

ANTENNAS AND WAVE PROPAGATION

III B. Tech - I Semester

LT PC

Course Code: A3EC20

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Course Overview:

It gives comprehensive study of basic antenna fundamentals, types of antennas, radiation pattern, main lobes and side lobes. Student will come to know how the different antennas work, student also gain knowledge in microwave antennas, antenna arrays. Wave propagation concepts, frequency range, transmission losses, calculations, space wave propagation, and troposphere wave propagation.

Prerequisite(s): Electromagnetic and Transmission Lines.

Course Objectives:

1. To understand the basic terminology and concepts of Antennas.
2. To attain knowledge on the basic parameters those are considered in the antenna design process and the analysis while designing that.
3. Analyze the electric and magnetic field emission from various basic antennas and mathematical formulation of the analysis.
4. To have knowledge on antenna operation and types as well their usage in real time field.
5. Aware of the wave spectrum and respective band based antenna usage and also to know the propagation of the waves at different frequencies through different layers in the existing layered free space environment structure.

Course Outcomes:

After going through this course the student will be able to

- Define various antenna parameters
- Analyze radiation patterns of antennas
- Evaluate antennas for given specifications
- Illustrate techniques for antenna parameter measurements
- Design antennas for specific applications

SYLLABUS

UNIT-I

Antenna Basics: Introduction, Basic Antenna Parameters - Patterns, Beam Area, Radiation Intensity, Beam Efficiency, Directivity-Gain-Resolution, Antenna Apertures, Effective Height. Related Problems.

Thin Linear Wire Antennas: Radiation from Small Electric Dipole, Quarterwave Monopole and Halfwave Dipole – Current Distributions, Field Components, Radiated Power, Radiation Resistance, Beamwidths, Directivity, Effective Area and Effective Height. Natural current distributions, fields and

patterns of Thin Linear Center-fed Antennas of Different Lengths, Illustrative Problems. Loop Antennas - Introduction, Small Loop, Comparison of Far Fields of Small Loop and Short Dipole, Radiation Resistances and Directivities of Small and Large Loops (Qualitative Treatment).

UNIT - II

VHF, UHF AND Microwave Antennas - I: 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: Microstrip Antennas - Introduction, Features, Advantages and Limitations, Rectangular Patch Antennas - Geometry and Parameters, Characteristics of Microstrip Antennas. Impact of Different Parameters on Characteristics, Reflector Antennas - Introduction, Flat Sheet and Corner Reflectors, Paraboloidal Reflectors - Geometry, Pattern Characteristics, Feed Methods, Reflector Types - Related Features, Illustrative Problems.

Lens Antennas - Introduction, Geometry of Non-metallic Dielectric Lenses, Zoning, Tolerances, Applications.

UNIT-IV

Antenna Arrays: Point Sources - Definition, Pattern, arrays of 2 Isotropic Sources - Different Cases, Principle of Pattern Multiplication, Uniform Linear Arrays - Broadside Arrays, Endfire Arrays, EFA with Increased Directivity, Derivation of their Characteristics and Comparison, BSAs with Non-Uniform Amplitude Distributions - General Considerations and Binomial Arrays, Illustrative Problems.

Antenna Measurements: Introduction, Concepts - Reciprocity, Near and Far Fields, Coordinate 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 - I: Introduction, Definitions, Categorizations 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.

Wave Propagation - II: 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.

TEXT BOOKS:

1. Antennas for All Applications – John D. Kraus and R. J. Marhefka, and Ahmad S. Khan TMH, New Delhi, 4th ed., (Special Indian Edition) 2010.
2. Electromagnetic Waves and Radiating Systems – E.C. Jordan and K.G. Balmain, PHI, 2nd ed 2000

REFERENCE BOOKS:

1. Antenna Theory - C.A. Balanis, John Wiley & Sons, 3rd ed., 2005.
2. Antennas and Wave Propagation – K.D. Prasad, Satya Prakashan, Tech India Publications, New Delhi, 2001.
3. Transmission and Propagation – E.V.D. Glazier and H.R.L. Lamont, The Services Text Book of Radio, vol. 5, Standard Publishers Distributors, Delhi.
4. Antennas – John D. Kraus, McGraw-Hill (International Edition), 2nd Ed. 1988.