

## Course guide

# 230671 - US - Ultrasonic Systems. Instrumentation and Applications

Last modified: 10/11/2022

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

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

### LECTURER

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**Coordinating lecturer:** Consultar aquí / See here:  
<https://telecos.upc.edu/ca/estudis/curs-actual/professorat-responsables-coordinadors/responsables-assignatura>

**Others:** Consultar aquí / See here:  
<https://telecos.upc.edu/ca/estudis/curs-actual/professorat-responsables-coordinadors/professorat-assignat-idioma>

### DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

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#### 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

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- Lectures
- Application classes
- Laboratory practical work
- Individual work (distance)
- Exercises
- Oral presentations

## 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.

## STUDY LOAD

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

**Total learning time:** 125 h

## CONTENTS

### 1. Introduction

**Description:**

Overview and history of ultrasound

**Full-or-part-time:** 4h

Theory classes: 2h

Self study : 2h

### 2. Ultrasound physics

**Description:**

Vibrations and waves. Elastic properties of solids. Acoustic waves in solids

**Full-or-part-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

**Full-or-part-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

**Full-or-part-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

**Full-or-part-time:** 27h

Theory classes: 6h

Self study : 21h

## ACTIVITIES

### LABORATORY

**Description:**

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

**Full-or-part-time:** 12h

Laboratory classes: 12h

### EXERCISES

**Description:**

Exercises to strengthen the theoretical knowledge.

**Full-or-part-time:** 16h

Guided activities: 16h



## ORAL PRESENTATION

**Description:**

Presentation of an individual work.

**Full-or-part-time:** 30h

Guided activities: 30h

## GRADING SYSTEM

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Final work: 40%

Exercises: 30%

Laboratory assessments: 30%

## BIBLIOGRAPHY

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**Basic:**

- Cheeke, J.D.N. Fundamentals and applications of ultrasonic waves. 2nd ed. CRC Press, 2012. ISBN 9781439854945.

**Complementary:**

- Rose, J.L. Ultrasonic waves in solid media. Cambridge: Cambridge University Press, 1999. ISBN 0-521-54889-6.

- Papadakis, E.P. Ultrasonic: instruments and devices: reference for modern instrumentation, techniques, and technology. Academic Press, 2000. ISBN 9780125319515.

- Schmerr, L.W.; Song, S.-J. Ultrasonic nondestructive evaluation systems: models and measurements [on line]. New York: Springer, 2007 [Consultation: 18/07/2017]. Available on: <http://dx.doi.org/10.1007/978-0-387-49063-2>. ISBN 9780387490618.