

San José State University
Electrical Engineering Department
EE 260, RFID Systems, Spring 2016

Instructor:	Robert H. Morelos-Zaragoza
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Office Hours:	TR 15:00-16:30 or by appointment (email)
Class Days/Time:	MW 19:30-20:45
Classroom:	Clark 234
Prerequisites:	EE 251, equivalent, or instructor's approval

Course Description

This course gives an introduction to radio-frequency identification (RFID) systems. Emphasis is on RFID technology applications in biomedical devices, object tracking and identification. Complemented with practical laboratory experiments. A final project (written report and oral presentation) covers RFID applications in a topic of interest to the student.

Course Goals and Student Learning Objectives

This course provides an introduction to the theory and practice of RFID systems. The first part is an overview of different automatic identification systems, including optical (barcodes), contact based (smart cards and memory cards) and contactless RFID systems. This is then followed by an analysis of the components of an RFID system. The course continues with a detailed discussion of different coupling methods. Important spectrum shaping techniques are also included. Digital modulation and error control coding techniques are then analyzed in the context of RFID systems. Finally, interference issues and applications of RFID technology are covered. The course is complemented with research papers and Matlab™ models. Moreover, using physical RFID tags and readers, laboratory experiments are conducted during class time.

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 Understand the basic components and applications of RFID systems

- LO4 Describe radio spectrum allocation and frequency ranges of RFID systems
- LO5 Specify laboratory-based operational and measurement criteria for RFID systems
- LO6 Analyze and characterize RFID reader architectures
- LO7 Analyze modulation techniques used in RFID systems
- LO8 Apply basic concepts of error correcting coding techniques in RFID systems
- LO9 Understand and analyze theoretical and practical effects of tag interference and inter-reader interference in RFID systems and basic anti-collision procedures
- LO10 Understand basic data security techniques for RFID systems

Recommended Texts/Readings

Recommended (not required)

Finkenzeller, *RFID Handbook: Fundamentals and Applications*, 2nd Ed., Wiley, 2003.

Reference books

Curty, Declercq, Dehollain and Joehl, *Design and Optimization of passive UHF RFID Systems*, Springer, 2007.

V.D. Daniel, A. Puglia and M. Puglia, *RFID: A Guide to Radio Frequency Identification*, Wiley, 2007

Thornton and Lathem, *RFID Security*, Syngress, 2006.

Other material

Handouts and papers 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.

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 are two midterm exams and a final presentation. The midterms exams are taken home. Exams cover the assigned reading materials and class lecture notes. There will be absolutely 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. Some homework problems require the use of a computer to perform simulations of the algorithms covered in class.

Grades

Homework/Lab reports	15%
Midterm Exam 1	20%
Midterm Exam 2	20%
Final project (oral and written)	45%
Total	100%

Grading Percentage Breakdown

90% and above	A
80% - 89%	B
70% - 79%	C
60% - 69%	D
below 60%	F

EE260: RFID Systems – Spring 2016 –Course Schedule

Week	Topics
1	Introduction to RFID systems
2	Classification of RFID systems
3	RFID reader architectures – part 1
4	RFID reader architectures – part 2
5	Digital modulation formats used in NFC systems – part 1 Laboratory experiment # 1: Tag interrogation zone and range
6	Digital modulation formats used in NFC systems – part 2. Midterm exam 1
7	Digital modulation formats used in RFID systems – part 1
8	Digital modulation formats used in RFID systems – part 2 Laboratory experiment # 2: Interference between tags and environment
9	Error control coding techniques in RFID systems
10	Reader interference and tag anti-collision techniques Laboratory experiment # 3: Digital modulation formats
11	Data security techniques in RFID systems – part 1 Laboratory experiment # 4: Inter-reader interference and tag programming
12	Data security techniques in RFID systems – part 2. Midterm exam 2
13	Applications of RFID – part 1 (Bioengineering)
14	Applications of RFID – part 2 (Object Tracking and Identification)
15	Final project – Presentations (20 min. ea.) and reports are due on the date of the final exam: Wednesday May 18 19:45 – 22:00

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.