ECE 515  
Modern Digital Communications – Course Syllabus  
Spring 2014  
Instructor: Guillermo Atkin

Office: SH – 141, 312-567-6810  
Office Hours: T and R: TBA  
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Class Hours: TBA

Description: Review of modulation and coding. Trellis coded modulation. Digital signaling over fading multipath channels. Spread spectrum signals for digital communications. Multiple access systems, time-division multiple access, code-division multiple access, frequency-division multiple access. OFDM communications systems.

Prerequisites:

- ECE 513 and ECE 511 (or instructor consent)
- Understanding of continuous and discrete linear systems.
- Knowledge of probabilities and random variables.
- Understanding of digital modulation methods and optimum receiver.
- Understanding of block and convolutional codes. Encoding and decoding.
- Knowledge of evaluation of probabilities of error in and AWGN channel.


References:

Course Outline:

Review of Modulation and Coding Theory
   i.  Review of the main components of a Digital Communication System
   ii. Review of Block Codes - Convolutional codes
   iii. Lattices

Trellis Coded Modulation (TCM)
   i.  Introduction and Fundamentals
   ii.  Trellis Representation
   iii.  Set Partitioning
   iv.  Examples of TCM schemes
   v.   Decoding TCM
   vi.  Performance Evaluation in AWGN channel
   vii. Upper Bound to Error Probability
   viii. Lower Bound to Error Probability
   ix.  Examples
   x.   Computation of dfree

Digital Signaling over Fading Multipath Channels
   i.  Characterization of Fading Multipath Channels
   ii.  The Effect of Signal Characteristics on the Choice of a Channel Model
   iii.  Diversity Techniques for Fading Multipath Channels
   iv.  Digital Signaling over a Frequency-Selective, Slowly Fading Channel
   v.   Binary and M-ary Signaling over a Frequency-Nonselective, Slowly Fading Channel
   vi.  Coded Waveforms for Fading Channel
   vii. Probability of Error. Hard and Soft Decision
   viii. Performance of Convolutional Codes
   ix.  Constant Weight and Concatenated Codes
   x.   Analysis and Performance of TCM for Fading Channels

Spread Spectrum Signals for Digital Communications
   i.  Model of a Spread Spectrum Communications System
   ii.  Direct Sequence Spread spectrum Signals
   iii.  Rake Receivers
   iv.  Multi-user Detection
   v.   Frequency Hopped Spread Spectrum Signals
   vi.  Other types of Spread Spectrum Signals
   vii. Spread Spectrum in multipath channels

Multiuser Communications
   i.  Multiple Access Techniques (CDMA, TDMA, FDMA, SDMA, PDMA)
   ii.  Capacity of Multiple Access Systems.

Multichannel and Multicarrier System
   i.  Multichannel Digital Communications in AWGN
   ii.  Multicarrier Communications
OFDM

i. Introduction

ii. Transmitter and Receiver Structure

iii. Performance Analysis

Grading.

Coursework will be graded as follows:

1. Homework 10% (every week, due Tuesdays)
2. Projects 20% (TBA)
3. Exams 1 20% (02/16/2012)
4. Exams 2 25% (03/29/2012)
5. Final exam 25% (TBA)

HW should be submitted before the beginning of the class on Tuesdays (MC section) using the Digital Dropbox (Blackboard) for other sections the due date is Thursday before the class. Homework solutions will be posted in the Blackboard on Friday. No late HW will be accepted without previous instructor consent.

Grade Policy: A (≥ 90%); B(80 - 89%); C(66 - 79%); D(50 - 65%)

Reasonable accommodations will be made for students with documented disabilities. In order to receive accommodations, students must obtain a letter of accommodation from the Center for Disability Resources and make an appointment to speak with me as soon as possible. The Center for Disability Resources is located in the Life Sciences Building, room 218, 312-567-5744 or disabilities@iit.edu.