Integrated Circuits and Systems

- from Fundamentals to Ultimate Frontiers -

Prof. Dr. Ing. Domenico Zito

Master Course (30 hours)

Synopsys: This course provides an introduction to integrated circuits and systems from the fundamentals to ultimate frontiers of digitalization in information and communication technologies. The contents are selected in order to offer a learning path to the students of the Master degree programme of the Faculty of Physics, Astronomy and Informatics at the Jagellonian University. In addition to the course contents, the students can also take advantage of an independent series of seminars on ultimate frontiers in integrated circuits and systems, from future emerging wireless communication and sensing applications to quantum computing.

Objectives: To master the operating principles and design of modern integrated circuits and systems.

Contents: Introduction to integrated circuits and systems, from the fundamentals to the frontiers of digitalization, with emphasis on analysis and design of analog and radio-frequency integrated circuits and systems in silicon technologies. Analog sensor interface architecture and building blocks. Semiconductor devices; large-signal and small-signal models; noise models, single-stage and differential amplifiers, operational amplifiers, feedback and oscillators. Wireless transceiver architectures and building blocks.

Learning outcomes: Analyze and explain the main design challenges for the implementation of integrated circuits and systems in nano-scale silicon technology.
Analyze and design the main building blocks of modern analog and radio-frequency integrated systems, such as analog sensor interfaces and wireless transceivers.

Assessment: Final written exam (1.5 hours)

Format: 2x 1.5-hour lecture per week (Thursday, Friday)

Lecture Plan:	Date
Lecture 1. Introduction to Integrated Circuits and Systems:	21.04
Lecture 2. Semiconductors	22.04
Lecture 3. Semiconductor devices: PN	28.04
Lecture 4. Semiconductor devices: BJTs	29.04
Lecture 5. Semiconductor devices: MOSFETs	12.05
Lecture 6. Single-stage amplifiers: CE/CS	13.05
Lecture 7. Single-stage amplifiers: CB/CG, CC/CD, Cascode	19.05
Lecture 8. Differential and operational amplifiers	20.05
Lecture 9. Feedback and Oscillators	26.05
Lecture 10. Noise theory	27.05
Lecture 11. Semiconductor noise	02.06
Lecture 12: Analog-to-Digital Interfaces	03.06
Lecture 13. Wireless transceivers: Architectures	09.06
Lecture 14. Wireless transceivers: Building-blocks	10.06

Seminar Series

Seminar 1: Silicon Technology Evolution (25.05)
Seminar 2: System-on-Chip Radars and Radiometers for Bio, Geo and Space Sciences (01.06)
Seminar 3. Next-generation (5G/6G) Wireless Transceivers (08.06)
Seminar 4: Toward Monolithic Silicon Quantum Processors (15.06)

Format: Presentation (45 min) and Q&A (15 min) per week (Wednesday).