



IDENTIFYING DATA

Advanced acoustics

Subject	Advanced acoustics			
Code	V05G300V01933			
Study programme	Degree in Telecommunication Technologies Engineering - In extinction			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Optional	4th	1st
Teaching language	English			
Department				
Coordinator	Sobreira Seoane, Manuel Ángel			
Lecturers	García Lomba, Guillermo Sobreira Seoane, Manuel Ángel			
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General description	In this subject, the use of advanced calculation methods in Acoustics are introduced. The Finite Element Method (FEM) and the Boundary Element Method (BEM) are applied to study problems of acoustic radiation, diffraction and modal analysis (calculation of mode shapes and resonance frequencies). Statistical Analysis Methods (SEA) are also introduced and applied to the calculation of flanking transmission in buildings.			

Skills

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.
B7	CG7: The ability to analyze and assess the social and environmental impact of technical solutions.
C75 (CE75/OP18)	The ability to elaborate noise maps and their geographical information display.
C76 (CE76/OP19)	The ability to apply numerical methods in acoustical problem solving.
C77 (CE77/OP20)	The ability to identify industrial noise problems and to design appropriate control solutions.

Learning outcomes

Expected results from this subject	Training and Learning Results	
Knowledge on the application of numerical methods in acoustics.	B2	C75
Knowledge on the application of calculation models of sound transmission in structures.	B5	C76
Knowledge on design techniques of mufflers.	B7	C77
Capacity for understanding the results of complex acoustic measures and relate them with the calculations obtained by means of simulations.		
Knowledge of noise control measures in industrial environments.		

Contents

Topic	
Introduction.	Review of acoustic concepts: impedance, boundary conditions, Helmholtz and Euler equations.
The Finite Elements Method in Acoustics (FEM)	Theoretical introduction to the Finite Element Method. Radiation Problems with FEM. Diffraction Problems. Modal analysis with FEM: resonance frequencies and modes

The Boundary Element Method in Acoustics (BEM)	Introduction to the Boundary Element Method in Acoustics. Integral equation of Kirchhoff Helmholtz. Application to radiation and diffraction problems. The calculation of resonances in BEM.
Calculation methods based in S.E.A. Calculation of sound transmission in buildings.	Building Acoustics: acoustic insulation in buildings and determination of the flanking transmission. Calculation method of the international standard ISO 12354.
Other calculation methods.	Ray tracing and application to evaluation of sound propagation outdoors. Prediction of noise levels in industrial plants. Noise control.

Planning			
	Class hours	Hours outside the classroom	Total hours
Mentored work	6	24	30
Practices through ICT	12	9	21
Previous studies	0	15	15
Lecturing	19	38	57
Problem and/or exercise solving	2	8	10
Essay	2	10	12
Report of practices, practicum and external practices 1		4	5

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

Methodologies	
	Description
Mentored work	The student have develop two projects and deliver the corresponding reports for evaluation. Through this methodology the general competencies CG2, CG5, CG7 and the specific competency CE77 are developed. Transversal competencies as CT3 and CT4 are also developed.
Practices through ICT	The student will work with different software packages to apply the different calculation methods presented un the subject. 1. CAD and mesh generation: FreeCAD and Gmsh. 2. Finite Element calculations : COMSOL. 3. Boundary Element calculations: OpenBEM. 4. Calculations in building acoustics. Through this methodology the specific competencies CE 75, CE67 and CE77 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, CG7 and the specific competencies CE75, CE76 and CE77 are developed.
Lecturing	Lectures will be given, developing the main theoretical concepts of the subject. Through this methodology the general competencies CG2, CG5, CG7 and the specific competencies CE75, CE76 and CE77 are developed.

Personalized assistance	
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.
Mentored 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.
Practices through ICT	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	
Mentored work	Tutored practical project, with the delivery of a final report. The learning aims related to the ability to elaborate projects and application of calculation methods (numerical methods) are assessed. Learning aims related to the identification of problems are also assessed (through the application of numerical calculations).	50	B2 B5 B7	C75 C77
Problem and/or exercise solving	Written test, with short questions on the theory of the subject. Evaluation of learning aims involving knowledge of legislation and how to perform measurements.	25	B2 B5	

Essay	Questions and report of the practical tasks. Evaluation of those learning aims related to noise measurement and analysis of acoustic problems using numerical calculations.	25	B5 B7	C76 C77
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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 impossible to follow the recommended system .

LANGUAGE: Any student can choose which language will use during the assessment process (English, Spanish).

CONTINUOUS ASSESSMENT:

In order to be qualified following the continuous assessment process, the student will have to assist at least to the 80% of the programmed activities. The continuous assessment will be carried out by using the methodologies/tests previously described. Once a student has signed a document of agreement with the process of continuous assessment, he/she will enrolled in the continuous assesment process and in no case he/she will be assesed as "not shown up".

- The short answer test will be done in some of the last weeks of the semester, in the dates approved and published by the academic committee of the degree (CAG).
- Tutored works will be developed in small 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 students have to shown good skills in all the assesed learning aims (at least 4 over 10 points in each learning aim assesed).

The final grade will be obtained through the addition of the marks obtained during the process with the weights given before. At least five over ten points should be obtained to pass the subject. If it happens that the minimum requirement (4 over 10 points in all the learning outcomes) is not fulfilled and the weighted average is greater than 5 points, the final mark will be 4 over 10 points.

The final examination for those students following the countinuous assessment process will be similar to the short answer test and will take place in the published official dates. This final examination will be compulsory for students who have not reached the minimum required mark and optional for students willing to get a higher grade. Those students having less than four points in some of the practical tasks should deliver those aditional jobs required by the teachers of the subject prior the date of the final examination.

Second call:

- A student following the continuous evaluation process could choose between:
 1. A short answer test examination, similar to the written test of the coutinuous assessment process, to be done in the published official date. The marks obtained in the practical tasks and tutored works during the continuous assessment process are preserved and the final grade will be obtained following the same methodology than the described previously. Those students having less than four points in some of the practical tasks should deliver those additional jobs required by the teachers of the subject prior the date of the final examination.
 2. Give up the marks obtained during the continuous assessment process and take the final exam corresponding to the exam-only assessment.

EXAM-ONLY ASSESSMENT:

A final examination is available for those students that for some reason could not follow the continuous evaluation assessment process which will take place in the published official date. The final examination will be designed to guarantee that the students show that all the learning aims have been reached in the same degree as all the students who have followed the continous assessment process. The student should get 5 over 10 points to pass the subject.

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

EXTRAORDINARY CALL:

The same criteria as in case of exam only assessment will be followed for the extraordinary call.

Sources of information

Basic Bibliography

Ciskowski R.D. and Brebbia C.A., **Boundary Element Methods in Acoustics**,
CEN European Standards, **EN 12354-1:2000. Building Acoustics - Estimation of acoustic performance of buildings from the performance of elements - Part 1: Airborne sound insulation between rooms**,
Reddy, J.N., **An introduction to the Finite Element Method**,, 2ª y 3ª ed,
Complementary Bibliography
Johnson C., **Numerical solution of PDE by the finite element method**,
Quarteroni A, Valli A., **Numerical approximation of partial differential equations**,
Juhl, P.M., **The Boundary Element Method for Sound Field Calculations**,

Recommendations

Contingency plan

Description

In this subject a PREVENTIVE, more than REACTIVE ,panning is followed to avoid that in case of exceptional alarm state the planning of the subject is affected.

Besides it is to foresee that, to individual title, some student or any of the professors could see forced to keep in quarantine, well by contagion or by contact with some positive of *COVID. Therefore it proposes :

EDUCATIONAL METHODOLOGIES:

1. It will keep always all the available educational material in the on-line platform of the subject (MOOVI).
2. The platform MOOVI will be the mechanism of communication of incidences, so much to particular level like community. In her it will publish , if necessary, a protocol of concrete performance in front of some concrete emergency.
3. It will supply , in case to be necessary, temporary access to a licence COMSOL so that the students (or some student in particular) can make the practices of remote form in case of confinement/quarantine.

EVALUATION:

Written and presentations will be on-line in case of need. Anyway, any student affected to individual title by a confinement will have the possibility to make on-line evaluation.

The specific details on dates and methodology of on-line evaluation will published in the platform MOOVI.
