

III B.Tech I Sem (E.C.E)

23A04502	<u>ANTENNAS & WAVE PROPAGATION</u>	L	T	P	C
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Course Objectives:

1. To learn the antennas basic terminology, radiation mechanism of antennas and dipole antennas.
2. To gain knowledge on HF, VHF & UHF antennas, their operation and applications.
3. Analyze the working and applications of Microwave antennas.
4. Understand different techniques involved in the design of antenna arrays and antenna parameter measurements.
5. To study the various types of radio wave propagation methods.

Course Outcomes:

At the end of this course, the students will be able to

1. Understand the antennas basic terminology and radiation mechanism of antennas.
2. Gain knowledge on VHF and UHF antennas, their operation and applications.
3. Design and analyze the working and applications of Microwave antennas.
4. Analyze different techniques involved in the design of antenna arrays and antenna parameter measurements.
5. Gain a comprehensive knowledge about the types of radio wave propagation methods.

UNIT - I

Antenna Basics & Dipole antennas: Definition of antenna, Radiation Mechanism – single wire, two wire, dipoles, Antenna Parameters - Radiation Patterns, Main Lobe and Side Lobes, Beam widths, Beam Area, Radiation Intensity, Beam Efficiency, Directivity, Gain and Resolution, Aperture Efficiency, Effective Height and length, 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

HF, VHF and UHF Antennas: 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. Log periodic Antenna, 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

Microwave Antennas : Microstrip 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: Point sources - Definition, Patterns, 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, BSAA with Non-uniform Amplitude Distributions - General considerations and Binomial Arrays, Illustrative problems.

Antenna Measurements: Introduction, 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.

TEXT BOOKS:

1. John D. Kraus, Ronald J. Marhefka and Ahmad S.Khan, “Antennas and wave propagation”, TMH, New Delhi, 4th Ed., 2010.
2. C.A. Balanis, “Antenna Theory- Analysis and Design”, John Wiley & Sons, 2nd Edn., 2001.
3. K.D. Prasad and SatyaPrakashan, “Antennas and Wave Propagation”, New Delhi, Tech. India Publications, 2001.

REFERENCES:

1. E.C. Jordan and K.G. Balmain, “Electromagnetic Waves and Radiating Systems”, 2nd Edition, PHI, 2000.
2. G.S.N Raju, “Antenna and Wave Propagation”, Pearson Education India, 3rd Edition 2009.
3. R K Shevgaonkar,” Electromagnetic Waves”. Tata McGraw-Hill, 2006