2020/2021 – M1 IMDEA Course Plan
Semester 1

Teaching Unit	Course	Contents	Working hours	ECTS
Starter Courses	Acoustics	Exercises on plane wave theory in the time domain and frequency domain.	**15**	**5**
	Mathematics	This courses concerns basics of mathematics in Finite dimension (Bachelor level).	**15**	
	Programming	General principles of Python programming Simple exercises on programming (vectors, matrix, plot, files reading and writing)	**15**	
	Signal	Exercises are proposed on Fourier series decomposition, Fourier transform and Discrete Fourier transform. Some simulations are expected based on Matlab programming	**15**	
	Vibrations	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.	**15**	
	Project	Propagation of a sound wave in a tube coupled to a one degree of freedom excitator	**15**	
Acoustics & Mechanics	Acoustics I	plane lave in rectangular and cylindrical waveguide Reflection, transmission in a waveguide Scattering of plane wave with an interface	**52**	**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	**27**	**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).	**25**	**3**
	Instrumentation basics	This course is divided into two parts : Instrumentation and metrology for acoustics and vibrations Instrumentation and metrology for electronics	**21**	**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**	**2**
Signal Processing & Electronics	Electronics Basics	Electronic circuit theory, diodes, impulse response, resonant circuits, active filters, transistor…	**12**	**1**
	Digital electronics	Introduction to digital electronics, digital signal processing, devices, IDE (integrated development environment).	**10**	**1**
Electroacoustics	Loudspeaker system	Model and measure usual loudspeaker systems (sealed enclosure, vented enclosure)	**39**	**4**
	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**
Professional	Seminars	Seminars given by engineers, researchers working in the field of electroacoustics	**10**	**0**
Communication	English	The aim of this course if to know and practice technical english for acoustics, mechanics, electronics and electroacoustics.	**18**	**1**
			358	**30**