INTRODUCTION TO WIRELESS COMMUNICATION

Course Objectives

1. To introduce the fundamentals of wireless and cellular communication systems.
2. To understand wireless propagation models and fading phenomena.
3. To study wireless channel modeling and spread spectrum techniques.
4. To analyze diversity techniques and MIMO systems.
5. To understand multiple access techniques and emerging 5G technologies.

Module-I (8 hours)

Evolution of mobile radio communication fundamentals, General Model of Wireless Communication Link, Types of Signals, Cellular Infrastructure, Cellular System Components, Antennas for Cellular Systems, Operation of Cellular Systems, Channel Assignment, Frequency reuse, Channel Assignment strategies, Handoff Strategies Cellular Interferences, Sectorization; Wireless Channel and Radio Communication, Free Space Propagation Model, Channel Noise and Losses, Fading in Land Mobile Systems, Multipath Fading, Fading Effects on Signal and Frequency, Shadowing;

Module-II (6 hours)

Wireless Channel Modeling: AWGN Channel, Rayleigh Channel, Rician Fading Channel, Nakagami Fading Channel, Okumura and Hata Path Loss Model; Channel Modelling: Stochastic, Flat Fading, Wideband Time Dispersive Channel Modelling. Spread Spectrum Modulation, Pseudo-Noise Codes with Properties and Code Generation Mechanisms, DSSS and FHSS System.

Module-III (6 hours)

Diversity Combining Techniques: Selection Combining, Threshold Combining, Equal Gain Combining, Maximum Ratio Combining; Spatial Diversity and Multiplexing in MIMO Systems, Channel Estimation.

Module-IV (6 hours)

Equalization Techniques: Transversal Filters, Adaptive Equalizers, Zero Forcing Equalizers, Decision Feedback Equalizers, and related algorithms; Multiplexing and Multiple Access: FDMA, TDMA, CDMA, OFDMA, SC-FDMA, IDMA Schemes and Hybrid Method of Multiple Access Schemes, RAKE Receiver;

Module-V (4 hours)

Multiple Accesses for Radio Packet Systems: Pure ALOHA, Slotted ALOHA, CSMA and their versions; Packet and Pooling Reservation Based Multiple Access Schemes. Introduction to 5G.

Course Outcomes

After successful completion of the course, students will be able to:

CO1: Explain the architecture and operation of cellular communication systems and frequency reuse concepts.
CO2: Analyze wireless propagation characteristics, fading effects, and path loss models.
CO3: Evaluate wireless channel models, spread spectrum techniques, and pseudo-noise code generation.
CO4: Apply diversity combining methods, MIMO concepts, and channel estimation techniques to improve communication performance.
CO5: Compare multiple access techniques (FDMA, TDMA, CDMA, OFDMA) and explain the fundamentals of 5G wireless communication.

Text Books

1. Theodore S. Rappaport, Wireless Communications: Principles and Practice, Pearson Education.
2. Andrea Goldsmith, Wireless Communications, Cambridge University Press.
3. Ke-Lin Du and M. N. S. Swamy, Wireless Communication Systems: From RF Subsystems to 4G Enabling Technologies, Cambridge University Press.

Reference Books

1. David Tse and Pramod Viswanath, Fundamentals of Wireless Communication, Cambridge University Press.
2. Jochen Schiller, Mobile Communications, Pearson Education.
3. William C. Y. Lee, Mobile Cellular Telecommunications, McGraw Hill.