

ECE 584

Analog CMOS Integrated Circuit Design

Spring 2022

<u>Instructor:</u>	Dr. George L. Engel (EB-3043)
<u>Time:</u>	M, W (1:30 PM - 2:45 PM)
<u>Location:</u>	EB-3009
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<u>Office Hours:</u>	M, W 3:00 PM - 4:00 PM and T, R 2:00 - 3:00 pm

Course Description

Course material includes the study of the operating principles of CMOS analog integrated circuits, physics of MOS devices, linearized models of MOSFETs, and circuit design techniques for realizing CMOS operational amplifiers, current references, voltage references, etc.

Grading Policy

Midterm Exam	25 %
Final Exam	25 %
Midterm Project	25 %
Final Project	25 %

Administrative Issues

Based on University Class Attendance Policy 1I9: It is the responsibility of students to ascertain the policies of instructors with regard to absence from class, and to make arrangements satisfactory to instructors with regard to missed course work. Failure to attend the first session of a course may result in the students place in class being assigned to another student.

If you have a documented disability that requires academic accommodations, please go to Disability Support Services (DSS) for coordination of your academic accommodations. DSS

is located in the Student Success Center, Room 1270; you may contact them to make an appointment by calling (618) 650-3726 or sending an email to disabilitysupport@siue.edu. Please visit the DSS website located online at www.siue.edu/dss for more information.

Students are expected to be familiar with and follow the Student Academic Code. It is included in the SIUE Policies and Procedures under Section 3C2.2.

Required Texts

Analog Integrated Circuit Design
John Wiley & Sons
Tony Carusone, David A. Johns, Kenneth W. Martin
ISBN Number: 978-0-470-77010-8

Course Outline

WEEK 1

M Jan 10 MOS Transistors (Sec. 1.2)

W Jan 12 Advanced MOS Modeling (Sec. 1.3)

WEEK 2

M Jan 17 *** NO CLASS - MARTIN LUTHER KING DAY ***

W Jan 19 Passive Devices (Sec. 1.6)

WEEK 3

M Jan 24 Variability and Mismatch (Sec. 2.3)

W Jan 26 Analog Layout Considerations (Sec. 2.4)

WEEK 4

M Jan 31 Simple CMOS Current Mirror (Sec. 3.1)

W Feb 02 Common Source Amplifier (Sec 3.2)

WEEK 5

M Feb 07 Source Follower (Sec. 3.3)

W Feb 09 Common Gate Amplifier (Sec. 3.4)

WEEK 6

M Feb 14 Cascode Current Mirrors (Sec. 3.6)

W Feb 16 Cascode Gain Stage (Sec. 3.7)

WEEK 7

M Feb 21 MOS Differential Pair (Sec. 3.8)

W Feb 23 Frequency Response of Linear Systems (Sec. 4.1)

WEEK 8

M Feb 28 Frequency Response of Elementary Transistor Circuits (Sec. 4.2)

W Mar 02 Midterm Exam (Chapters 1, 2, 3)

WEEK 9

M Mar 07 *** SPRING BREAK ***

W Mar 09 *** SPRING BREAK ***

WEEK 10

M Mar 14 Cascode Gain Stage (Sec. 4.3)

W Mar 16 Source Follower Amplifier (Sec. 4.4)

WEEK 11

M Mar 21 Feedback Amplifiers Review (Chapter 5)

W Mar 23 Two-Stage CMOS Opamp (Sec. 6.1)

WEEK 12

M Mar 28 Two-Stage CMOS Opamp (Sec. 6.1)

W Mar 30 Op-Amp Compensation (Sec. 6.2)

WEEK 13

M Apr 04 Folded Cascode Opamp (Sec 6.4)

W Apr 06 Folded Cascode Opamp (Sec 6.4)

WEEK 14

M Apr 11 Analog Integrated Circuit Biasing (Sec. 7.1)

W Apr 13 Establishing Constant Voltages and Currents (Sec. 7.3)

WEEK 15

M Apr 18 Establishing Constant Voltages and Currents (Sec. 7.3)

W Apr 20 Noise Analysis and Modeling (Chapter 9)

WEEK 16

M Apr 25 Noise Analysis and Modeling (Chapter 9)

W Apr 27 Noise Analysis and Modeling (Chapter 9)

COVID-19 Pandemic Policies Related to Classroom Instruction (Spring 2022)

Health and Safety

The measures outlined below are required and any student who does not comply may be in violation of the *COVID-19 People-Focused Health and Safety Policy*, as well as the University's *Student Code of Conduct*.

The full text of the *COVID-19 People-Focused Health and Safety Policy* can be found here:
<https://www.siu.edu/policies/Covid.shtml>

Classrooms, Labs, Studios, and Other Academic Spaces

Under current University policy, whether in the classroom, lab, studio, or other academic spaces, students (regardless of vaccination status) shall wear face coverings that fully cover the nose and mouth and practice physical distancing measures to the extent practicable based on the specific classroom capacity and pedagogy. Classroom furniture should not be rearranged, and furniture that has been taped off or covered should not be used.

Students who forget to wear a face covering will be reminded of their obligation to comply with SIUE's *COVID-19 People-Focused Health and Safety Policy* and temporarily asked to leave the class until they are able to conform to the policy. Students who forget or lose their face coverings may be able to obtain replacements from a friend, a faculty member, or a nearby departmental office. Face coverings are also available for purchase in the Cougar Store (MUC).

Students who refuse to wear a face covering will be asked to leave the classroom and referred to the Dean of Students for non-compliance with community health and safety protocols. Repeated non-compliance may result in disciplinary actions, including the student being administratively dropped from an on-ground/face-to-face course or courses without refund if no alternative course format is available.

If a student has a documented health condition which makes wearing a face covering medically intolerable, that student should contact ACCESS to explore options with the understanding that ACCESS will not grant accommodations which excuse the need for a face covering while on campus or in the classroom. ACCESS will work with qualifying individuals to find reasonable alternatives, whenever such solutions are available. Please call or contact the ACCESS Office via email to schedule an online appointment to discuss potential alternatives. ACCESS office (Student Success Center, Room 1203, 618-650-3726, and myaccess@siue.edu).

General Health Measures

At all times, students should engage in recommended health and safety measures, which include:

- Conducting a daily health assessment. If you have [COVID-19 symptoms](#), but not yet tested positive, have had COVID-19 close contact exposure, or are COVID-19 diagnosed as presumptive or confirmed positive, contact your health provider or SIUE Health Service at cougarcare@siue.edu or 618-650-2842. More information on reporting procedures is available [here](#).
- Frequent washing or disinfecting of hands.
- Adhere fully to the current face mask and physical distancing rules as articulated in policy: <https://www.siue.edu/about/announcements/coronavirus/safety-guidelines-support/face-mask-pick-up.shtml>
- If present, adhere to directional signs and traffic flow patterns in buildings and offices. In many spaces, doors for entering and exiting buildings are designated.

Academic Integrity

Students are reminded that the expectations and academic standards outlined in the Student Academic Code (3C2) apply to all courses, field experiences and educational experiences at the University, regardless of modality or location. The full text of the policy can be found here: <https://www.siue.edu/policies/3c2.shtml>.

Recordings of Class Content

Faculty recordings of lectures and/or other course materials are meant to facilitate student learning and to help facilitate a student catching up who has missed class due to illness or quarantine. As such, students are reminded that the recording, as well as replicating or sharing of any course content and/or course materials without the express permission of the instructor of record, is not permitted, and may be considered a violation of the University's Student Conduct Code (3C1), linked here: <https://www.siue.edu/policies/3c1.shtml>.

Potential for Changes in Course Schedule or Modality

As the COVID-19 pandemic continues, there remains a possibility that planned classroom activities will need to be adjusted. Depending on circumstances and following state-issued recommendations, potential changes include alterations to distancing requirements, course modality (e.g., transition from face-to-face to online, hybrid, or hy-flex, mask wearing, in-course activities, etc). These changes would be implemented to ensure the successful completion of the course while preserving health and safety. In these cases, students may be provided with an addendum to the class syllabus that will supersede the original version. If the course schedule or modifications significantly alter expectations, a new syllabus will be issued.