EEE4306 - Electronic Circuits 2

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 This course explores the fundamentals of the analog and digital IC design, operation principle of transistors, and how we can leverage transistors to build complex structures such as OpAmps, current sources, supply voltages and more. Throughout the semester, the students will be introduced to various critical circuits which the analog and digital ICs depend upon. The course objective is to provide a thorough background of analog circuits, discuss the real world applications, IC design challenges and prepares students for other areas of analog and digital IC design.

 Class Times:

M,W | Period 5 (11:45AM - 12:35 PM)

Location: LAR 0239   http://campusmap.ufl.edu/?loc=0722

Fridays are remote Quiz only.

Office Hours: with appointment only.

Pre-Reqs

Electronics Circuits 1 (or equivalent knowledge of the topic)

Recommended

Circuits 2, Signal Processing

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 (DC/ac) (a detailed review will be provided)**
- **Bode blot and frequency response (short review will be offered)**
- **Fourier and Laplace Transforms**

Those who want to have a head start:

Read the first 2-3 chapters of Razavi's Analog CMOS IC textbook (link provided below)

Class location & dates:

Location: Online

Time: TBD

Exams and office hours:

Midterm 1: TBD

Midterm 2: TBA

Final Exam: TBA

Office hours:

Dr. Maghari: <u>maghari@ece.ufl.edu</u>   Office Hours: TBD

Send an email to set up a meeting.

Please put 4306 in the subject of your email for any email correspondence.

Textbooks

Design of Analog CMOS Integrated Circuits (2nd edition)

(Highly recommended)

By B. Razavi

Publisher: McGraw-Hill Education; 2 edition (January 20, 2016)
ISBN-10: 0072524936
ISBN-13: 978-0072524932
 Link to **Amazon (Links to an external site.)Links to an external site.**

Grading basis

Homeworks	**15%**
Quiz	**15%**
Midterm 1	**20%**
Midterm 2	**20%**
Extra Credit Quiz	**5%**
Final	**30%**
Total	**100%+ 5% extra credit quiz**

Course Outline

- Review
  - MOS & *Bipolar* Basics (*Bipolar* is optional and may be discussed at the end of the semester)
    - Large signal
    - Small signal
  - Amplifiers
    - Single Stage
      - Transistor level simulation in Cadence
      - Analog Layout
    - Multi-Stage
  - Cascode and Current mirrors
    - Current mirrors
      - Layout and matching
    - Cascode mirrors and amplifiers
  - Differential circuits
    - Fully Differential OTAs
      - Inter-digit and common-centroid layout
    - Common-mode setting
    - Multi-stage
  - Frequency Response
    - Single-stage

- Multi-stage OTA
- Miller compensation
- Voltage and Current References
  - Fixed-Gm Bias
  - Bandgap Voltage Reference
- Applications of MOS

About the instructor:

Nima Maghari received the B.S. degree in electrical engineering from the University of Tehran, Iran, in 2004 and the Ph.D. degree in electrical engineering from Oregon State University in 2010.

He is currently an associate professor at the department of electrical and computer engineering, University of Florida, Gainesville. From 2004 to 2006, he was with IC-LAB, University of Tehran, where he was involved with audio delta-sigma converters and low-voltage bandgap references. In 2008 he was recipient of CICC-AMD outstanding student paper award. He is currently serving as an Associated Editor of IEEE Transactions on Circuits and Systems-I. He has published more than 50 conference and journals papers in IEEE and IEE.

His research interests include high performance analog-to-digital converters, delta-sigma modulators, phased-locked loops, synthesizable analog circuits, time-assisted data conversion techniques and low-power low-voltage regulators.

Academic Honesty Policy:

You are not allowed to cheat or to tolerate cheating. The University's honesty policy, which I follow, can be found at https://sccr.dso.ufl.edu/wp-content/uploads/sites/4/2018/08/The-Orange-Book-Web.pdf

Links to an external site..

You may consult with other students on homeworks or projects. However, solutions or reports that you turn in must be **your work alone**. For example, you must create your own computer files and run your own simulations.

- You are expected to do your own work.
- You are expected to report any violations of the Honor Code that you become aware of.
- It is a violation of the Honor Code to turn in solutions to homeworks, labs or tests copied from other students or from published handouts or solutions.

- You are welcome to work with other students on homeworks and lab reports. However, once you understand the method of solution you should work through the calculations yourself.

How to study for this course:

The best way to learn how to analyze circuits and to prepare for tests is to *practice*. There are at least two sets of skills that you must master. One is figuring out how to approach an unfamiliar circuit or problem; the other is how to work through the solution to the problem or the analysis. If you always get help with setting up the problem, or just watch someone else solve the problem, you do not get any practice at all. To learn this material and to do well in the course, you must work problems and analyze circuits by yourself.

Disabilities Accomodations:

Students requesting classroom accommodation must first register with the Dean of Students Office. The Dean of Students Office will provide documentation to the student who must then provide this documentation to the Instructor when requesting accommodation.

UF Religious Holiday Policy:

"Students, upon prior notification of their instructors, shall be excused from class or other scheduled academic activity to observe a religious holy day of their faith. No major test, major class events or major university activity should be scheduled on a major religious holiday. Professors and university administration shall not penalize students who are absent from academic or social activities because of religious observance. Students shall be permitted a reasonable amount of time to make up material or activities covered in their absence."

To excuse religious holidays, students need to give the instructor a 1 week notice prior to the specific holiday.

UF Counseling Services:

Resources are available on-campus for students having personal problems or lacking clear career and academic goals. Resources include:

- University Counseling Center, 301 Peabody Hall, 392-1575, Personal and Career Counseling.
- SHCC Mental Health, Student Health Care Center, 392-1171, Personal and Counseling.
- Center for Sexual Assault/Abuse Recovery and Education (CARE), Student Health Care Center, 392-1161, sexual assault counseling.
- Career Resource Center, Reitz Union, 392-1601, career development assistance and counseling.

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. "

Make-Up Opportunities:

It is very hard for me to make you a customized exam. With a University-approved excuse and arranged for in advance, or in an emergency, a make-up exam.