

## EC 532: ANTENNA THEORY AND PROPAGATION (3-0-0:3)

### Introduction

Review of Maxwell's Equation; Condition of radiation of electromagnetic waves and introduction to Antenna; Vector Potential and Retarded Vector Potential; Radiation fields of a Hertzian dipole (electric); Duality Principle, Radiation fields due to short magnetic dipole.

### Fundamentals of antenna and antenna parameters

Antenna Characteristics: Radiation Pattern, Beam Width; Radiation Resistance and efficiency; Directivity and Gain, Impedance, VSWR, Polarization; Effective height and Receive Aperture; Noise Temperature of Antenna. Radiation fields and Characteristics of  $\lambda/2$  dipole; discussion on  $\lambda/4$  monopole antenna; Current distribution and Radiation patterns of center-fed dipoles of length  $\lambda$ ,  $3\lambda/2$  and  $2\lambda$ . Horizontal and Vertical antennas over a plane ground.

### Array antenna

Antenna Arrays: electric Field due to 2 element arrays, 3 element Arrays; Pattern Multiplication; Uniform Linear Array: End fire and Broad side; Phased array.

### Analysis of different types of antenna

Compute the input and mutual impedance of the antennas, Characteristics and properties of : Travelling Wave Antenna, Helical Antenna, Folded Dipole, Yagi-Uda Array, Loop Antenna, Electrically Short Antennas, Broad Band Antenna (Log periodic Antenna), Microstrip Patch Antenna. Radiation from an aperture: Sectoral and Pyramidal Horn Antennas, Design of Optimum Horn Antenna; Parabolic and Corner Reflectors and feed systems.

### Propagation characteristics

Methods of Propagation: Ground Wave Propagation, Components of ground wave, Field strength dependence on physical factors. Sky wave Propagation, Ionospheric Layers, Virtual Height, Critical Frequency, MUF, Skip distance, Sporadic Reflections. Space wave propagation: Tropospheric Scatter, Ducting Super refraction, Sub refraction. Friis Transmission Formula, SNR of a Radio Link. Physical (Medium) effects on Radio wave Propagation: Absorption, Refraction and Radio Horizon, Diffraction, Multipath Propagation and fading, Noise, Doppler effect., to study impedance characteristics of antennas.

### Text Books and References:

1. Antenna (for all application), John D. Kraus and Ronald J. Marhcfska; Tata- MacGraw Hill, 3<sup>rd</sup> Edition
2. Antenna Theory: Analysis & Design, Constantine A. Balanis; Willey, 3<sup>rd</sup> Edition
3. Modern Antenna Handbook; Constantine A. Balanis; Willey, 3<sup>rd</sup> Edition
4. Microstrip Antenna Design Handbook- Ramesh Garg; Artech House (2001)
5. Electromagnetic Waves & Radiating Systems, EC Jordan & K.G. Balmain; Pearson Education, 2<sup>nd</sup> Edition (2009)