

## Course guide

# 230606 - ECS - Electronics for Communications Systems

**Last modified:** 11/05/2022

**Unit in charge:** Barcelona School of Telecommunications Engineering  
**Teaching unit:** 710 - EEL - Department of Electronic Engineering.

**Degree:** MASTER'S DEGREE IN ELECTRONIC ENGINEERING (Syllabus 2013). (Optional subject).  
MASTER'S DEGREE IN TELECOMMUNICATIONS ENGINEERING (Syllabus 2013). (Optional subject).  
MASTER'S DEGREE IN ADVANCED TELECOMMUNICATION TECHNOLOGIES (Syllabus 2019). (Optional subject).

**Academic year:** 2022    **ECTS Credits:** 5.0    **Languages:** English

### LECTURER

---

**Coordinating lecturer:** XAVIER ARAGONES

**Others:** XAVIER ARAGONÉS

### PRIOR SKILLS

---

The MOS transistor - Physical structure and Modeling (DC equations). Small-signal model. Concepts of operation point (quiescent point) and response to the small signal. DC and Small-signal analysis of basic analog circuits - the common-source amplifier. Circuit analysis in the Laplace domain.

### REQUIREMENTS

---

The MOS transistor - Physical structure and Modeling (DC equations). Small-signal model. Concepts of operation point (quiescent point) and response to the small signal. DC and Small-signal analysis of basic analog circuits - the common-source amplifier. Circuit analysis in the Laplace domain.

### DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

---

#### Specific:

1. Ability to design and manufacture integrated circuits
2. Ability to use programmable logical devices, as well as to design analog and digital advanced electronics systems. Ability to design communication devices, such as routers, switches, hubs, transmitters and receivers in different bands.
3. Ability to apply advanced knowledge in photonics, optoelectronics and high-frequency electronic
4. Ability to implement wired/wireless systems, in both fix and mobile communication environments.

#### Transversal:

5. EFFECTIVE USE OF INFORMATION RESOURCES: Managing the acquisition, structuring, analysis and display of data and information in the chosen area of specialisation and critically assessing the results obtained.
6. FOREIGN LANGUAGE: Achieving a level of spoken and written proficiency in a foreign language, preferably English, that meets the needs of the profession and the labour market.

## TEACHING METHODOLOGY

- Lectures
- Laboratory classes
- Laboratory practical work
- Individual work (distance)
- Exercises
- Extended answer test (Final Exam)

## LEARNING OBJECTIVES OF THE SUBJECT

Learning objectives of the subject:

The aim of this course is to give students an overview of the problems and issues that must be dealt with when designing circuits for communication transmitter and receiver front-ends, as well as a comprehensive overview of the basic concepts and theoretical foundation of analog/RF design in microelectronic CMOS technology. Concepts will be worked out with practical design exercises to be developed using professional circuit design CAD tools, and hands-on exercises to be developed along the course.

Learning results of the subject

- Understand and analyze circuit solutions to implement the different blocks that constitute the RF/analog part in communication terminals (receivers, transmitters), both wired and wireless.
- Understand the issues that pose a limitation on the operating frequency of these circuits, and the basic techniques for bandwidth extension and operation at high frequency.
- Understand and evaluate the circuit non-idealities and how affect their performance.

## STUDY LOAD

Type	Hours	Percentage
Hours large group	13,0	10.40
Hours small group	26,0	20.80
Self study	86,0	68.80

**Total learning time:** 125 h

## CONTENTS

### 1. Basic CMOS amplification circuits

#### Description:

Basic 1-stage amplifiers: Common-source, common drain.

Bias circuits: the current mirror

Frequency response.

Bandwidth estimation

Bandwidth extension

**Full-or-part-time:** 14h

Theory classes: 14h



## 2. Differential amplifiers

### Description:

Differential amplifiers: resistive load and current mirror load. DC analysis. AC gain and BW. CMRR, PSRR and Slew-Rate.

### Full-or-part-time: 24h

Theory classes: 2h

Laboratory classes: 6h

Self study : 16h

## 3. Narrowband amplifiers. Noise and Linearity.

### Description:

Narrowband amplifiers - The source-degenerated resonant LNA.

Noise analysis in communication circuits - NF.

Linearity in communications systems

### Full-or-part-time: 32h

Theory classes: 4h

Laboratory classes: 6h

Self study : 22h

## 5. Oscillators

### Description:

Definitions and figures of merit

Oscillator types: ring oscillator, relaxation, Colpitts, LC

The LC-CMOS VCO

### Full-or-part-time: 18h

Theory classes: 2h

Laboratory classes: 4h

Self study : 12h

## GRADING SYSTEM

Final examination: 40 %

Partial examinations and exercises: 20 %

Laboratory assessments: 40 %

## BIBLIOGRAPHY

### Basic:

- Carusone, T.C.; Johns, D.; Martin, K.W. Analog integrated circuit design. International student version. New York: John Wiley, 2013. ISBN 9781118092330.

- Lee, T.H. The design of CMOS radio-frequency integrated circuits. 2nd ed. Cambridge: Cambridge University Press, 2004. ISBN 0521835399.

- Razavi, B. Fundamentals of microelectronics. Hoboken: John Wiley & Sons, 2008. ISBN 9780471478461.

## RESOURCES

**Other resources:**

Notes, exercises, tutorials and labs available through the Atenea virtual campus.