Antenna and Wave Propagation(304190)

Teaching Scheme:
Lectures:4 Hrs/ Week

Examination Scheme:
In Semester Assessment:
Phase I : 30
End Semester Examination:
Phase II: 70

Course Objectives:

- To understand the applications of electromagnetic engineering.
- To formulate and solve the Helmholtz wave equation and solve it for Uniform plane wave
- To analyze and understand the Uniform plane wave propagation in various media
- To solve the electric field and magnetic fields for a given wire antenna.

Course Outcomes:

After successfully completing the course students will be able to

- Formulate the wave equation and solve it for uniform plane wave
- Analyze the given wire antenna and its radiation characteristics
- Identify the suitable antenna for a given communication system

Unit I : Uniform Plane Waves 8L

Maxwell Equations in phasor form, Wave Equation, Uniform Plane wave in Homogeneous, free space, dielectric, conducting medium. Polarization: Linear, circular & Elliptical polarization, unpolarized wave. Reflection of plane waves, Normal incidence, oblique incidence, Electromagnetic Power and Poynting theorem and vector.

Unit II : Wave Propagation 8L

Fundamental equations for free space propagation, Friis Transmission equation. Attenuation over reflecting surface, Effect of earth's curvature. Ground, sky & space wave propagations. Structure of atmosphere. Characteristics of ionized regions. Effects of earth's magnetic field. Virtual height, MUF, Skip distance. Ionospheric abnormalities. Multi-hoppropagation. Space link geometry. Characteristics of Wireless Channel: Fading, Multipath delay spread, Coherence Bandwidth, and Coherence Time.

Unit III : Antenna Fundamentals 6L

Introduction, Types of Antenna, Radiation Mechanism. Antenna Terminology: Radiation pattern, radiation power density, radiation intensity, directivity, gain, antenna efficiency, half power beam width, bandwidth, antenna polarization, input impedance, antenna radiation efficiency,

effective length, effective area, reciprocity. Radiation Integrals: Vector potentials A, J, F, M, Electric and magnetic fields electric and magnetic current sources, solution of inhomogeneous vector potential wave equation, far field radiation

Unit IV : Wire Antennas 6L

Analysis of Linear and Loop antennas: Infinitesimal dipole, small dipole, and finite length dipole half wave length dipole, small circular loop antenna. Complete Analytical treatment of all these elements.

Unit V : Antenna Arrays 6L

Antenna Arrays: Two element array, pattern multiplication N-element linear array, uniform amplitude and spacing, broad side and end-fire array, N-element array: Uniform spacing, non uniform amplitude, array factor, binomial and DolphTchebyshev array. Planar Array, Circular Array, Log Periodic Antenna, YagiUda Antenna Array

Unit VI : Antennas and Applications 6L

Structural details, dimensions, radiation pattern, specifications, features and applications of following Antennas: Hertz & Marconi antennas, V- Antenna, Rhombic antenna. TW antennas. Loop antenna, Whip antenna, Biconical, Helical, Horn, Slot, Microstrip, Turnstile, Super turnstile & Lens antennas. Antennas with parabolic reflectors

Text Books

1. C.A. Balanis, "Antenna Theory - Analysis and Design", John Wiley.
2. Mathew N O Sadiku, " Elements of Electromagnetics" 3rd edition, Oxford University Press

Reference Books

1. John D Kraus, Ronald J Marhefka, Ahmad S Khan, Antennas for All Applications, 3rd Edition, TheMcGraw Hill Companies.
2. K. D. Prasad, "Antenna & Wave Propagation", SatyaPrakashan, New Delhi.
3. John D Kraus, " Antenna& Wave Propagation", 4th Edition, McGraw Hill, 2010.
4. Vijay K Garg, Wireless Communications and Netwoking, Morgan Kaufmann Publishers, An Imprint of Elsevier, 2008.