Last update: 30-06-2017

230606 - ECS - Electronics for Communications Systems

Coordinating unit: 230 - ETSETB - Barcelona School of Telecommunications Engineering

Teaching unit: 710 - EEL - Department of Electronic Engineering

Academic year: 2017

Degree: MASTER'S DEGREE IN ELECTRONIC ENGINEERING (Syllabus 2013). (Teaching unit Optional)
MASTER'S DEGREE IN TELECOMMUNICATIONS ENGINEERING (Syllabus 2013). (Teaching unit Optional)

ECTS credits: 5 Teaching languages: English

Teaching staff

Coordinator: XAVIER ARAGONES

Others: XAVIER ARAGONÉS, ANTONI TURO, FRANCESC MOLL, DANIEL BARDES

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.

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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

Total learning time: 125h	Hours large group:	13h	10.40%
	Hours medium group:	0h	0.00%
	Hours small group:	26h	20.80%
	Guided activities:	0h	0.00%
	Self study:	86h	68.80%

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Content

1. Basic amplification circuits

Learning time: 14h

Theory classes: 14h

Description:
Basic 1-stage amplifiers: Common-source, common drain.
Bias circuits: the current mirror
Frequency response.
Bandwidth estimation
Bandwidth extension

2. Differential amplifiers

Learning time: 24h

Theory classes: 2h
Laboratory classes: 6h
Self study : 16h

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

3. Narroband amplifiers. Noise and Linearity.

Learning time: 32h

Theory classes: 4h
Laboratory classes: 6h
Self study : 22h

Description:
Narrowband amplifiers - The source-degenerated ressonant LNA.
Noise analysis in communication circuits - NF.
Linearity in communications systems

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4. Power amplifiers	Learning time: 26h Theory classes: 2h Laboratory classes: 6h Self study : 18h

Description:
- Figures of Merit.
- General design considerations. Matching networks
- Basic power amplifiers. Class A, Class B, Class AB and Class C.

5. Oscillators	Learning time: 18h Theory classes: 2h Laboratory classes: 4h Self study : 12h

Description:
Definitions and figures of merit
Oscillator types: ring oscillator, relaxation, Colpitts, LC
The LC-CMOS VCO

Qualification system

Final examination: 40 %
Partial examinations and controls: 20 %
Laboratory assessments: 40 %

Bibliography

Basic:

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

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

Razavi, Behzad. Fundamentals of microelectronics. 2nd ed. Wiley, 2013. ISBN 9781118156322.

Others resources:

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