

Modeling and implementation of analog and mixed analog/digital circuits and systems on chip

5.0 credits	30.0 h + 30.0 h	2q
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Teacher(s) :	Bol David ;
Language :	Anglais
Place of the course	Louvain-la-Neuve
Inline resources:	 > http://moodleucl.uclouvain.be/enrol/index.php?id=2373
Prerequisites :	LELEC2531 and LELEC2532.
Main themes :	<p>Over the last decades, integrated circuits have evolved from chips with a single function to complex systems on a single silicon chip. Such modern systems-on-chip (SoCs) features digital signal processors, microcontrollers, analog and RF circuits to provide the necessary interfaces to the physical world made of sensor signals, audio/video interfaces, electronic signals or wireless communications. These analog/mixed-signal (AMS) SoCs require the co-integration, co-design and co-verification of analog and digital circuits on the same CMOS technology platform. In this course, we will study the implementation of mixed analog/digital circuits with the help of behavioral modeling, as an essential tool within the design flow of AMS SoCs.</p> <p>This course concludes the ELEC formation in electronic circuits and systems.</p>
Aims :	<p>a. Contribution of the activity to the learning outcomes of the program AA1 Knowledge base : electronic concepts (AA1.1), simulation and CAD tools (AA1.2) AA2 Engineering skills : analysis and modeling of an electronic system, AA3 R&D skills : find appropriate references on the existing solutions in the field of the course's project (AA3.1) AA4 Project management AA5 Communication skills : analysis and writing of a technical datasheet (AA5.3-5.5), efficient oral communication (AA5.6).</p> <p>b. After this course, the electrical engineers in circuit and systems should be able to:</p> <ul style="list-style-type: none"> -- critically compare analog and digital circuit solutions within a given applicative system context with respect to signal quality, power consumption, cost and flexibility, -- analyze the sources and propagation of analog non-idealities into a mixed-signal chain, -- generate appropriate abstractions for analog building blocks and model their behavior at high level in Verilog-AMS language, -- choose and setup an appropriate methodology for designing, simulating and verifying a mixed-signal system from specification phase to block partitioning to physical implementation, -- co-simulate and co-verify analog blocks with a digital circuit in Verilog to mitigate the limitations of analog blocks and to extract specifications for the mixed-signal circuit implementation, -- analyze and produce industrial-level datasheets of an electronic system in the context of a design project , -- analyze scientific-level papers in the field of electronic circuit and systems, -- clearly and efficiently communicate technical results they obtained with an oral presentation. <p><i>The contribution of this Teaching Unit to the development and command of the skills and learning outcomes of the programme(s) can be accessed at the end of this sheet, in the section entitled "Programmes/courses offering this Teaching Unit".</i></p>
Evaluation methods :	A group evaluation is done with 2 problem-based learning activities and an individual evaluation is based on a project-based assignment concluded by the oral exam. An intermediate formative evaluation allows the student to situate themselves at the mid-point.

Teaching methods :	The course is organized as follows : -- 13 lectures and/or specific seminars given by experts from the industrial world regarding the design, modeling and implementation. They will be broadly illustrated by recent mixed-signal SoC examples from both the industrial and research worlds. -- 2 problem-based learning activities by groups focus on the development of soft skills linked to the course topic (use of industrial datasheets, rapid exploration of an unknown system, reading of technical literature). -- An individual project, about the optimization of an AMS SoC for wireless communication, biomedical signal processing or integrated sensors (temperature, image, radiations, ...). This self-learning project will be based on CAD and the interaction between the students, the teachers and assistants will be encouraged by the use of a discussion forum on Moodle platform.
Content :	-- AMS SoC design methodologies -- Behavioral analog modeling -- Analog non idealities and auto-compensation -- Digital assistance of analog circuits -- A/D and D/A conversion ' system-level -- Time-digital and digital-time conversion -- PLL, DLL and FLL -- Analog blocks to support digital systems
Bibliography :	Supports -- Slides of the lectures on Moodle -- Forum on moodle -- Technical documentation on moodle
Other infos :	The whole basicformation in electronic circuits is compulsory: ELEC1530, LELEC2531 and LELEC2532. It is highly recommended to have followed an advanced course in implementation of digital circuits (LELEC2570 Design of digital integrated circuits) and/or analog integrated circuit design (LELEC2650 Design of analog integrated circuits).
Cycle and year of study :	> Master [120] in Electro-mechanical Engineering > Master [120] in Electrical Engineering > Master [120] in Mathematical Engineering > Master [120] in Computer Science and Engineering
Faculty or entity in charge:	ELEC