Course guides
230036 - ECOMSE - Communication Electronics

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

Degree: BACHELOR’S DEGREE IN ELECTRONIC SYSTEMS ENGINEERING (Syllabus 2009). (Compulsory subject).
BACHELOR’S DEGREE IN TELECOMMUNICATIONS TECHNOLOGIES AND SERVICES ENGINEERING (Syllabus 2015). (Optional subject).

Academic year: 2021  ECTS Credits: 6.0  Languages: Catalan

LECTURER

Coordinating lecturer: Mateo, Diego

Others: Turo, Antoni
Aragonés, Xavier
Barajas, Enrique
Altet, Josep

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Generical:
12 CPE N3. They will be able to identify, formulate and solve engineering problems in the ICC field and will know how to develop a method for analysing and solving problems that is systematic, critical and creative.

TEACHING METHODOLOGY

Lectures
Application classes
Laboratory classes
Group work (distance)
Individual work (distance)
Exercises
Short answer tests (Control)
Long answer tests (Final Exam)
Laboratory work

LEARNING OBJECTIVES OF THE SUBJECT

The Student must be able to understand the different specifications of the basic architectures of receivers and transmitters in communications systems as well as their building circuits. The student must be able to design some blocks of a basic transceiver and understand how their different non-idealities affect the system performance.
At the end of the course the student must be able of:
- Understand and describe the requirements and role of each circuit of a transceiver.
- Understand, describe and analyze the different circuital solutions for each of these circuits, their circuital and technological limitations (IC point of view), their different performances compromises and realistic criteria for their design.
- Understand the limits in the frequency response of the circuits analyzed during the course as well as be able of estimating the bandwidth and using basic bandwidth extension techniques.
- Understand and evaluate qualitatively the effects of the non-idealities of the circuits in the system performance.
**STUDY LOAD**

<table>
<thead>
<tr>
<th>Type</th>
<th>Hours</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Hours large group</td>
<td>39,0</td>
<td>26.00</td>
</tr>
<tr>
<td>Self study</td>
<td>85,0</td>
<td>56.67</td>
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<tr>
<td>Hours small group</td>
<td>26,0</td>
<td>17.33</td>
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**Total learning time:** 150 h

**CONTENTS**

1. **General aspects of communication circuits**

**Description:**
- 1.1. Introduction to communication circuits.
- 1.2. Basic concepts in communication circuits.
- 1.3. Figures of Merit. Non-linearities, interferences, noise, sensitivity and dynamic margin.
  - 1.3.1. Estimation of noise parameters.
  - 1.3.2. Linearity, large signal performance and spurious-free dynamic range (IP3 and SFDR).
- 1.4. Non-idealities effects at system level.
- 1.5. Passive RLC networks (resonant and impedance transformers)

**Full-or-part-time:** 17h 55m
- Theory classes: 3h 27m
- Laboratory classes: 2h
- Self study: 12h 28m

2. **Basic transistor stages**

**Description:**
- 2.1. The MOS transistor. Large and small-signal models.
- 2.2. Common-source, common-drain and common-gate topologies.
- 2.3. Current mirror.
- 2.4. Differential pair.
- 2.5. The BJT transistor. Large and small-signal models.
- 2.6. Basic topologies with BJT transistors.

**Full-or-part-time:** 56h 21m
- Theory classes: 8h 54m
- Laboratory classes: 14h
- Self study: 33h 27m
3. Amplifiers for receivers in communication systems

**Description:**
3.1. Bandwidth-estimation techniques.
3.2. Bandwidth-extension techniques.
3.3. Tuned amplifiers.
3.4. Low-noise amplifiers.
3.5. Input impedance matching.
3.6. Transimpedance amplifiers for optical communications.

**Full-or-part-time:** 22h 33m
Theory classes: 5h 24m
Laboratory classes: 4h
Self study: 13h 09m

4. Power amplifiers

**Description:**
4.1. General considerations.
4.2. Figures of Merit.
4.3. Impedance matching.
4.4. Basic power amplifiers. Class A, Class B, Class AB and Class C.
4.5. Switched amplifiers: Class D, Class E and Class F.
4.6. Linearization techniques

**Full-or-part-time:** 22h 33m
Theory classes: 5h 24m
Laboratory classes: 4h
Self study: 13h 09m

5. Signal generators

**Description:**
5.1. Fundamentals of oscillator design.
5.2. Describing function.
5.3. Basic LC and crystal topologies.
5.4. Multivibrators.
5.5. Voltage-controlled variable frequency oscillators.

**Full-or-part-time:** 7h 12m
Theory classes: 3h
Self study: 4h 12m

6. Frequency synthesizers

**Description:**
2. Phase-Locked Loops: basic PLL.
3. First and second-order PLLs. N-integer PLLs
4. Charge-Pump PLLs.
5. Phase detectors.

**Full-or-part-time:** 4h 27m
Theory classes: 4h 27m
# ACTIVITIES

<table>
<thead>
<tr>
<th>(ENG) Proves de resposta llarga (Control)</th>
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<td>Theory classes: 0h 50m</td>
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<th>(ENG) Exercicis</th>
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<td><strong>Full-or-part-time:</strong> 6h 40m</td>
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<td>Theory classes: 6h 40m</td>
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<thead>
<tr>
<th>P1: Tutorial (MOS transistor and CS amplifier)</th>
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<td><strong>Full-or-part-time:</strong> 4h</td>
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<td>Laboratory classes: 4h</td>
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<th>P2: Basic amplifier stages.</th>
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<td><strong>Full-or-part-time:</strong> 4h</td>
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<th>P3: Estimation and BW extension</th>
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<th>P4: Differential pair</th>
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<td>Theory classes: 4h</td>
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<th>P5: Tuned LNA: design</th>
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<td>Laboratory classes: 2h</td>
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<tr>
<th>P6: Tuned LNA: noise and linearity</th>
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<td><strong>Full-or-part-time:</strong> 4h</td>
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<td>Laboratory classes: 4h</td>
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P7: Linear Power Amplifier

Full-or-part-time: 4h
Laboratory classes: 4h

P8: VCOs and signal generators

Full-or-part-time: 4h
Theory classes: 4h

Final Exam

Full-or-part-time: 3h
Theory classes: 3h

GRADING SYSTEM

Final grade based on the respective qualifications of the theory part (60% of the total grade) and the laboratory part (40%). The theory part consists in a final exam (40% of the total grade) and 40% of the continuous grade obtained from a short exam done in the middle of the semester and short works & tasks done at home and delivered during the course. If the final exam grade is greater than the continuous grade, only the final exam is considered.

BIBLIOGRAPHY

Basic: