| DENOMINACIÓN ASIGNATURA: ELECTRONIC INSTRUMENTATION IN ENERGETIC SYSTEMS | | | | | | | | |
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| **GRADO:** | | **Grado en Ingeniería de la Energía (INGLÉS)**<br>**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)<br>**2. SENSORS AND TRANSDUCERS**<br>2.1 What a transducer is?<br>2.2 Pros & cons of transducers (electrical)<br>2.3 Active and passive sensors<br>2.4 Sensors classification approach<br>EXAMPLES | X | | | Course syllabus and guidelines<br>Basic concepts about electronic sensors<br><br>**SPOC course** | 1.66 | 2 |
| 2 | 2 | **3. TRANSDUCER PERFORMANCE –SPECIFICATIONS**<br>3.1 Introduction: static and dynamic regime<br>3.2. Accuracy, precision<br>3.3. Calibration curve<br>3.4. Full-scale and measurement range<br>3.5. Sensitivity<br>3.6. Linearity<br>3.7. Resolution and threshold<br>3.8. Repeatability, hysteresis and stability<br>3.9 Bandwidth<br>EXAMPLE: sensor characteristics / static performance | | | | Understand concepts and order of magnitude of sensitivity in different sensors.<br>Understand concepts and order of magnitude of linearity & hysteresis in different sensors<br>Evaluation and analysis of sensor's performance and specifications<br>**SPOC course** | 1.66 | 2 |
| 3 | 3 | **4. SIGNAL CONDITIONING I**<br>4.1 Signal conditioning circuits<br>4.2 Potentiometric circuit<br>4.3 Wheatstone bridge (WB)<br>EXAMPLE<br>EXERCISES: signal conditioning - potentiometric circuit and WB | X | | | Understand different potentiometric circuits. When they should be used and proper circuit design.<br>Potentiometric circuit exercises.<br>Ro analysis for max sensitivity. Small-signal drawback.<br>Understand Wheatstone bridge circuit properties, usefulness: small-signal, linearity, balanced, …<br>Correct Wheastone bridge choice when amplifying.<br>**SPOC course** | 1.66 | 4 |

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| 4 | 4 | **4. SIGNAL CONDITIONING II**<br>4.4 Amplification<br>4.4.1. Amplifier characteristics.<br>4.4.2. Load effects<br>4.4.3. Ideal O.A. O.A. when open loop and feedback (inverting, non-inverting, adder, buffer, etc.)<br>4.4.4. Differential amplification<br>4.4.5 Instrumentation amplifier | X | | | Identify the need for amplification<br>Operational amplifier-based circuits and schemes<br>I-V converter<br>Brief introduction to instrumentation amplifier<br><br>Exercises including Wheatstone bridge + strain + instrumentation amplifier | 1.66 | 4 |
| 5 | 5 | **5. TRANSDUCERS FOR TEMPERATURE MEASUREMENTS**<br>5.1 Applications. Definition, scales, …<br>5.2. Temperature measurements through mechanical effects<br>5.3. Thermometry by ICs.<br>5.4. Resistive temperature sensors<br>5.5. Thermistors / Thermocouples<br>5.6. Comparative<br>Temperature Sensors: EXERCISES first approach<br><br>SIGNAL CONDITIONING EXERCISES: Wheatstone Bridge and Amplification- PRACTICE 1 REPORT | | | | Identify most used commercial and off-the-shelf temperature sensors and signal conditioning, being able to select among them depending on the application<br>**SPOC course** | 1,66 | 3 |
| 6 | 6 | **PRACTICE 1: TEMPERATURE SENSOR CALIBRATION (I)** | | | **LAB** | | 1.66 | 7 |
| 7 | 7 | **PRACTICE 1: TEMPERATURE SENSOR CALIBRATION (II)** | | | **LAB** | | 1.66 | |
| 8 | 8 | **6. STRAIN SENSORS**<br>6.1. Applications of interest. Basic concepts: extensiometry.<br>6.2. Principle of operation.<br>6.3. Strain gauges: types.<br>6.4. Static performance and orientation.<br>6.5. Signal conditioning.<br>Strain sensor EXERCISE: first approach<br><br>SIGNAL CONDITIONING EXERCISES: Wheatstone Bridge and Amplification- PRACTICE 2 REPORT | | X | | Basic strain measurement principles.<br>Basis on extensiometry: deformation, units, concepts, …<br>Signal conditioning circuits | 1.66 | |
| 9 | 9 | **PRACTICE 2: STRAIN GAGES** | | | **LAB** | | 1.66 | 4 |

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| 10 | 10 | **7. DISPLACEMENT AND LEVEL SENSORS**<br>7.1. Applications. Definition, scales, …<br>7.2. Resistive potentiometers.<br>7.3. Hall effect sensors.<br>7.4. Inductive and capacitive sensors.<br>7.4.2. Measuring circuits.<br>**4. SIGNAL CONDITIONING II**<br>4.5 MODULATION / Demodulation in instrumentation systems<br>4.5.1 Introduction. Pros and cons.<br>4.5.2. AM modulation: characteristics and ways to implement.<br>4.6 FILTERING<br><br>SIGNAL CONDITIONING EXERCISES: - PRACTICE 3 REPORT | | X | | Identify most used comercial and off-the-shelf position, level and displacement Sensors, being to select ampng them depending on the application.<br>Proper selection of modulation type, frequency, filtering, etc.<br>Modulation, demodulation: resume | 1.66 | 3 |
| 11 | 11 | **PRACTICE 3: INDUCTIVE SENSOR AND FILTERING** | | | **LAB** | | 1.66 | 7 |
| 12 | 12 | **8. OPTICAL SENSORS**<br>8.1 Light properties. Photometry: units. Optical sources and specifications<br>8.2. Photoconductive cell.<br>8.3. PN junctions: photodiodes<br>8.4. Photovoltaic cell.<br>EXERCISES: optical sensor systems PRACTICE 4 REPORT | X | | | Signal conditioning: proper selection of sampling frequency, number of bits.<br>System block diagram: basis of A/D and D/A converters<br><br>Knowing light properties for measuring.<br>Optical sensor types.<br>Signal conditioning for optical sensors. | 1.66 | 5 |
| 13 | 13 | **PRACTICE 4: MOTOR MOTION CONTROL and conditioning (I)** | | | **LAB** | | 1.66 | 2 |
| 14 | 14 | **PRACTICE 4: MOTOR MOTION CONTROL and conditioning (II)** | | | **LAB** | **INDIVIDUAL REPORT DELIVERY** | 1.66 | 2 |
| **SUBTOTAL** | | | | | | | **23 + 46 = 69** | |
| 15 | | Tutorials, mentoring hours, handling, etc. | | x | | ¿Tutoría colectiva para resolver dudas de toda la asignatura? | 3 | |
| 16-18 | | Assessment | | x | | | 3 | 7 |
| **TOTAL** | | | | | | | **82** | |