

## Course guide

### 205249 - VA - Vibroacoustics

**Last modified:** 19/04/2023

**Unit in charge:** Terrassa School of Industrial, Aerospace and Audiovisual Engineering  
**Teaching unit:** 712 - EM - Department of Mechanical Engineering.

**Degree:** BACHELOR'S DEGREE IN AUDIOVISUAL SYSTEMS ENGINEERING (Syllabus 2009). (Optional subject).  
BACHELOR'S DEGREE IN CHEMICAL ENGINEERING (Syllabus 2009). (Optional subject).  
BACHELOR'S DEGREE IN ELECTRICAL ENGINEERING (Syllabus 2009). (Optional subject).  
BACHELOR'S DEGREE IN INDUSTRIAL ELECTRONICS AND AUTOMATIC CONTROL ENGINEERING (Syllabus 2009). (Optional subject).  
BACHELOR'S DEGREE IN MECHANICAL ENGINEERING (Syllabus 2009). (Optional subject).  
BACHELOR'S DEGREE IN TEXTILE TECHNOLOGY AND DESIGN ENGINEERING (Syllabus 2009). (Optional subject).  
BACHELOR'S DEGREE IN AEROSPACE TECHNOLOGY ENGINEERING (Syllabus 2010). (Optional subject).  
BACHELOR'S DEGREE IN AEROSPACE VEHICLE ENGINEERING (Syllabus 2010). (Optional subject).  
BACHELOR'S DEGREE IN INDUSTRIAL DESIGN AND PRODUCT DEVELOPMENT ENGINEERING (Syllabus 2010). (Optional subject).  
BACHELOR'S DEGREE IN INDUSTRIAL TECHNOLOGY ENGINEERING (Syllabus 2010). (Optional subject).

**Academic year:** 2023    **ECTS Credits:** 3.0    **Languages:** English

#### LECTURER

---

**Coordinating lecturer:** Clot Razquin, Arnau

**Others:** Balastegui Manso, Andreu  
Pàmies Gómez, Teresa  
Arcos Villamarín, Robert  
Romeu Garbí, Jordi

#### PRIOR SKILLS

---

It is highly recommended that the student knows the key concepts of vectorial mechanics (statics, kinematics, and dynamics). It is also recommended that the student has a good mathematical background.

#### REQUIREMENTS

---

None

#### TEACHING METHODOLOGY

---

The teaching method is divided into three types of activities:

- Theoretical lectures: Introduction of the theoretical basis of the subject (concepts, methods, and results), using examples to ease its comprehension.
- Laboratory demonstrations: Experimental demonstrations that aim to clarify the theoretical concepts of the subject.
- Autonomous work: Self-directed study of the course notes and problems presented by the lecturers to gain a deeper understanding of the subject's key concepts.

## LEARNING OBJECTIVES OF THE SUBJECT

Theoretical and experimental understanding of the vibration response of a structural component. Understanding natural modes of vibration and their importance in the study of the response of a system.

Theoretical and experimental understanding of the vibroacoustic response of a structural component. Understanding the noise radiated by a structure and how it is related to its vibration response.

## STUDY LOAD

Type	Hours	Percentage
Hours large group	30,0	40.00
Self study	45,0	60.00

**Total learning time:** 75 h

## CONTENTS

### Module 1: Vibration response of a structural component

#### Description:

Definition of the vibration concepts natural frequency, damping, free and forced response, and frequency response functions. Introduction to the vibration of discrete and continuous systems. Introduction to the simulation of the vibration response of a system.

#### Specific objectives:

To understand the vibration response of a structural component

#### Related activities:

Theoretical lectures, self-guided learning, laboratory demonstration vibrations module, Proposed exercises.

#### Full-or-part-time: 37h 30m

Theory classes: 15h

Self study : 22h 30m

### Module 2: Vibroacoustic response of a structural component

#### Description:

Definition of the basic concepts in acoustics. Introduction to the propagation of sound in outdoors and to its modal behaviour in rooms. Introduction to the numerical simulation of the vibroacoustic response of a system.

#### Specific objectives:

To understand the vibroacoustic response of a structural component

#### Related activities:

Theoretical lectures, self-guided learning, laboratory demonstration vibroacoustics module, Vibroacoustic simulation report.

#### Full-or-part-time: 37h 30m

Theory classes: 15h

Self study : 22h 30m

## ACTIVITIES

---

### Theoretical lectures

**Description:**

Theoretical lectures of the course

**Specific objectives:**

To understand the vibroacoustic behaviour of structural components. To know the calculation methods that allow to predict and analyse this behaviour.

**Full-or-part-time:** 47h

Theory classes: 22h

Self study: 25h

### Submit assignments vibrations module

**Description:**

Submit assignments proposed in the vibration module.

**Specific objectives:**

To be able to solve problems using the acquired knowledge.

**Delivery:**

Solution to the proposed exercises.

**Full-or-part-time:** 7h

Theory classes: 2h

Self study: 5h

### Laboratory demonstration vibrations module

**Description:**

Free and forced vibration of a structural component.

**Specific objectives:**

To know the numerical and experimental techniques used to study the vibration of a structural component.

**Delivery:**

Report of laboratory demonstration.

**Full-or-part-time:** 7h

Theory classes: 2h

Self study: 5h



### Laboratory demonstration vibroacoustics module

**Description:**

Vibration and noise radiated by a structural component.

**Specific objectives:**

To know the experimental techniques used for the study of the vibroacoustic response of a structural component.

**Delivery:**

Submit report of the laboratory demonstration.

**Full-or-part-time:** 7h

Theory classes: 2h

Self study: 5h

### Vibroacoustic simulation

**Description:**

Use of a finite element software for acoustic simulations

**Specific objectives:**

To know the numerical techniques used for the study of the vibroacoustic response of a structural component.

**Delivery:**

Vibroacoustic simulation report.

**Full-or-part-time:** 7h

Theory classes: 2h

Self study: 5h

## GRADING SYSTEM

The final mark of this course is obtained from the following calculation:

$$\text{Final mark} = 0.15 \cdot \text{PV} + 0.35 \cdot \text{LV} + 0.15 \cdot \text{LA} + 0.35 \cdot \text{SA}$$

PV: Deliverable exercises from the vibration module.

LV: Vibrations laboratory report.

LA: Acoustics laboratory report.

SA: Acoustics numerical simulations report.

## EXAMINATION RULES.

The laboratory demonstrations will be done in groups. It will be mandatory to assist to the demonstrations.

The deliverable exercises and the laboratory reports will have to follow the report writing instructions that will be provided during the course.

## BIBLIOGRAPHY

**Basic:**

- Thomson, William Tyrrell. Theory of vibration with applications. 4th ed. Cheltenham: Nelson Thornes, cop. 1993. ISBN 0748743804.
- Beranek, Leo L.; Mellow, Tim J. Acoustics: sound fields, transducers and vibration [on line]. 2nd ed. London: Academic Press, 2019 [Consultation: 21/03/2023]. Available on: <https://www.sciencedirect-com.recursos.biblioteca.upc.edu/book/9780128152270/acoustics>. ISBN 9780128152270.