

ECE 5023: Introduction to Data Converters and Phase-Locked Loops

Course Description

This course focuses on fundamentals of data converters and timing circuits, including discrete-time analog/mixed signal analysis and signal conditioning for asynchronous and synchronous computing. The topics include analog switches, sampling circuits, switched-capacitor amplifiers and filters, ADCs, DACs, PLLs, DLLs and discrete-time neural networks.

Transcript Abbreviation: Intro A/D & D/A

Grading Plan: Letter Grade

Course Deliveries: Classroom

Course Levels: Undergrad, Graduate

Student Ranks: Senior, Masters, Doctoral

Course Offerings: Spring

Flex Scheduled Course: Never

Course Frequency: Even Years

Course Length: 14 Week

Credits: 3.0

Repeatable: No

Time Distribution: 3.0 hr Lec

Expected out-of-class hours per week: 6.0

Graded Component: Lecture

Credit by Examination: No

Admission Condition: No

Off Campus: Never

Campus Locations: Columbus

Prerequisites and Co-requisites: Prereq: 4021, or Grad standing in Engr or Physics.

Exclusions:

Cross-Listings:

Course Rationale: Switched-cap circuits are essential elements of electronic systems. The topics are not covered by any course. It's a significant gap in our curriculum

The course is required for this unit's degrees, majors, and/or minors: No

The course is a GEC: No

The course is an elective (for this or other units) or is a service course for other units: Yes

Subject/CIP Code: 14.1001

Subsidy Level: Doctoral Course

Programs

Abbreviation	Description
EE	Electrical Engineering

Course Goals

Be familiar with various switched-capacitor integrated circuit designs.
Be competent at the specifications, performance metrics and tradeoffs of discrete-time circuits.
Be exposed to the latest industrial trends and challenges pertaining to integration and semiconductor technologies.
Apply the acquired theoretical knowledge to perform design projects using IC PDKs and simulation and design tools.

Course Topics

Topic	Lec	Rec	Lab	Cli	IS	Sem	FE	Wor
Basic definitions, main tasks of switched-capacitor circuits and the challenges facing their implementation in VLSI applications	4.0							
Performance metrics, limitations, and tradeoffs	6.0							
Circuit architectures of digital-to-analog converters	4.0							
Circuit structures of analog-to-digital converters	12.0							
Architectures and linear models of phase-locked loops	4.0							
Practical design considerations	4.5							
Implementation examples and product data sheets	4.5							

Representative Assignments

Homeworks
Quizzes
Exams
Design Projects

Grades

Aspect	Percent
Quizzes	20%
Exams	50%
Final Design Project	30%

Representative Textbooks and Other Course Materials

Title	Author
<i>Data Converters (recommended)</i>	F. Maloberti

ABET-EAC Criterion 3 Outcomes

Course Contribution		College Outcome
***	a	An ability to apply knowledge of mathematics, science, and engineering.
	b	An ability to design and conduct experiments, as well as to analyze and interpret data.
***	c	An ability to design a system, component, or process to meet desired needs.
	d	An ability to function on multi-disciplinary teams.
***	e	An ability to identify, formulate, and solve engineering problems.
	f	An understanding of professional and ethical responsibility.
	g	An ability to communicate effectively.
*	h	The broad education necessary to understand the impact of engineering solutions in a global and societal context.
	i	A recognition of the need for, and an ability to engage in life-long learning.
***	j	A knowledge of contemporary issues.

Course Contribution		College Outcome
***	k	An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

EE ABET-EAC Criterion 9 Program Criteria Outcomes

Course Contribution		Program Outcome
	1	an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
	2	an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
	3	an ability to communicate effectively with a range of audiences
	4	an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts
	5	an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
	6	an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
	7	an ability to acquire and apply new knowledge as needed, using appropriate learning strategies

Additional Notes or Comments

5023 will cover basics of switch-capacitor circuits, data converters (flash and SAR ADCs, DACs) and PLLs. use 7020 to teach advanced data converters, including pipeline, delta-sigma, time-interleaved and folding ADCs.

Updated text info, 3/5/20, CED

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