

2021/2022 - M1 IMDEA Course Plan Semester 1

Teaching Unit	Course	Contents	Working hours	ECTS
Acoustics & Mechanics	Acoustics I	Plane wave in rectangular and cylindrical waveguide Reflection, transmission in a waveguide Scattering of plane wave with an interface	60	6
	Room acoustics	Physical phenomena involved in the sound propagation in a room. Control of room acoustics by passive (materials). Measurements of room characteristics, simulate the room acoustics	30	3
	Vibrations I	One Degree of Freedom (DOF) System : free and forced vibrations. Two Degree of Freedom (DOF) System : free and forced vibrations with and without damping. N Degree of Freedom System. From discrete to continuous systems, elementary model for the longitudinal vibrations of a bar Transverse vibrations of strings, transverse vibrations of membranes	20	2
Methodology	Maths for acoustics I	Projection techniques on orthogonal bases. Advanced matrix operations (Projections, LU, QR, Householder, Decomposition in Singular Values). Practical applications of the Hilbertian theory. Approximation by least mean square polynomial or with exponential. Solving a given physical problem through adapted development (orthogonal polynomials).	30	3
	Instrumentation basics	This course is divided into two parts : Instrumentation and metrology for acoustics and vibrations Instrumentation and metrology for electronics	21	2
Signal Processing & Electronics	Electronics Basics	Electronic circuit theory, diodes, impulse response, resonant circuits, active filters, transistor...	12	1
	Signal I	4 to 6 projects in Python dedicated to : - Discrete time signals, Fourier transform - Basics on digital filtering, basics on time frequency transform, basics on beamforming	20	2
	Python for audio	Time domain computing : Python basics and manipulation of sound waves, sound envelopes and synchronous detection. Frequency domain: Spectral analysis, direct and inverse Fourier transforms, frequency resolution, windowing, spectrograms. Musical sounds: analysis & Synthesis of musical sounds Mini Project: simulation of a microphone pair recording and writing of flanging effect function.	24	3
Electroacoustics	Microphone basics	Be able to choose a microphone according to the datasheet. Be able to model (sensitivity) an electrodynamic omnidirectional microphone.	10	1
	Transducers basics	Model an electroacoustic system with an analytical approach and equivalent circuits. Usual characteristics of an electroacoustic chain. Analyze a mechanical system and represent the equivalent electrical diagram. Calculate analytically the response of a mechanical system. Analyze an acoustic system and represent the equivalent electrical diagram. Calculate analytically the response of an acoustic system. Represent the equivalent network to the usual couplings (electromechanical, electroacoustic). Represent the equivalent network to an electrodynamic transducer. Calculate analytically the response (efficiency, sensitivity) of an electrodynamic transducer	20	2
	Loudspeaker system	Model and measure usual loudspeaker systems (sealed enclosure, vented enclosure)	39	4
Professional	Seminars	Seminars given by engineers, researchers working in the field of electroacoustics	10	0
Communication	English	The aim of this course is to know and practice technical English for acoustics, mechanics, electronics and electroacoustics.	18	1
			314	30