III Year II Semester	L	T	P	C
Code: 20EC6319	3	0	0	3

MULTI CARRIER COMMUNICATION SYSTEMS

Course Objectives:

1. To introduce the Fundamentals of multi carrier communication.
2. To introduce orthogonal frequency division multiplexing.
3. To learn the various channel estimation methods and significance of PAPR.
4. To introduce multiple input multiple output OFDM.
5. To understand multiple access in OFDM.

Unit-I: Basic principles of Multi Carrier Communication Systems

Multi carrier communication system fundamentals, OFDM system model, Single carrier communication, Comparison of OFDM with other single carrier modulation schemes, Peak to average Power Ratio in multi carrier Modulation, FFT implementation, Power spectrum, Channel capacity.

Unit-II: Orthogonal Frequency Division Multiplexing (OFDM)

Introduction, principle of OFDM, Modulation and Demodulation of OFDM system, Algorithm implementation IFFT/FFT of OFDM, implementation of transceivers, frequency-selective channels, inter carrier interference, adaptive modulation and capacity, channel estimation, peak to average power ratio, Synchronization in OFDM, Synchronization & system architecture, Timing and Frequency Offset estimation, single carrier modulation with frequency-domain equalization.

Unit-III: Channel Estimation and PAPR reduction in OFDM

Channel Estimation in OFDM systems, Differential and Coherent detection, Pilot symbol aided estimation, Block type and Comb type pilot arrangement, Decision directed channel estimation, MMSE estimation using time and frequency domain.

PAPR in OFDM, PAPR properties of OFDM signals, PAPR reduction techniques with signal distortion, Techniques for distortion less PAPR reduction, Selective mapping and Optimization techniques.

Unit-IV: MIMO-OFDM

A Basic OFDM System Model, MIMO OFDM, Multi-band OFDM, MIMO channel estimation, MIMO channel estimation- basic concepts, MIMO-OFDM synchronization and frequency offset estimation, Concepts of Time and Frequency domain equalization, OFDM based cognitive radio, Cognitive OFDM Systems, Spectrum sensing to detect Specific Primary System, Spectrum Sensing for Cognitive OFDMA Systems.

Unit-V: OFDMA

LTE Multiple Access, OFDMA Basics, SC-FDMA Basics, SC-FDMA and MIMO in LTE, Uplink User Data Transmission, Downlink User Data Transmission, Uplink Physical Layer Signaling Transmission, Downlink Physical Layer Signaling Transmission, UE Capability Classes and Supported Features, Physical Layer Measurements, Physical Layer Parameter Configuration.

Course Outcomes:

A student who successfully fulfils this course requirement will be able to:

S. No	Course Outcome	BTL
1.	Know the importance of multi carrier communication schemes.	L2
2.	Understand concept of OFDM and various issues in it.	L2
3.	Understand and compare various channel estimation and PAPR reduction methods.	L3
4.	Understand concept of MIMO OFDM and apply to cognitive radio.	L3
5.	Understand the significance of multiple access in OFDM.	L2

Correlation of COs with POs & PSOs:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	2	-	-	-	-	-	-	-	-	-	-	-	2	-
CO 2	2	2	-	-	-	-	-	-	-	-	-	-	2	-
CO 3	2	2	-	-	-	-	-	-	-	-	-	-	2	-
CO 4	2	2	-	-	-	-	-	-	-	-	-	-	2	-
CO 5	2	2	-	-	-	-	-	-	-	-	-	-	2	-

Text Books:

1. Aditya K. Jagannatham, Principles of Modern Wireless Communication Systems, McGraw Hill Education, 2016.
2. Ramjee Prasad, OFDM for Wireless Communications Systems, Artech House, 2004.
3. Bahai, Saltzberg and Ergen, Multi-Carrier Digital Communications, Theory and Applications of OFDM, Second Edition, Springer, 2004.
4. Y. Li. G. Stuber, "OFDM for Wireless Communication", Springer, 2006.

Reference Books:

1. Andrea Goldsmith, Wireless Communications, Cambridge University Press, 2006.
2. Ye (Geoffrey) Li and Gordon L. Stuber, Orthogonal Frequency Division Multiplexing for Wireless Communications, Springer, 2006.
3. Jonathan Rodriguez, "Fundamentals of 5G Mobile Networks", John Wiley & Sons.
4. David Tse , Pramod Viswanath, Fundamentals of Wireless Communication, Cambridge University Press, (2005).
5. E. Biglieri, R. Calderbank, A. Constantinides, A. Goldsmith, A. Paulraj, "MIMO Wireless Communications", Cambridge University press, First Edition, 2010.