San José State University
Charles W. Davidson College of Engineering
Department of Electrical Engineering
EE286 – Mobile and Wireless Networking (Fall 2018)

Course and Contact Information

Instructor:	Prof. Pedro E. Santacruz
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Office Hours:	Tuesday & Thursday, 4:00pm – 5:30pm
Class Days/Time:	Tuesday & Thursday, 6:00pm – 7:15pm
Classroom:	Boccardo Business Center, Room 204
Prerequisites:	Graduate standing, EE250 and EE281

Course Information and Materials

Course materials such as syllabus, handouts, notes, assignment instructions, etc. can be found on the Canvas learning management system course website. Students are responsible for regularly checking with the messaging system through Canvas and email to learn of any updates.

Course Description

This course covers networking topics with specific focus on mobile and wireless scenarios and applications. The main objective of this course is to provide understanding of a wide range of current and next-generation wireless networking protocols and technologies. The course focuses on the most widely used mobile and wireless network standards including cellular (LTE), Wi-Fi, Bluetooth, etc. During the course, students will understand the specific mechanisms of different network architectures and develop tools to analyze their performance. Finally, since wireless and mobile networking is a dynamic and changing field, the course will provide an introduction to upcoming technologies for the mobile and wireless scenarios, including 5G cellular, Fog Networks, and the Internet of Things.

Course Learning Outcomes

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

1. CLO 1 – Understand the structure of current 4G cellular networks (including LTE) and the requirements of 5G cellular networks

2. CLO 2 - Understand the infrastructure and requirements of Mobile IP and Mobile IPv6

3. CLO 3 – Analyze the performance of IEEE 802.11 Wi-Fi with an in-depth look at the distributed coordination function (DCF) and carrier sense multiple access with collision avoidance (CSMA/CA)

4. CLO 4 – Learn the basic foundations of wide variety of common wireless networking standards including: Bluetooth, WiMAX (IEEE 802.16), and ZigBee (IEEE 802.15.4)

5. CLO 5 – Analyze routing and scheduling in wireless mesh networks (WMN)

6. CLO 6 – Develop and implement distributed algorithms and protocols in the context ad hoc wireless sensor networks

7. CLO 7 – Describe modern network architecture paradigms, e.g., Fog Networks and the Internet of Things

Required Texts/Readings

Required Textbook/Readings

- EE286 Lecture notes, available on Canvas. (No required textbook)
- NS-3 Tutorial and Manuals
- List of required papers on Canvas

Other Readings

- *Computer and Communication Networks* by Nader F. Mir, 2nd Edition, Pearson Prentice-Hall, 2015
- *Wireless Networking Complete* by Zheng et al., Morgan Kaufmann Publishers, 2010
- Fog Networks website: www.fognetworks.org

Lectures

The course will follow the selected subjects as listed on the course description. Additional theory and examples will be given and discussed in class as much as time permits.

Important Note: Attendance is expected. Whether you come to class or not, you are responsible for keeping up with what happens in class. If you miss a class (other than for illness or an emergency), it is not reasonable for you to expect me to repeat the material that was covered in the class that you missed just for you. This applies both to the content of the class as well as to announcements about class policies, events, deadlines, etc. Please note that lecture materials are NOT solely based on the required text and so students are responsible for knowing the contents of lectures in order to prepare themselves for the exams. Students can expect a lower letter grade if they miss too many lectures.

Success in this course is based on the expectation that students will spend, for each unit of credit, a minimum of 45 hours over the length of the course (normally three hours per unit per week) for instruction, preparation/studying, or course related activities, including but not limited to internships, labs, and clinical practica. Other course structures will have equivalent workload expectations as described in the syllabus.

Homework Assignments

Five homework assignments will be given with due dates as shown on the syllabus. Homework must be submitted in class and solutions will be available after the due date.
- Do NOT submit HW via email. Submit HWs in class as hard-copies (paper) only
- Late submission will NOT be accepted (absolutely!)
- There are no make-up homework assignments

To get credit for your homework, submissions must be neat, clean, and must be done professionally. Your official name, course #, and homework # must be visibly shown on each assignment. You are expected to prepare

homework assignments individually. You may discuss the problem and general concepts with other students, but there should be no sharing of answers. A good rule to follow is that you should be working alone when preparing the document you will be submitting.

Exams and Projects

There will be <u>one midterm exam, a comprehensive final exam, and two projects with reports</u>. The exam and project due dates are listed on the course schedule section of this syllabus. Since make-up exams will NOT be allowed, <u>please make sure that you are able to attend all exams at the indicated scheduled dates and times</u> (from the beginning of the semester) in order to register for the course.

- All exams are closed-book exams.
- One sheet (double-side) of hand-written notes is allowed for the midterm exam and two sheets of hand-written notes are allowed for the final exam.
- Exam questions will NOT be interpreted during the exam.
- There will be <u>no make-up exams</u> (in very special circumstances, written excuse and official proofs are required for making-up exams).
- Exam solutions will be discussed in class after the exam dates. Written solutions will NOT be distributed.

Grading Policy

The overall course grades (letter-grades) will be assigned based on the grading standard as shown below. The weights of the whole course work assignments are:

- Homework assignments: 15%
- Two projects with reports (10% each):   20%
- A closed-book midterm exam: 30%
- A closed-book comprehensive final exam: 35%

And the overall course grade (letter-grade) will be assigned based on the distribution below:

Percentage Grade	Letter Grade
94 or above	A
90 – 93	A-
87 – 90	B+
84 – 86	B
80 – 83	B-
77 – 79	C+
74 – 76	C
70 – 73	C-
67 – 69	D+
64 – 66	D
60 – 63	D-
Below 60	F

Classroom Protocol

SJSU classes are designed such that in order to be successful, it is expected that students will spend a minimum of forty-five hours for each unit of credit (normally three hours per unit per week), including preparing for class, participating in course activities, completing assignments, and so on.

EE289 students understand that professional attitude is necessary to maintain a comfortable academic environment in the classroom. Some examples include:

- Students will put their cell phones in quiet/vibration mode during the lecture
- Office hours are strictly for questions and clarification, not for the instructor to summarize lecture for students that have missed class
- Students should come to the class on time and leave the class at the end of lecture to minimize distractions
- Students will consult the course syllabus for class policies and requirements before requesting the instructor for any special considerations and/or exceptions
- To minimize possible tension during the exams, students are requested to follow the exam rules closely
- Email correspondence should be conducted in a professional manner

University Policies

General Expectations, Rights and Responsibilities of the Student

As members of the academic community, students accept both the rights and responsibilities incumbent upon all members of the institution. Students are encouraged to familiarize themselves with SJSU's policies and practices pertaining to the procedures to follow if and when questions or concerns about a class arises. See University Policy S90–5 at http://www.sjsu.edu/senate/docs/S90-5.pdf. More detailed information on a variety of related topics is available in the SJSU catalog, at http://info.sjsu.edu/web-dbgen/narr/catalog/rec-12234.12506.html. In general, it is recommended that students begin by seeking clarification or discussing concerns with their instructor. If such conversation is not possible, or if it does not serve to address the issue, it is recommended that the student contact the Department Chair as a next step.

Dropping and Adding

Students are responsible for understanding the policies and procedures about add/drop, grade forgiveness, etc. Refer to the current semester's Catalog Policies section at http://info.sjsu.edu/static/catalog/policies.html. Add/drop deadlines can be found on the current academic year calendars document on the Academic Calendars webpage at http://www.sjsu.edu/provost/services/academic_calendars/. The Late Drop Policy is available at http://www.sjsu.edu/aars/policies/latedrops/policy/. Students should be aware of the current deadlines and penalties for dropping classes.

Information about the latest changes and news is available at the Advising Hub at http://www.sjsu.edu/advising/.

Consent for Recording of Class and Public Sharing of Instructor Material

University Policy S12-7, http://www.sjsu.edu/senate/docs/S12-7.pdf, requires students to obtain instructor's permission to record the course:

- Common courtesy and professional behavior dictate that you notify someone when you are recording him/her. You must obtain the instructor's permission to make audio or video recordings in this class. Such permission allows the recordings to be used for your private, study purposes only. The recordings are the intellectual property of the instructor; you have not been given any rights to reproduce or distribute the material.
- Course material developed by the instructor is the intellectual property of the instructor and cannot be shared publicly without his/her approval. You may not publicly share or upload instructor generated material for this course such as exam questions, lecture notes, or homework solutions without instructor consent.

Academic integrity

Your commitment, as a student, to learning is evidenced by your enrollment at San Jose State University. The [University Academic Integrity Policy S07-2](http://www.sjsu.edu/senate/docs/S07-2.pdf) at http://www.sjsu.edu/senate/docs/S07-2.pdf requires 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 [Student Conduct and Ethical Development website](http://www.sjsu.edu/studentconduct/) is available at http://www.sjsu.edu/studentconduct/.

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](http://www.sjsu.edu/president/docs/directives/PD_1997-03.pdf) at http://www.sjsu.edu/president/docs/directives/PD_1997-03.pdf requires that students with disabilities requesting accommodations must register with the [Accessible Education Center](http://www.sjsu.edu/aec) (AEC) at http://www.sjsu.edu/aec to establish a record of their disability.

EE Honor Code – Honesty and Respect for Others and Public Property

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*
- *Copy project information from others*
- *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.

Schedule is subject to change with fair notice by class announcement

Course Schedule

Week	Date	Topics, Readings, Assignments, Deadlines
1	08/21/2018	Course syllabus, information, and overview
1	08/23/2018	Course Introduction
2	08/28/2018	Cellular Networks: Overview, 3G, 4G
2	08/30/2018	Cellular Networks: LTE Last day to drop (08/31/2018)
3	09/04/2018	Cellular Networks: LTE
3	09/06/2018	Cellular Networks: Mobile IP, 5G Requirements Last day to add and register late (09/10/2018)
4	09/11/2018	802.11 Wi-Fi: Overview, collision model HW #1 Due
4	09/13/2018	802.11 Wi-Fi: DCF, CSMA/CA
5	09/18/2018	802.11 Wi-Fi: DCF, CSMA/CA
5	09/20/2018	802.11 Wi-Fi: Capacity analysis
6	09/25/2018	Other Wireless Networks: Bluetooth HW #2 Due
6	09/27/2018	Other Wireless Networks: ZigBee
7	10/02/2018	Other Wireless Networks: ZigBee continued
7	10/04/2018	Proximity and P2P: BLE, Wi-Fi Direct, LTE Direct, BLE, iBeacon
8	10/09/2018	Midterm Exam Review HW #3 Due
8	10/11/2018	Mesh Networks: Overview Project #1 Due
9	10/16/2018	Mesh Networks: Topology
9	10/18/2018	Midterm Exam (in Class)
10	10/23/2018	Mesh Networks: Routing, Scheduling
10	10/25/2018	Wireless Sensor Networks: Coverage
11	10/30/2018	Wireless Sensor Networks: DSDV
11	11/01/2018	Wireless Sensor Networks: DSR
12	11/06/2018	Wireless Sensor Networks: TORA

Week	Date	Topics, Readings, Assignments, Deadlines
		HW #4 Due
12	11/08/2018	Wireless Sensor Networks: TORA continued
13	11/13/2018	Wireless Sensor Networks: AODV
13	11/15/2018	Wireless Sensor Networks: Comparison
14	11/20/2018	Wireless Sensor Networks: Comparison
14	11/22/2018	Thanksgiving Holiday – NO CLASS
15	11/27/2018	Internet of Things: Intro and Applications HW #5 Due
15	11/29/2018	Internet of Things: FOG Networks
16	12/04/2018	Internet of Things: FOG Networks
16	12/06/2018	Final EXAM Review Project #2 Due
Final Exam	12/13/2018	Final EXAM (Thursday, December 13, 2018, 1715 - 1930)