Hellen and John C. Hartmann Department of Electrical and Computer Engineering

New Jersey Institute of Technology
ECE 489 Communications Systems Laboratory

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Pre-Requisites: ECE 421

TEXTBOOK(S)/MATERIALS REQUIRED: lab manual at http://ECELabs.njit.edu on the NJIT Intranet

Catalog Description:
The laboratory experiments are designed using Matlab/Simulink and Software Defined Radio (SDR). The major lab tasks include time and frequency domain analysis of AM and FM signals, generation and detection of digitally modulated waveforms such as BPSK, QPSK, 16QAM and 64QAM which are widely used in wireless communication networks. Through the experiments, students learn how to use Matlab/Simulink to control the SDR, to assess and combat the impairments due to noise and interference, and become familiar with instruments such as spectrum analyzers, audio analyzers and noise generators.

COURSE LEARNING OBJECTIVES:

Students will be able to
1. Understand spectra of AM FM signals; how depth of modulation is affecting the signal spectrum.
2. Understand how noise effects digital systems communications.
3. Understand and utilize the basic techniques of digital communication for coding, eye diagrams and Bit Error Rate testing (BER)
4. Use the principles of CDMA and demonstrate a multi user BPSK CDMA system
5. Understand the principles of OFDM
6. Use Labview to control instruments
7. Understand the definition of Software Defined Radio, be able to describe how it works and its utility.
8. Explain the methods and results of experiments; produce a professional quality lab report.

ABET Criterion 3 Student Learning Outcomes

1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics (CLO 1-8);
5. an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives (CLO 1-8)
6. an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions (CLO 1-8)

Grading Policy:

An important goal of a lab course is to impart hands-on experience. Students work in teams. Although it may appear that the grade is given based on the submitted report only, it should be realized that an essential part of the lab experience is actually doing the experiment. No grade will be given for a lab session if the student did not attend the session. Lab reports are due the week after the lab is completed unless discussed with the instructor in advance. There a penalty of one point out 10 points for each week for late report.Grades will be determined with 30% of the grade from the prelab and class participation and 70% from the lab reports. Each student should include in his/her report a section titled "Discussion and Analysis of results." This is an important part of the

experiment and it is given 50% of the grade of the report. The report should be readable by itself without referencing the lab manual, etc. It should be written using your own words. Cutting and pasting form the manual and other resources is not acceptable.

To summarize 10 total points for each experiment: 3 points Data, 4 points for Discussion and Analysis of results: 3 points for other items including:

1. Title Sheet and Cover
2. Abstract or Synopsis
3. Procedure
4. Connection Diagram (s)
7. Curves and graphs if appropriate
9. Discussion and Conclusions

Experiments:

1.	AM Modulation
2.	FM Modulation
3.	PBRS Generation Eye Diagrams, noisy channel model (2 weeks)
4.	Detection with decision Maker, Line Coding and BER testing
5.	BPSK & QPSK
6.	CDMA1: 1-channel baseband processing gain and noise effect on performance
7.	CDMA2: Full 2-user System with BPSK mod Spectra at each stage
8.	CDMA BER Detection
9.	OFDM – frequency division multiplexing
10.	SDR 1: Introduction to Lab View PRBP generation and BER vs. noise power
11.	SDR 2: Transmit and Receive, Receive pwr vs. distance
12.	SDR 3: Modulate – Constellations and Eye Diagram

The Honor Code

Students should be familiar with NJIT Honor Code. This code will be rigorously upheld, any violations will be brought to the immediate attention of the administration.