ECE538 Design and Analysis of Analog Digital Interface Circuits

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Office Hours: MWF 11-noon, or by appointment

Credits:

	Lecture	Lab	Other	Total
Credit Distribution	3	1	0	4
Clock Hour Distribution	3	3	0	6

Prerequisites:
The prerequisites for this course are ECE312, ECE332 and ECE451. ECE332 and EC312 can be co-requisites. Having taken ECE534 is a real plus before taking this course, but it is not required.

Course Description:
This course covers the topic of interface circuit designs analog and digital interfaces. Modern data communication systems, integrated sensor systems, and the complex system-on-chip (SOC) designs require a variety of analog and digital interface circuits from low power to high performance, and to high precision. Analog and digital interface circuit designs often involve many conflicting design requirements. With VLSI processing technologies becoming more and more complex in terms of process variations and the desire for high precision analog-to-digital/digital-to-analog circuits, analog and digital interface circuits can become a critical component in many ICs. This course is intended to introduce students with the basic concept of designing and analyzing analog and digital interface circuits using a variety of design techniques for tradeoffs among cost, power consumption, speed, and precision. The topics this course will cover include:

1. architectural and circuit level design and analysis of integrated analog-to-digital and digital-to-analog interfaces in modern CMOS VLSI technology,
2. analog-digital converter designs using Nyquist and over-sampled techniques,
3. sample/hold amplifiers,
4. continuous-time and switched-capacitor filters,
5. low power mixed signal design techniques,
6. data communication systems including interface circuitry, and
7. CAD tools for analog design for simulation and synthesis.

Text and Other Course Materials:
This course will use the lecture notes assembled by the instructor to cover the contents of this course. There will be additional reading materials provided to students to complement the contents covered during lectures.

Course Opjectives:
Upon completing this course, students are expected to have the following skills:

1. Understand the basic principles of designing analog and digital interface circuits,
2. Be able to choose from different converter architectures based on a given design specification,
3. Be able to design different analog and digital interface circuits using MOS transistors and capacitors,

4. Be able to analyze analog and digital interface circuits using Cadence design tools,
5. Be able to perform design tradeoffs among cost, power consumption, performance, and precision in designing analog and digital interface circuits, and
6. Understand the general context in which the analog and digital interface circuits are used in data communication systems and SOCs.

Course Topics and Weekly Schedule:

	Topics Covered
Weeks1-5	Introduction to digital-to-analog converters and the associated supporting topics. The topics covered include R-String DAC, R-2R DAC, current mode DAC, systematic and random error analysis, and some practical design examples.
Weeks 6-7	Basic concepts and fundamental limits of analog-to-digital conversion
Weeks 8-13	Introduction to analog-to-digital converters and the associated supporting topics. The topics covered include sampling theory and circuits, comparator design, successive approximation ADC, flash ADC, pipeline ADC, sigma-delta ADC.
Weeks 14-16	Applications of ADC/DAC in SOCs

Instructional Methodology:
The course meets 3 times per week for lectures (ECE538). The learning style is inquiry-based top-down learning. In addition to basic set of labs, a term project is also required for each student. Discussions will also be held to help students make progress on the term project.

Methods of Evaluation:
This course uses +/- grading with the following scale:

A	>= 95
A-	>= 90 and < 95
B+	>= 86 and < 90
B	>= 83 and < 86
B-	>= 80 and < 83
C+	>= 75 and < 80
C	>= 70 and < 75
D	>= 60 and < 70
F	< 60

The final grade will be derived based on the following breakdown:

Homework/Design Projects: 35%

Midterm: 30%

Final Exam: 35%

Use of Online Homework Helper Sites:

The online “homework helper” sites including, but not limited to, Chegg, NoteHall, Quizlet and Koofers, is meant as study resources to help students better understand basic concepts covered in this course. They are NOT intended to do homework/exams

from this course for you. the use of these online sites to ask them to do homework/exams for you is not permitted in this course.

Important information for students: All students are expected and required to report any COVID-19 symptoms to the university immediately, as well as exposures or positive tests from a non-CSU testing location. If you suspect you have symptoms, please fill out the COVID Reporter (https://covid.colostate.edu/reporter/).

If you know or believe you have been exposed, including living with someone known to be COVID positive, or are symptomatic, it is important for the health of yourselfand others that you complete the online COVID Reporter. Do not ask your instructor to report for you. If you do not have internet access to fill out the online COVID-19 Reporter, please call (970) 491-4600. You will not be penalized in any way for reporting. If you report symptoms or a positive test, you will receive immediate instructions on what to do, and CSU's Public Health Office will be notified. Once notified, that office will contact you and most likely conduct contact tracing, initiate any necessary public health requirements and/or recommendations and notify you if you need to take any steps. For the latest information about the University's COVID resources and information, please visit the ***CSU COVID-19 site****: https://covid.colostate.edu/.*