

San José State University
Charles W. Davidson College of Engineering
Electrical Engineering Department
EE174-01 Analog Peripheral for Embedded Systems, Fall 2021

Course and Contact Information

Instructor(s):	Tan Van Nguyen
Office Location:	Engineering Building, Room 261
Telephone:	(408) 230-8813
Email:	tan.v.nguyen@sjsu.edu
Office Hours (Online):	MW 15:30-16:30 and after class or by appointment
Class Days/Time:	MW 17:45-19:00
Classroom:	Clark Building 324
Prerequisites:	EE110 and EE112 with grade of C- or better
Lab Room:	ENG 244 (If needed)

Course Format

- In person.
- Students are required to have an electronic device (laptop, desktop or tablet).

Student Study Spaces for Fall 2021 – Learn Anywhere

A [Study Resources](#) page has been added to the **Campus Resources tab** on the [Learn Anywhere](#) site to help students find these spaces. The rooms are available August 19 through December 6, 2021. No reservations are required. The students can just go to the room, set themselves up, and start working.

Faculty Web Page and MYSJSU Messaging

Course materials such as syllabus, handouts, notes, assignment instructions, etc. can be found on my faculty web page at <http://www.sjsu.edu/people/tan.v.nguyen/courses> and/or on [Canvas Learning Management System course login website](#) at <http://sjsu.instructure.com>. You are responsible for regularly checking with the messaging system through [MySJSU on Spartan App Portal](#) <http://one.sjsu.edu> (or other communication system as indicated by the instructor) to learn of any updates.

Course Description

Introduction to analog peripherals for embedded systems such as Op-Amps, Data Conversion ADC/DAC, Linear and Switching DC-DC Converters, Energy Harvesting and systems, Radio Frequency Identification (RF-ID) and Near Field Communication (NFC), Phase-locked Loop (PLL), clock generators, Touch screen technology and displays. Industry based projects and applications are integral to the course.

Course Goals

This course introduces analog peripherals for embedded systems. In an embedded system on top of a general purpose microcontroller or DSP processor, there are other components to talk to the outside world. These components, peripherals, are such as Data converters, DC-DC Converters, Energy harvesting, solar cells, near field communication (NFC), RF-IDs, phase lock loops and clock generators, displays and touch screens. The course aims to establish an environment to expose students to other important block in embedded system architecture. This platform will be based on technical discussion, and lab experiences. The goal is students gain technical expertise to design and develop peripherals system in conjunction with an embedded system.

Course Learning Outcomes (CLO)

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

1. Demonstrate an understanding of the fundamentals of Electrical Engineering, including its mathematical and scientific principles, analysis and design.
2. Demonstrate the ability to apply the practice of Engineering in real-world problems.

Departmental Course Learning Outcomes

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

CLO 1 – Understand thoroughly Op-amp specifications, its applications and different types of comparators.
Lab: Design Op-Amp circuits.

CLO 2 – Understand the concept, the challenges of the Data conversion and associated performance metrics such as INL, DNL, ENOB, SNDR. Lab: Design and ADC/DAC circuits.

CLO 3 – Understand different architectures of linear, switching DC to DC convertor and associated performance metrics such as efficiency, loading. Lab: Design DC-DC converter circuits.

CLO 4 – Understand the different techniques and methods for energy harvesting in an embedded system.
Lab: Design harvesting circuit.

CLO 5 – Understand a short range communication using standard protocols such as NFC and RFID.
Lab: Exercise NFC tags with R/W applications.

CLO 6 – Understand phase-locked loop concept, clock generator and understand the phase locking concepts and associated performance metrics such as jitter, eye-opening, skew, phase noise. Lab: Design PLL circuits.

CLO 7 – Understand touch screen technology, image sensing and displays system using an embedded system.

Required Texts/Readings

Textbook

Instructor notes and handouts.

Other Readings

Different white papers, hardware and software tools by vendors.

Course Requirements and Assignments

Labs and Projects

There are six labs and one project for this course. Project is mainly based on designing an embedded system application, using studied analog peripherals such as Op-Amp, ADC-DAC, DC-DC converters, PLL, NFC. For the final project, each lab group (maximum 3 students) must write a formal project report using a Microsoft Office word processor and demonstrate the project in class.

Quizzes and Reports

There are several quizzes/reports for this course. There will be no make-up quizzes and those absent will receive no credit. Students must write their answers clearly in an organized fashion. All in-class quizzes are open-book and notes. Further instructions if any will be provided during quizzes.

Exams and Final Project

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

- There will be no make-up exams (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:

Exam 1	15%
Exam 2	15%
Quizzes/Reports	15%
Labs	20%
Design Project	10%
Final Exam	25%

Grading Information

Determination of Grades

- This course must be passed with a C- or better as CSU graduation requirement.
- Grading percentage breakdown as follow

<i>Grade</i>	<i>Percentage</i>
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<i>A plus</i>	<i>97 and above</i>
<i>A</i>	<i>94 to 96.9%</i>
<i>A minus</i>	<i>90 to 93.9%</i>
<i>B plus</i>	<i>87 to 89.9 %</i>
<i>B</i>	<i>84 to 86.9%</i>
<i>B minus</i>	<i>80 to 83.9%</i>
<i>C plus</i>	<i>77 to 79.9%</i>
<i>C</i>	<i>74 to 76.9%</i>
<i>C minus</i>	<i>70 to 73.9%</i>
<i>D plus</i>	<i>67 to 69.9%</i>
<i>D</i>	<i>64 to 66.9%</i>
<i>D minus</i>	<i>60 to 63.9%</i>
<i>F</i>	<i>Below 60%</i>

Classroom Protocol

Important Note: Attendance is expected. Students can expect a lower letter grade if they miss too many lectures. Arrive on time, no food in class or lab, turn off cell phone, NO private discussion in class. EE174 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

1. 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](http://www.sjsu.edu/advising/) at <http://www.sjsu.edu/advising/>.

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*
- *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.*

EE174: Analog Peripheral for Embedded Systems, Fall 2021 Tentative Course Schedule

Subject to change with fair notice as announced by the instructor in class.

Week	Date	Topics, Readings, Assignments, Deadlines
1	08/23	Introduction to Analog Peripheral for Embedded Systems

Week	Date	Topics, Readings, Assignments, Deadlines
1	08/25	Op-Amp: Introduction
2	08/30	Op-Amp: Gain, Offset, Comparator, Schmitt trigger
2	09/01	Op-Amp: Applications
3	09/06	No Class - Labor Day
3	09/08	Experimental Lab on Op-Amp
4	09/13	Data Conversion: Sampling, Quantization
4	09/15	Data Conversion: Performance Metrics (ENOB, INL, DNL)
5	09/20	Data Conversion: ADC Architectures and DAC Signal Reconstructions
5	09/22	Data Conversion: Experimental Lab on ADC
6	09/27	DC-DC Conversion: Introduction, Concept, Linear Regulators
6	09/29	DC-DC Conversion: Concept, Switching Regulator
7	10/04	DC-DC Conversion: Efficiency and Loading
7	10/06	Midterm 1
8	10/11	DC-DC Conversion: Experimental Lab
8	10/13	Energy Harvesting: Introduction, Basic Concepts
9	10/18	Energy Harvesting: Energy Storage, Solar Cells
9	10/20	Energy Harvesting: Experimental Lab
10	10/25	Short Range Communications: Concepts and Needs
10	10/27	Short Range Communications: RF-ID, NFC, IEEE Standards on NFC
11	11/01	Short Range Communications: Experimental Lab
11	11/03	Phase Locking: Introduction to PLL
12	11/08	Phase Locking: Synthesizer and Clock Generators (Crystal)
12	11/10	Phase Locking: Clock and Data Recovery – Final Project Submit for Approval
13	11/15	Phase Locking: Performance Metrics (Jitter, Skew, eye-diagram opening, ...)
13	11/17	Midterm 2
14	11/22	Phase Locking: Experimental Lab
14	11/24	No Class – Thanksgivings
15	11/29	Display & Touch Screen: Image Sensors: LCD Display, Touch Sensor, Touch
15	12/01	Display and Touch Screen: Image Sensors (CCD/CMOS) - Project Demo and presentation
16	12/06	Project Demo and Presentation
16	12/08	Final Exam (2 hours 15 minutes) 17:15-19:30

Additional Rules for Fall 2021 EE Laboratories

Code of conduct while in labs on campus

- Students attending in-person labs are required to wear face coverings, regularly sanitize/wash hands, and maintain 6 feet (about 2 arms' length) distance between each other at all times while in the building. Check SJSU Health Advisories website for updated information about university requirements and rules <https://www.sjsu.edu/healthadvisories/>
- Students need to check with the lab instructor about the process to get on campus.
- Students must only work in designated stations at all times.
- Disposable masks will be provided if forgotten.
- If attending in person lab 2 days in a row, washed/clean cloth masks or new disposable masks must be worn each day.
- Disinfecting wipes are provided in each lab, and students are expected to wipe down their stations before and after each use.
- Students are strongly encouraged to bring a personal mouse or keyboard to avoid using shared devices.
- Please keep in mind drinking fountains are not available, so plan accordingly.