

Course Syllabus

Course No. & Title: EEL 4936/EEL 6936 Wireless Communication Systems Lab

Term & Meeting Info: Fall 2008

Instructor Info:

Dr. Hüseyin Arslan;

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Office Hours: Wednesday, 11:30 – 1:00 p.m. & Tuesday 1:00-2:30 pm.

Catalog Description:

An extensive hands-on introduction to digital communications and wireless communication systems; involving testing, modeling, simulation, and measurements of the performance of digital communication systems at both sub-system and complete system levels. Not available on an S/U basis.

Semesters Offered: Spring and Fall Each Year

Prerequisites: Introduction to Communication Systems or equivalent.

Suggested Co-requisites: WAMI lab, DSP/FPGA labs, Personal & Mobile Communication, Advanced Topics on Wireless Communications, Digital Comm. Sys, Digital Commun. Sys.

Courses that require this course as a direct prerequisite: None

Level: Senior level undergraduate and graduate

Credits: 3 **Class Duration:** 1 Hour and 45 minutes lecture + 4 hours lab

Text Info: *Instructor will provide the required documents.*

You are not granted permission to sell notes or tapes of class lectures.

Reference (supplemental reading): *Related reading material will be provided via web postings and handouts.*

Course Outcomes: Students will learn

1. Blocks of a basic digital communication system (simulation, modeling, test, and measurement of sub-system and system performance)
2. Use of modern test and measurement tools and their relation with software-defined-radio (SDR)
3. Various system measurement techniques, methods, and tools
4. Simulation and performance evaluation of various digital modulations with several pulse shaping techniques
5. Theory and practical usage of Time-Frequency (TF) analysis. Using TF analysis to understand and evaluate the communication system behavior
6. Modulation and waveform analysis techniques and tools
7. Radio channel using sounding technique and the radio communication problem in multipath propagation
8. Simulation, and hardware emulation of interference and its effect on wireless systems
9. Nonlinear distortions in the RF front end
10. Wireless signals and standard waveforms
11. Impairments in digital communication systems and modeling the impairments
12. Synchronization to digitally modulated signals for detection and estimation of the transmitted symbols

Test & Grading Info:

The following is tentative and subject to change:

Lab Reports	40%
Project presentation and project report	30%
Final Exam	20%
Pre-Labs (& lab quizzes)	10%

TA's & Help Sessions: Open Lab hours are posted on the lab door (ENB 236.)

Course content and (Approx. # of Lectures):

- 8 mandatory experiments (8 weeks)
- 2 optional experiments (2 weeks) – pick 2 out of 4 optional experiments
- 1 project (3 weeks) – Students need to start thinking about the project well ahead of time (project reports and project presentations are due last day of classes – during the last week lab hours)
- 1 Final exam (last week of classes – during the regular class hour of last week)
- Quizzes (random quizzes (pop-quiz) at the beginning of some labs – related to pre-lab assignments, reading materials, and what is learned in the class etc. Note that within the same lab (let's say lab-5) a TA might apply pop-quiz, but, the others might not)
- Lab reports (after each lab – will be collected before the next lab. Related to what is learned in the lab and commenting on the observations, relating it with the theory and expectations. Identifying the differences and commenting on why if any.)

Specialization: *Elective course for EE students.*

Professional Component: Engineering Science - 40 % Engineering Design - 60 %

(Eng Science = math/science required for creative applications; Eng Design = decision making process of devising a system, component or process to meet a desired need)

Late policy:

Quizzes must be taken during scheduled times and pre-labs must be completed before the beginning of the laboratory session. Late pre-labs or make-up quizzes will not be accepted unless pre-arranged and with good reason. Laboratory reports are due the beginning of the subsequent laboratory session unless otherwise announced. Late lab reports will not be accepted unless pre-arranged and with good reason.

Attendance Policy and Open Lab Hours:

You are expected to view all lectures and be present for all 3 hours and 50 minutes of each laboratory session. Anyone wishing to leave the lab early must have his/her data checked for completeness before leaving. You should not leave early unless you have every part of the lab complete, including calculations, and only have the report SUMMARY to finish.

Laboratory hours:

You will receive a schedule that details the operating hours for the Lab in ENB-236. The schedule will also be posted on the door.

Graduate students and some undergraduate students who are working on Senior Design Projects also have special access to the lab. You are asked not to attempt entry into the lab outside the scheduled hours, even if you see that there are some other non-TA students in the room. This is a strict policy.

TA Signatures on Your Work:

A TA signature must be on your work (cover page and all graphs/printouts, at a minimum) else it will not be considered complete when you submit your lab report. You should have the TA review and sign your work before you leave the lab. If you must leave early on some occasion, the TA in charge of the make-up session that you attend must sign your work.

Cheating: University Policies on cheating can be found in your student catalog. **The standard penalty for cheating is an automatic 2-letter reduction in the overall course grade.**

Laboratory Partners:

Typically students will work in teams of three. The team members will be rotated weekly when possible; in the case that multiple laboratory exercises are addressed in a single session, the partners will likely remain the same. Similarly, in the case of a lab exercise that will last multiple sessions, the partners will remain the same. The teaching assistant will make sure that on a given team, there is ~equal participation from each student and may make specific team assignments to address this point

Laboratory Assignments:

For many laboratories you will be required to complete a pre-laboratory assignment – this assignment must be turned in at the beginning of the lab period. For all laboratories you need to read over the previous lecture material and the laboratory assignment you are about to undertake. If you are not familiar with the background and procedures, you will have difficulty completing the laboratory on time. Short unannounced quizzes on this material may be given at the beginning of some laboratory sessions. You can work with your lab partner to complete the pre-laboratory assignments, but each of you must turn in your own work separately.

For each laboratory assignment you will also have to complete a post-laboratory report. For this report, you are strongly encouraged to collaborate with your partner and discuss the results, but the descriptions and conclusions must be completed individually. You will be graded primarily on the quality of the technical content, not the quantity or style of presentation. Your reports should be neat, accurate and concise (the Summary portion must be less than one page). Laboratory reports are due the week following the laboratory experiment, unless notified otherwise, and should be turned in to the TA at the start of the laboratory period.

General Instructions for Writing Your Laboratory Reports

1. Your completed laboratory assignment is to consist of your original laboratory procedure sheets (with data tables and blanks filled in), plus a short report.
2. Each report is to include a ½ to 1 page SUMMARY.
3. For some laboratories, specific questions are asked and specific plots and figures are requested. These figures, graphs, tables and answers to specific questions specified in the lab write-up are to be included as additional pages under “Discussion of Results”. Make sure all figures include a description of what the figure represents (title or caption), and that x- and y-axes of all plots are clearly labeled.
4. Some laboratory procedures ask you to make OBSERVATIONS based on the data that you have recorded, and to perform specific calculations within the procedure. Make sure that you make every effort to respond to all data and observation requests throughout the procedure. Comments should be hand-written (in the interests of saving time).
5. You may also want to make a few additional notes while completing the experiments: **observe** the graphs and data, and try to **interpret** them. These notes will help you to write a good summary.
6. Ask questions during the laboratory period to aid in your understanding.
7. Your reports should be generated using a word processor. Hand-written tables, figure captions, etc. are allowed, but avoid using hand-written summaries and discussion.

8. While you are encouraged to discuss issues and trade ideas with your lab partner and other students in the lab, your lab SUMMARY and (where applicable) DISCUSSION OF RESULTS must be in your own words.
9. Do your best to reflect your understanding of the concepts related to the lab, and discuss the main results you achieved. The clear communication of your understanding of the relevant concepts of the experiment is the most important aspect of your report.

The following is a template to help you write your reports. Note that for some of the experiments, there may be additional guidelines.

LABORATORY REPORT

Lab # and Title:

Date:

Name:

Lab Partners:

SUMMARY (Required for all labs - 1 page maximum): Discuss the main conclusions/findings from the experiments or simulations, using the comments you recorded while doing the experiment. Address the concepts addressed in the tutorial lecture and experimental procedures. For example: how did theory and experiment agree or disagree? What results have been suggested by the data? What have you learned? Each conclusion should include some numbers that are taken from the data in your procedure. The TA should be able to correlate each summary with specific data in each student's procedure. This is not a summary of the procedures you followed; rather it is a summary of the results you achieved and the lessons that were learned.

DISCUSSION OF RESULTS (Not required for all labs): Here you can address specific questions or instructions required in a particular lab, and attach any plots and figures. This should not include any extended discussion, but should be well organized and labeled.

Lab and Course Schedule – (tentative and subject to change)

Mandatory labs (weeks 1 through 8):

1. Introduction to radios and SDR
2. Modern measurement tools and relations with SDR
3. Understanding various system measurements along with Lab-13 set-up of WAMI lab
4. Digital Modulations
5. Pulse shaping filters
6. Time-Frequency analysis
7. Radio Channel and Channel Sounding
8. Synchronization to digital signals

Optional Labs (weeks 9 and 10, - pick 2 out of 4 experiments given below):

9. Interference
10. Impairments in digital communication systems and modeling the impairments
11. Understanding nonlinear distortions in the RF front end:
12. Wireless signals and standard waveforms

Projects (weeks 11, 12, and 13)

By week 11, you are expected to pick a project to carry out from week 11 until the last week of the semester. A project proposal is required at least one week before the week 11. The project proposal needs to be approved by the instructor. Unapproved projects and any delay due to the unapproval of the project is students' responsibility. Therefore, students are required to work with the instructor well ahead of the time for identifying a proper project. Like the regular labs, projects will be carried out with teams of three students, and the partners will remain the same during the project period. The projects will only be carried out during the regular laboratory hours with the existence of the TAs.

Additional Course Features: This course utilizes University of South Florida's state of the art wireless communication systems laboratory. Students work in 3 person laboratory teams that change throughout the semester.

Relation of Course to EE Dept. Program Outcomes:

Outcome a – An ability to apply knowledge of basic math, science and engineering

Outcome b – An ability to design and conduct experiments, as well as analyze and interpret data

Outcome c – An ability to design a systems, component, or process to meet desired needs

Outcome g – An ability to communicate effectively

Outcome k – An ability to use techniques, skills and modern engineering tools necessary for engineering practice

Outcome l – Knowledge of probability & statistics and advanced mathematics (e.g., calculus, DE, linear algebra, complex variables & discrete mathematics)

Actions Taken to Improve the Course: This is the first time the course is being offered.

Standard Syllabus Prepared by:

Hüseyin Arslan

Date of Approval of Standard Syllabus by Area:

December, 2007