SABANCI UNIVERSITY

Faculty of Engineering & Natural Sciences

EE 440 – Mixed-Signal Integrated Circuits

EE 540 – Mixed-Signal Integrated Systems and Applications

Spring 2022/2023 Syllabus

Instructor	**Teaching Assistant**
Ömer Ceylan	TBD

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Office Hours: TBD

Zoom Link: https://sabanciuniv.zoom.us/j/9757380583

Zoom Meeting ID: 975 738 0583

Class Schedule

Lectures

Monday: 8:40 – 9:30 am FENS L029

Wednesday: 11:40 – 13:30 am FENS L056

Recitation / Lab

Wednesday: 5:40 – 6:30 pm FENS G025

Textbooks

Phillip E. Allen & Douglas R. Holberg: CMOS Analog Circuit Design

Franco Maloberti: Data Converters

Behzad Razavi: Design of CMOS Phase-Locked Loops

Important: *We may have to revise the course plan according to the countrywide reassessment to be made regarding higher education. This is expected to happen at the beginning of April. The content to be delivered is certain but the method of course delivery, the number and dates of exams, and some other details are subject to change.*

Course Content:

Building blocks for mixed-signal integrated circuits: comparators, sampling circuits, amplifiers, digital-to-analog converters (DACs), voltage controlled oscillators, charge pumps, phase-frequency detectors, etc.

Analog-to-digital converters (ADCs)

Phase-locked loops (PLLs)

Readout Integrated Circuits (ROICs)

Learning Outcomes:

1. To be able to understand the specifications of commonly used mixed-signal integrated circuit building blocks: comparators, sampling circuits, amplifiers, control logics, voltage-controlled oscillators, charge pumps, phase-frequency detectors
2. To be able to evaluate the power, speed, noise, and area trade-off for individual blocks and overall system of ADCs and frequency synthesizers.
3. To be able to combine individual blocks to design a more complex system such as ADC and PLL, and to be able to understand how parameters of a building block affect the others and overall system performance.
4. To be able to design custom and automated digital circuits to control ADC and frequency synthesizer operations.
5. To have knowledge on different ADC architectures: Single and Multislope ADC, SAR ADC, Flash ADC, Pipeline ADC
6. To have knowledge on different frequency synthesizer architectures: Basic PLL, Integer-N, Fractional-N
7. To design, simulate and verify the individual blocks and overall system of ADCs and frequency synthesizers by using Computer Aided Design (CAD) tools.
8. To learn the possible use of ADCs and frequency synthesizers in different applications.
9. To learn the possible use of mixed-signal integrated circuits in different applications such as readout integrated circuits (ROICs), CMOS image sensors, etc.

Tentavive Course Schedule:

Date	Subjects
Week 1	Introduction, ADC specifications
Week 2	Overview of ADC architectures
Week 3	Sampling circuits
Week 4	Comparators
Week 5	DACs
Week 6	SAR ADCs
Week 7	Pipeline ADCs
Week 8	Flash ADCs, Slope ADCs

Week 9	Presentations
Week 10	PLL basics, Midterm
Week 11	Oscillators, Phase detector, Charge Pump
Week 12	PLL Architectures
Week 13	Mixed Signal Design Methodology
Week 14	Readout Integrated Circuits (ROICs)

Course Policies:

- Cheating will not be tolerated.
- For homeworks, labs and projects late submission is penalized up to 2 days.
    - Up to 6 hours late 5% reduction
    - Up to 12 hours late 10% reduction
    - Up to 24 hours late 20% reduction
    - Up to 48 hours late 30% reduction
- There will be 4 labs about sampling circuits, comparators, DACs, VCOs after the topics are covered in class.
- There will be a Course Project that you will design an ADC using the knowledge you have learned in class and labs.
- There will be a presentation of a state-of-the art ADC or PLL paper.

Grading Policy:

Homeworks/Labs	20%
Paper presentation	10%
Course project	20%
Midterm	20%
Final	30%

Important Notes:

- For proctored exams, your webcam and microphone should be on during the exam. In the case of non-compliance with this and other declared exam procedures, your exam will be void. Make sure to check that your webcam and microphone function properly before the exam.
- You may be given an oral exam to check the authenticity of the written exam by going through the questions of the written exam.
- You must attend the synchronous Zoom lectures, recitations, etc. and real-time online exams with your SU email account.