Universidad Zaragoza

Academic Year/course: 2021/22

31000 - Acoustic engineering

Syllabus Information

Academic Year: 2021/22
Subject: 31000 - Acoustic engineering
Faculty / School: 110 - Escuela de Ingeniería y Arquitectura
Degree: 581 - Bachelor's Degree in Telecomunications Technology and Services Engineering
ECTS: 6.0
Year: 4
Semester: First semester
Subject Type: Optional
Module:

1. General information

1.1. Aims of the course

Acoustic Engineering (AI) is an introductory subject to the physical acoustic phenomena related to the propagation, reflection and transmission of acoustic waves, sound vibration and radiation, electroacoustics and perceptual acoustics. The student is introduced to acoustic engineering applications in the field of architectural acoustics and noise control, acoustic-mechanical-electrical transduction mechanisms, underwater acoustics, and ultrasound and infrasound.

These approaches and objectives are aligned with some of the Sustainable Development Goals, SDG, of the 2030 Agenda (https://www.un.org/sustainabledevelopment/es/) and certain specific goals, in such a way that the acquisition of the Learning outcomes of the subject provides training and competence to the student to contribute to a certain extent to their achievement:

- Goal 3: Ensure healthy lives and promote well-being for all at all ages
  Target 3.d Strengthen the capacity of all countries, particularly developing countries, in early warning, risk reduction and management of national and global health risks
- Goal 8: Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all
  Target 8.2 Achieve higher levels of economic productivity through diversification, technological modernization and innovation, including by focusing on high value-added and labor-intensive sectors
- Goal 9: Industry, innovation and infrastructure
  Target 9.5 Increase scientific research and improve the technological capacity of industrial sectors in all countries, particularly developing countries, including by fostering innovation and significantly increasing, by 2030, the number of people working in research and development per million inhabitants and the spending of the public and private sectors in research and development
  Target 9.1 Develop reliable, sustainable, resilient and quality infrastructure, including regional and cross-border infrastructure, to support economic development and human well-being, with a particular emphasis on affordable and equitable access for all.

1.2. Context and importance of this course in the degree

The Acoustic Engineering subject is a subject corresponding to the 4th year of the Telecommunication Technologies and Services engineering degree, within the mention of Sound and Image. The course is focused on the theoretical study and practical examples of the most basic and general aspects of acoustic engineering. The subject is complemented by the Environmental and Architectural Acoustics subject with which it provides the competencies assigned to the Acoustics block.

A Sound and Imaging Engineer needs a solid foundation in acoustics to tackle the various sound-related problems that he will face in the exercise of his profession. This subject lays the foundations of physical and perceptual acoustics, as well as provides you with an overview of the different applications of acoustic engineering.

1.3. Recommendations to take this course

It is recommended that the student:

1. has successfully completed the subjects related to circuits, signals and systems in the first and second years of the study plan:

Circuits and Systems, Signals and Systems and Digital Signal Processing.

2. has successfully completed the following third-year subjects:

Radiation and Propagation, Audio and Image Processing

2. Learning goals

2.1. Competences

Basic and general competences

CB3 - That students have the ability to gather and interpret relevant data (usually within their study area) to make judgments that include a reflection on relevant issues of a social, scientific or ethical nature

Transversal competences

C1 - Ability to conceive, design and develop Engineering projects.

C3 - Ability to combine general and specialized engineering knowledge to generate innovative and competitive proposals in professional activity

C4 - Ability to solve problems and make decisions with initiative, creativity and critical reasoning.

C6 - Ability to use the techniques, skills and tools of Engineering necessary for the practice of it

C7 - Ability to analyze and assess the social and environmental impact of technical solutions acting with ethics, professional responsibility and social commitment

C9 - Ability to manage information, management and application of technical specifications and legislation necessary for the practice of Engineering.

C10 - Ability to learn continuously and develop autonomous learning strategies

With this subject the following specific technology competencies are obtained:

CSI3 Ability to carry out projects of premises and facilities for the production and recording of audio and video signals.

CSI4 Ability to carry out acoustic engineering projects on: Insulation and acoustic conditioning of premises; public address installations; specification, analysis and selection of electroacoustic transducers; noise and vibration measurement, analysis and control systems; environmental acoustics; underwater acoustic systems.

2.2. Learning goals

R1 Knows and understands the basic acoustic phenomena related to vibrations, acoustic waves and their transmission

R2 Knows and understands what an acoustic circuit is and knows how to analyze simple circuits.

R3 Knows what electroacoustic transducers are and their most common technologies for Microphones, Speakers etc.

R4 Knows the sound perception system of the human being, including the physiology of the auditory system, the mechanism of auditory perception and the psychological and physiological effects of noise

R5 Know the problems of the propagation of sound in closed rooms and in the aquatic environment.

R6 Understand and know the typical acoustic signals and most common applications.

R7 Knows how to implement basic signal processing algorithms and techniques applied to the most typical acoustic signals (for example, voice, music, ultrasound and acoustic signals in biomedical applications.)

2.3. Importance of learning goals

The basic understanding of the Acoustic Engineering subject, as well as the principles on which this subject is based, is totally essential for the exercise of the competences of a graduate in Telecommunication Technologies and Services Engineering in the image and sound itinerary. The entire set of skills acquired in this subject will be very useful for their professional training.

The concepts and techniques developed and the practical training received in this subject will facilitate the understanding of the phenomena related to the processes of emission, transmission and reception of all types of mechanical waves: sounds, infrasound, ultrasound and vibrations and will provide the basis for deepening in more detailed aspects of acoustic engineering applications.

3. Assessment (1st and 2nd call)

3.1. Assessment tasks (description of tasks, marking system and assessment criteria)

E1: Written Tests (60%):

60% of the final grade will be made up of the grade obtained in a written test made up of theory questions and problems. The student must obtain an average mark of at least 4 out of 10 in this section to pass the course.

Passing the exam certifies that the student has achieved the learning results R1, R2, R3, R4, R5, R6 and R7 and the score indicates the depth with which these results have been achieved.

There may be partial tests during the master classes, which will be included in this qualification. Activities will be evaluated in the master classes, class attendance is recommended.

E2: Tutored practical work (20%)

20% of the final grade will be made up of the scores awarded (from 0 to 10) to the deliverables associated with the supervised work carried out by the students. The score indicates the degree of acquisition of the learning outcomes R2, R3, R4, R5 and R7

The analytical and critical capacity of the student will be fundamentally valued in solving medium-sized problems using the necessary calculation and simulation tools, answering the questions posed, and presenting, transmitting and interpreting the results obtained. The initiatives of the students to tackle original solutions will be valued especially positively.

E3: Laboratory work (20%)

20% of the final grade will be made up of the scores awarded to the practical sessions and their results. The evaluation of the practices will be carried out through the documentation requested and the observation of performance and attitude in the laboratory.

Score from 0 to 10 points. The score indicates the degree of acquisition of the learning outcomes R2, R3, R4, R5 and R7.

The laboratory work will evaluate the student's ability to apply knowledge to a practical problem closely related to the theoretical concepts of the subject, their skill in using calculation and simulation tools, answering the teacher's questions, and communicating and transmitting skills.

4. Methodology, learning tasks, syllabus and resources

4.1. Methodological overview

The teaching-learning methodologies that will be used to achieve the proposed learning results are the following:

M1: Participatory master class

Presentation by the teacher of the main contents of the subject (40 hours). This activity will be carried out in the classroom in person or if circumstances require it, not in person through telematic means. In this part of the learning process, students are provided with the theoretical knowledge that enables them to achieve all specified learning outcomes and all specified competencies.

M8: Classroom practices

Proposal and / or resolution of exercises and problems related to the contents of the subject (10 hours). Sometimes the problems are raised in advance, being necessary to invest some work prior to classroom practices (M13). This activity is designed to gradually advance all specified learning outcomes and competencies.

M4: Tutored practical work

As the development of the subject progresses, the teacher will request deliveries associated with the group resolution of practical problems corresponding to the various parts of the syllabus. The results will be accounted for in the form and on the date indicated by the teacher for each delivery. This activity is designed to consolidate all specified learning outcomes and competencies and its development and outcome constitutes one of the assessment activities (E2).

M11: Supervision of supervised practical work

During the practical work each group of students will meet periodically with the teacher to supervise the status of the work, evaluate its progress and resolve doubts (2 hours). The learning outcomes and skills that the student acquires through this activity are common to activity M4.

M9 and M15: Work associated with laboratory practices

The face-to-face part (M9) involves 10 hours in the laboratory or in remote sessions if circumstances so advise, divided into 5 practical sessions lasting 2 hours. The correct use of the practices also requires some previous work to prepare them and some later work to analyze the results and establish concepts (M15). These activities consolidate and reinforce all specified learning outcomes and competencies. In the scripts of each practice, the specific activities to be carried out (face-to-face and non-face-to-face) and the way in which the student has to demonstrate the acquisition of the corresponding results and skills will be specifically detailed, since this work also constitutes one of the evaluation activities (E3).

4.2. Learning tasks

A1. Participatory master classes
A2: Classroom practices
A3: Laboratory practices
A4: Tutored practical work
A5: Tutoring
A6: Evaluation

4.3. Syllabus

Unit 0. Introduction to acoustic engineering
- 0.1. Fields of application
- 0.2. Basic acoustic quantities
- 0.3. Noise, signals and time-frequency representations

Block 1: Physical Acoustics

Unit 1. Vibrant Systems
- 1.1. Damped and forced oscillatory movement.

1.2. Vibration in ropes, bars, membranes and plates.
Unit 2. Acoustic waves
2.1. One-dimensional wave equation
2.2. Three-dimensional wave equation
2.3. Propagation and radiation of acoustic waves
Unit 3. Acoustic filters
3.1. Acoustic elements
3.2. Acoustic circuits
3.3. Silencers

Block 2: Psychoacoustics
Unit 4. Physiology of the human ear
4.1. The ear and its functions
Unit 5. Auditory perception
5.1. Spatial location
5.2. Loudness and loudness level
5.3. Masking
5.4. Critical bands
5.5. Pitch and frequency
5.6. Noise and intelligibility

Block 3: Electroacoustics
Unit 6. Electro-mechanical-acoustic systems.
6.1. Equivalent circuits.
6.2. Transduction.
Unit 7. Speakers
7.1. Electrodynamic Speakers
7.2. Electrostatic speakers
7.3. horns
7.4. Acoustic boxes
Unit 8. Microphones
8.1. Pressure microphones
8.2. Pressure gradient microphones
8.3. Microphone combination
Untt 9. Accelerometers
9.1. Technologies
9.2. Applications

Block 4: Applications
Unit 10. Acoustics in mobile phones
Unit 11. Sound in large venues
Unit 12. Ultrasounds and Infrasound
Unit 13. Underwater acoustics

4.4. Course planning and calendar

The course calendar, both for face-to-face sessions in the classroom and for laboratory sessions, will be determined by the academic calendar established by the center for the course.

The start and end dates of the theoretical and problem classes, as well as the dates of the laboratory practices and global assessment tests will be those set by the School. The delivery dates and monitoring of the tutored practical work will be announced well in advance in class and on the subject's website in the teaching digital ring: https://moodle.unizar.es/.

4.5. Bibliography and recommended resources

http://psfunizar10.unizar.es/br13/egAsignaturas.php?codigo=31000