Syllabus
2024 - 2025

GENERAL INFORMATION

Data of the subject	
Subject name	Integrated Devices for Communications
Subject code	DEAC-MIT-527
Mainprogram	Official Master´s Degree in Telecommunications Engineering
Involved programs	Máster Universitario en Ingeniería de Telecomunicación y Mást. Univ. en Administración de Empresas [First year] Máster Universitario en Ingeniería de Telecomunicación [First year] Máster Universitario en Ingeniería de Telecomunicación y Máster en Ciberseguridad [First year] Máster Universitario en Ingeniería de Telecomunicación + Máster Big Data.Tecnología y Anal. Avanzada [First year] Máster Universitario en Ingeniería de Telecomunicación + Máster in Smart Grids [First year]
Level	Postgrado Oficial Master
Quarter	Semestral
Credits	3,0 ECTS
Type	Obligatoria
Department	Department of Electronics, Control and Communications
Coordinator	Ignacio Herrera Alzu
Office hours	Upon request

Teacher Information	
Teacher	
Name	Ignacio Herrera Alzu
Department	Department of Electronics, Control and Communications
EMail	iherrera@icai.comillas.edu
Profesores de laboratorio	
Teacher	
Name	Antonio José López Angulo
Department	Department of Electronics, Control and Communications
EMail	ajlopez@icai.comillas.edu

DESCRIPTION OF THE SUBJECT

Contextualization of the subject

Prerequisites

Basic knowledge about Digital Electronics, Analog Electronics and Radiofrequency.

Course contents

Contents

Theoretical

Topic 1: Introduction to Integrated Circuit Design

- Integrated Circuit historical evolution, concepts and terminology.
- Introduction to the different integrated circuit technologies, with emphasis on CMOS.
- Integrated Circuit complexity and physical limits of the technology.
- Integrated Circuit markets and applications: consumer, industrial, automotive, aerospace, medical, etc.
- Microelectronics and VLSI technology trends.

Topic 2: Integrated Circuit Manufacturing, Packaging and Test

- Integrated Circuit manufacturing process.
- Photolithography and wafer processing.
- Die packaging process, dicing, bonding, SiP.
- Testing process, wafer level, package level.
- Chip manufacturing trends.

Topic 3: Design Flow for Digital Integrated Circuits

- Design abstraction levels, views and Hardware Description Languages (HDL).
- Requirements specification, design levels, logic simulation.
- Synthesis and Static Timing Analysis (STA).
- Physical/layout semi-custom design.
- Place and Route, power grid, clock tree.
- Design Rule Checking (DRC) and Layout Vs Schematic (LVS).
- Parasitic extraction and post-layout simulation.
- Power simulations.

Topic 4: Design Flow for Analog Integrated Circuits

- Requirements specification, schematic capture, electrical simulation.
- Physical/layout full-custom design.
- Design Rule Checking (DRC) and Layout Vs Schematic (LVS).
- Parasitic extraction and post-layout simulation.
- Power simulations.

Topic 5: Telecommunication Subsystems and Antennas

- Integrated devices for telecommunication subsystems.
- RF circuit and antenna design and integration.
- RF link design.

Practical

- Design of integrated devices and circuits from a requirements specification.
- Review of theoretical concepts about CMOS transistor-level, analog and digital design.

- Use of ECAD Open Source tools for Integrated Circuit design.
- Schematic capture, layout edition, logic and electric simulation, design rule checking (DRC, ERC, LVS).
- Laboratory sessions and Final Project work.
- Timely submission of practical work assignments and Final Project.
- Oral presentation to class mates.

EVALUATION AND CRITERIA

Evaluation activities	Evaluation criteria	Weight
• Mid-Semester Exam • Final Exam	Evaluation of problem solving approach, methodology and numerical resolution. Even if numerical results may be incorrect, the methodology has to be consistent and the reasoning has to be logical.	60
• Lab Sessions • Final Project	Previous work awareness, work result completeness, quality of the results, ability to interpret and describe clearly the practical results, ability to link to theoretical concepts, teamwork, presentation skills, originality.	40

Grading

Acquisition of theoretical knowledge (60%):

- Mid-semester Exam (20%).
- Final Exam (40%).

Acquisition of practical knowledge (40%):

- Lab Sessions (25%).
- Final Project (15%).

Ordinary

Ordinary Grading (Nord) is computed as follows:

- Nord = Nexa_inter * 0,2 + Nexa_final_ord * 0,4 + Nprac * 0,25 + Nproy * 0,15

Where:

- Nexa_inter: mid-semester exam score.
- Nex_final_ord: ordinary final exam score.
- Nprac: lab session average score.
- Nproy: final project score.

Extraordinary

Extraordinary Grading (Nextraord) is computed as follows:

- Nextraord = Nexa_inter * 0,1 + Nexa_final_extraord * 0,5 + Nprac * 0,25 + Nproy * 0,15

Where:

- Nexa_inter: mid-semester exam score.
- Nex_final_extraord: extraordinary final exam score.
- Nprac: lab session average score.
- Nproy: final project score.

Class attendance

Class attendance is mandatory, according to article 93 of the ICAI Academic Normative. The class attendance requirements will be applied separately to the theoretical and practical sessions:

- For the theoretical sessions, failure to fulfill this mandatory norm could prevent the student from taking the ordinary final exam.
- For the practical sessions, failure to fulfill this mandatory norm could prevent the student from taking the ordinary and extraordinary final exam. In any case, the non-justified absences will be penalized in the score.

WORK PLAN AND SCHEDULE

Activities	Date of realization	Delivery date
Schedule Week / Class Part 1 / Class Part 2 1 / Course Info / Introduction to IDT / Introduction to IDT 2 / CMOS Technology / CMOS Technology 3 / CMOS Manufacturing / CMOS Design Basics 4 / Lab1 - Transistor / Lab 1 - Transistor 5 / CMOS Digital Design I / Lab 2 - Inverter 6 / CMOS Digital Design II / Lab 3 - Oscillator 7 / Problem Resolution / Lab 4 - Full Adder 8 / Mid-semester Exam / Mid-semester Exam 9 / CMOS Analog Design I / Lab 5 - Current Mirror 10 / CMOS Analog Design II / Lab 5 - Common Source Amplifier 11 / Chip Design / Problem Resolution 12 / RF Devices Basics / RF Devices Basics 13 / Antenna and RF Links / Problem Resolution 14 / Ordinary Final Exam / Ordinary Final Exam		
Study of the theoretical contents	After each class	
Problem resolution	Weekly	

Lab work and assignment submission	Weekly	Before following lab session
Preparation for Mid-semester Exam	February	
Preparation for Ordinary Final Exam	April	
Final Project work and assignment submission	April-May	Before Ordinary Final Exam

BIBLIOGRAPHY AND RESOURCES

Basic References

Basic:

- N. Weste, D. Harris: "CMOS VLSI Design: A Circuits and Systems Perspective". Addison Wesley/Pearson, 4th Ed., 2011.
- J.M. Rabaey: "Digital Integrated Circuits - A Design Perspective". Prentice Hall, 2nd Ed., 1996.
- R.J. Baker: "CMOS Circuit Design, Layout and Simulation". Wiley, 3rd Ed., 2010.

Complementary:

- B. Razavi: "Design of Analog CMOS Integrated Circuits". McGraw-Hill Edition, International Ed., 2001.
- T.C. Carusone, D.A. Johns, K.W. Martin: "Analog Integrated Circuit Design". Wiley, 2nd Ed., 2012.
- B. Razavi: "RF Microelectronics". Prentice Hall, 2nd Ed., 2012.
- D.M. Pozar: "Microwave Engineering". Wiley, 4th Ed., 2012.
- A. Sedra, K. Smith: "Microelectronics circuits". Oxford University Press, 2011.
- P.R. Gray, R.G. Meyer: "Analysis and Design of Analog Integrated Circuits". John Wiley & Sons, 3rd Ed., 1993.