ESE 517
Integrated Electronic Devices and Circuits II

Spring 2014

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Course Description

This is an advance, project oriented, analog integrated circuit design class. Topics considered will include design of switched-capacitor circuits, digital-to-analog and analog-to-digital data converters, delta-sigma modulation, filters, imagers, biomedical instrumentation and adaptive neural computation. The various practical aspects of analog and mixed-signal circuit design, like structured design, scalability, parallelism, low-power consumption, and robustness to process variations, will be covered.

Course Learning Objectives

1. an ability to apply knowledge of mathematics, science, and engineering
2. an ability to identify, formulate, and solve engineering problems
3. an ability to communicate effectively
4. an ability to understand current research issues

Student Learning Outcomes

1. students will acquire understanding of the fundamentals of the design and analysis of data converters
2. students will be introduced to the current state-of-the-art data converters
3. students will be able to understand trade-offs and limits in the design of analog-to-digital converter

Classes: Tu 4pm-7pm, Chemistry 124
Office hours: TuTh 11:00am-1:00pm or by appointment

Text Book:
Class Handouts and Technical Papers.

References:
B. Razavi, “Design of Analog CMOS Integrated Circuits”

Suggested Reading: (or browsing, for project ideas)
1. IEEE Journal of Solid-State Circuits
2. IEEE Transactions on Circuits and Systems I
3. IEEE Transactions on Neural Networks: special issues on neural hardware

Grading
A. Research Paper Presentation
Each student will make a presentation based on an assigned research paper. These presentations will be scheduled during the lectures, in the second part of the semester, and they will be 15 minute long each. The presentation will count with 20% in the final grade.

B. Class Project
The students would organize themselves into groups, each comprising of 2 or 3 members. The group will schedule meeting hour (1 hour per week) with the instructor to discuss project issues. The group can choose a design of pipeline ADC converter with the defined specifications (the project will consist of 4 tasks) or a specific project from the following areas: biomedical signal processing and acquisition, smart imagers, speech processors and sensory systems. Group formation and definition of the project is due by the end of Week 2.

Course Schedule

Week 1  Discrete-time systems.
Week 2  Switched capacitor circuits.
Week 3  Switched capacitor circuits.
Week 4  Sample-and-hold circuit and comparators.
Week 5  Data converter fundamentals.
Week 6  Digital-to-analog Nyquist-rate converters.
Week 7  Analog-to-digital Nyquist-rate converters (integrating, SAC, algorithmic).
Week 8  Analog-to-digital Nyquist-rate converters (flash, two-step, interpolating, folding, pipelined).
Week 9  Delta-sigma modulation.
Week 10  Technical paper study.
Week 11  Analog computation blocks.
Week 12  Biomedical instrumentation.
Week 13  Project presentations.