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|  | ***Department of Electronics and Telecommunication Engineering***  ***(NBA ACCREDIATED)***  ***Antenna and Radio Wave Propagation Laboratory***  ***Academic Year 2020-2021***  ***Odd Semester*** |

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| **Course Code** | ECC603 |
| **Subject Professor In-charge** | Prof. Santosh Jagtap |
| **Student Name** | Anuj Shah |
| **Roll Number** | 18104B0024 |
| **Class** | TE EXTC |
| **Division** | B |
| **Date of Performance** | 28th April 2021 |
| **Date of Submission** |  |

**EXPERIMENT NO.9**

**Design Yagi Uda antenna and Plot far field radiation pattern and measure its parameters.**

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| **Total**  **(10 Marks)** | **Sign** |
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**EXPERIMENT No.9**

**Title:** Design Yagi Uda antenna and plot radiation pattern and measure its

performance parameters by using 4NEC simulation tool.

**Estimated time to complete this experiment:** 02 hours

**Objective:** Design of directional antennas

**CO to be achieved:** CO1, CO2.

**Expected Outcome of Experiment:** Design andPerformance analysis of Yagi Uda antenna.

**Pre Lab/ Prior Concepts:** Half Dipole**,** Radiation pattern, HPBW, Gain

**Theory (2 Marks)**

Principle of Yagi Uda, Active element and Parasitic elements

Yagi-Uda antenna:

A Yagi-Uda antenna is a directional antenna consisting of two or more parallel resonant antenna elements in an end-fire array; these elements are most often metal rods acting as half-wave dipoles. Yagi-Uda antennas consist of a single driven element connected to a radio transmitter and/or receiver through a transmission line, and additional parasitic elements with no electrical connection, usually including one so-called reflector and any number of directors.

Also called a beam antenna and parasitic array, the Yagi-Uda is very widely used as a high-gain on the VF, VHF and UHF bands. It has moderate to high gain depending on the number of elements present, sometimes reaching as high as 20 dBi, in a unidirectional beam pattern. As an end-fire array, it can achieve a front-to-back ratio of up to 20 dB. It retains the polarization common to its elements, usually linear polarization (its elements being half-wave dipoles). It is relatively lightweight, inexpensive and simple to construct. The bandwidth of the Yagi-Uda antenna, the frequency range over which it maintains its gain and feedpoint impedance, is narrow, just a few percent of the center frequency, decreasing for models with higher gain, making it ideal for fixed-frequency applications. The largest and best-known use is terrestrial rooftop television antennas, but it is also used for point-to-point fixed communication links, in radar antennas, and for long distance shortwave communication by shortwave broadcasting stations and radio amateurs.

Active element:

In a multielement antenna array (such as a Yagi-Uda antenna), the driven element or active element is the element in the antenna (typically a metal rod) which is electrically connected to the receiver or transmitter. In a transmitting antenna it is driven or excited by the RF current from the transmitter, and is the source of the radio waves. In a receiving antenna it collects the incoming radio waves for reception, and converts them to tiny oscillating electric currents, which are applied to the receiver. Multielement antennas like the Yagi typically consist of a driven element, connected to the receiver or transmitter through a feed line, and a number of other elements which are not driven, called parasitic elements. The driven element is often a dipole. The parasitic elements act as resonators and couple electromagnetically with the driven element, and serve to modify the radiation pattern of the antenna, directing the radio waves in one direction, increasing the gain of the antenna.

When a “driven element” is referred to in an antenna array, it is often assumed that other elements are not driven (ie. parasitic, passive) and that the array is tightly coupled (spacing far below a wavelength).

Parasitic element:

In a radio antenna, a passive radiator or parasitic element is a conductive element, typically a metal rod, which is not electrically connected to anything else. Multielement antennas such as the Yagi-Uda antenna typically consist of a “driven element” which is connected to the radio receiver or transmitter through a feed line, and parasitic elements, which are not. The purpose of the parasitic elements is to modify the radiation pattern of the radio waves emitted by the driven element, directing them in a beam in one direction, increasing the antenna’s directivity (gain). A parasitic element does this by acting as a passive resonator, something like a guitar’s sound box, absorbing the radio waves from the nearby driven element and re-radiating them again with a different phase. The waves from the different elements interfere , strengthening the antenna’s radiation in the desired direction, and cancelling out the waves in undesired directions.

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| **Yagi Uda Design** |
| **Design Specification:**  Frequency (f) : 750 MHz  Velocity factor=0.92  Wire Diameter (d) = λ/100   |  | | --- | | **λ =c/f=0.4 m** |   Basic Yagi-Uda Antenna Design | Download Scientific Diagram     |  |  |  | | --- | --- | --- | | **Sr. No.** | **Parameter** | **Length** | | 1 | Length of Active Element | 0.46 λ | | 2 | Length of Reflector | 0.55 λ | | 3 | Length of first director | 0.45 λ | | 4 | Length of second director | 0.40 λ | | 5 | Length of third director | 0.35 λ | | 6 | Spacing between Active element(feeder) and reflector | 0.20 λ | | 7 | Spacing between Active element(feeder) and director | 0.125 λ | | 8 | Spacing between directors | 0.20 λ | |

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| **Yagi Uda Antenna Geometry**      **Parameter Setting**   1. **3 Elements Yagi Uda**        1. **5 Elements Yagi Uda** |
| **Radiation Pattern** |
| 1. **3 Element Yagi Uda** |
|  |
| **5 Element Yagi Uda Antenna** |
| **Observations:** |
| |  |  |  | | --- | --- | --- | | **Parameter** | **3 Elements** | **5 Elements** | | HBPW | 60 degree | 50 degree | | Gain | 8.57 dB | 9.64 dB | |

**Conclusion:**

* The Yagi-Uda array has a directional radiation pattern.
* The HPBW decreases as the number of array elements increases.
* The gain increases as the number of array elements increases.