DENOMINACIÓN ASIGNATURA: ELECTRONICS INSTRUMENTATION IN ENERGETIC SYSTEMS								
GRADO:		**Grado en Ingeniería de la Energía (BILINGÜE)** **BACHELOR IN ENERGY ENGINEERING**				**CURSO: 4º**		**CUATRIMESTRE: 2º**
WEEKLY PROGRAMMING								
WEEK	**SESSION**	**CONTENT DESCRIPTION**	**GROUPS (Marcar X)**		SPECIAL ROOM FOR SESSION (computer class room, audio-visual class room,…)	**WEEKLY SCHEDULE FOR STUDENTS**		
			LECTURE	**SEMINAR**		**DESCRIPTION**	**CLASS HOURS**	**HOMEWORK** Max 7h per week
1	1	**1. INTRODUCTION** (goals, skills, methodology, EIES schedule) **2. SENSORS AND TRANSDUCERS** 2.1 What a transducer is? 2.2 Pros & cons of transducers (electrical) 2.3 Active and passive sensors 2.4 Sensors classification approach **3. TRANSDUCER PERFORMANCE –SPECIFICATIONS** 3.1 Introduction: static and dynamic regime 3.2. Accuracy, precision 3.3. Calibration curve 3.4. Full-scale and measurement range 3.5. Sensitivity 3.6. Linearity 3.7. Resolution and threshold 3.8. Repeatability, hysteresis and stability 3.9 Bandwidth EXAMPLES	X			Students must propose an example of instrumentation system in real life. Block diagram Students must propose some sensor examples sensors they are familiar with Understand concepts and order of magnitude of sensitivity in different sensors. Understand concepts and order of magnitude of linearity & hysteresis in different sensors Evaluation and analysis of sensor's performance and specifications	1.66	4
2	2	**4. SIGNAL CONDITIONING I** 4.1 Signal conditioning circuits 4.2 Potentiometric circuit 4.3 Wheatstone bridge (WB) EXAMPLE EXERCISES: static performance EXERCISES: signal conditioning - potentiometric circuit and WB	X			Understand different potentiometric circuits. When they should be used and proper circuit design. Potentiometric circuit exercises. Ro analysis for max sensitivity. Small-signal drawback. Understand Wheatstone bridge circuit properties, usefulness: small-signal, linearity, balanced, … Correct Wheastone bridge choice when amplifying. Estimate sensitivity, linearity, hysteresis,… from calibration curves. Basic error analysis	1.66	4

3	3	**4. SIGNAL CONDITIONING II** 4.4 Amplification 4.4.1. Amplifier characteristics. 4.4.2. Load effects 4.4.3. Ideal O.A. O.A. when open loop and feedback (inverting, non-inverting, adder, subtractor, etc.) 4.4.4. Differential amplification 4.4.5 Instrumentation amplifier SIGNAL CONDITIONING EXERCISES: Wheatstone Bridge and Amplification	X			Identify the need for amplification Operational amplifier-based circuits and schemes I-V converter Brief introduction to instrumentation amplifier Exercises including Wheatstone bridge + strain + instrumentation amplifier	1.66	4
4	4	**5. TRANSDUCERS FOR TEMPERATURE MEASUREMENTS** 5.1 Applications. Definition, scales, … 5.2. Temperature measurements through mechanical effects 5.3. Thermometry by ICs. 5.4. Resistive temperature sensors 5.5. Thermistors / Thermocouples 5.6. Comparative Temperature Sensors: EXERCISES first approach	X			Identify most used commercial and off-the-shelf temperature sensors and signal conditioning, being able to select among them depending on the application	1.66	6
5	5	Temperature Sensors: EXERCISES. Thermistor / thermocouples / RTD		X			1.66	
6	6	**6. STRAIN SENSORS** 6.1. Applications of interest. Basic concepts: extensiometry. 6.2. Principle of operation. 6.3. Strain gauges: types. 6.4. Static performance and orientation. 6.5. Signal conditioning. Strain sensor EXERCISE: first approach	X			Basic strain measurement principles. Basis on extensiometry: deformation, units, concepts, … Signal conditioning circuits	1.66	4
7	7	Strain Sensors: EXERCISES AND GUIDELINES		X		Exercises including Wheatstone bridge + strain + instrumentation amplifier	1.66	3
8	8	**7. DISPLACEMENT AND LEVEL SENSORS** 7.1. Applications. Definition, scales, … 7.2. Resistive potentiometers. 7.3. Hall effect sensors. 7.4. Inductive and capacitive sensors. 7.4.2. Measuring circuits.	X			Identify most used comercial and off-the-shelf position, level and displacement Sensors, being to select ampng them depending on the application.	1.66	7

9	9	**4. SIGNAL CONDITIONING II** 4.5 Modulation / Demodulation in instrumentation systems 4.5.1 Introduction. Pros and cons. 4.5.2. AM modulation: characteristics and ways to implement. 4.5.3. FM modulation: characteristics and ways to implement. 4.6. Analog-to-Digital conversion 4.6.1. A/D and D/A conversion; definition; 4.6.2. A/D Amplitude and time discretization. Impact on the measuring performance. 4.7. Instrumentation system: a perspective. Modulation / Demodulation + position: EXERCISES	X			Proper selection of modulation type, frequency, filtering, etc. Modulation, demodulation: resume. Signal conditioning: proper selection of sampling frequency, number of bits. System block diagram: basis of A/D and D/A converters Position and level sensors: EXERCISES Modulation & Demodulation exercises	1.66	7
10	10	**8. OPTICAL SENSORS** 8.1 Light properties. Photometry: units. Optical sources and specifications 8.2. Photoconductive cell. 8.3. PN junctions: photodiodes 8.4. Photovoltaic cell. 8.5. Fiber-optic Sensors EXERCISES: optical sensor systems	X			Knowing light properties for measuring. Optical sensor types. Signal conditioning for optical sensors.	1.66	6
11	11	**LAB PROJECT - SESSION 1**		X	LAB	**INDIVIDUAL PORTFOLIO DELIVERY**	1.66	
12	12	**LAB PROJECT - SESSION 2**		X	LAB		1.66	
13	13	**LAB PROJECT - SESSION 3**		X	LAB	**INDIVIDUAL REPORT DELIVERY**	1.66	
14	14	**LAB PROJECT - SESSION 4**		X	LAB		1.66	
15	15	¿EXERCISES UPON REQUEST? Pending questions…	X			Exercises (to be determined). Weak points reinforcement. Review of basic aspects or unclear issues. Recommendation: students must fill in the electronic survey for quality assurance IF AVAILABLE Feedback from students	1.66	
SUBTOTAL							**30 + 45 + 12 = 88**	
LABORATORIOS (presencial) en semanas marcadas (P1) y (P2) en cronograma y trabajo posterior no contemplado en el apartado anterior							**8+6**	
15		Tutorials, mentoring hours, handling, etc.		x		¿Tutoría colectiva para resolver dudas de toda la asignatura?	3	7
16-18		Assessment		x			3	17
TOTAL							**102**	

LAB SESSIONS SCHEDULE						
SESSION	**WEEK**	**DESCRIPTION**	**LAB**	**WEEKLY SCHEDULE FOR STUDENT**		
				DESCRIPTION	**CLASS HOURS**	**HOMEWORK** Max 7h per week
1	11	LAB PROJECT/S SELECTED BY STUDENTS			2	1.5
2	12	LAB PROJECT/S SELECTED BY STUDENTS			2	1.5
3	13	LAB PROJECT/S SELECTED BY STUDENTS			2	1.5
4	14	LAB PROJECT/S SELECTED BY STUDENTS			2	1.5
TOTAL					8+4	

(*) Sólo se incluye el tiempo del análisis posterior de los resultados, pues la preparación anterior a las sesiones de laboratorio está contemplada en el cronograma estándar pues es un trabajo participativo que se discute en el aula

La entrega de los informes finales de prácticas y cuestionarios previos se adaptará al calendario en función de las fechas de festivos finalmente aprobados por la Comunidad Autónoma