

M1 Program

The first year of the Master of Science in Acoustics mainly deals with a discovery by the students of various domains of Acoustics and the acquisition of fundamental skills required to understanding acoustic problems.

The first semester includes 4 scientific teaching units, focused on the physical understanding of sound waves.

- **An Introduction to Acoustics: sound and sound propagation** (16h lectures, 16h exercises, 18h practical works). This course aims at explaining the nature of sound, the common quantitative evaluation of sounds and the linear propagation in air. In particular following concepts are introduced: Sound levels and loudness, linearized acoustic equations, speed of sound, sound intensity, plane waves, spherical waves, acoustic impedance, reflection, absorption, transmission, These basic concepts and tools are applied during exercise classes and practical works with popular resolution methods and simple acoustic measurements.

- **Signal processing and speech signal** (12h lectures, 20h ex, 18h pw). This course introduces the common mathematical tools required for modelling and analyzing both signals and systems encountered in Acoustics and speech processing. These tools and concepts are numerically applied to speech signals in laboratory classes.

- **Continuum Mechanics** (30h lectures, 30h ex). This course aims to provide the physical understanding of the mechanical phenomena (hydrodynamics, elasticity, diffusion) that generate or not mechanical waves. This course is composed of three parts: major diffusion and transport phenomena, physical hydrodynamics and linear elasticity.

- **Fundamentals of Mechanics** (44h lectures, 16h ex). This course provides a background in general mechanics and fluid mechanics. This general approach of mechanics allows reviewing the key mechanical concepts encountered in Acoustics (strain, pressure, deformation, velocity, entropy, temperature, kinetic and potential energy, power, conservation equations...).

Language and Project. The educational program of the first semester also includes language, communication and project management courses. In particular, students should gradually be able to follow scientific lectures entirely in French and entirely in English. For students having more difficulties in French or English, weekly sessions of tutored discussions are also offered.

The students must also choose their spring semester project in acoustics (visiting researchers and laboratories), and spend some time the related literature review.

The second semester focusses on the discovery of the various domains of acoustics in industry and research. This is achieved through applied courses, an acoustic project in cooperation with a laboratory, optional courses, and an internship in an acoustic research department:

- **Acoustic Modelling – Numerical Methods for Acoustics** (16h lectures, 10h ex). This course provides the skills that are required to implement numerical simulations in acoustics. The most popular numerical methods implemented in industrial and research computer codes are presented. The different approaches are applied on simple and practical cases. Students carry out a part of the work autonomously.
- **Acoustic Modelling – Project** (autonomous work). Groups of 2 or 3 students are conducting a project they have chosen and that is supervised by a researcher of the master team. The work consists in modelling a simple acoustic problem or in studying a more complex problem. It can include a numerical or experimental part and is partially carried out in one of the laboratories of the Centre Lyonnais d'Acoustique or possibly in collaboration with a company.
- **Vibrations** (16h lectures, 16h ex, 28h pw): general approach of vibrational mechanics, from the oscillator with one or n degrees of freedom, up to continuous models. This course is focused on discrete models of complex systems that provide estimates of resonance frequencies and maximal amplitudes. Practical works are offered by the Lab of Vibrations and Acoustics.

A cycle of **seminars** (24h) and an optional teaching unit consisting in 3 modules to be chosen (3x24h) provide the opportunity to discover various aspects of Acoustics, such as an introduction to Music Acoustics:

- **Acoustics and Music**: characteristics of music signals (physical and perceptive aspects), functional classification of musical instruments, vibro-acoustics of free oscillating instruments, wind instruments, bowed strings and self-oscillating instruments, electro-acoustics, synthesis and processing of music signals.

These optional courses can also open a window on specific industrial domains such as building construction (course of **Materials for Building and Construction**), structural mechanics (course of **Structural Mechanics**), medical applications (course of **Ultrasound Imaging**) – or on specific scientific methods (courses of **Adaptive Filtering, Probabilities and Statistics** or **Finite Elements**).

- **Internship**. The first year of the master ends with a 1-to-3-month internship in a laboratory or a R&D department in Acoustics. Trainee positions in various domains of Acoustics are proposed by the laboratories associated to the master. Students may also complete their internship in a company or in an external lab in any country.