



IDENTIFYING DATA

Room Acoustics

Subject	Room Acoustics			
Code	V05G300V01635			
Study programme	Degree in Telecommunications Technologies Engineering			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Optional	3rd	2nd
Teaching language	Spanish			
Department	Signal Theory and Communications			
Coordinator	Sobreira Seoane, Manuel Ángel			
Lecturers	Sobreira Seoane, Manuel Ángel			
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General description	Architectural acoustics, develops the fundamental theoretical principles of the architectural acoustics, in the fields of room acoustics and acoustic isolation. The aims of the subject are: provide a sufficient theoretical background that allow the understanding of the behaviour of the sound filed in rooms; define the parameters that allow to evaluate the acoustic quality of rooms; develop the techniques of design that allow to optimise the acoustic behaviour of rooms; detail the parameters that allow to evaluate the acoustic isolation in buildings and introduce the problematic of the calculation of the acoustic insulation in the buildings and building elements.			

Competencies

Code	
B2	CG2: The knowledge, comprehension and ability to apply the needed legislation during the development of the Technical Telecommunication Engineer profession and aptitude to manage compulsory specifications, procedures and laws.
B5	CG5: The knowledge to perform measurements, calculations, assessments, appraisals, technical evaluations, studies, reports, task scheduling and similar work to each specific telecommunication area.
C36	CE36/SI3 The capacity to implement projects at places and installations for the production and recording of audio and video signals.
C37	CE37/SI4 The ability to carry out acoustic engineering projects related to: acoustical isolation and conditioning of rooms, loudspeaker installations, specification, analysis and selection of electro acoustical transducers, measurement, analysis and control of radio vibration systems, environmental acoustics, submarine and acoustical systems.

Learning outcomes

Expected results from this subject	Training and Learning Results	
Knowledge on the theoretical fundamentals of room acoustics.	B2	C36
Ability to analyse the acoustic behaviour of rooms and identify acoustic problems.	B5	C37
Capacity to design solutions to acoustic problems in rooms.		
Capacity to write expert technical reports on room acoustics measurement test and analysis.		
Ability to check and assess the acoustic quality of rooms.		
Capacity to design different kind of rooms matched to the specific acoustic requirements (recording studios, control rooms, conference rooms and classrooms).		

Contents

Topic	
Introduction	Basic concepts in acoustics. Acoustic power, sound pressure, sound intensity. Levels and decibels.
Statistical theory in acoustics.	Average sound pressure in rooms. Reverberation time: Sabine and Eyring equations.
Absorbents and Acoustic Diffusers.	Porous absorbing materials. Membrane and Helmholtz resonators. Acoustic diffusers.

Wave theory in rooms.	Three dimensional wave equation. Resonant frequencies and resonant modes in rooms. Modal density. Frequency response of rooms. The influence of dimension relations and frequency response.
Geometrical theory.	Method of the virtual image. Reflections in flat surfaces. The acoustic behaviour of curved surfaces
Acoustic design of rooms.	Descriptors of room acoustics. Echoes in rooms. Focalization effects in rooms. Acoustic behaviour of audience: seat dip. Geometrical design of rooms. Design of conference rooms and classrooms. Recording studios: LEDE and Non-Environment design techniques.
Acoustic insulation.	Introduction to the acoustic insulation. Acoustic isolation of single panels. Insulation of double walls. Introduction to the flanking transmission evaluation in buildings. Noise control in buildings.

Planning

	Class hours	Hours outside the classroom	Total hours
Supervised work	7	28	35
Computer practices	12	9	21
Previous studies	0	15	15
Lecturing	19	38	57
Problem solving	2	10	12
Short answer tests	2	8	10

*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.

Methodologies

	Description
Supervised work	The students will have to develop and write a report on three small projects: 1. Design and building Helmholtz and membrane resonators. 2. Design and acoustic measurements on scale models. 3. Software to calculate acoustic reflectors and diffusers Through this methodology the general competencies CG2, CG5 and the specific competency CE36 and CE37 are developed.
Computer practices	During practical sessions, the student will learn the use of software to measure and analyse the impulse response of rooms. Through this methodology the general competencies CG5 and the specific competency CE36 and CE37 are developed.
Previous studies	The students must study and prepare with the sources of information given before the lectures and the practical sessions. Through this methodology the general competencies CG2, CG5 and the specific competency CE36 and CE37 are developed.
Lecturing	Lectures will be given, developing the main theoretical concepts of the subject. Through this methodology the general competencies CG2, CG5 and the specific competency CE36 and CE37 are developed.

Personalized attention

Methodologies	Description
Lecturing	Lectures are developed within a continuous interaction framework, where students can answer questions delivered by the teacher. They could also solve their particular doubts during the sessions.
Supervised work	Tutored works are developed in small working groups. The works are followed during meetings between the groups and the teacher. In those meetings the students can interact and ask their questions to the teacher.
Computer practices	In practical sessions, each student must solve his/her own tasks. The teacher will be available during the session to solve any problem/question or doubt the student may have.

Assessment

	Description	Qualification	Training and Learning Results
Supervised work	Tutored practical project, with the delivery of a final report. The learning aims containing the development of the ability to develop projects are assessed through this practical tutored works.	35	C36 C37

Computer practices	Practical tasks, solved in a computer lab with specific acoustic software.	15	B2 B5
Problem solving	Written examination, solving calculation problems. Evaluation of the learning aims, mainly in those aspects related to "know how to carry calculations out" in the field of room acoustics. To be done at the end of the semester in the dates agreed and published by the Degree Academic Comitee (Comisión Académica de Grado-CAG).	25	B5
Short answer tests	Short answers related to the theoretical content of the subject. Evaluation of the knowledge of regulations in the matter of room acoustics. To be done at the mid of the semester in the dates agreed and published by the Degree Academic Comitee (Comisión Académica de Grado-CAG).	25	B2

Other comments on the Evaluation

Following the guidelines of the degree, two systems of evaluation are offered: continuous assessment (recommended) and a final examination. Evaluation with only a final examination will be only allowed in situations in which it is imposible to follow the system recommended.

CONTINUOUS ASSESSMENT:

In order to be qualified following the continuous assessment process, the student will have to attend at least to the 80% of the programmed activities. The continuous assessment will be based in the evaluation of practical task, projects and two tests. Once a student has signed a document of agreement with the process of continuous assessment, the final degree will be obtained by a weighted average of the grades obtained in the methodologies/tests described.

Some considerations on the continous assessment process:

- Tutored works are developed in groups. The final grade will be weighted taking into account the results of a cross assesment survey. To consider as "satisfactory" the contribution of each student to the group a minimum grade of 2 over 5 points is established.
- The student have to show good skills in all the learning outcomes, therefore, four points over a ten points scale must be obtained in all the learning outcomes evaluated during the continuous evaluation process.
- The final grade will be obtained through a weighted average, with the weights included in the qualification column of the methodologies/tests section, once the minimum grade is obtained in each activity. If the 4 over 10 condition in all the activities is not fulfilled, the final grade resulting from the continuous assesment process will be 4 over 10 points.

Final examination: The final examination, both in first or second chance (may/june or july), will include two parts:

- A written examination covering a short answer tests and a troubleshooting part.
- Practical activities: practical questions and delivering the reports of practical works the teacher may ask.
- The final examination will be developed on the official dates published by the acadademic staff.

Those students who have passed the subject following the continuous assessment process, will have the chance to attend the final examination in order to get a higher grade (either in the written part or the practical activities or both).

Those students who did not succeed in some of the parts of the evaluation process, will have the chance to do only the part of the final examination required to fulfill the requirement.

If the subject is passed in first chance, there is no chance to attend the second opportunity to improve the final grade.

The subject is assessed in a 0 to 10 points scale and it is considered "passed" if the final grade obtained is equal or greater than 5.

NON CONTINUOUS ASSESSMENT:

If a student does not sign the agreement to follow the continous assesment process, he/she will be evaluated through the final examination, with the same structure as commented before. The student have to show he/she has got the same skills as the students who have followed the continuous assessment process. The final grade will be obtained by averaging the grades of each part (written examination+ practical questions and reports) provided at least of 4 over 10 points have been obtained en each part. The final grade should be greater than 5 over 10 points.

EXTRAORDINARY CALL:

The same criteria as the established in case of non continuous assessment will be followed for the extraordinary call.

Sources of information

Basic Bibliography

Higini Arau, **ABC de la acústica arquitectónica**,

Heinrich Kuttruff, **Room Acoustics**, 5,

Manuel A. Sobreira, **Acústica Arquitectónica (Apuntes de la Asignatura)**,

Complementary Bibliography

Phillip R. Newell, **Recording Studio Design**, 3,

Lothar Cremer, **Principles and applications of room acoustics**,

Recommendations

Subjects that continue the syllabus

Advanced acoustics/V05G300V01933

Legislation and noise measurement techniques/V05G300V01934

Subjects that it is recommended to have taken before

Fundamentals of Sound and Image/V05G300V01405

Fundamentals of Acoustics Engineering/V05G300V01531
