

## 230036 - ECOMSE - Communication Electronics

Coordinating unit:	230 - ETSETB - Barcelona School of Telecommunications Engineering
Teaching unit:	710 - EEL - Department of Electronic Engineering
Academic year:	2019
Degree:	BACHELOR'S DEGREE IN ELECTRONIC SYSTEMS ENGINEERING (Syllabus 2009). (Teaching unit Compulsory) BACHELOR'S DEGREE IN ENGINEERING PHYSICS (Syllabus 2011). (Teaching unit Optional) BACHELOR'S DEGREE IN TELECOMMUNICATIONS TECHNOLOGIES AND SERVICES ENGINEERING (Syllabus 2015). (Teaching unit Optional)
ECTS credits:	6
Teaching languages:	Catalan

### Teaching staff

Coordinator:	Vidal, Eva Mateo, Diego
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### 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

#### Learning objectives of the subject:

The aim of this course is to give students a clear overview of the problems and issues that must be dealt with on designing electronic circuits for communications as well as a comprehensive overview of the basic concepts, technologies and theoretical foundation of analog/RF electronic design. Concepts will be worked out with examples from practical systems and hands-on exercises to be developed along the course.

#### Learning results of the subject:

- ¿ Understand the principles and concepts involved in designing the RF/analog part of transceiver circuits in a communication system.
- ¿ Understand the relation between receiver specifications and circuit specifications.
- ¿ Ability to analyse and design simple circuits in a RF or optical transceiver.



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### Study load

Total learning time: 150h	Hours large group:	39h	26.00%
	Hours small group:	26h	17.33%
	Self study:	85h	56.67%

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### Content

<p>1. General aspects of communication circuits</p>	<p>Learning time: 17h 55m Theory classes: 3h 27m Laboratory classes: 2h Self study : 12h 28m</p>
<p>Description:</p> <ul style="list-style-type: none"> <li>1.1. Introduction to communication circuits.</li> <li>1.2. Basic concepts in communication circuits.</li> <li>1.3. Figures of Merit. Non-linearities, interferences, noise, sensitivity and dynamic margin. <ul style="list-style-type: none"> <li>1.3.1. Estimation of noise parameters.</li> <li>1.3.2. Linearity, large signal performance and spurious-free dynamic range (IP3 and SFDR).</li> </ul> </li> <li>1.4. Non-idealities effects at system level.</li> <li>1.5. Passive RLC networks (resonant and impedance transformers)</li> </ul>	
<p>2. Basic transistor stages</p>	<p>Learning time: 56h 21m Theory classes: 8h 54m Laboratory classes: 14h Self study : 33h 27m</p>
<p>Description:</p> <ul style="list-style-type: none"> <li>2.1. The MOS transistor. Large and small-signal models.</li> <li>2.2. Common-source, common-drain and common-gate topologies.</li> <li>2.3. Current mirror.</li> <li>2.4. Differential pair.</li> <li>2.5. The BJT transistor. Large and small-signal models.</li> <li>2.6. Basic topologies with BJT transistors.</li> </ul>	
<p>3. Amplifiers for receivers in communication systems</p>	<p>Learning time: 22h 33m Theory classes: 5h 24m Laboratory classes: 4h Self study : 13h 09m</p>
<p>Description:</p> <ul style="list-style-type: none"> <li>3.1. Bandwidth-estimation techniques.</li> <li>3.2. Bandwidth-extension techniques.</li> <li>3.3. Tuned amplifiers.</li> <li>3.4. Low-noise amplifiers.</li> <li>3.5. Input impedance matching.</li> <li>3.6. Transimpedance amplifiers for optical communications.</li> </ul>	

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<p>4. Power amplifiers</p>	<p>Learning time: 22h 33m Theory classes: 5h 24m Laboratory classes: 4h Self study : 13h 09m</p>
<p>Description:</p> <ul style="list-style-type: none"> <li>4.1. General considerations.</li> <li>4.2. Figures of Merit.</li> <li>4.3. Impedance matching.</li> <li>4.4. Basic power amplifiers. Class A, Class B, Class AB and Class C.</li> <li>4.5. Switched amplifiers: Class D, Class E and Class F.</li> <li>4.6. Linearization techniques</li> </ul>	
<p>5. Signal generators</p>	<p>Learning time: 7h 12m Theory classes: 3h Self study : 4h 12m</p>
<p>Description:</p> <ul style="list-style-type: none"> <li>5.1. Fundamentals of oscillator design.</li> <li>5.2. Describing function.</li> <li>5.3. Basic LC and crystal topologies.</li> <li>5.4. Multivibrators.</li> <li>5.5. Voltage-controlled variable frequency oscillators.</li> </ul>	
<p>6. Multipliers</p>	<p>Learning time: 12h 59m Theory classes: 5h 24m Self study : 7h 35m</p>
<p>Description:</p> <ul style="list-style-type: none"> <li>6.1. Definition of characteristic parameters.</li> <li>6.2. Examples of multipliers in bipolar and CMOS technologies. The Gilbert cell.</li> <li>6.3. Additional linearization techniques.</li> </ul>	

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7. Frequency synthesizers	Learning time: 4h 27m Theory classes: 4h 27m
<p>Description:</p> <ul style="list-style-type: none"> <li>7.1. General considerations. Figures of merit.</li> <li>7.2. Phase-Locked Loops: basic PLL.</li> <li>7.3. First and second-order PLLs. N-integer PLLs</li> <li>7.4. Charge-Pump PLLs.</li> <li>7.5. Phase detectors.</li> </ul>	

### Planning of activities

(ENG) Proves de resposta llarga (Control)
(ENG) Presentació oral
(ENG) Exercicis
(ENG) Pràctica de laboratori
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(ENG) Pràctica de laboratori
(ENG) Pràctica de laboratori
(ENG) Proves de resposta llarga (Examen Final)

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### Qualification system

Final grade based on the respective qualifications of the theory (60%) and the laboratory (40%) parts. The theory part consists in 60% from a final exam and 40% from the short exams done and the eventual works & exercises delivered during the course.

### Bibliography

#### Basic:

Razavi, B. RF microelectronics. 2nd ed., int.ed. Upper Saddle River: Pearson Education International, 2012. ISBN 9780137134731.

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.