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 Front activity hours: 81.0

For enrolled in 2017/2018

Taught in 2018/2019

Course year 2

Language ENGLISH

Curriculum PERCORSO COMUNE

Location Lecce

Semester First Semester

Exam type Oral

Assessment Final grade

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 transistor1,2,3,4,5,6 (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 components1,7 (6 ore)

-Integrated capacitors: implementation, accuracy and layout issue
-Integrated resistors: implementation, accuracy and layout issue

- Analog switches1,8 (6 ore)

-Analog switches implementation
-Charge injection and clock feedtrough

- Bias circuits1,9,10 (6 ore)

-CMOS current mirrors
-Current reference
-Voltage reference

- Basic gain stages1,11 (9 ore)

-Gain stages
-Output stages
-Level shifter

- Exercitation

-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"