

# Introduction to Analog and Mixed Signal Design (Monolithic Amplifier Circuits)

## **Instructor**

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## **Course Website**

<https://coursetools.ummu.umich.edu/2003/fall/eecs/413/001.nsf>

## **Course Description**

This course is an introduction to CMOS analog and mixed signal design, but also introduces advanced topics.

The course begins with a review of MOS transistors basics, and small signal analysis. Single stage and differential amplifiers are described. CMOS opamps, stability, and frequency compensation are covered. Advanced topics such as switched capacitor circuits, band gap references and Phase Locked Loops are discussed.

This course includes a major design project. Students work with a commercial 0.25 $\mu$ m CMOS process. A full suite of commercial design tools from Cadence is used for schematic entry, simulation and layout. (The tools and process technology are close to the state of the art for analog design). Students will have the opportunity to send the best design projects to be fabricated through the MOSIS IC prototyping service ([www.mosis.org](http://www.mosis.org))

Taken alone this course should be a good foundation in analog / mixed-signal design. This course is a prerequisite for EECS 511 (analog to digital converters and interfaces) EECS 522 (analog and RF circuits).

## **Prerequisites**

EECS 311 or an equivalent is required. Some background in device physics is also required (EECS 320 or equivalent)

## **Contents (may change a little)**

- Introduction
- Basic MOS device physics
- Single Stage Amplifiers
- Difference Amplifiers
- Frequency Response
- Feedback
- Operational Amplifiers
- Compensation
- Switched Capacitor Circuits
- Mismatch
- Short Channel Effects
- Layout and Packaging
- Phase Locked Loops (time permitting)

## **Lab sessions**

Although you may have registered for a lab session there is no formal hands on lab for this class. Instead there will be take home CAD assignments. There will also be a few CAD sessions in the CAEN labs hosted by the TA.

## Office Hours

*Flynn*            Wednesday 3:15PM – 5:30PM, EECS 2417E

*Stamplis*        TBD

Students are strongly encouraged to make use of office hours

## Text Books

Semi-complete handouts will be given for all lecture material. The notes will be fairly comprehensive but I recommend you also acquire the Razavi textbook on which the course is based.

*Required:*            Design of Analog CMOS Integrated Circuits  
Razavi  
McGraw Hill

The following text books may be useful for reference. (No need to buy these)

*Also useful:*        CMOS Analog Circuit Design, second edition  
Philip Allen, and Douglas Holberg  
Oxford Press

Analysis and Design Of Analog Integrated Circuits  
Gray, Hurst, Lewis and Meyer  
Edition 4th  
Publisher Wiley

Analog Integrated Circuit Design  
David Johns and Ken Martin  
Wiley

## Grades

Problem sets	10%
CAD assignments	10%
Exams        (Two midterms)	40%
Mini project	10%
Final Project (Report and presentation)	30%

### **Late Policies**

Homeworks and reports are normally due in class. A late penalty of 20% will be assessed if homeworks are 1 day late, 40% if two days late. Later homeworks will not be accepted.

### **CAD Tools**

Cadence will be used for schematic entry, simulation and layout. Within Cadence Spectre will be used for simulation, Opus for layout and Diva for verification.

## Things to Do

- Get a CAEN account
- Sign CAD usage agreements  
Stop by Paulette Ream EECS 2417
- Attend the Cadence Tutorial (covers schematic entry and simulation)

Monday and Tuesday (Sept. 8 and 9) from 5-7pm, EECS 2340

This is optional, only for those new to Cadence.  
Tutorial material is already on coursetools