

III B.Tech I Semester

15AEC28 - ANTENNAS & WAVE PROPAGATION

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Course Objectives:

1. To introduce the fundamental principles of antenna theory and various types of antennas.
2. Applying the principles of antennas to the analysis, design, and measurements of antennas.
3. To know the applications of some basic and practical configurations such as dipoles, loops, and broadband, aperture type and horn antennas.

UNIT - I

Antenna Basics & Dipole antennas: Introduction, Basic antenna parameters- patterns, Beam Area, Radiation Intensity, Beam Efficiency, Directivity-Gain-Resolution, Antenna Apertures, Effective height, Fields from oscillating dipole, Field Zones, Shape-Impedance considerations, Polarization – Linear, Elliptical, & Circular polarizations, Antenna temperature, Antenna impedance, Front-to-back ratio, Antenna theorems, Radiation – Basic Maxwell's equations, Retarded potential-Helmholtz Theorem, Radiation from Small Electric Dipole, Quarter wave Monopole and Half wave Dipole – Current Distributions, Field Components, Radiated power, Radiation Resistance, Beam width, Natural current distributions, far fields and patterns of Thin Linear Center-fed Antennas of different lengths, Illustrative problems.

UNIT- II

VHF, UHF and Microwave Antennas - I: Loop Antennas - Introduction, Small Loop, Comparison of far fields of small loop and short dipole, Radiation Resistances and Directives of small and large loops (Qualitative Treatment), Arrays with Parasitic Elements - Yagi - Uda Arrays, Folded Dipoles & their characteristics. Helical Antennas-Helical Geometry, Helix modes, Practical Design considerations for Monofilar Helical Antenna in Axial and Normal Modes. Horn Antennas- Types, Fermat's Principle, Optimum Horns, Design considerations of Pyramidal Horns, Illustrative Problems.

UNIT - III

VHF, UHF and Microwave Antennas - II: Micro strip Antennas- Introduction, features, advantages and limitations, Rectangular patch antennas- Geometry and parameters, characteristics of Micro strip antennas, Impact of different parameters on characteristics, reflector antennas - Introduction, Flat sheet and corner reflectors, parabola reflectors- geometry, pattern characteristics, Feed Methods, Reflector Types - Related Features, Lens Antennas - Geometry of Non-metallic Dielectric Lenses, Zoning , Tolerances, Applications, Illustrative Problems.

UNIT- IV

Antenna Arrays & Measurements: Point sources - Definition, Patterns, arrays of 2 Isotropic sources- Different cases, Principle of Pattern Multiplication, Uniform Linear Arrays – Broadside

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Arrays, Endfire Arrays, EFA with Increased Directivity, Derivation of their characteristics and comparison, BSAA with Non-uniform Amplitude Distributions - General considerations and Binomial Arrays, Illustrative problems.

Antenna Measurements: Introduction, Concepts- Reciprocity, Near and Far Fields, Coordination system, sources of errors, Patterns to be Measured, Pattern Measurement Arrangement, Directivity Measurement, Gain Measurements (by comparison, Absolute and 3-Antenna Methods).

UNIT - V

Wave Propagation: Introduction, Definitions, Characterizations and general classifications, different modes of wave propagation, Ray/Mode concepts, Ground wave propagation (Qualitative treatment) - Introduction, Plane earth reflections, Space and surface waves, wave tilt, curved earth reflections, Space wave propagation - Introduction, field strength variation with distance and height, effect of earth's curvature, absorption, Super refraction, M-curves and duct propagation, scattering phenomena, tropospheric propagation, fading and path loss calculations, Sky wave propagation - Introduction, structure of Ionosphere, refraction and reflection of sky waves by Ionosphere, Ray path, Critical frequency, MUF, LUF, OF, Virtual height and Skip distance, Relation between MUF and Skip distance, Multi-HOP propagation, Energy loss in Ionosphere, Summary of Wave Characteristics in different frequency ranges, Illustrative problems.

Course Outcomes:

Through lecture, and out-of-class assignments, students are provided learning experiences that enable them to:

- a. Understand the basic principles of all types of antennas and
- b. Analyze different types of antennas designed for various frequency ranges.
- c. Become proficient with analytical skills for understanding practical antennas.
- d. Design some practical antennas such as dipole, Yagi-uda, and horn antennas.
- e. Determine the radiation patterns (in principal planes) of antennas through measurement setups.
- f. Develop technical & writing skills important for effective communication.
- g. Acquire team-work skills for working effectively in groups.

TEXT BOOKS:

1. John D. Kraus and Ronald J. Marhefka and Ahmad S.Khan, "Antennas and wave propagation," TMH, New Delhi, 4th Ed., (special Indian Edition), 2010.
2. C.A. Balanis, "Antenna Theory- Analysis and Design," John Wiley & Sons, 2nd Edn., 2001.

REFERENCES:

1. E.C. Jordan and K.G. Balmain, "Electromagnetic Waves and Radiating Systems," 2nd Edition, PHI, 2000.
2. K.D. Prasad, SatyaPrakashan, "Antennas and Wave Propagation," New Delhi, Tech. India Publications, 2001.