Course and Contact Information

Coordinator: Dr. Hiu Yung Wong
Instructor: Ankita Moholkar
Office Location: Online (Zoom)
Email: ankita.moholkar@sjsu.edu
Office Hours: By Appointment
Lab Day/Time: Thursday, 10:30 AM- 1:15 PM
Lab room: Online (Zoom)
Prerequisites: EE122, and EE128 with grades of C- or better
Knowledge of building the circuit in LTSpice

Course Description

This course teaches the design of fundamental building blocks for analog integrated circuits. It begins with a review of Operational Amplifier Theory, MOSFET models, and basic single-stage amplifiers. We then discuss current mirrors, current sources, and differential pairs with active loads using CMOS transistors. After introducing the concepts of frequency response and high-frequency MOSFET models, frequency responses of various single stage amplifiers are discussed. Miller effect and dominant pole approximation are described to analyze the high-frequency characteristics of the amplifiers. Feedback concept is then introduced and the impact of feedback on four amplifier types are studied. Finally, concept of stability and phase margin is introduced to analyze two-stage operational amplifier circuit. The students will also learn the basics of output-stage design in power amplifiers. The laboratory experiments associated with this course involves building, measuring, and verifying key circuits learned from the class.

Course Format

Technology Intensive and Hybrid Class

The students are expected to have stable internet access to attend the online lectures through Zoom. The students need to have Webcam installed on their computer and be able to use LockDown Browser by Respondus to take quizzes and exam. Their computers should be compatible to install LTspice and ADALM2000 and Scopy to do laboratory exercises. Students should also have microphone and camera installed and able to share their screen so that TA’s can help solve their simulation and circuit problems. Please see the following for more details.
Faculty Web Page and MYSJSU Messaging

Course materials such as syllabus, handouts, notes, assignment instructions, etc. can be found 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 to learn of any updates. For help with using Canvas see Canvas Student Resources page (http://www.sjsu.edu/ecampus/teaching-tools/canvas/student_resources)

Course Goals and Student Learning Objectives:

1. Students will be able to understand the MOSFET small-signal model and analyze the circuit behavior of single stage amplifiers using the small-signal model.

2. Students will be able to understand the concept of gain, bandwidth, frequency response of the single-stage and differential amplifiers.

3. Students will be able to understand the concept of feedback and the advantage of negative feedback.

4. Students will be able to understand the stability of the amplifiers.

5. Students will be able to verify the circuit operation learned from the class in hands-on lab experiments and in circuit simulations.

6. Students will be able to design basic output stage in power amplifier.

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.

ABET Outcomes:

The numbers in parentheses in the course learning objectives refer to ABET criterion outcomes satisfied by the course. These are listed below as a reference:

1. an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics

2. an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors

3. an ability to communicate effectively with a range of audiences

4. an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts

5. an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives

6. an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions

7. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.
Course Learning Outcomes

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

CLO 1. Apply the knowledge of mathematics, science, and engineering in circuit analysis (1)

CLO 2. Analyze and design integrated amplifier circuits to meet desired needs (1)

CLO 3. Identify, formulate, and solve engineering problems in Analog circuit design (1)

CLO 4. Write concise experimental reports to deliver findings and results effectively (3)

CLO 5. Demonstrate to use the techniques, skills, and modern engineering tools necessary for engineering practice (6)

Required Texts/Readings

Textbook


Other technology requirements / equipment / material

Computer/Laptop, Webcam, Speaker, Microphone, Breadboard, Jumper wires, OS compatible with Zoom, LTspice, ADALM2000, Scopy, LockDown Browser by Respondus

Course Requirements and Assignments

Students are expected to attend all classes (online through Zoom) and participate actively in the seminar and lab sessions (CLO5) (through zoom), submit the assignments (CLOs 1-3) and lab reports (CLO4) on time and attend the mid-term and final exams (CLOs 1-3). Assignments and Lab Reports must be submitted on time to receive full credit. Late submission of Assignments and Lab Reports within 3 days after the due date will only receive half of the credits. No credits will be given after the late submission due date.

Review the following policy about your responsibility:

- Office of Graduate and Undergraduate Programs’ Syllabus Information web page at http://www.sjsu.edu/gup/syllabusinfo/

“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.”

Final Examination or Evaluation

Exams maybe open or closed book. If closed book is used, students need to use LockDown Browser by Respondus. Students are allowed to use calculator but no aid sheet is allowed. There will be no make-up exam and those absent will receive no credit. Students must write their answers clearly in an organized fashion. Further instructions will be provided during exams. The course is based on letter grading and grading percentage breakdown is as follow:

Grading Information

Please also see Spring 2021 Special University Grading Policy (https://www.sjsu.edu/registrar/academic-records/grade-changes.php)
Determination of Grades

- Every assignment has equal weight (totally 15% of the final score)
- Every lab has equal weight (totally 25% of the final score). Unless specified, lab report constitutes 50% of the lab score (lab report score) and lab attendance (online or in-person if the student elects to be in-person) constitutes another 50% (lab attendance score). Students must attend at least 2 hours in each lab to receive full lab attendance score. Attending less than 2 hours will receive prorated score (e.g. attending 1 hour will receive 50% of the lab attendance score). Students still get full lab attendance score even they attend less than 2 hours if they can demonstrate to TA they have completed the lab.
- Assignment and lab reports must be submitted on time to receive full credit. Late submission: Half of the credit will be given if submitted within 3 days after the due date. No credit will be given if submitted after late submission due date.

Grading Breakdown:

A = 100 to 93 points
A minus = 92 to 88 points
B plus = 87 to 84 points
B = 83 to 79 points
B minus = 78 to 75 points
C plus = 74 to 72 points
C = 71 to 69 points
C minus = 68 to 65 points
D plus = 64 to 62 points
D = 61 to 59 points
D minus = 58 to 55 points
F = 55 points or lower

Classroom Protocol

Students are required to be in class on time. Students are welcome to ask questions through chat box or interrupting the lecturer. However, students should only discuss issues related to the class.

University Policies

Per University Policy S16-9, university-wide policy information relevant to all courses, such as academic integrity, accommodations, etc. will be available on Office of Graduate and Undergraduate Programs’ Syllabus Information web page at http://www.sjsu.edu/gup/syllabusinfo/”

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.

**Proctoring Software and Exams**

Exams will be proctored in this course through Respondus Monitor and LockDown Browser. Please note it is the instructor’s discretion to determine the method of proctoring. If cheating is suspected the proctored videos may be used for further inspection and may become part of the student’s disciplinary record. Note that the proctoring software does not determine whether academic misconduct occurred, but does determine whether something irregular occurred that may require further investigation. Students are encouraged to contact the instructor if unexpected interruptions (from a parent or roommate, for example) occur during an exam.

**Recording Zoom Classes**

This course or portions of this course (i.e., lectures, discussions, student presentations) will be recorded for instructional or educational purposes. The recordings will only be shared with students enrolled in the class through Canvas. If, however, you would prefer to remain anonymous during these recordings, then please speak with the instructor about possible accommodations (e.g., temporarily turning off identifying information from the Zoom session, including student name and picture, prior to recording).

**Students are not allowed to record without instructor permission**

Students are prohibited from recording class activities (including class lectures, office hours, advising sessions, etc.), distributing class recordings, or posting class recordings. Materials created by the instructor for the course (syllabi, lectures and lecture notes, presentations, etc.) are copyrighted by the instructor. This university policy (S12-7) is in place to protect the privacy of students in the course, as well as to maintain academic integrity through reducing the instances of cheating. Students who record, distribute, or post these materials will be referred to the Student Conduct and Ethical Development office. Unauthorized recording may violate university and state law. It is the responsibility of students that require special accommodations or assistive technology due to a disability to notify the instructor.

**Technology Requirements**

Students are required to have an electronic device (laptop, desktop or tablet) with a camera and built-in microphone and speaker/headphone. SJSU has a free equipment loan program available for students.

Students are responsible for ensuring that they have access to reliable Wi-Fi during tests. If students are unable to have reliable Wi-Fi, they must inform the instructor, as soon as possible

or at the latest one week before the test date to determine an alternative. See Learn Anywhere website for current Wi-Fi options on campus.

**Zoom Classroom Etiquette**

1. Mute Your Microphone: To help keep background noise to a minimum, make sure you mute your microphone when you are not speaking.
2. Be Mindful of Background Noise and Distractions: Find a quiet place to “attend” class, to the greatest extent possible.
3. Avoid video setups where people may be walking behind you, people talking/making noise, etc.
4. Avoid activities that could create additional noise, such as shuffling papers, listening to music in the background, etc.
5. Limit Your Distractions/Avoid Multitasking: You can make it easier to focus on the meeting by turning off notifications, closing or minimizing running apps, and putting your smartphone away (unless you are using it to access Zoom).
6. Use Appropriate Virtual Backgrounds: If using a virtual background, it should be appropriate and professional and should NOT suggest or include content that is objectively offensive or demeaning.

Online Exams
Testing Environment: Setup

1. No earbuds, headphones, or headsets visible.
2. The environment is free of other people besides the student taking the test.
3. If students need scratch paper for the test, they should present the front and back of a blank scratch paper to the camera before the test.
4. No other browser or windows besides Canvas opened.
5. A workplace that is clear of clutter (i.e., reference materials, notes, textbooks, cellphone, tablets, smart watches, monitors, keyboards, gaming consoles, etc.)
6. Well-lit environment. Can see the students’ eyes and their whole face. Avoid having backlight from a window or other light source opposite the camera.
7. Personal calculator is allowed.

Testing Environment: Scan
Before students can access the test questions, they are expected to conduct a scan around their testing environment to verify that there are no materials that would give the student an unfair advantage during the test. The scan will include:
   1. the desk/work-space
   2. a complete view of the computer including USB ports and power cord connections
   3. a 360-degree view of the complete room

Students must:
1. Remain in the testing environment throughout the duration of the test.
2. Keep full face, hands, workspace including desk, keyboard, monitor, and scratch paper, in full view of the webcam

Technical difficulties

Internet connection issues:
Canvas autosaves responses a few times per minute as long as there is an internet connection. If your internet connection is lost, Canvas will warn you but allow you to continue working on your exam. A brief loss of internet connection is unlikely to cause you to lose your work. However, a longer loss of connectivity or weak/unstable connection may jeopardize your exam.

Other technical difficulties:
Immediately email the instructor a current copy of the state of your exam and explain the problem you are facing. Your instructor may not be able to respond immediately or provide technical support. However, the copy of your exam and email will provide a record of the situation.

Contact the SJSU technical support for Canvas:
If possible, complete your exam in the remaining allotted time, offline if necessary. Email your exam to your instructor within the allotted time or soon after.

**Additional Rules for Spring 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/](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.

**Component Pickup Procedure**

- Necessary components and devices will be provided to students by the department.

- Students living within a 60 miles radius from campus will receive a designated time to pick up their components.

- Those living further than 60 miles can have their components and/or devices mailed in which a return label will be included.

- Prior to picking up or mailing, students must fill out the [DocuSign form](https://www.sjsu.edu/healthadvisories/) including the designated receiver’s information.
- If a student would like to designate someone else to pick up on behalf of them, there will be an option on the Docusign.

- In the case components are lost or broken, students must contact the department as soon as possible to avoid an incomplete grade and/or registration hold.

- Students will have to come on campus a second time to pick up the ADALM 2000 should a course requires it. Unfortunately, the shipment for the devices will arrive sometime after school has begun.

Dropping Course after Receiving Components

- Students must return components to the EE department either in person or through mail using the provided return label.

- Components and devices must be in the office by September 8th to avoid an incomplete grade and/or registration hold.

Adding a Course

- If a student has completed a Docusign form for a course, but components have not been picked up/mailed yet, and they choose to add another course, an email can be sent to ee-techsupport-group@sjsu.edu to amend their previous form.

- If a student has their components or devices already, an additional Docusign form will need to be submitted prior to adding a new course.

- If multiple courses need to be added, students need to wait until enrolled before submitting one Docusign for all the courses.

- Please submit these forms prior to September 8th to receive new components or devices.

Returning Components and Devices

- Detailed instructions on returning procedure will be provided to students later in the semester.

- Students need to return components and devices in working condition to avoid an incomplete grade and/or registration hold.

- Course of action will be discussed on a case by case basis for any broken or missing components at the time of return.

- Components and devices need to be returned no later than December 8th.

- Please plan to drop off or mail components at an appropriate time, as those returned past the deadline will not be accepted and will result in an incomplete grade and/or registration hold.
## Laboratory Schedule (tentative)

*Schedule and the content of lab assignments are subject to change with fair notice by email and class announcement.*

<table>
<thead>
<tr>
<th>Week</th>
<th>Date</th>
<th>Lab</th>
<th>Report</th>
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<tbody>
<tr>
<td>1</td>
<td>28-Jan</td>
<td>No Lab</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>4-Feb</td>
<td>Lab 1: SPICE Modeling of OpAmp</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>11-Feb</td>
<td>Lab 1: SPICE Modeling of OpAmp</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>18-Feb</td>
<td>Lab 2: MOS Cascode and Current Mirrors (no lab report)</td>
<td>Report 1 due</td>
</tr>
<tr>
<td>5</td>
<td>25-Feb</td>
<td>Lab 2: MOS Cascode and Current Mirrors (no lab report)</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>4-Mar</td>
<td>Lab 3: Design of Audio Amplifier</td>
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<tr>
<td>7</td>
<td>11-Mar</td>
<td>Lab 3: Design of Audio Amplifier</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>18-Mar</td>
<td>Lab 4: Physical Verification of OpAmp</td>
<td>Report 3 due</td>
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<tr>
<td>9</td>
<td>25-Mar</td>
<td>Lab 4: Physical Verification of OpAmp</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>1-Apr</td>
<td>No Lab</td>
<td>Report 4 due</td>
</tr>
<tr>
<td>11</td>
<td>8-Apr</td>
<td>Lab 5: MOS Current Mirrors (continuation of Lab 2)</td>
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<tr>
<td>12</td>
<td>15-Apr</td>
<td>Lab 6: Differential Pair</td>
<td>Report 5 due</td>
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<tr>
<td>13</td>
<td>22-Apr</td>
<td>Lab 6: Differential Pair</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>29-Apr</td>
<td>Lab 7: High Frequency Modeling</td>
<td>Report 6 due</td>
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<tr>
<td>15</td>
<td>6-May</td>
<td>Lab 7: High Frequency Modeling</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>13-May</td>
<td>No Lab</td>
<td>Report 7 due</td>
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<tr>
<td>17</td>
<td>20-May</td>
<td>No Lab</td>
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