III Year I Semester	L	T	P	C
Code:20EC5314	3	0	0	3

ANTENNAS AND WAVE PROPAGATION

Course Objectives:

1. To understand the applications of the electromagnetic waves in free space.
2. To learn the working principles of various types of antennas.
3. To understand the concept of antenna arrays.
4. To understand the major applications of antennas with an emphasis on how antennas are employed to meet electronic system requirements.
5. To understand the concepts of radio wave propagation in the atmosphere.

UNIT–I: Antenna Fundamentals:

Introduction, Radiation Mechanism – single wire, 2 wire, dipoles, Current Distribution on a thin wire antenna. Antenna Parameters - Radiation Patterns, Patterns in Principal Planes, Main Lobe and Side Lobes, Beamwidths, Polarization, Beam Area, Radiation Intensity, Beam Efficiency, Directivity, Gain and Resolution, Antenna Apertures, Aperture Efficiency, Effective Height, illustrated Problems.

UNIT–II: Thin Linear Wire Antennas:

Retarded Potentials, Radiation from Small Electric Dipole, Quarter wave Monopole and Half wave Dipole –Current Distributions, Evaluation of Field Components, Power Radiated, Radiation Resistance, Beamwidths, Directivity, Effective Area and Effective Height. Natural current distributions, fields and patterns of Thin Linear Center-fed Antennas of different lengths, Radiation Resistance at a point which is not current maximum.

UNIT–III: Antenna Arrays and Arrays with Parasitic Elements:

Antenna Arrays: 2 element arrays–different cases, Principle of Pattern Multiplication, N element Uniform Linear Arrays – Broadside, End-fire Arrays, Derivation of their characteristics and comparison; Concept of Scanning Arrays. Directivity Relations (no derivations). Related Problems. Binomial Arrays, Effects of Uniform and Non-uniform Amplitude Distributions, Design Relations.

Arrays with Parasitic Elements, Yagi-Uda Arrays, Folded Dipoles and their characteristics. **Loop Antennas**: Small Loops - Field Components, Comparison of far fields of small loop and short dipole, Concept of short magnetic dipole, D and R_r relations for small loops. **Helical Antennas**–Significance, Geometry, basic properties; Design considerations for helical antennas in Axial Mode and Normal Modes (Qualitative Treatment).

UNIT–IV: Microwave Antennas and Antenna Measurements:

Microstrip Antennas-Introduction, Features, Advantages and Limitations, Rectangular Patch Antennas–Geometry and Parameters, Impact of different parameters on characteristics. **Reflector Antennas:** Flat Sheet and Corner Reflectors. **Paraboloidal Reflectors**–Geometry, characteristics, types of feeds, F/D Ratio, Spill Over, Back Lobes, Aperture Blocking, Off-set Feeds, Cassegrain Feeds. **Horn Antennas**: Types, Optimum Horns, Design Characteristics of Pyramidal Horns.

Lens Antennas– Geometry, Features, Dielectric Lenses and Zoning, Applications. **Antenna**

Measurements– Patterns Required, Set Up, Distance Criterion, Directivity and Gain Measurements (Comparison, Absolute and3-Antenna Methods).

UNIT–V: 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 and Skip Distance –Calculations for flat and spherical earth cases, Optimum Frequency, LUHF, 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.

Course Outcomes:

A student who successfully fulfils this course requirement will be able to:

S. No	Course Outcome	BTL
1.	Identify basic antenna parameters.	L2
2.	Quantify the fields radiated by various types of antennas.	L3
3.	Design and analyze antenna arrays and loop antennas.	L4
4.	Design and analyze wire antennas, reflector antennas, lens antennas, horn antennas, microstrip antennas and antenna measurements to assess antenna's performance.	L4
5.	Identify the characteristics of radio wave propagation.	L2

Correlation of Cos with Pos & PSOs:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3	2	-	-	-	-	-	-	-	-	-	-	3	-
CO 2	3	2	1	-	-	-	-	-	-	-	-	-	2	-
CO 3	2	2	3	-	-	-	1	-	-	-	-	2	2	-
CO 4	2	2	3	-	-	-	1	-	-	-	-	2	2	-
CO 5	3	2	-	-	-	-	-	-	-	-	-	-	3	-

Text Books:

1. Antennas for All Applications–John D.Kraus and Ronald J.Marhefka, 3rd Edition, TMH, 2003.
2. Electromagnetic Waves and Radiating Systems – E.C. Jordan and K.G. Balmain, PHI, 2nd Edition, 2000.

Reference Books:

1. Antenna Theory- C.A.Balanis, John Wiley and Sons, 2nd Edition, 2001.
2. Antenna and Wave Propagation–K.D. Prasad, Satya Prakashan, Tech India. Publications, New Delhi, 2001.