San José State University
Department of Electrical Engineering
EE 160, Principles of Communication Systems,
Fall 2017

Instructor:	Robert Morelos-Zaragoza
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Office Hours:	TR 15:00 – 16:00
Class Days/Time:	TR 16:30 – 17:20
Classroom:	ENG345
Prerequisite:	EE 112/110

Course Description

Introduction to communication systems. Harmonics for analysis of amplifiers and amplitude modulators. Sampling and its applications to frequency shifting. Communication receiver architectures: Direct-conversion and heterodyne. Amplitude modulators and demodulators. Basic binary modulation techniques.

Course Goals and Student Learning Objectives

This course provides an introduction to communication systems. The course begins with a review of sinusoidal signals and Fourier analysis. Fourier series and harmonics are applied to understanding specifications of practical amplifiers, such as third intercept point (IP3). The sampling theorem is introduced with applications in the frequency shifting of signals. This is followed by an analysis of analog modulation (AM) techniques, including spectral density and correlation and signal-to-noise ratios. Binary communication systems are, including on-off keying, amplitude-shift keying and frequency-shift keying. The course ends with an analysis of the performance of binary modulation techniques in communication systems.

GE/SJSU Studies Learning Outcomes (LO)

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 Understand methods of analog and digital modulation (a,c)
LO4 Specify and compare components of analog and digital communication systems (c)
LO5 Perform laboratory based operational and measurement criteria for analog and digital communication systems in both time and frequency domains (b)
LO6 Describe baseband and passband signals and explain their associated system implementation (hardware) consequences (c)
LO7 Demonstrate the process of spectral translation (downconversion and upconversion) via narrowband signal analysis and filtering (a)
LO8 Analyze the power spectral density properties of signals in the presence of noise (a)
LO9 Analyze filtering mechanisms (e.g., low-pass, bandpass, matched, correlation) and their impact on the performance of a communication system (c)
LO10 Understand the complexity interplay in communications systems in terms of circuit and component requirements (c)
LO11 Interpret and report on computer-based performance predictions of analog and digital (binary) modulation systems (k)
LO12 Understand the impact of noise on communication system performance (c)

ABET outcomes

The letters in parentheses in each of the course learning outcomes above refer to ABET (Accreditation Board for Engineering and Technology) criterion 3 outcomes satisfied. These are listed below as a reference:

(a) An ability to apply knowledge of mathematics, science, and engineering
(b) An ability to design and conduct experiments, as well as to analyze and interpret data
(c) An ability to design a system, component, or process to meet desired needs
(d) An ability to function on multi-disciplinary teams
(e) An ability to identify, formulate, and solve engineering problems
(f) An understanding of professional and ethical responsibility
(g) An ability to communicate effectively
(h) The broad education necessary to understand the impact of engineering solutions in a global and societal context
(i) A recognition of the need for, and an ability to engage in life-long learning
(j) A knowledge of contemporary issues
(k) An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

Required Texts/Readings

Textbook

Proakis and Salehi, *Fundamentals of Communication Systems*, Prentice Hall, 2005. (This is the same textbook in EE161.)

Other readings (optional)

Proakis, Salehi and Bauch, *Contemporary Communication Systems Using Matlab*, 2nd ed., Brooks Cole, 2002.
Stern and Mahmoud, *Communication Systems*, Prentice Hall, 2004.
Sklar, *Digital Communications: Fundamentals and Applications*, 2nd Ed., Prentice Hall, 2001.

Other material

Handouts either posted in the web page or distributed in class.

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. The instructor may need to attend international conferences and symposia. The dates shall be announced on the first day of class and either makeup lectures will be announced or another instructor will deliver the lectures.

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. Information about late drop is available at 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 two midterm exams and a final exam. Exams cover the assigned reading materials and class lecture notes. All exams are open book and notes. There will be no make-up exams (only in very special circumstances, both written excuse and official proofs are required for extraordinary exams). Exam solutions will be discussed in class after the exam dates and posted in the web site of the course. Homework will be given as follows. Some homework problems require the use of a computer to perform simulations.

Assignment	Topic(s)	Learning Objectives
1	Nonlinearities and harmonics	LO3, LO4
2	Fourier series	LO5
3	Fourier transform	LO5
4	Sampling process	LO5, LO6, LO7
5	Amplitude modulation	LO6, LO7, LO10
6	Binary line coding	LO4, LO10, LO11
7	Binary transmission	LO4, LO10, LO11, LO12
8	BPSK and BFSK modulations	LO11, LO12

Grades

Assignments	20%
Exam 1	10%
Exam 2	10%
Final exam	25%
Laboratory	35%
Total	100%

Grading Percentage Breakdown

97% and above	A+
94% - 97%	A
93% - 90%	A-
89% - 87%	B+
86% - 84%	B
83% - 80%	B-
79% - 77%	C+
76% - 74%	C
73% - 70%	C-
69% - 67%	D+
66% - 64%	D
63% - 60%	D-
below 60%	F

University Policies

Academic integrity

Students should know that the University's Academic Integrity Policy is availabe at 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.

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.*

Course Schedule **(Subject to change with fair notice as announced by the instructor in class)**

Week	Topics
1	Introduction. Sinusoidal signals and LTI systems. Nonlinearities and harmonics – part I
2	Nonlinearities and harmonics – part II
3	Fourier series
4	Fourier transform
5	Sampling theorem and applications
6	Review and **Midterm exam 1**
7	Amplitude modulation (AM) – part I
8	Amplitude modulation (AM) – part II
9	Spectral density and correlation
10	Signal to noise ratios in AM systems
11	Pulse sequences and spectral shaping
12	Review and **Midterm exam 2**
13	Binary modulation I: ASK and OOK
14	Binary modulation II: FSK
15	Error performance of binary communication systems
	Final Exam, Wednesday, December 13, 14:45-17:00