

COMMUNICATION ENGINEERING AND ELECTRONIC TECHNOLOGIES

(Lecce - Università degli Studi)

Teaching MICROELECTRONIC DESIGN

GenCod A004877

Owner professor STEFANO D'AMICO

Teaching in italian MICROELECTRONIC DESIGN

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SSD code ING-INF/01

Reference course COMMUNICATION ENGINEERING AND ELECTRONIC

Course type Laurea Magistrale

Credits 9.0

Teaching hours Ore-Attivita-frontale: 81.0

For enrolled in 2018/2019

Taught in 2019/2020

Course year 2

Language INGLESE

Curriculum PERCORSO COMUNE

Location Lecce

Semester Primo-Semestre

Exam type Orale

Assessment Voto-Finale

Course timetable

<https://easyroom.unisalento.it/Orario>

BRIEF COURSE DESCRIPTION

The course is aimed at providing principles and tools to analyze and design analog circuits in CMOS integrated technology.

REQUIREMENTS

Fundamental bases of Analog Electronics are required.

COURSE AIMS

After the course the student should be able to:

- 1) Describe the basic analog circuits (bandgap reference, current mirrors, differential couple, Miller opamp, class A and class AB output stages, etc...).
- 2) Evaluate the performance parameters and discuss complexity issues associated with different basic analog circuits.
- 3) Demonstrate circuit analysis capability of not standard circuits.
- 4) Understand the technology limits in circuit design.
- 5) Use the simulator to analyse performance of analog circuits.
- 6) Express properly the results of the analysis and the design of analog circuits.

TEACHING METHODOLOGY

The Course forecasts 33 hours of theoretical lectures about technology description and fundamental circuit analysis. The theoretical concepts are verified in laboratory by using state of the art circuit simulator. 36 hours of laboratory are forecast. Moreover, 12 lectures about manual analysis and design of circuit examples are proposed.

ASSESSMENT TYPE

The final (oral) exam consists of two cascaded parts:

1. the first part is based on the discussion about a report on the assigned circuit. The circuit must be simulated at the calculator. The student is asked to learn using the simulator, to illustrate the circuit design, to evaluate the performance parameters, and to define the operation of each part of the circuit. it is aimed to verify to what extent the student has gained knowledge and understanding of the use of the circuit simulator and the circuit analysis.
2. the second part is on circuit analysis of one of the basic circuits studied during the course; it is aimed to determine to what extent the student the circuit analysis capability, ability to identify and use data to formulate responses to well-defined problems, problem solving abilities and the capacity integrate different concepts and tools.

FULL SYLLABUS

- The MOS transistor^{1,2,3,4,5,6} (6 ore)
 - Description of the NMOS transistor
 - Second order effects: velocity saturation of carriers and variation of the threshold voltage
 - Noise in MOS device
 - MOS transistor layout

- Passive components^{1,7} (6 ore)
 - Integrated capacitors: implementation, accuracy and layout issue
 - Integrated resistors: implementation, accuracy and layout issue

- Analog switches^{1,8} (6 ore)
 - Analog switches implementation
 - Charge injection and clock feedthrough

- Bias circuits^{1,9,10} (6 ore)
 - CMOS current mirrors
 - Current reference
 - Voltage reference

- Basic gain stages^{1,11} (9 ore)
 - Gain stages
 - Output stages
 - Level shifter

- Excercitation
 - Analysis and design of circuit examples¹ (12 ore)

- Laboratory
 - Design experiences by using the circuit simulator 12 (36 ore):
 - Transistor Behaviour:
 - Coarse MOS parameter extraction
 - MOS behaviour worst case variation
 - Channel length modulation effects
 - Low-voltage current mirror design
 - VTH dependence on MOS gate length (L)
 - VTH dependence on MOS gate width (W)
 - Velocity saturation effects

 - Circuit design
 - A Low-voltage bandgap
 - A two-stage opamp

REFERENCE TEXT BOOKS

1. Baschirotto, "Slides del corso" (http://microel_group.unisalento.it/)
2. S. D'Amico "Chapter 4: The MOS transistor" (http://microel_group.unisalento.it/)
3. Johns & Martin "Analog Integrated circuits design", John Wiley and Sons, Inc., pages 7-45.
4. Johns & Martin "Analog Integrated circuits design", John Wiley and Sons, Inc., pages 102-107.
5. Johns & Martin "Analog Integrated circuits design", John Wiley and Sons, Inc., pages 116-130.
6. Johns & Martin "Analog Integrated circuits design", John Wiley and Sons, Inc., pages 187-226.
7. Johns & Martin "Analog Integrated circuits design", John Wiley and Sons, Inc., pages 108-115.
8. Johns & Martin "Analog Integrated circuits design", John Wiley and Sons, Inc., pages 401-451.
9. Johns & Martin "Analog Integrated circuits design", John Wiley and Sons, Inc., pages 131-175.
10. Gray, Hurst, Lewis, Mayer "Analysis and design of integrated circuits" Fourth edition, John Wiley and Sons, Inc. pages 299-332
11. Johns & Martin "Analog Integrated circuits design", John Wiley and Sons, Inc., pages 227-310.
12. A. Baschirotto, S. D'Amico "IDESA Advanced tutorial series"