

San José State University
Department of Electrical Engineering
EE 265, Hands-On Wireless Communications Using Software
Defined Radios, Fall 2017

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Office Hours:	TR 15:00 to 16:00
Class Days/Time:	MW 16:30-17:45
Classroom:	E401
Prerequisites:	EE 210 or instructor's consent

Course Description

This course is an experimental approach to wireless communications. The topics will include analog/digital transmission, ADC/DAC, and wireless channel modeling. Students will be exposed to MATLAB, software defined radios (USRP), GNU Radio, GRC (GNU Radio Companion) as part of homework assignments and projects. GNU Radio (<http://gnuradio.org>) software development platform is based on Python and C++ languages. At the end of the class, students will be able describe design challenges associated with building a wireless digital communication system.

Course Goals and Student Learning Objectives

After completing this course, students will be able to understand and describe some of the design challenges associated with building a wireless digital communication system based on software-defined radios.

GE/SJSU Studies Learning Outcomes (LO), if applicable

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

LO1 Demonstrate an understanding of the fundamentals of Electrical Engineering, including its mathematical and scientific principles, analysis and design.

LO2 Demonstrate the ability to apply the practice of Engineering in real-world problems.

Course Content Learning Outcomes

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

- LO3** Analyze the spectral domain representation of periodic signals.
- LO4** Analyze characteristics of noise and interference in wireless channels.
- LO5** Analyze filters, such as low-pass, bandpass and matched (correlation) and understand their impact on the performance of a communication system.
- LO6** Describe analog modulation schemes, FM and AM, and specify the effect of system parameters (such as carrier frequency, bandwidth, rate) on performance.
- LO7** Specify and quantify the effect of ADC and DAC on wireless system performance.
- LO8** Describe digital modulation schemes (PSK, DPSK, GMSK, QPSK and QAM) and the effects of system parameters and synchronization errors in their performance.
- LO9** Analyze the multipath effects of wireless channels and demonstrate their compensation with equalization.
- LO10** Describe multicarrier (OFDM) modulation and its performance.
- LO11** Interpret and report performance predictions of wireless communications with software-defined radios.

Required Texts/Readings

Textbook

C.R. Johnson and W.A. Sethares, *Telecommunications Breakdown: Concepts of Communication Transmitted via Software-Defined Radio*, Prentice Hall, 2004.
(<http://eceserv0.ece.wisc.edu/~sethares/telebreak.html>)

NOTE: There is a newer version: *Software Receiver Design: Build Your Own Digital Communication System in Five Easy Steps*, Cambridge University Press, 2011.
Either version of the textbook is acceptable.

Other Readings

J. Proakis and Salehi, *Contemporary Communication Systems Using Matlab*, PWS, 1998.
H. Meyr, M. Moeneclaey and S. A. Fechtel, *Digital Communication Receivers*, Wiley, 1997.

Classroom Protocol

Students are expected to participate actively in class. Students will turn their cell phones off or put them on vibrate mode while in class. They will not answer their phones in class.

Dropping and Adding

Students are responsible for understanding the policies and procedures about add/drops, academic renewal, etc. [Information on add/drops are available at http://info.sjsu.edu/web-dbgen/narr/soc-fall/rec-298.html](http://info.sjsu.edu/web-dbgen/narr/soc-fall/rec-298.html). [Information about late drop is available at http://www.sjsu.edu/sac/advising/latedrops/policy/](http://www.sjsu.edu/sac/advising/latedrops/policy/). Students should be aware of the current deadlines and penalties for adding and dropping classes.

Assignments and Grading Policy

There will be one midterm exam and a final exam. Exams are closed book and notes. Students can bring a formula sheet (one page – both sides). There will be no make-up exams. Exam solutions will

be posted in the web site of the course. Homework will be given regularly and due one week later. Homework, projects and exams require the use of MATLAB/Octave scripts.

Grades

Midterm exam	25 %
Project	25 %
Final exam	25 %
Assignments (Homework and post-lab reports)	25 %
Total	100 %

Grading Percentage Breakdown

90% and above	A
89% - 85%	A-
84% - 82%	B+
81% - 79%	B
78% - 75%	B-
74% - 72%	C+
71% - 69%	C
68% - 65%	C-
64% - 62%	D+
61% - 59%	D
58% - 55%	D-
below 55%	F

University Policies

Academic integrity

Students should know that the University's [Academic Integrity Policy is available at http://www.sa.sjsu.edu/download/judicial_affairs/Academic_Integrity_Policy_S07-2.pdf](http://www.sa.sjsu.edu/download/judicial_affairs/Academic_Integrity_Policy_S07-2.pdf). Your own commitment to learning, as evidenced by your enrollment at San Jose State University and the University's integrity policy, require you to be honest in all your academic course work. Faculty members are required to report all infractions to the office of Student Conduct and Ethical Development. The website for [Student Conduct and Ethical Development is available at http://www.sa.sjsu.edu/judicial_affairs/index.html](http://www.sa.sjsu.edu/judicial_affairs/index.html).

Instances of academic dishonesty will not be tolerated. Cheating on exams or plagiarism (presenting the work of another as your own, or the use of another person's ideas without giving proper credit) will result in a failing grade and sanctions by the University. For this class, all assignments are to be completed by the individual student unless otherwise specified. If you would like to include in your assignment any material you have submitted, or plan to submit for another class, please note that SJSU's Academic Policy F06-1 requires approval of instructors.

Campus Policy in Compliance with the American Disabilities Act

If you need course adaptations or accommodations because of a disability, or if you need to make special arrangements in case the building must be evacuated, please make an appointment with me as soon as possible, or see me during office hours. Presidential Directive 97-03 requires that students with disabilities requesting accommodations must register with the DRC (Disability Resource Center) to establish a record of their disability.

EE Department Honor Code

The Electrical Engineering Department will enforce the following Honor Code that must be read and accepted by all students.

“I have read the Honor Code and agree with its provisions. My continued enrollment in this course constitutes full acceptance of this code. I will NOT:

- Take an exam in place of someone else, or have someone take an exam in my place
- Give information or receive information from another person during an exam
- Use more reference material during an exam than is allowed by the instructor
- Obtain a copy of an exam prior to the time it is given
- Alter an exam after it has been graded and then return it to the instructor for re-grading
- Leave the exam room without returning the exam to the instructor.”

Measures Dealing with Occurrences of Cheating

- Department policy mandates that the student or students involved in cheating will receive an “F” on that evaluation instrument (paper, exam, project, homework, etc.) and will be reported to the Department and the University.
- A student’s second offense in any course will result in a Department recommendation of suspension from the University.

EE 265 / Hands-On Wireless Communications Using Software Defined Radios, Fall 2017, Course Schedule

(Subject to change with fair notice)

Week	Topics, Readings, Assignments, Deadlines
1	Introduction. Review of signals and linear systems
2	Random processes, lowpass and bandpass representation Homework # 1
3	Frequency shifting and amplitude modulation (AM) transmission and reception
4	Frequency modulation (FM) transmission and reception Homework # 2
5	Analog-to-digital conversion
6	Digital-to-analog conversion Homework # 3
7	Baseband digital transmission
8	Baseband digital transmission Homework # 4
9	Wireless digital transmission
10	Wireless channel modeling Homework # 5
11	Wireless channel modeling
12	Midterm Exam. Project assigned
13	Synchronization and channel estimation Homework # 6
14	Equalization, RAKE receiver and OFDM
15	Wireless standards and applications
Final Exam	Tuesday 12/19 14:45-17:00 Project report and presentation due

- 1) At least four of the lectures will be held in the RF Communications Laboratory located in room 238 (second floor) of the Engineering building. The dates will be announced in advance in class and posted in the webpage. There will be post-lab assignments and therefore ALL students are REQUIRED to attend the lectures held in the laboratory.
- 2) I may attend a conference and/or give a presentation out of town this semester, there will be either extra time in the lectures or a make-up lecture whose date/time will be announced in advance.

