230671 - US - Ultrasonic Systems. Instrumentation and Applications

Coordinating unit: 230 - ETSETB - Barcelona School of Telecommunications Engineering
Teaching unit: 710 - EEL - Department of Electronic Engineering
Academic year: 2017
Degree: DEGREE IN ELECTRONIC ENGINEERING (Syllabus 1992). (Teaching unit Optional)
ERASMUS MUNDUS MASTER'S DEGREE IN PHOTONICS ENGINEERING, NANOPHOTONICS AND BIOPHOTONICS (Syllabus 2010). (Teaching unit Optional)
MASTER'S DEGREE IN ELECTRONIC ENGINEERING (Syllabus 2009). (Teaching unit Optional)
MASTER'S DEGREE IN ELECTRONIC ENGINEERING (Syllabus 2013). (Teaching unit Optional)
ECTS credits: 5
Teaching languages: English

Teaching staff
Coordinator: Salazar Soler, Jorge
Others: Chavez Dominguez, Juan Antonio
Turo Peroy, Antonio

Degree competences to which the subject contributes

Transversal:
1. 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.
2. 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
- Application classes
- Laboratory practical work
- Individual work (distance)
- Exercises
- Oral presentations
- Extended answer test (Final Exam)

Learning objectives of the subject

Learning objectives of the subject

The aim of this course is to train students in the design, dimensioning and evaluation of ultrasonic systems. The course starts with the basics of waves and stops at the detailed treatment of complete ultrasonic systems putting considerable emphasis on the specific instrumentation and the applications.

Learning results of the subject

- Understanding the general principles, the instrumentation involved and the operation of systems based on ultrasonic waves.
- Ability to design, implement and operate ultrasonic systems.
- Ability to conceive and design electronic circuits for generating and processing ultrasonic signals.
- Ability to analyse, design and evaluate the operation of electromechanical devices used in ultrasonic systems.
- Ability to develop and evaluate ultrasonic measurement techniques for new applications.

<table>
<thead>
<tr>
<th>Study load</th>
<th>Hours large group:</th>
<th>26h</th>
<th>20.80%</th>
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<tbody>
<tr>
<td></td>
<td>Hours medium group:</td>
<td>0h</td>
<td>0.00%</td>
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<tr>
<td></td>
<td>Hours small group:</td>
<td>13h</td>
<td>10.40%</td>
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<td></td>
<td>Guided activities:</td>
<td>0h</td>
<td>0.00%</td>
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<tr>
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<td>Self study:</td>
<td>86h</td>
<td>68.80%</td>
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## Content

### 1. Introduction

**Description:** Overview and history of ultrasound

**Learning time:** 4h
- Theory classes: 2h
- Self study: 2h

### 2. Ultrasound physics

**Description:** Vibrations and waves. Elastic properties of solids. Acoustic waves in solids

**Learning time:** 31h
- Theory classes: 6h
- Laboratory classes: 4h
- Self study: 21h

### 3. Ultrasonic transducers

**Description:** Types (piezoelectric, capacitive, EMAT, SAW, micromachined, composite...). Modelling and simulation of electromechanical devices. Transducer characterization (electrical, acoustical, optical). Ultrasonic beam focusing and steering

**Learning time:** 31h
- Theory classes: 6h
- Laboratory classes: 4h
- Self study: 21h

### 4. Ultrasonic systems

**Description:** Main performance characteristics (dynamic range, impedance matching, bandwidth, propagation medium). Ultrasonic generators (pulsers, burst generators). Conditioning of ultrasonic signals. Measurement techniques

**Learning time:** 32h
- Theory classes: 6h
- Laboratory classes: 5h
- Self study: 21h
5. Applications

**Description:**
Non-destructive testing and evaluation. Ultrasonic imaging. Sensors. Piezoelectric generators. Ultrasound therapy. Other industrial applications

**Learning time:** 27h
- Theory classes: 6h
- Self study: 21h

### Planning of activities

#### LABORATORY

**Description:**
Specification, design, simulation, implementation and characterization of a measurement system based on ultrasonic waves.

#### EXERCISES

**Description:**
Exercises to strengthen the theoretical knowledge.

#### ORAL PRESENTATION

**Description:**
Presentation of an individual work.

#### EXTENDED ANSWER TEST (FINAL EXAMINATION):

**Description:**
FINAL EXAMINATION

### Qualification system

Final work: 40%
Exercises: 30%
Laboratory assessments: 30%
Bibliography

Basic:


Complementary: