ANTENNAS AND WAVE PROPAGATION

V Semester: ECE

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AECB18	Core	2	1	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

COURSE OBJECTIVES:

I Principles of radiation, antenna parameters and working principle of VHF, UHF and Microwave antennas used in communications, broad casting, radar, navigation and similar systems.

II Familiarize with basic antenna types and common structures, measurement of antenna characteristics and application of antennas over the radio frequency (RF) to micro wave (MW) frequency range.

III The applications of smart, wideband and ultra wideband (UWB) antennas for wireless communications, satellite communication, and radar systems.

COURSE OUTCOMES:

After successful completion of the course, Students will be able to:

CO 1 **Explain** the basic antenna parameters and antenna theorems using electromagnetic field theory.

CO 2 **Recall** the Maxwell's equations in illustrating the radiation mechanism and retarded potentials.

CO 3 **Illustrate** the field components and radiation resistance of half wave dipole, quarter wave mono pole and loop antennas using vector magnetic potentials.

CO 4 **Interpret** the radiation characteristics of yagi-uda, horn and helical antennas in far field region.

CO 5 **Analyze** the radiation characteristics of micro strip antennas using electric field distribution on aircraft and missiles.

CO 6 **Outline** the performance of smart antennas using fixed weight and adaptive beam forming techniques in digital wireless communication systems.

CO 7 **Develop** the pattern characteristics of a parabolic reflector by using the ratio of focal length to aperture size in domestic satellite television reception.

CO 8 **Illustrate** the working principle of lens, slot antennas using Fermat's and Babinet's principle.

CO 9 **Identify** the radiation patterns of broadside, end fire and binomial arrays using pattern multiplication principle.

CO 10 **Classify** the performance of antennas by measuring the radiation pattern, directivity and gain.

CO 11 **Select** the different modes of wave propagation through ground wave, space wave and sky wave.

CO 12 **Design** basic antenna structures such as aperture, horns and antenna arrays.

MODULE-I	ANTENNA BASICS	Classes: 09
Antenna fundamentals: Introduction, Basic Antenna Parameters-Patterns, Beam Area, Radiation Intensity, Beam Efficiency, Directivity-Gain-Resolution, Antenna Apertures, Effective Height, illustrative Problems, Fields from Oscillating Dipole, Field Zones, Front-to-Back Ratio, Antenna Theorems, Radiation, Retarded Potentials, Radiation from Small Electric Dipole, Quarter Wave Monopole and Half Wave Dipole, Current Distributions, Field Components, Radiated Power, Radiation Resistance, Loop Antennas- Introduction, Small circular Loop, Comparison of Far Fields of Small Loop and Short Dipole.		
MODULE-II	**VHF,UHF AND MICROWAVE ANTENNAS-I**	**Classes: 10**
Arrays with Parasitic Elements, Yagi-Uda Array, Folded Dipoles and 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.		
MODULE-III	**VHF,UHF AND MICROWAVE ANTENNAS-II**	**Classes: 10**
Microstrip Antennas-Introduction, Basic characteristics of micro strip antennas, Feeding Methods, Methods of Analysis, Rectangular and Circular micro strip antennas, Basic concepts of Smart antennas, concepts and benefits of smart antennas, fixed weight beam forming, adaptive beam forming. Reflector Antennas- Introduction, Paraboloidal Reflectors- Geometry, Pattern Characteristics, Feed Methods Lens Antennas: Introduction, Geometry of Non-metallic Dielectric Lenses, Zoning, Tolerances, Applications, Slot Antenna, Babinet's Principle, Applications.		
MODULE-IV	**ANTENNA ARRAYS AND MEASUREMENTS**	**Classes: 08**
Antenna Arrays: Point Sources- Definition, Patterns, Arrays of 2 Isotropic Sources – Different Cases, Principle of Pattern Multiplication, Uniform Linear Arrays- Broadside Arrays, End-fire 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)		
MODULE-V	**RADIO WAVE PROPAGATION**	**Classes: 08**
Wave Propagation - I: Introduction, definitions, categorizations ,different Modes of Wave Propagation; Ground wave propagation: Introduction, plane earth reflections, , 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, duct propagation, scattering phenomena, tropospheric propagation, fading and path loss calculations; 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. John D. Kraus, Ronald J. Marhefka, Ahmad S. Khan, "Antennas and Wave Propagation", TMH, 4th Edition, 2010.
2. C.A. Balanis, "Antenna Theory", John Wiley and Sons, 2nd Edition, 2001

Reference Books:

1. E.C. Jordan, K.G. Balmain, "Electromagnetic Waves and Radiating Systems", PHI, 2nd Edition, 2000.
2. E.V.D. Glazier, H.R.L. Lamont, "Transmission and Propagation", Her Majesty's Stationery Office, 1958.
3. F.E. Terman, "Electronic and Radio Engineering", McGraw-Hill, 4th Edition, 1955.
4. K.D. Prasad, SatyaPrakashan, "Antennas and Wave Propagation", Tech India Publications, 1st Edition, 2001.

Web References:
1. https://web.stanford.edu/class 2. https://www.electronicagroup.com 3. https://www.cpri.in 4. https://nptel.ac.in/courses/antennas
E-Text Books:
1. https://www.ebookgalaxy.in/2016/01/antennas-and-wave-propagation-by-g-s-n 2. https://www.archive.org 3. https://www.jntubook.com/antennas-wave-propagation-textbook-free-d