# ANTENNAS AND WAVE PROPAGATION

**Course Code: 13EC1116**

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**Pre requisites:** EM waves and Transmission lines.

**Course Outcomes:**

At the end of the course the student will be able to

**CO 1** Identify the importance of various antenna parameters.

**CO 2** Use Maxwell's equations to calculate fields from dynamic charge and current distributions.

**CO 3** Comprehend VHF, UHF, Microwave antennas and their Design.

**CO 4** Design array antenna systems from specifications.

**CO 5** Comprehend various modes of radio wave propagation.

## UNIT-I (15 Lectures)

### ANTENNA BASICS:

Introduction, Radiation Mechanism, Antenna Parameters-Radiation Patterns, Patterns in Principle Planes, Main Lobe and Side Lobes, Beam widths, Beam Area, Radiation Intensity, Beam Efficiency, Directivity, Gain and Resolution, Antenna Apertures, Aperture Efficiency, Effective Height, Antenna Theorems- Applicability and Proofs for equivalence of directional characteristics.

### RADIATION FROM WIRES:

Retarded Potentials, Small Electric Dipole, Quarter wave Monopole and Half wave Dipole Radiation characteristics

## UNIT-II (10 Lectures)

### ANTENNA ARRAYS:

Two element array, Principle of Pattern Multiplication, N element

Uniform Linear Arrays - Broadside, End fire Arrays, EFA with Increased directivity, Binomial Arrays, Methods of Array synthesis-Tchebyscheff Distribution and Fourier Transform Method.

## UNIT-III (9 Lectures)

### HF, VHF AND UHF ANTENNAS:

Traveling wave radiators –basic concepts, Long wire antennas-field strength calculations and patterns, V-antennas, Rhombic Antennas and Design Relations, Small Loop antennas- Concept of short magnetic dipole, Helical Antennas, Yagi-Uda Arrays, Log periodic antennas.

## UNIT-IV (11 Lectures)

### MICROWAVE ANTENNAS:

Reflector Antennas: Flat Sheet and Corner Reflectors, Paraboloidal Reflectors, Cassegrain Feeds.

Slot antennas-Babinet's principle, Microstrip antennas, Horn antennas, Lens antennas (Qualitative treatment only)

### ANTENNA MEASUREMENT THEORY:

Antenna Measurements-Patterns Required, Set Up, Distance Criterion, Directivity and Gain Measurements (Comparison, Absolute and 3 Antenna Methods).

## UNIT-V (15 Lectures)

### WAVE PROPAGATION:

Concepts of Propagation- frequency ranges and types of propagations. Ground Wave propagation - characteristics, Parameters, Wave Tilt, Flat and Spherical Earth Considerations, Sky Wave Propagation-Formation of Ionospheric Layers and their characteristics, Mechanism of Reflection and Refraction, Critical Frequency, MUF & Skip Distance Calculations for flat and spherical earth cases, Optimum Frequency, Virtual Height, Ionospheric Abnormalities, Ionospheric Absorption, Fundamental Equation for Free-Space Propagation, Basic Transmission Loss Calculations, Space Wave Propagation - Mechanism, LOS and Radio Horizon, Tropospheric Wave Propagation-Radius of Curvature of path, Effective Earth's Radius, Effect of

Earth's Curvature, Field Strength Calculations, M-Curves and Duct Propagation, Tropospheric Scattering.

## TEXT BOOKS:

1. G.S.N Raju, *"Antennas and Wave Propagation"*, 1st Edition Pearson Education, 2004.
2. K.D.Prasad, Satya Prakashan, *"Antennas and Wave Propagation",* Tech Publications, 3rd Edition, 2001.

## REFERENCES:

1. C.A. Balanis, *"Antenna Theory"*, 3rd Edition, John Wiley & Sons, 2012.
2. E. C. Jordan and K. G. Balmain, *"Electromagnetic Waves and Radiating Systems"*, PHI, 2nd edition, 2000.
3. John D. Kraus and Ronald J. Marhefka, *"Antennas and Wave propagation",* TMH, 4rd Edition, 2010.