



# SILVER OAK UNIVERSITY

**College of Technology**

**Master of Technology**

**Electronics and Communication**

**Course Name: Advanced Wireless Communication Systems**

**Course Code: 1010097140**

**Semester: 2<sup>nd</sup>**

**Prerequisite:** Digital Communications, Signals and Systems, Wireless communications

**Course Objective:**

1. To learn about MIMO communication systems, capacity of MIMO, space time coding scheme and MIMO in 4G/5G wireless communications with available technology and schemes

**Teaching Scheme:**

Teaching Scheme				
L	T	P	Contact Hours	Credit
3	0	2	5	4

**Content:**

Unit No.	Course Contents	Teaching Hours	Weightage %
1	<b>Introduction - Crowded spectrum</b> - Need for high data rates – Multiple input multiple output systems – Multi antenna systems and concepts - Spatial multiplexing - MIMO system model- MIMO system capacity- Channel known to the transmitter - Channel unknown to the transmitter - Water pouring principle – Capacity calculation – SIMO - MISO - Ergodic capacity - Outage capacity – Influence of fading Correlation on MIMO capacity - Influence of LOS on MIMO capacity.	8	15
2	<b>Data transmission over multipath channels</b> - Single carrier approach - Multicarrier approach - OFDM - OFDM generation - Cyclic prefix - Performance of space - Time coding on frequency-Selective fading channels- Capacity of MIMO - OFDM systems - Performance analysis of MIMO-OFDM systems.	8	15
3	<b>Delay diversity scheme-</b> Alamouti space - time code - Maximum likelihood decoding - Maximum ratio combining - Transmit diversity - Space-time block codes - STBC for real	7	15
	<b>signal constellations</b> - Decoding of STBC-OSTBC - Capacity of OSTBC channels - Space-time code Word design criteria – Multiplexing architecture - VBLAST architecture.		
4	<b>Codebooks for MIMO,</b> Beamforming, Beamforming principles, Increased spectrum efficiency, Interference cancellation, Switched beamformer, Adaptive beamformer, Narrowband beamformer, Wideband beamformer	5	10
5	Channel Estimation, Channel estimation techniques, Estimation and tracking, Training based channel estimation, Blind channel estimation, Channel estimation architectures, Iterative channel estimation, MMSE channel estimation, Correlative channel sounding, Channel estimation in single carrier systems, Channel estimation for CDMA, Channel estimation for OFDM.	8	25
6	Relaying, Multi-Hop, and Cooperative Communications - Introduction and Motivation, Fundamentals of Relaying, Relaying with Multiple, Parallel Relays, Routing and Resource Allocation in Multi-Hop Networks, Routing and Resource Allocation in Collaborative Networks, Relay Network Coding, Applications.	6	20

**Course Outcome:**

<b>Sr. No.</b>	<b>CO statement</b>	<b>Unit No</b>
<b>CO-1</b>	Understand the fundamental concepts of Multiple Input Multiple Output (MIMO) systems and their capacity calculations.	1,2
<b>CO-2</b>	Learn about various data transmission techniques over multipath channels, including Single Carrier and Orthogonal Frequency Division Multiplexing (OFDM) approaches.	2,3
<b>CO-3</b>	Explore advanced coding schemes like Space-Time Block Codes (STBC) and their applications in wireless communication systems.	3,4
<b>CO-4</b>	Gain insights into beamforming principles, codebooks for MIMO, and techniques for increased spectrum efficiency.	4,5
<b>CO-5</b>	Master channel estimation techniques and their applications in wireless communication systems.	5,6
<b>CO-6</b>	Design and simulate mobile communication systems	6

**Teaching & Learning Methodology: -**

1. Direct Instruction
2. Flipped Classrooms
3. Kinesthetic Learning
4. Context-Based Learning
5. Adaptive Teaching

**List of Experiments/Tutorials:****Total Hours : 28**

<b>Sr. No.</b>	<b>Practical Name</b>
1	Understand the different wireless channel Models.
2	Performance comparison of SISO, SIMO, MISO and MIMO.
3	To study Channel capacity of MIMO system
4	Perform The Alamouti scheme
5	To perform Space time coding in MIMO Communications.

### **Major Equipment:**

USRP

### **Books Recommended:-**

1. Claude Oestges, Bruno Clerckx, "MIMO Wireless Communications : From Real-world Propagation to Space-time Code Design", Academic Press, 1st edition, 2010.
2. MohinderJanakiraman, "Space - Time Codes and MIMO Systems", Artech House Publishers, 2004.
3. EzioBiglieri, Robert Calderbank, Anthony Constantinides, Andrea Goldsmith, ArogyaswamiPaulraj, H. Vincent Poor, "MIMO Wireless Communications, Cambridge. 4. Rakesh Singh Kshetrimayum, "Fundamentals of MIMO Wireless Communications", Cambridge University Press 2017
5. ArogyaswamiPaulraj, RohitNabar, and DhananjayGore. "Introduction to Space-Time Wireless Communications" (Cambridge University Press, New York, NY, USA)
6. Yong Soo Cho, Jaekwon Kim, Won Young Yang, Chung G. Kang, "MIMO-OFDM WIRELESS COMMUNICATIONS WITH MATLAB" Wiley
7. Aditya K. Jagannatham, "Principles of Modern Wireless Communication Systems" McGrawHillEducation

