Fourth Year Eight Semester (EVEN)

Department Elective Course -6

EC402: Smart Antennas

Details of course:-

Course Title	Course Structure			Pre-Requisite
	L	T	P	
Smart Antennas	3	0	2	NIL

Course Objective: To introduce and explore the smart antennas and MIMO antennas for RADAR, and wireless communication systems

Course Outcomes:
CO1: Explore the concepts of Antennas and its array beam forming methods
CO2: Explore the concepts of smart and adaptive antennas
CO3: Apply different adaptive algorithms for smart antennas to achieve minimized interference
CO4: Explore the concept of direction of arrival and angle of arrival estimation techniques
CO5: Explore the basics of mm Wave massive MIMO architectures

S. No.	Content	Contact Hours
Unit 1	Basics of antennas and its characteristics, antenna arrays and its beamforming analysis, Introduction to Smart Antennas, Architecture of a Smart Antenna System: Transmitter and Receiver, Types of Smart Antennas, Benefits and Drawbacks of Smart Antennas, Applications of Smart Antennas.	8
Unit 2	Fixed Beamforming techniques in smart antennas, Fixed Sidelobe Cancelling, Retrodirective Arrays, Butler Matrix, Spatial Filtering with Beamformers, Switched Beam Systems, Multiple Fixed Beam System, Adaptive Arrays, Uplink Processing, Diversity Techniques, Angle Diversity, Maximum Ratio Combining, Adaptive Beamforming, Fixed Multiple Beams versus Adaptive Beamforming, Downlink Processing	8

Unit 3	Smart antenna receivers and algorithms for radio base stations: Reference signal methods, The least mean square algorithm, The recursive least square algorithm, adaptive beam forming algorithms, Neural network DoA base beam forming, Downlink beamforming.	10
Unit 4	Fundamentals of Matrix Algebra, Array Correlation Matrix, AOA Estimation Methods: Bartlett AOA Estimate, Capon AOA Estimate, Linear Prediction AOA Estimate, Maximum Entropy AOA Estimate, Pisarenko Harmonic Decomposition AOA Estimate, Min-Norm AOA Estimate, MUSIC AOA Estimate, ESPRIT AOA Estimate.	8
Unit 5	Introduction, Multiple-Antenna MS Design, RAKE Receiver Size, Mutual Coupling Effects, Dual-Antenna Performance Improvements, Downlink Capacity Gains, Principles of MIMO systems: SISO, SIMO, MISO, MIMO, Hybrid antenna array for mmWave massive MIMO: Massive Hybrid Array Architectures, Hardware Design for Analog Subarray.	8
	Total	42

Books:-

S. No	Name of Books/Authors/Publisher
1	Smart Antenna Engineering'/ Ahmed El Zooghby, , ARTECH HOUSE, INC 2005, First Edition.
2	Smart antenna with MATLAB'/Frank B. Gross/ McGraw-Hill, 2015,2nd Edition
3	SMART ANTENNAS"/ Lal Chand Godara / CRC PRESS
4	mmWave Massive MIMO: A Paradigm for 5G/ Shahid Mumtaz, Jonathan Rodriguez, Linglong Dai/ 2016, First edition