ELEC4110 Digital Communications and Wireless Systems (Fall 23-24)
Credits: 3

Course Description

The aim of this course is to provide a comprehensive treatment of the theory, analysis, and design of digital communications and introduce advance concepts such as M-ary modulation, signal space concept, wireless communication systems, cellular networks, 5G and beyond.

List of Topics

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

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

13 **Cellular Systems, 5G and Beyond**
Overview of Cellular Networks, Evolution of Cellular Systems, 5G Systems and Beyond

Reference Books:

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

Prerequisites
Background in signals and systems, probability, random variables, stochastic processes,

Grading Scheme:

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