

## ECMC2T5A: SMART ANTENNAS

### UNIT I

**Introduction:** Basic Idea of Smart Antenna, Benefits of Smart Antenna System, Emerging fields of Smart Antennas. Early Forms of Spatial Processing, Review of Fundamentals of Electromagnetic Fields and Antennas.

### UNIT II

**Array Fundamentals:** Array Weighting-Blackman weights, Hamming Weights, Gaussian Weights, Kaiser Bessel Weights. Fixed Beam Arrays, Fixed Sidelobe Cancelling, Retrodirective Arrays.

### UNIT III

**Principles of Random Variables and Process:** Definition of Random Variables, Probability Density Functions, Expectation and Moments, Common Probability Density Functions, Stationarity and Ergodicity, Autocorrelation and Power Spectral Density, Correlation Matrix.

### UNIT IV

**Smart Antennas:** Introduction, The Historical Development of Smart Antennas, Fixed Weight Beamforming Basics: Maximum S/I Ratio, Minimum Mean Square Error, Maximum Likelihood, and Minimum Variance. Diversity, Secorization.

### UNIT V

**Adaptive Beamforming:** Least Mean Squares (LMS), Sample Matrix Inversion (SMI), Recursive Least Squares (RLS), Constant Modulus (CM), Least Squares Constant Modulus, Conjugate Gradient (CG) Method, Spreading Sequence Array Weights, Description of the new SDMA receiver.

### UNIT VI

**Angle of Arrival Estimation-I:** Fundamentals of Matrix Algebra, Array Correlation Matrix, Non-Blind Beamforming, Blind Beam Forming, Angle of Arrival Estimation Methods: Bartlett AOA Estimate, Capon AOA Estimate, Linear Prediction AOA Estimate,

### UNIT VII

**Angle of Arrival Estimation-II:** Maximum Entropy Angle of Arrival Estimate, Pisarenko Harmonic decomposition AOA Estimate, Min-Norm AOA Estimate, MUSIC AOA Estimate, ESPRIT AOA Estimate.

### UNIT VIII

**Smart Antenna Performance:** Beamforming Array Performance, Receive Diversity Performance, Combined Diversity and Beamforming Performance, Choosing a Spatial Processing Technique, Multi User Modulation Schemes.

**TEXT BOOKS:**

1. Smart Antennas for Wireless Communications with MATLAB – Frank B. Gross, McGraw –Hill, 2005.
2. Space Time Processing for CDMA Mobile Communications – Pieter van Rooyen, Michiel Lotter and Danie van Wyk – Kluwer Academic Publishers – 2000.

**REFERENCE BOOKS:**

1. Smart Antennas - Tapan K. Sarkar, Michel C. Wicks, M.S. Palma and Robert J. Bonnea – John Wiley & Sons – 2003.
2. Adaptive Antenna Arrays: Trends and Applications – S.Chandran- Springer – 2004.
3. Introduction to Space Time Wireless Communications - A Paulraj, Rohit nabar and Dhananjay Gore – Cambridge University Press – 2003.

