EEE5320 Analog IC Design I
(available on EDGE/ONLINE)

Class Periods: M,W,F | (12:50 PM - 1:40 PM)

Location: NEB 0102

Academic Term: Fall 2023

Instructor:
Adam Khalifa
Email: a.khalifa@ufl.edu
Please put EE5320 in the subject of your email for any email correspondence.
Office Hours: Wednesdays 4:00pm-6:00pm
Office location: NEB 527
Zoom link (use during office hours only): https://ufl.zoom.us/my/adamkhalifa

About the instructor:
Adam Khalifa received the B.S. and M.Phil. degrees in electronic and computer engineering from The Hong Kong University of Science and Technology in 2011 and 2013, respectively, and the Ph.D. degree in electrical and computer engineering from Johns Hopkins University, Baltimore, MD, USA, in 2019. As a postdoc fellow, he worked at the Harvard Medical School on novel neural interface technologies. Adam Khalifa is currently an Assistant Professor of Electrical and Computer Engineering at the University of Florida. He is a transdisciplinary innovator in the field of neuroengineering and has been developing neural interfacing technologies since 2010.
https://khalifa.ece.ufl.edu/about/

Teaching Assistant:
Morgan Thomas (HW and Exams)
Email: morganana13@ufl.edu
Office hours: TBD
Location: TBD

Han Wan (Cadence and Labs)
Email: hanwu@ufl.edu
Office hours: TBD
Location: TBD

Pre-Reqs: Electronics Circuits 1 & 2 (or equivalent knowledge of the topic)
**If you have not taken these courses and still would like to enroll, please contact me.

What you need to know before taking this course:
- Basic knowledge of circuits, KVL/KCL, first order systems (RC time constant)
- Basic knowledge of large signal and small signal analysis
- Basics of MOS transistors
- Bode plot and frequency response

Those who want to have a head start: Read the first 2-3 chapters of Razavi's Analog CMOS IC textbook

Course Description: This course explores the fundamentals of analog IC design. Throughout the semester, the students will be introduced to various critical circuits on which the analog IC depends. The state-of-the-art applications will be discussed for each of these circuits, and the past and future challenges and the roadmap of analog IC will be tackled. A cornerstone of this course is its focus on Metal-Oxide-Semiconductor Field-Effect Transistors (MOSFETs). In this course, the students will be introduced to the Cadence platform, an industry-preferred simulation and layout engine, not only to analyze the provided circuits but also to design several commonly used structures. An extensive tutorial on Cadence will be provided to help familiarize the students with this simulation platform.

Course Objectives: The course objective is to provide a thorough background of analog circuits, discuss real-world applications and introduce the student to the IC design challenges.

Main Textbook:
- Title: Design of Analog CMOS Integrated Circuits (2nd edition)
- Author: B. Razavi
- Publisher: McGraw-Hill Education; 2 edition (January 20, 2016)
- https://www.amazon.com/Design-Analog-CMOS-Integrated-Circuits/dp/0072380322/ref=sr_1_1?ie=UTF8&qid=1350343502&sr=8-1&keywords=razavi+analog+design
- 0072380322

Attendance Policy, Class Expectations, and Make-Up Policy

Excused absences must be consistent with university policies in the Graduate Catalog (https://catalog.ufl.edu/graduate/regulations) and require appropriate documentation. Additional information can be found here: https://gradcatalog.ufl.edu/graduate/regulations/

Course Schedule:

Week 1: Intro and MOSFET Basics / Corresponding Book Chapters 1
Week 2: Amplifiers (single-stage) / Corresponding Book Chapters 3

Week 3: Amplifiers (single-stage)/ Corresponding Book Chapters 3
Week 4: Cascode and Current Mirrors / Corresponding Book Chapters 5
Week 5: Current Mirrors / Corresponding Book Chapters 5
Week 6: Differential Circuits / Corresponding Book Chapters 4/ Midterm
Week 7: Differential Circuits / Corresponding Book Chapters 4
Week 8: Frequency Response / Corresponding Book Chapters 6
Week 9: Frequency Response / Corresponding Book Chapters 6
Week 10: Feedback/ Corresponding Book Chapters 8
Week 11: Amplifiers (multi-stage) / Corresponding Book Chapters 9
Week 12: Reference Generator / Corresponding Book Chapters 12
Week 13: Noise/ Corresponding Book Chapters 7/ Project
Week 14: ADC
Week 15: Review / Final Exam

Evaluation of Grades

Assignment	Percentage of Final Grade
Homework Sets (4)	15%
Cadence Assignments (4)	15%
Midterm Exam	20%
Final Exam	30%
Final Project	20%
	100%

You have 1 week to complete the HW. Late HW will not be accepted (exceptions can be made).

Grading Policy

The following is given as an **example** only. It shows the **minimum** grade you can achieve for a certain grade point.

Percent	Grade	Grade Points
93.4 - 100	A	4.00
90.0 - 93.3	A-	3.67
86.7 - 89.9	B+	3.33
83.4 - 86.6	B	3.00
80.0 - 83.3	B-	2.67
76.7 - 79.9	C+	2.33
73.4 - 76.6	C	2.00
70.0 - 73.3	C-	1.67
66.7 - 69.9	D+	1.33
63.4 - 66.6	D	1.00
60.0 - 63.3	D-	0.67
0 - 59.9	E	0.00

More information on UF grading policy may be found at:

UF Graduate Catalog
Grades and Grading Policies

Students Requiring Accommodations

Students with disabilities who experience learning barriers and would like to request academic accommodations should connect with the disability Resource Center by visiting https://disability.ufl.edu/students/get-started/. It is important for students to share their accommodation letter with their instructor and discuss their access needs, as early as possible in the semester.

Course Evaluation

Students are expected to provide professional and respectful feedback on the quality of instruction in this course by completing course evaluations online via GatorEvals. Guidance on how to give feedback in a professional and respectful manner is available at https://gatorevals.aa.ufl.edu/students/. Students will be notified when the evaluation period opens, and can complete evaluations through the email they receive from GatorEvals, in their Canvas course menu under GatorEvals, or via https://ufl.bluera.com/ufl/. Summaries of course evaluation results are available to students at https://gatorevals.aa.ufl.edu/public-results/.

In-Class Recording

Students are allowed to record video or audio of class lectures. However, the purposes for which these recordings may be used are strictly controlled. The only allowable purposes are (1) for personal educational use, (2) in connection with a complaint to the university, or (3) as evidence in, or in preparation for, a criminal or civil proceeding. All other purposes are prohibited. Specifically, students may not publish recorded lectures without the written consent of the instructor.

A "class lecture" is an educational presentation intended to inform or teach enrolled students about a particular subject, including any instructor-led discussions that form part of the presentation, and delivered by any instructor hired or appointed by the University, or by a guest instructor, as part of a University of Florida course. A class lecture does not include lab sessions, student presentations, clinical presentations such as patient history, academic exercises involving solely student participation, assessments (quizzes, tests, exams), field trips, private conversations between students in the class or between a student and the faculty or lecturer during a class session.

Publication without permission of the instructor is prohibited. To "publish" means to share, transmit, circulate, distribute, or provide access to a recording, regardless of format or medium, to another person (or persons), including but not limited to another student within the same class section. Additionally, a recording, or transcript of a recording, is considered published if it is posted on or uploaded to, in whole or in part, any media platform, including but not limited to social media, book, magazine, newspaper, leaflet, or third party note/tutoring services. A student who publishes a recording without written consent may be subject to a civil cause of action instituted by a person injured by the

publication and/or discipline under UF Regulation 4.040 Student Honor Code and Student Conduct Code.

University Honesty Policy

UF students are bound by The Honor Pledge which states, "We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honor and integrity by abiding by the Honor Code. On all work submitted for credit by students at the University of Florida, the following pledge is either required or implied: "On my honor, I have neither given nor received unauthorized aid in doing this assignment." The Honor Code (https://sccr.dso.ufl.edu/process/student-conduct-code/) specifies a number of behaviors that are in violation of this code and the possible sanctions. Furthermore, you are obligated to report any condition that facilitates academic misconduct to appropriate personnel. If you have any questions or concerns, please consult with the instructor or TAs in this class.

Commitment to a Safe and Inclusive Learning Environment

The Herbert Wertheim College of Engineering values broad diversity within our community and is committed to individual and group empowerment, inclusion, and the elimination of discrimination. It is expected that every person in this class will treat one another with dignity and respect regardless of gender, sexuality, disability, age, socioeconomic status, ethnicity, race, and culture.

If you feel like your performance in class is being impacted by discrimination or harassment of any kind, please contact your instructor or any of the following:

• Your academic advisor or Graduate Program Coordinator

• Jennifer Nappo, Director of Human Resources, 352-392-0904, jpennacc@ufl.edu

• Curtis Taylor, Associate Dean of Student Affairs, 352-392-2177, taylor@eng.ufl.edu

• Toshikazu Nishida, Associate Dean of Academic Affairs, 352-392-0943, nishida@eng.ufl.edu

Software Use
All faculty, staff, and students of the University are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against University policies and rules, disciplinary action will be taken as appropriate. We, the members of the University of Florida community, pledge to uphold ourselves and our peers to the highest standards of honesty and integrity.

Student Privacy
There are federal laws protecting your privacy with regards to grades earned in courses and on individual assignments. For more information, please see: https://registrar.ufl.edu/ferpa.html

Campus Resources:
Health and Wellness

U Matter, We Care:
Your well-being is important to the University of Florida. The U Matter, We Care initiative is committed to creating a culture of care on our campus by encouraging members of our community to look out for one another and to reach out for help if a member of our community is in need. If you

or a friend is in distress, please contact umatter@ufl.edu so that the U Matter, We Care Team can reach out to the student in distress. A nighttime and weekend crisis counselor is available by phone at 352-392-1575. The U Matter, We Care Team can help connect students to the many other helping resources available including, but not limited to, Victim Advocates, Housing staff, and the Counseling and Wellness Center. Please remember that asking for help is a sign of strength. In case of emergency, call 9-1-1.

Counseling and Wellness Center: https://counseling.ufl.edu, and 392-1575; and the University Police Department: 392-1111 or 9-1-1 for emergencies.

Sexual Discrimination, Harassment, Assault, or Violence
If you or a friend has been subjected to sexual discrimination, sexual harassment, sexual assault, or violence contact the **Office of Title IX Compliance**, located at Yon Hall Room 427, 1908 Stadium Road, (352) 273-1094, title-ix@ufl.edu

Sexual Assault Recovery Services (SARS)
Student Health Care Center, 392-1161.

University Police Department at 392-1111 (or 9-1-1 for emergencies), or
http://www.police.ufl.edu/.

Academic Resources

E-learning technical suppor*t*, 352-392-4357 (select option 2) or e-mail to Learning-support@ufl.edu.
https://lss.at.ufl.edu/help.shtml.

Career Connections Center, Reitz Union, 392-1601. Career assistance and counseling;
https://career.ufl.edu.

Library Support, http://cms.uflib.ufl.edu/ask. Various ways to receive assistance with respect to using the libraries or finding resources.

Teaching Center, Broward Hall, 392-2010 or 392-6420. General study skills and tutoring.
https://teachingcenter.ufl.edu/.

Writing Studio, 302 Tigert Hall*,* 846-1138. Help brainstorming, formatting, and writing papers.
https://writing.ufl.edu/writing-studio/.

Student Complaints Campus*:* https://sccr.dso.ufl.edu/policies/student-honor-code-student-conduct-code/;https://care.dso.ufl.edu.

On-Line Students Complaints*: https://distance.ufl.edu/state-authorization-status/#student-complaint.*