# 22EC309 ANTENNA THEORY: ANALYSIS AND DESIGN

Source- http://www.cmg-change.com/wp-content/uploads/2018/03/Listening-antenae.jpg

Hours Per Week :

| L | T | P | C |
|---|---|---|---|
| 2 | 0 | 2 | 3 |

**PREREQUISITE KNOWLEDGE:** Electromagnetic waves and Transmission Lines

**COURSE DESCRIPTION AND OBJECTIVES:**

This course offers fundamental knowledge of antenna theory analysis and design. The objective of this course is to make the student familiarize with parameters of antenna, antenna array, VHF, UHF and Microwave Antennas. By the end of this course students will have good understanding of antenna fundamentals and the know-how of designing various kind of antennas such as dipole, loop, micrsotrip patch antennas and arrays. Students will also learn industry standard simulation software Ansys HFSS, ADS, Matlab which they will use for their design projects. Students will design an antenna from scratch, will simulate it in HFSS and at the end write a report on this project.

## MODULE –1

**UNIT-1** **8L+0T+8P=16 Hours**

**ANTENNA FUNDAMENTALS:**

Antenna Radiation Mechanism: Single wire and Two wire. Current distribution on Thin wire antenna.

Antenna Parameters: Radiation patterns, Patterns in principal planes, Beam widths, Radiation intensity, Directivity, Gain, Reciprocity theorem, Radiation resistance of dipole antenna, Relation between effective aperture and directivity, Effective height, Field regions, Polarization, Friis transmission equation. Radiation resistance of Half wave dipole antenna.

**UNIT-2** **8L+0T+8P=16 Hours**

**LINEAR ANTENNA ARRAY DESIGN AND ANALYSIS:**

Analysis of uniformly spaced arrays: Two element array, N element array, Non Uniform Excitation: Binomial array, Dolph - Tschebyscheff array. Principle of multiplication of patterns, Smart Antenna.

**PRACTICES:**

- Half wave dipole design and analysis using HFSS.
- Radiation pattern of wire antennas using Matlab.
- Radiation pattern of Broad side and End fire array using Matlab.
- Radiation pattern of Binomial and Dolph- Chebyshev array using Matlab.
- Half wave dipole design and analysis using HFSS.
- Radiation pattern of wire antennas using Matlab.
- Radiation pattern of Broad side and End fire array using Matlab.
- Radiation pattern of Binomial and Dolph- Chebyshev array using Matlab

## MODULE-2

**UNIT-1** **8L+0T+8P=16 Hours**

**WIRE AND APERTURE ANTENNAS:**

Folded dipole, Loop antenna, Yagi-Uda array, Helical antenna, Pyramidal Horn antenna, Parabolic reflector antennas, Slot Antenna.

**SKILLS:**

- ✓ *Determine the dipole size for the given frequency range.*
- ✓ *Draw the radiation patterns in various planes for uniform linear array (Broad side/endfire).*
- ✓ *Draw the radiation patterns of helical/ horn / aperture antennas.*
- ✓ *Determine the possible link distance for a given antenna height and vice versa.*
- ✓ *Design of microstrip antenna.*

**UNIT-2** **8L+0T+8P=16 Hours**

**MICROSTRIP PATCH ANTENNA:**

Introduction, Working principle, basic characteristics, feeding methods, design of rectangular and circular patch antennas. MIMO patch Antenna.

**PRACTICES:**

- Design Horn Antenna using HFSS.
- Design Rectangular Microstrip patch antenna using HFSS.
- Design Circular Microstrip patch antenna using HFSS.
- Design Helical Antenna using HFSS
- Design Series Fed microstrip patch antenna array
- Design Corporate fed microstrip patch antenna array.

**COURSE OUTCOMES:**

Upon successful completion of this course, students will have the ability to:

| CO No. | Course Outcomes | Blooms Level | Module No. | Mapping with POs |
|---|---|---|---|---|
| 1 | Apply the concepts and properties of Electro-Magnetism to obtain parameters of antennas. | Apply | 1 | 1, 2, 4, 5, 9, 10, 12 |
| 2 | Analyse the different array techniques to improve directivity. | Analyse | 1 | 1, 2, 4,5, 9, 10,12 |
| 3 | Analyse the antennas based on frequency, configure the geometry and establish the radiation patterns of VHF, UHF and Microwave antennas. | Analyse | 2 | 1, 2,4,5, 9, 10,12 |
| 4 | Analyse the basic concept of patch antenna and MIMO antenna. | Analyse | 2 | 1, 2,3,4,5, 9, 10, 12 |

**TEXT BOOKS:**


1. Constantain A Balanis, “Antenna Theory: Analysis and Design”, 4th edition, Wiley Publishers, 2015.
2. J.D.Kraus and Ronald J Marhefka, “Antennas and Wave propagation”, 4th edition, TMH, 2014.


**REFERENCE BOOKS:**


1. Edward C Jordan and Keith G Balmain, “Electromagnetic Waves and Radiating Systems”, 2nd edition, PHI, 2003
2. Keith henney, Radio Engineering Handbook, 3rd edition TMH.
3. John Leonidas Volakis, Antenna Engineering Handbook, 3rd edition, 2007.
4. W. L.Stutzman, and G.A. Thiele,”Antenna Theory and Design”, 2 nd Ed., John Wiley & Sons., 1998.
5. R.S.Elliot,”Antenna Theory and Design”, Revised edition, Wiley-IEEE Press., 2003.