ANTENNAS AND PROPAGATION

V Semester: ECE

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AEC011	Core	3	1	-	4	30	70	100
Contact Classes: 45	Tutorial Classes: 15	Practical Classes: Nil				Total Classes: 60		

OBJECTIVES:

The course should enable the students to:

I. Be Proficient in the radiation phenomena associated with various types of antennas and understand basic terminology and concepts of antennas along with emphasis on their applications.
II. Analyze the electric and magnetic field emission from various basic antennas with mathematical formulation of the analysis.
III. Explain radiation mechanism of different types of antennas and their usage in real time field.
IV. Justify the propagation of the waves at different frequencies through different layers in the existing layered free space environment structure.

COURSE OUTCOMES (COs):

1. Discuss about the radiation mechanism in wire antennas and Analyze the concept of antenna properties based on reciprocity theorem
2. Understanding the significance of loop antennas uniform linear arrays and helical antennas
3. Describe the various types of Microwave antennas and their applications.
4. Analyze the reflector antennas with their applications, measure the different antenna parameters.
5. Analyze the structure of atmosphere for the wave propagation.

COURSE LEARNING OUTCOMES (CLOs):

1. Discuss about the radiation mechanism in single wire, double wire antennas and the current distribution of thin wire antenna.
2. Discuss the different parameters of an antenna like radiation patterns, radiation intensity, beam efficiency, directivity and gain etc,
3. Analyze the concept of antenna properties based on reciprocity theorem; evaluate the field components of quarter wave monopole and half wave dipole.
4. Understand the significance of loop antennas in high frequency range and its types; derive their radiation resistances and directivities.
5. Discuss the uniform linear arrays such as broadside array and end fire array, derive their characteristics.
6. Analyze the practical design considerations of horn antennas and monofilar helical antenna in axial and normal modes.
7. Discuss the various types of Microwave antennas and analyze the design consideration of pyramidal horn.
8. Analyze the concept of complementary in slot antennas using Babinet's principle and understand the impedance of slot antennas.
9. Understand the significance, features and characteristics of micro strip patch antennas, analyze the impact of different parameters on characteristics.
10. Understand and analyze the reflectors are widely used to modify the radiation pattern as a radiating element, its types.

11. Discuss various concepts related to antennas such as feed methods like front feed, rear feed, offset feed and aperture blockage.
12. Discuss various methods and techniques for experimental measurements of antennas such as pattern measurement, directivity measurement, gain measurement etc.
13. Understand the wave propagation through the complete study of the wave by the nature and characteristics of media during the wave travels.
14. Understand the space wave propagation focusing on field strength variation with distance and height, effect of earth's curvature, absorption and super refraction.
15. Analyze the structure of ionosphere and understand the sky wave propagation through refraction and reflection by ionosphere.
16. Apply the concept of antennas and propagation to understand and analyze real time applications.
17. Acquire the knowledge and develop capability to succeed national and international level competitive examinations.

Unit-I	**ANTENNA BASICS AND THIN LINEAR WIRE ANTENNAS:**	**Classes: 08**

Antenna fundamentals: Introduction, radiation mechanism, single wire, 2 wires, dipoles, current distribution on a thin wire antenna; Antenna Parameters, radiation patterns, patterns in principal planes, main lobe and side lobes, beam widths, radiation intensity, beam efficiency, directivity, gain and resolution, antenna apertures, aperture efficiency, effective height; Antenna properties based on reciprocity theorem; 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, beam widths, directivity, effective area and effective height; Natural current distributions, fields and patterns of thin linear center-fed antennas of different lengths; Illustrated problems.

Unit-II	**LOOP ANTENNAS AND ANTENNA ARRAYS**	**Classes: 09**

Loop Antennas: Introduction, small loop; Comparison of Far fields of small loop and short dipole; Radiation resistances and directivities of small and large loops. 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; Folded Dipoles and their characteristics; Arrays with parasitic elements, Yagi-Uda array, Helical antennas-Helical geometry, Helix modes, Practical design considerations for monofilar Helical antenna in axial and normal modes.

Unit-III	**VHF,UHF AND MICROWAVE ANTENNAS**	**Classes: 09**

VHF, UHF and Microwave Antennas: Horn antennas- Types, Fermat's principle, optimum horns, design considerations of pyramidal horns; Illustrative problems; Lens antennas: Introduction, geometry of Non-metallic dielectric lenses zoning, tolerances, applications; Slot antenna, its pattern, Babinet's principle and complementary antennas, impedance of slot 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.

Unit-IV	**REFLECTOR ANTENNAS AND ANTENNA MEASUREMENTS**	**Classes: 10**

Reflector Antennas: Introduction, flat sheet and corner reflectors; Paraboloidal reflectors: Geometry, pattern characteristics, feed methods, reflector types- Related features; 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: Comparison method, absolute and 3-antenna methods.

Unit-V	RADIO WAVE PROPAGATION	Classes: 09

Wave Propagation - I: Introduction, definitions, categorizations , general classifications, different Modes of Wave Propagation; Ground wave propagation: 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, 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, Satya Prakashan, Antennas and Wave Propagation‖, Tech India Publications, 1st Edition, 2001.

Web References:

1. http:// web.stanford.edu/class
2. http://www.electronicagroup.com
3. http://www.cpri.in/about-us/departmentsunits/library-and-information-centre/digital-library-links.html
4. http://nptel.ac.in/courses/antennas

E-Text Books:

1. http://www.ebookgalaxy.in/2016/01/antennas-and-wave-propagation-by-g-s-n.html#.WBGI7NJ97IU
2. https://www.jntubook.com/antennas-wave-propagation-textbook
3. http://117.55.241.6/library/E-Books/Antennas_mcgraw-hill_2nd_ed_1988-john_d_kraus.pdf
4. http://www.archive.org