				VH:52	VH:52h30				
Basic Teaching Unit:1.1	Coefficient :3 Credits:3 L T T			TW	Other				
Titled	Sensors-Conditione	rs		15h 00	15h 00	22h 30	55h		
Objectifs	At the end of this mo suited to the measur processing.	odule, the student m rement carried out	ust know ho and know ł	w to cho now to t	oose th format	ne sens t a sig	sor best gnal for		
Focusedabilities									
					L re	evel equire	ment		
Content (blocks of skill)	The subject's conter Courses and Tutori 1) Sensor metrology • Place the sensor in • Associated vocabul speed, influence quar 2) Sensors • resistive, capacitive ultrasonic, Hall effec (photoresistor, photo 3) Measurements of acceleration, tempera 4) Signal conditioner Practical work : • Calibration of diffe Inductive) • Active and passive	nt : als the instrumentation lary (measuring ran ntities, repeatability e, inductive, piezoel ct, interference, opto diode, phototransis input quantities (po ature, pressure, flow rs rent sensors (Resist sensors a measurement cha	chain ge, sensitivit y, fineness, et lectric, therm pelectronic tor), digital s sition, speed v) tive, Capaciti in.	y, linear c.) oelectric ensors, c	ity, c, etc.				
Type of control and monitoring	Continuous monitorii	ng: 60%; Exam: 40	%						

				VH:5	VH:52h30			
Basic Teaching Unit:1.1	1.1 Coefficient :3 Credits:3 L T T			TW	Other			
Titled	Signal processing te	echniques		15h 00	15h 00	22h 30	55h	
Objectifs	At the end of this m implemented in con potential.	odule, the student tinuous signal prod	must know the cessing and	he math know h	ematic ow to	explo	erations	
Focusedabilities								
					L re	evel equire	ment	
Content (blocks of skill)	The subject's conter Courses and Tutori 1) Mathematical basi • Deterministic, cont • Mathematical repre • Spectral analysis • Convolution • Correlation • Sampling 2) Implementations of • Processing of conti correlation, spectral a modulation (amplitue • Hardware and softw software, spectral an Practical work • Processing of differ • Filtering. Noise elin • Image process	nt : als ics of signal process inuous signals esentation. of signal processing nuous-time signals: analysis and energy de, phase, frequenc vare tools for signal alyzer. rent continuous tim mination. ing.	sing techniques convolution interpretatio y). l processing: e signals.	and m, industri	al			
Type of control and monitoring	Continuous monitorii	ng: 60%; Exam: 40	9%					

				VH:5	2h30		
Basic Teaching Unit:1.1		Coefficient :3	Credits:3	L	Τ	TW	Other
Titled	Instrumentation el	ectronics 1		15h 00	15h 00	22h 30	55h
Objectifs	Study of specific tec	chniques involved in	i instrumenta	tion elec	etronic	ës.	
Focusedabilities					L	evel equirer	ment
Content (blocks of skill)	The subject's contect Courses and Tutor 1) Real amplifiers (in rejection, nonlinearination) 2) Linear operation of generators, logarithm 3) Non-linear operation of generators, logarithm 3) Non-linear operation of the subscription of the subscription operation operation of the subscription operation of the subscription operation operat	ent : ials nput current, offset ty, static and dynam (feedback, voltage r nic amplifiers, etc.) ion (oscillators, sign isolation amplifiers y converters, NA, A mplifier : operation of an osci- and adjustment of a conversion and pha	voltage, com nic responses egulators, cu nal generator N N Illator any type of co se-locked lo	nmon mo). rrent rs, oscillator op	ode		
Type of control and monitoring	Continuous monitori	ng: 60%; Exam: 40	9%				

				VH:5	2h30		
Basic Teaching Unit:1.1		Coefficient :3	Credits:3	L	T	TW	Other
Titled	Instrumentation co	mputing 1		15h 00	15h 00	22h 30	55h
Objectifs	At the end of this signals and impleme	module, the studen ant data acquisition	t must know using an acqu	how to	o proc	ess el	ectrical
Focusedabilities							
					L re	evel equire	ment
Content (blocks of skill)	The subject's conte Courses and Tutor 1) Numbering (codin 2) Combinatorial and etc.) 3) Logical componen 4) Principle of quant and DA converters 5) Presentation of a r metrological charact sampling frequency, 6) Programming an acquisition card) Practical work : 1. Combinatorial log 2. Microcontrollers.	nt : ials ng, codes) d sequential functio nts (connection rule tizers, multipliers, s multifunction acqui veristics (resolution, output power). acquisition chain (la gic: Logic gates	ons (registers, es) amplers, bloc sition card ar measuremen anguage, mul	counter ckers, A nd its nt interva tifunctio	s, D Il, on		
Type of control and monitoring	Continuous monitori	ng: 60%; Exam: 40)%				

				VH:52	2h30		
Basic Teaching Unit:1.1		Coefficient :3	Credits:3	L	Τ	TW	Other
Titled	Material properties			15h 00	15h 00	22h 30	55h
Objectifs	Know basic notions system	for shaping and ch	naracterizing	a beam	throu	gh an	optical
Focusedabilities					L	evel equire	ment
Content (blocks of skill)	The subject's conten Courses and Tutori 1) Electrical properti 2) Mechanical prope 3) Thermal propertie 4) Optical properties 5) Magnetic properti Practical work • Traction •Hardness • Resistivity • Hall effect • Photoelectric effect	t : als es rties s es es t netric Analysis (DS	5				
Type of control and monitoring	Continuous monitorii	ng: 60%; Exam: 40	%				

				VH:52h30			
Basic Teaching Unit:1.1		Coefficient :3	Credits:3	L	T	TW	Other
Titled	Wave Optics-Photo	nics		15h 00	15h 00	22h 30	55h
<i>Objectifs</i>	At the end of this m measurement chain a	odule, the student r and exploit the resu	nust know h	ow to in	nplem	ent an	optical
1 ocuseuubuutes							
					L re	evel equire	nent
Content (blocks of skill)	The subject's conten Courses and Tutori 1. The wave model • Concept of light vil • Polarization • Composition of ligh • Two-wave interfere • Interferometric dev (Michelson, Fabry-P 2. Diffraction • Optical and spectro • Laser (principle, ap • Detectors Practical work • Polarization • Two-wave interfere • Interferometric dev • Diffraction	t : als bration ht vibrations, interfe ence (Young slits, t ices and measurem errot) escopic networks oplication) ence (Young slits, t ices and measurem	erence term hin sections) ent technique hin sections) ent technique	es			
Type of control and monitoring	Continuous monitorii	ng: 60%; Exam: 40	%				

				VH:52h30				
Basic Teaching Unit:1.1		Coefficient : 2	Credits:2	L	T	TW	Other	
Titled	Harmonic Analysis	and Statistical An	alysis	15h 00	15h 00	22h 30	55h	
Objectifs	At the end of this m used in the analysi statistical methods of	odule, the student 1 s and know how f estimation, testing	must know the to exploit stand correlated	he mathe their po ion regr	ematic tential ession	cal tecl l, mas 	hniques ster the	
Focusedabilities								
					L re	evel. equire	ment	
Content (blocks of skill)	The subject's content Courses and Tutori 1) Additional analysi • Generalized integra • Numerical series, so • Bessel Plancherel's 2) Probability compl • Binomial law • Poisson's law • Normal law • Exponential law 3) Inferential statistic • Sampling law • Estimates • Hypothesis testing • Correlation regress	nt : als is is eries, and Fourier tr theorem ements cs	ransform					
Type of control and monitoring	Continuous monitorii	ng: 60%; Exam: 40	%					

			VH:52h30					
Basic Teaching Unit:1.1		Coefficient :2 Credits:2 L T		Τ	TW	Other		
Titled	Metrology 2 and Qu	uality 1		15h 00	15h 00	22h 30	55h	
Objectifs	At the end of this me standards and the qu managing a fleet of r	odule, the student n ality approach and neasuring instrume	nust become acquire the t nts.	aware o first noti	f the i ons of	import f the to	ance of ools for	
Focusedabilities								
					L re	ævel equirer	nent	
Content (blocks of skill)	The subject's contex Courses and Tutori Metrology • Deepen the notions 1), in terms of determ method), in the case • Metrological functi management system • Calibration docume • Organization of me metrology, accredita traceability). Quality assurance • Good laboratory pr • Presentation of qua • Organization of qua • Organization of qua • Organization of qua • Calibration and ver • Use of a spreadshee • Writing procedures	nt : als of metrology acquining measurement of independent company: (ISO 10012) ents and verification etrology: internation tion, and certification actices lity standards ality in the company ification of a measure according to stand	ired in the m at uncertainty aponents. measurements n documents. nal, national, on (connection y (ISO 9000 uring instrum rement data ards	odule (N (GUM nt legal on, series) nent	ſetr			
Type of control and monitoring	Continuous monitorii	ng: 60%; Exam: 40	9%					

			tient :2 Credits:2 VH:52h30				
Basic Teaching Unit:1.1	,	Coefficient :2	Credits:2	L	Τ	TW	Other
Titled	Fluid mechanics			15h 00	15h 00	22h 30	55h
Objectifs	At the end of this mo a hydraulic installation	odule, the student n on. Estimate energy	nust know ho v losses in a f	ow to de low.	sign a	nd/or 1	manage
Focusedabilities							
					1	Lev require	vel ement
Content (blocks of skill)	The subject's content Courses and Tutori 1) Fluid statics. 2) Viscosimetry. 3) Fundamental equa 4) Dynamics of real 1 pressure losses, chart 5) Sensors of charact viscosity) Practical work : • Fluid statics: forcest container, Archimed • Fluid dynamics: met losses. • Viscosimetry: Meat methods. Influence of • Comparison of sense	nt : als ations of perfect flui fluids (stationary fle ts) teristic quantities (p s exerted by a fluid ean thrust. easurements of sing surement of viscosi of temperature. sors: flow measurer	ids. ows, singular pressure, flow on the walls gular and line ty by differe nents.	r and lin v, speed, of a ar pressu	ear		
Type of control and monitoring	Continuous monitorii	ng: 60%; Exam: 40	%				

				VH:52h30					
Basic Teaching Unit:1.1		Coefficient :2	Credits:2	L	Τ	TW	Other		
Titled	Thermal machines,	Cryogenics		15h 00	15h 00	22h 30	55h		
Objectifs	At the end of this thermal machines wi	module, the studer	nt must knov ees, as well as	w the op s cryoge	peration nic tec	on of chniqu	various es.		
Focusedabilities									
					L re	evel equire	ment		
Content (blocks of skill)	 Ine subject's conten Courses and Tutori 1) Changes of states 2) Cycles with or wi 3) Thermal machines 4) Exchangers 5) Diagrams 6) Steam engines 7) Refrigerating macc 8) Cryogenics: Liqued technology Practical work The thermal engines Refrigerating mach Determination of la of heat exchanges in Cryogenerator: Enerefrigeration cycles Liquefier: Liqueface Exchangers. Change of state: draw 	t : ials thout phase change. s: Driving and recei chines and heat pum effiers and Cryogene a cryostat. ergy balance, coeffi ction yield, Factor o aw the vapor pressu	iving machin perators. Cryos zation. Therm cient of perfo of merit ure curve of I	es. genic nal analy ormance _N2	vsis				
Type of control and monitoring	Continuous monitori	ng: 60%; Exam: 40)%						

	VH:52h30						
Basic Teaching Unit:1.1	,	Coefficient :2	Credits:2	L	Τ	TW	Other
Titled	Supervised project			15h 00	15h 00	22h 30	55h
Objectifs	Research, structure environments and tra Select information in Identify the different	and integrate inf aning courses. a relevant manner. stages of the project	ormation on	profes	sions,	profe	essional
Focusedabilities							
					L re	evel equire	nent
Content (blocks of skill)	Discovery of profess the following approa 1) Preparation for a o 2) Working from a p different professions post-Bachelor's surve 3) Carrying out job s workplace, etc.), doc comparing the inform 4) Business conferen 5) Raising awareness protection 6) Introduction to the 7) Help with the orga	ions and profession iches: company or organiz roduct or service, ic that lead to its man eys, graduates' care surveys (interviewin curveys (interviewin curventary research nation collected in laces. s of the risks associa e project approach: anization of events,	al environme ation visit, dentification ufacture, Pre er paths, etc. og a professio on the same j both ways, ated with pro actors, specif alumni days	ents usir of the sentatio nal at th ob, and fessions ications	n of heir and		
Type of control and monitoring	Continuous monitori	ng: 60%; Exam: 40	%				

				VH:52			
Basic Teaching Unit:1.1		Coefficient :2	Credits:2	L	Т	TW	Other
Titled	Languages, Culture	e and Communicat	tion 3	15h 00	15h 00	22h 30	55h
Objectifs	At the end of this m scientific and technic	odule, the student cal project.	must know l	how to a	argue	and pr	esent a
Focusedabilities							
Content (blocks of skill)	The subject's contex The programs in the modules (LCC1) argumentation and th project is introduced languages.	nt : three languages and and (LCC2). In he development of . Emphasis will be p	re similar to addition, a scientific a placed on the	those of training and techn two for	f the in nical reign		
Type of control and monitoring	Continuous monitorin	ng: 60%; Exam: 40	9%				

			Credits:3	VH:52h30					
Basic Teaching Unit:1.1	,	Coefficient :3		L	Τ	TW	Other		
Titled	Electrochemical an	d separation analy	15h 00	22h 30	55h				
Objectifs	At the end of this mod methods of physico-cl	dule, the student mu hemical analysis an	ist know how d interpret th	v to impl eir resul	ement ts.	the m	nain		
Focusedabilities					F				
					L	evel equire	ment		
Content (blocks of skill)	The subject's contex Courses and Tutori 1) Selective and indi 2) Conductivity. 3) Voltammetry. 4) Polarography. 5) Potentiometry. 6) Amperometry. 7) Gas and liquid chr Practical work : • Conductimetry. • Voltammetry. • Polarography. • Potentiometry. • Amperometry. • Gas phase and liquid	nt : ials cator electrodes romatography id phase chromatog	raphy						
Type of control and monitoring	Continuous monitori	ng: 60%; Exam: 40	%						

				VH:52h30			
Basic Teaching Unit:1.1	1	Coefficient :3	Credits:3	L	T	TW	Other
Titled	Low pressure techn	pressure technique: Vacuum					
Objectifs	Have the knowledge	to design and oper	ate a vacuum	n installa	tion		
Focusedabilities							
					L	ævel equirer	ment
Content (blocks of skill)	 The subject's content : Courses and Tutorials Properties of gases (mean free path, shocks on the walls, laminar regime, molecular regime) Production of vacuum (linked to volume, linked to surfaces) Pumps, conductances, gas flow Legal units and in use Low-pressure measurements Choice of components and materials Leak detection Application (development of thin layers) Practical work : Determination of the conductance of a pipe. Measurement of gas flow, pressure, and flow. Measurements of pumping speeds of primary pumps (vane, Roots, diaphragm, spiral, etc.). Preempting time of an enclosure. Limit pressure and degassing. Secondary vacuum: determination of the pumping speed of a secondary pump (oil diffusion pump, turbomolecular pump, cryogenic pump, etc.). Secondary pressure sensor (ionization gauge). Gas analysis by mass spectrometry. 						
Type of control and monitoring	Continuous monitori	ng: 60%; Exam: 40	0%				

				VH:52h30					
Basic Teaching Unit:1.1		Coefficient :3	Credits:3	L	T	TW	Other		
Titled	Automatic			15h 00	15h 00	22h 30	55h		
Objectifs	At the end of this m physical quantity (te	odule, the student mperature, power, s	must know h speed, etc.).	low to re	egulate	e or co	ontrol a		
Focusedabilities									
					L re	evel equire	ment		
Content (blocks of skill)	The subject's conte Courses and Tutori 1) Open systems, clo 2) Laplace transform 3) Transfer functions 4) Stability criteria 5) PID regulation Practical work : • Simulation and des • PID loop: temperat	nt : ials osed systems s, static and dynami sign support tools (C ure regulation	c behavior CAD)						
Type of control and monitoring	Continuous monitori	ng: 60%; Exam: 40	9%						

				VH:52h30				
Basic Teaching Unit:1.1		Coefficient :3	Credits:3	L	T	TW	Other	
Titled	Instrumentation ele	ectronics 2		15h 00	15h 00	22h 30	55h	
Objectifs	At the end of this me a signal in order to re	odule, the student n educe the influence	nust know ho of external d	ow to ele listurban	ectroni ces.	ically	process	
Focusedabilities								
					L re	evel equire	ment	
Content (blocks of skill)	The subject's conter Courses and Tutori 1) Random signals (n 2) Protection techniq isolation, optoelectro 3) Extraction of a use homodyne and hetere accumulator-averagi Practical work The differential amp Active filtering and of Oscillators and signal Special techniques in	nt : ials noise, disturbances) ues against spuriou onic couplers) eful signal from bac odyne detection (sy ng). lifier and the instrument enforcement al generator n instrumentation el	s signals (ga ekground noi nchronous de mentation an ectronics	lvanome se, etector, nplifier	etric			
Type of control and monitoring	Continuous monitorin	ng: 60%; Exam: 40	9%					

				VH:52			
Basic Teaching Unit:1.1		Coefficient :2	Credits:2	L	Т	TW	Other
Titled	Metrology 3 and Q	Metrology 3 and Quality 2 15h 15 00 00					
Objectifs	At the end of this me standards and the qu managing a fleet of r	odule, the student n ality approach and neasuring instrume	nust become acquire the nts.	aware o first noti	f the i ons of	mport f the to	ance of ools for
Focusedabilities							
					L re	evel equire	ment
Content (blocks of skill)	The subject's conte Courses and Tutori • Good laboratory pr • Notions on the prac- testing laboratories (• Environmental man	nt : ials actices ctice of quality assu ISO 17025 standard nagement systems (rance in cali l) ISO 14000 s	bration a eries)	nd		
Type of control and monitoring	Continuous monitori	ng: 60%; Exam: 40	%				

				VH:52h30					
Basic Teaching Unit:1.1		Coefficient :3 Credits:	Credits:3	L	T	TW	Other		
Titled	Vibrational and acc	Vibrational and acoustic mechanics15h15h0000				22h 30	55h		
Objectifs	Know the basics of v	vibration mechanics	and acousti	cs.					
Focusedabilities									
					L re	evel equire	ment		
Content (blocks of skill)	The subject's content : Courses and Tutorials Vibration mechanics Mass-spring system: free and forced oscillations with one degree of freedom, damping, transmissibility, resonance. Acoustics: physical bases, propagation, measurements of characteristic quantities. Practical work : •Speakers. • Kundt tube • Vibrating rope. • Ultrasound Interference								
Type of control and monitoring	Continuous monitori	ng: 60%; Exam: 40)%						

Basic Teaching Unit:1.1		Coefficient :3	Credits:3	VH:52h30					
				L	T	TW	Other		
Titled	Supervised project		·	15h 00	15h 00	22h 30	55h		
Objectifs	Training in the meth Different types of pr	odological approact	h in research sed	and dev	elopm	lent			
Focusedabilities									
					L re	evel equire	ment		
Content (blocks of skill)	The subject's conte	nt :							
Type of control and monitoring	Continuous monitori	ng:							

				VH:52				
Basic Teaching Unit:1.1		Coefficient :2	Credits:2	L	T	TW	Other	
Titled	Languages, Culture	Languages, Culture and Communication 415h 0015h 00						
Objectifs	At the end of this m issues and human res	odule, the student sources managemen	should have a	some ide	eas ab	out lal	oor law	
Focusedabilities								
					L	Level		
					re	equire	nent	
Content (blocks of skill)	 The subject's content : 1) Labor law 2) Introduction to Human Resources Management: Recruitment, employment contract, understanding a pay slip. 							
Type of control and monitoring	Continuous monitorii	ng: 60%; Exam: 40	%					