. Hence, the average power of an antenna as a function of radiated power is

$P_{avg} = P_{rad} / 4\pi r^2$ W/m2

The ratio of power density to the average power radiated is known as Directive Gain. Directivity of an Antenna is a measure of concentration of radiation in the direction of maximum radiation or the ratio of maximum power density to average power radiated.

Radiation Efficiency and Power gain: All practical antennas will have Ohmic losses as they are made up of conducting materials with finite conductivity. Radiation Efficiency is ratio of radiated power to the input power.

$\eta r = P_{rad} / P_{in}$

Power Gain of an Antenna is the ratio of the power radiated in a direction to the total input power.

Input Impedance: The input impedance of the antenna should be matched with that of the input transmission line. If the input impedance doesn't match, then the system degrades over time due to the reflected power.

Effective length: The length of an imaginary linear antenna with uniformly distributed current is defined as the Effective Length of an antenna such that both these antennas have same far field in $\pi/2$ plane.

Bandwidth: The bandwidth of antenna is defined as the range of frequencies over which the characteristics of the antenna are maintained to the specified value. This is because, the requirements for the characteristics of an antenna like the gain, impedance, standing wave ratio etc. may change during operation.

Effective Aperture: Generally, the term effective aperture or effective area is associated with the receiving antenna. Effective Aperture or Area of an antenna is the measure of the ability of an antenna to extract energy from the electromagnetic wave. Effective Aperture of an antenna is the ratio of the Power Received at the load to the average power density produced by the antenna.

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Antenna Polarization: The Antenna Polarization refers to the physical orientation of the electromagnetic wave radiated in a given direction. Polarization of an EM Wave is a time varying direction and relative magnitude of the electric field vector. If the direction is not specified, then the polarization in the direction of maximum gain is considered. There are other characteristics like Antenna Temperature, beamwidth, beam efficiency etc. which are also critical.

Conclusion: Thus, we studied various basic parameters (characteristics) of antenna.