

# Microelectrónica (MCRE 1)

Marisa López Vallejo

Pablo Ituero Herrero



Departamento de  
Ingeniería  
Electrónica

Universidad Politécnica de Madrid

Máster Oficial en Ingeniería  
de Sistemas Electrónicos

[www.die.upm.es](http://www.die.upm.es)



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## Microelectrónica (MCRE 1)

*Semester: 1*

*Number of credits: 4,5 (2,5 theory + 2 practical)*

*Type: optional*

### Objectives

The subject "Microelectronics" aims to train students of the Master in full-custom design of VLSI integrated circuits. This course provides a bridge between design and technology systems, processes and devices, considering the requirements of the circuits and systems that make use of these technologies.

This course aims to provide future designers vision systems covering hardware from system design aspects to the physical path, through their circuits and building blocks, mainly focused on CMOS technology, which is the most used today for circuit design application. It will also ensure a basic introduction to the structures and processes in the work necessary technology integrated circuit design.

Detailed objectives of the course are:

1. Achieve a thorough knowledge of the operation of MOS transistors.
2. Knowing the basics of the manufacturing process and the implications for the designer: the design rules.
3. Being able to design from schematic to layout any CMOS circuit.
4. Studying how to characterize CMOS designs in its main aspects: area, strength, capacity and delay.
5. Perform the design of CMOS logic gates following different architectures.

6. Design and analyze basic sequential circuits (t latch register)
7. Knowing different timing systems integrated circuits and associated implications.
8. Design subsystems (finite state machines, memories, data paths).
9. Learn VLSI design methods: since the completion of the base plane to complete the validation circuit.
10. Learn the basic principles of manufacturing test and how to take into account in the design.

## Program

### 1. Introduction to the design of ASICs (0.3 ECTS)

VLSI Design

CAD Tools

Representation of circuits and systems

### 2. NMOS and CMOS Logic:

Bar Charts

Switch logic

### 3. Transistors: operation

1. invertors

Logic gates

### 4. Basic CMOS manufacturing processes. Design Rules

Silicon semiconductor technology

Basic CMOS Process

Design Rules

### 5. Circuit characterization

resistance

capacity

Switching characteristics. retardation

Excitation of large capacity

Power consumption (static and dynamic). Dimensioning of power tracks;

"Latchup"

### 6. Sequential Logic

Timing system

Records

Stack (FIFO)

### 7. Timing

Strict two-phase approach

Extensions to the basic timing

Generating a clock signal  
Timing alternatives  
Timed CMOS logic structures;

8. Subsystems design (1):

PLA,  
Finite State Machine

9. Subsystems design (2):

Adders, shifters  
Memory: RAM, ROM

10. CMOS design methods

Input / output chip  
Structured Design Base Plan  
Alternatives CMOS chip design (Networks profundas, standard cell library, full-custom, FPGAs, ...)

11. Test of Integrated Circuits. Design for test

Need test  
Controllability, Observability and Fault Models  
Design Strategies for test:  
Techniques "ad-hoc"  
structured techniques  
Techniques for self-test  
System Level Test

## Bibliography

**N. Weste, D. Harris** (Libro de referencia). *CMOS VLSI Design: A Circuits and Systems Perspective* Pearson Addison Wesley, 2005

**J.M. Rabaey** *Digital Integrated Circuits: A Design Perspective* Prentice Hall, 1996

**N. Weste, K. Eshraghian** *Principles of CMOS VLSI Design: A Systems Perspective* Addison Wesley, 1993.

## Teachers

Coordinator: Marisa López Vallejo.

Teachers: Marisa López Vallejo.

Pablo Ituero Herrero

## Teaching Methodology

The course is given in person, by combining the following methodologies:

- Lectures on theoretical and practical part. They will be in the classroom using transparencies and blackboard. At least 25% of classes are practical.
- Individual Exercises, delivered and corrected in class.
- Realization of a group project.

## Evaluation

The evaluation of the course is done through three sources:

- A written examination (40%). In it the student, with or without the use of reference books or notes as appropriate, must solve problems, designs or aspects based questions developed in class.
- Delivery of practical work and exercises (50%).
- Participation in class (10%).

## Contact

Marisa López Vallejo. Despacho C-230. Email: [marisa@die.upm.es](mailto:marisa@die.upm.es)

Pablo Ituero Herrero. Despacho C-226. Email: [pituero@die.upm.es](mailto:pituero@die.upm.es)

Webs:

- [www.lsi.die.upm.es/~marisa/mcre.html](http://www.lsi.die.upm.es/~marisa/mcre.html)
- <http://moodle.upm.es/titulaciones/oficiales/course/view.php?id=2577>

