

ECE6012: Wireless Communications

Programme: **B.Tech. (ECE,CCE) & M.Tech (ECE)**

Year: **4th / M.Tech**

Semester :**Even**

Course Type : **Program**

Credits :**3/4**

Hours : **40**

Course Context and Overview (100 words):

The objective of the course is to introduce students about the fundamental wireless communication concepts such as frequency reuse and handoff, coverage and capacity tradeoff, trunking theory, interference issues. It presents different ways of modeling radio propagation mechanism and estimate the large-scale, small scale effects including fading, time delay spread and Doppler spread of radio signal in various operating scenarios. It describes how to measure and model the impact that signal bandwidth and motion have on the instantaneous received signal through the multi-path channel. It provides idea about modulation and multiple access techniques used in existing and emerging wireless standards.

Prerequisites Courses:

Digital Communication

Course outcomes (COs):

On completion of this course, the students will have the ability to:
CO1: Should be able to understand functions, operational principles of the various components of cellular wireless networks, connections setup and analyze capacity improvement Techniques
CO2 Will understand the complicated nature of wireless propagation and be able to apply different models to calculate link budget, path loss and optimize a cellular system for a service area considering traffic, mobility, path loss, coverage, capacity, QoS, Fading, shadowing etc.
CO3 Will be able to design system in case of diversity reception, fading to improve BER and understanding of multiple access / communication techniques such as spread spectrum, CDMA .
CO4 Will be able to understand and compare different modulation schemes, advance OFDM based systems like MIMO-OFDM, OTBC used in wireless communications.
CO5 Become familiar with some of the existing and emerging cellular system standards.

Course Topics:

Topics	Lecture Hours	
UNIT - I	5	7.5
1. FUNDAMENTALS OF WIRELESS COMMUNICATIONS		
1.1 Introduction to Wireless Communication, Cellular concept, Spectrum limitation	1	3
1.2 Wireless standards and data rates, features and overview	1	
1.3 Frequency Planning ,Clustering Co-channel interference, Adjacent channel interference Sectoring cell splitting, capacity improvement	1	1.5
1.4 Introduction to Tele-traffic Theory channel, Queuing models, M/M/1, M/M/C/C, Erlang B and Erlang C	2	3
UNIT - II	5	7.5
2. WIRELESS PROPAGATION CHANNELS		
2.1 Introduction of Wireless Propagation Models, Two Ray Ground Reflection	1	1.5
2.2 Empirical Models, Log Normal Shadowing, Okumura-Hata, Cost 251, Indoor Models	1	3
2.3 Link Budget analysis	1	
2.4 Wireless Communication System Model and Fading	1	1.5
2.5 Wireless Channel and Delay Spread Coherence Bandwidth and Coherence time of the Wireless Channel, Doppler Spread	1	1.5
UNIT - III	8	12
3. Diversity and CDMA Technology		
3.1 Review of Modulation and Demodulation Techniques	1	1.5
3.2 BER of wireless communication with BPSK in Rayleigh fading channel	1	1.5
3.3 Introduction to diversity, Multi antenna, Maximal Ratio Combiner	1	1.5
3.4 BER of BPSK with Diversity, Spatial Diversity, Diversity order	1	1.5
3.5 Multipath fading and Inter Symbol Interference, ISI and Doppler in Wireless Communication, Doppler spectrum and Jakes Model	1	1.5
3.6 Introduction to CDMA, Spread Spectrum and LFSR, Generation and Properties of PN Sequences	1	1.5
3.7 Correlation of PN Sequences and Jammer Margin, CDMA Advantages and RAKE Receiver	1	1.5
3.8 Multi-User CDMA Downlink and Uplink, CDMA Near-Far Problem	1	1.5
UNIT - IV	9	12
4. MIMO–OFDM Systems: 4G Technology (LTE, WiMax)		
4.1 Introduction to MIMO, MIMO System Model	1	6
4.2 MIMO MMSE Receiver , Zero-Forcing,	1	
4.3 Introduction to SVD, SVD based MIMO Capacity	1	
4.4 Orthogonal Space Time Block Coding (OTBC)	1	
4.5 Introduction to V-BLAST Receiver and MIMO Beam-forming	1	
4.6 Introduction to OFDM and Multi-Carrier Modulation, OFDM Schematic	2	

4.7 Cyclic Prefix and OFDM Based Parallelization and OFDM Example, Introduction to MIMO OFDM	1	
4.8 Carrier Frequency offset and PAPR in OFDM, introduction to SC-FDMA	1	
UNIT - V 5. Network Architecture	3	4.5
5.1 GSM system architecture, GSM RAN, Frame structure. GSM logical Channel: AGCH, BCCH, FCCH, SDCCH etc Signaling and call routing sequence, Call handoff, Roaming	1	4.5
5.2 LTE and LTE-A overview , LTE Network architecture	1	
5.3 5G requirements	1	

Textbook/ references:

TEXT BOOKS:

1. Andrea Gold Smith, "Wireless communications", Cambridge University Press, 2005
2. Rappaport. T.S., "Wireless communications", Pearson Education, 2003
3. Aditya K. Jagannatham, "Principles Of Modern Wireless Communication", McGraw Hill 2016.
4. David Tse, Pramod Viswanath, "Fundamentals of Wireless Communication", Cambridge 2005.

REFERENCES:

1. Simon Haykin & Michael Moher, "Modern Wireless Communications", Pearson Education, 2007
2. Andreas.F. Molisch, "Wireless Communications", John Wiley – India, 2006.
3. G. L. Stuber., "Principles of Mobile Communications" Kluwer Academic Publishers, 2001.

Additional Resources:

NPTEL

Evaluation Methods:

Item	Weightage
Quizzes	20
Midterm	30
Final Examination	50

Attendance:75% mandatory. 60 % for Medical Reason/academic leave. Below 60 % will not be allowed to sit in Examination. 60% to 75 % without any reason 1 grade less

If the students (like M. Tech Students) opted for project the credit will be 4

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