

ECMC1T5B: Antenna Arrays and Synthesis

Unit-I: Fundamental of Antennas

Introduction, historical advancements, types, radiation mechanism, review of fundamental parameters – radiation pattern, power density, intensity, directivity, gain, beam width, band width, efficiency, polarization, impedance, effective height, equivalent areas, Friis transmission equation, vector potential for electric current source and magnetic current source.

Unit – II: Linear Arrays

N-Element linear arrays for uniform and non uniform amplitude excitations, design considerations, array factor expressions, scanning arrays, and rectangular to polar graphical solution.

Unit – III: Mutual Coupling in Arrays

Schelkunoff's unit circle representation. Mutual coupling, impedance effects of mutual coupling, array pattern evaluation including mutual coupling.

Unit-IV: Two dimensional Arrays

Rectangular and Circular arrays, array factor, beam width, directivity, design considerations. Array factor, radiation pattern, directivity, radiation efficiency. Analysis of elliptical arrays, directivity, equivalence to linear arrays.

Unit-V: Antenna synthesis and Continuous Sources

Introduction, continuous sources, line-source, discretization of continuous sources, Schelkunoff polynomial method, Fourier transform method, line source; linear array. Woodward –Lawson method, line source; linear array. Taylor line-source(Tschebyscheff error) design procedure.

Unit-VI: Conformal Array Antenna Theory

Introduction, definition, history, the shapes of conformal antennas- introduction, 360° coverage using planar and curved surfaces. Hemispherical coverage- using planar surface, half sphere, cone, ellipsoid, paraboloid, comparison of shapes, multifaceted surfaces.

Unit-VII: Phased Array Antennas

Introduction, phased array fundamentals, pencil beam array. Analyses of micro strip patch arrays. Probe-fed patch array, generalized impedance matrix of probe layer, input impedance, impedance characteristics, active element patterns, EMC patch array, slot-fed patch array, strip line-fed slot-coupled array, finite patch array.

Unit-VIII: Antenna Measurements

Introduction, antenna ranges- reflection ranges, free space ranges, compact ranges, near field/ far field methods. Radiation patterns- instrumentation, amplitude pattern, phase measurements. Gain measurements- absolute gain measurements, gain transfer measurements. Directivity measurements, radiation efficiency, impedance measurements. Current measurements, polarization measurements.

Text Books

1. Antenna Theory Analysis and Design – Constantine A. Balanis, 2nd Edition, John Wiley & Sons, 2004.
2. Antenna Theory and Design – Warren L. Stutzman, Gary A. Thiele, 2nd Edition, John Wiley & Sons, 1998.
3. Adaptive Antennas- R.T. Compton. Jr., Prentice Hall, England, 1988.
4. Conformal Array Antenna Theory and Design – Lars Josefsson, Patrik Persson, Wiley Inter science Publication, 2006.
5. Phased Array Antennas, Arun K. Bhattacharyya, John Wiley & Sons, 2006.

Reference Books

1. Theory and Application of Antenna Arrays- M.T.Ma., John Wiley & Sons, 1974.
2. Antenna Theory and Design – Robert S. Elliott, John Wiley & Sons, 2005.
3. Antennas for all Applications – John D.Kraus, Ronald J.Marhefka, 3rd Edition, TMH,2003.