

University of California, Berkeley Extension

Integrated-Circuit Design and Techniques Program

X237: Design Techniques of High-Performance Data Converters

Course Syllabus

A. Course Description

Completely updated to reflect the extraordinary advances in the data converters, this course sets the professional online learning standard in the IC design sphere. This course is intended for practitioners who have experience in analog design or knowledge background on electronics and are interested in upgrading their design skills in data converters. Topics include: Nyquist-rate DACs, investigation of INL and DNL, Nyquist-rate ADCs, and design issues in Nyquist-rate ADCs.

B. Prerequisite

- "X236: Fundamentals of Modern Data Converter Design"

or fundamental knowledge on data converters and analog IC is expected.

C. Timeline

Pacing yourself well is one of the key factors to succeed in this course. *Mark your calendar* for the timeline and course events. *Make a plan* for studying lectures and then follow through. If you do that, the odds that you perform with excellence and succeed in this course are very high.

Timeline	Course events	Lecture pace
Day 30	Homework 1	30% of lectures done
Day 60	Homework 2	60% of lectures done
Day 90	Homework 3	90% of lectures done
Day 90	Final exam request	
Day 120	Midterm exam	100% of lectures done
Day 120	Final exam date confirmed	Review
Day 150	Proctored final exam	
Day 180	Course end	Lecture access expires

The course registration date (Day 1) is the date you receive the login information and welcome email. Remember, the final exam request process could take up to a month to complete.

D. Course Length

15 hours.

- The course length covers not only the audio runtime but also the time you need to catch up with the lecture presentation, including the time to re-listen the soundtrack (rewind and play), the time to watch the slides (pause), and the time to take notes.
- The students are expected to *take notes*. Remember, the shortest pencil is longer than the longest memory. You haven't really studied unless you write things down, including primary circuit diagrams, analysis, and key concepts, etc.
- Other than the 15-hour course length, you are expected to spend additional 30 hours studying the lectures, digesting the materials, working on the assignments, and preparing for the exams. This is based on the level of effort that a "UC Berkeley qualified" student must spend to be successful in the course.
- Most students listen/watch the lectures two or three times before they can fully grasp the concepts, cultivate problem-solving skills, and have a good grade on the final exam.

E. Credit

- *Type of Credit: Academic credit at UC Berkeley campus level*
- *Campus Department: Electrical Engineering & Computer Science (EECS)*
- *Level: Graduate School*
- *Number of Units: 1*

F. Instructors

- *Lead Instructor: Dr. Vincent Chang*
- *Program Instructor: Dr. Han-Bin Lin*
- *Instructor's bio: Please visit <http://www.ucberkeleyext.com/>.*

G. Learning Objectives

Upon successful completion of the course, students will be able to

- Analyze and design different types of Nyquist-rate D/A converters.
- Analyze and design different types of Nyquist-rate A/D converters.
- Conduct the in-depth INL and DNL analysis for Nyquist-rate D/A converters.

H. Short Session-By-Session Summary

Session 1. Nyquist-Rate DACs

- *Current Scaling D/A Converter: R-2R Implementation*
- *Charge-Scaling Switched-Capacitor D/A Converters*
- *Investigation of INL and DNL in Charge-Scaling DAC*
- *Thermometer-Code D/A Converters*

Session 2. Nyquist-Rate ADCs

- *Serial A/D Converter*
- *All-MOS Charge Redistribution ADC: Noninverting*

- *All-MOS Charge Redistribution ADC: Inverting*

Session 3. Design Issues in Nyquist-Rate ADCs

- *CMOS Clocked Comparators for Flash ADC Design*
- *Design Issues in Flash A/D Converters*

I. Methods of Instruction

- Online bilingual presentation—English and Mandarin
- Discussion with the instructor via email
- Homework assignment

Discussion Policy

To create a positive sharing & learning environment where all students can be benefited by learning from each other, the instructor may select your questions along with the instructor's answers and *anonymously* put them into Discussion Q&A.

If you have a concern the question you ask the instructor might be *anonymously* posted in the Discussion Q&A or you *don't* want to *anonymously* share your question with other fellow classmates, you should notify the instructor via email within 30 days from the course registration date.

J. Grade Structure

- Class participation & discussion= 30%
- Homework assignments =20%
- Mid-term (Take-home exam)=20%
- Proctored final exam=30%

K. Additional Classroom Info

Additional information will be posted and updated on a regularly basis. Please visit your Classrooms at <http://www.ucberkeleyext.com/>.