ELEC4110 Digital Communications and Wireless Systems

Course Description

Representation of signals, optimum detection of signals in noise, matched filtering, error probability calculations for digital modulation. Multilevel modulation schemes, comparison of digital communications systems, mobile and wireless channels, diversity techniques, spread-spectrum communications, Resource Partitioning in Multiuser systems (FDMA, TDMA, CDMA) and their applications in cellular mobile and wireless personal communications. *Prerequisite(s):* ELEC 3100

List of Topics

Week 1	**Course Introduction and Overview**
Week 2	**Review of Digital Binary Communication Systems** Review Binary Digital Communications, Derive Optimum Receiver Structure for Generic Binary Modulations, Popular Binary Modulation Scheme
Week 3	**Signal Space Concepts and Geometric Representation of Signals 1** Introduction, Signal Space Concepts, Basis Vectors/Functions, Determination of an Orthogonal Basis Set
Week 4	**Signal Space Concepts and Geometric Representation of Signals 2** Introduction, Signal Space Concepts, Basis Vectors/Functions, Determination of an Orthogonal Basis Set
Week 5	**Applications of Signal Space: M-ary Modulator and Optimal Detection 1** M-ary Modulation, Optimum Signal Detection, Determine the Optimum Receiver for General M-ary Signaling in the Presence of AWGN
Week 6	**Applications of Signal Space: M-ary Modulator and Optimal Detection 2** Optimum Detector Structure, The Optimum Receiver, Graphical Interpretation of Decision Region
Week 7	**MFSK Error Analysis** Probability of Error Expressions, Union Bound on Pe for Generic M-ary Modulations, Orthogonal Signaling and Its Variations
Week 8	**MQAM Error Analysis** M-ary Modulation Types, MFSK, MPSK,MQAM, Tradeoffs
Week 9	**Fading Channels and Effects on Physical Layer Design1** Introduction to Wireless Communications
Week 10	**Fading Channels and Effects on Physical Layer Design2** Small Scale Fading, Multipath-Dimension of Fading, Time-Varying Dimension of Fading, Summary of Fading Parameters
Week 11	**Diversity Techniques** Diversity Techniques for Combating Flat Fading, Time or Frequency Diversity, Antenna Diversity, Trade Off in Diversity
Week 12	**Spread Spectrum Techniques**

Spread Spectrum Systems, DSSS Communications, ISI Mitigation Using DS-SS in Frequency Selective Fading Channels, Rake Receiver

Week 13 **OFDM**

Motivations, OFDM Transmission, Advantages and Disadvantages of OFDM, Resource Partitioning in Multi-user Communications

Statement of Objectives/Outcomes:

On successful completion of this course, students will be able to:

CO1 - recognize the key technological developments of digital communications and wireless systems

CO2 - identify the fundamental principles related to digital communication technology

CO3 - use Matlab to solve simple simulation problems in digital communications

CO4 - comprehend technical specifications and understand how and why practical wireless systems are designed.

Suggested Textbook:

R. E. Ziemer and R. L. Peterson, *Introduction to Digital Communication*, Prentice Hall, 2nd Edition, 2001

Reference Books:

1. R. E. Ziemer and W. H. Tranter, *Principles of Communications: Systems, Modulation, and Noise*, Houghton Mifflin, 4th Edition, 1995
2. John G. Proakis and M. Salehi, *Communication Systems Engineering*, Prentice Hall, 1994
3. Simon Haykin, *Digital Communications*, Wiley, 1988
4. R. Kwok, V.K.N. LAU, *Wireless Internet and Mobile Computing: Interoperability and Performance*, John Wiley and Sons, 2007

Grading Scheme:

Homework (3 at 5% each)	15%
Midterm	25%
Group Project	10%
Final Exam	50%