

## **OTL551 SPACE TIME WIRELESS COMMUNICATION**

### DETAILED SYLLABUS

#### **OBJECTIVES:**

- To understand the concept of multiple antenna propagation.
- To understand the concept of capacity of frequency flat deterministic MIMO channel.
- To understand the concept of transmitter and receiver diversity technique.
- To design the coding for frequency flat channel.
- To analyze the concept of micro multi user detection.

#### **UNIT I MULTIPLE ANTENNA PROPAGATION AND ST CHANNEL CHARACTERIZATION**

Wireless channel – Scattering model in macro cells – Channel as a ST random field – Scattering functions, Polarization and field diverse channels – Antenna array topology – Degenerate channels – reciprocity and its implications – Channel definitions – Physical scattering model – Extended channel model – Channel measurements – sampled signal model – ST multiuser and ST interference channels – ST channel estimation.

#### **UNIT II CAPACITY OF MULTIPLE ANTENNA CHANNELS**

Capacity of frequency flat deterministic MIMO channel: Channel unknown to the transmitter – Channel known to the transmitter – capacity of random MIMO channels – Influence of ricean fading – fading correlation – XPD and degeneracy on MIMO capacity – Capacity of frequency selective MIMO channels.

#### **UNIT III SPATIAL DIVERSITY**

Diversity gain – Receive antenna diversity – Transmit antenna diversity – Diversity order and channel variability – Diversity performance in extended channels – Combined space and path diversity – Indirect transmit diversity – Diversity of a space-time – frequency selective fading channel.

#### **UNIT IV MULTIPLE ANTENNA CODING AND RECEIVERS**

Coding and interleaving architecture – ST coding for frequency flat channels – ST coding for frequency selective channels – Receivers–SISO–SIMO–MIMO–Iterative MIMO receivers – Exploiting channel knowledge at the transmitter: linear pre-filtering – optimal pre-filtering for

maximum rate – optimal pre-filtering for error rate minimization – selection at the transmitter – Exploiting imperfect channel knowledge

### **UNIT V ST OFDM, SPREAD SPECTRUM AND MIMO MULTIUSER DETECTION**

SISO-OFDM modulation, MIMO-OFDM modulation – Signaling and receivers for MIMO–OFDM – SISO–SS modulation – MIMO-SS modulation – Signaling and receivers for MIMO – SMIMO –MAC – MIMO – BC – Outage performance for MIMO-MU – MIMO - MU with OFDM – CDMA and multiple antennas.

### **OUTCOMES:**

At the end of the course, students would be able to

- Design and analyze the channel characterization.
- Analyze the capacity of random MIMO channel.
- Design and analyze the order diversity and channel variability.
- Analyze the multiple antenna coding and receivers.
- Analyze the MIMO multi user detection

### **TEXT BOOKS:**

1. Sergio Verdu, “Multi User Detection” Cambridge University Press, 2011
2. A. Paulraj, Rohit Nabar, Dhananjay Gore, “Introduction to Space Time Wireless Communication Systems”, Cambridge University Press, 2008

### **REFERENCE:**

1. Don Tarreri, “Principles of Spread Spectrum Communication systems”, Springer, Third edition, 2015