




Teacher(s)	Bol David (coordinator) ;Francis Laurent ;
Language :	English
Place of the course	Louvain-la-Neuve
Prerequisites	Students are expected to master the following skills: continuous-time and discrete-time signal representation both in time and frequency domains, mathematical system representations (transfer function, impulse response, filtering), principles and properties of Fourier, Laplace and z transforms, analysis of electrical circuits based on passive components (R, L, C), in DC, transient and AC regimes, understanding of general behavior of operational amplifiers, diodes and transistors with the associated basic electronic circuits, as they are covered within the courses LFSAB1106, LELEC1370 and LELEC1530
Main themes	<p>Our world is more and more digital with the increasing presence of information and electronic systems in industry, transportation, health cares and everyday's life. Many of the digital applications in these fields require the automatic acquisition of quantities from the physical world. In this course, we study the instrumentation chain and the sensors capable to perform this acquisition of physical quantities to translate them into analog electrical signals and then digital data.</p> <p>In this course, we will present different types of sensors used for the transduction of several physical values, e.g., occupancy, mechanical, acoustic, optical, bio/chemical, ' and the associated electronic circuits for signal conditioning and data transmission. We will highlight the figures of merit of the instrumentation chain and all sources of errors along it</p>
Learning outcomes	<p><b>At the end of this learning unit, the student is able to :</b></p> <p>With respect to the AA referring system defined for the Master in Electrical Engineering, the course contributes to the development, mastery and assessment of the following skills :</p> <ul style="list-style-type: none"> <li>• AA1.1, AA1.2, AA1.3</li> <li>• AA2.1, AA2.2</li> <li>• AA3.1, AA3.3</li> <li>• AA4.1, AA4.2, AA4.3, AA4.4</li> <li>• AA5.3, AA5.4, AA5.5</li> </ul> <p><b>After this course, the student will be able to :</b></p> <ul style="list-style-type: none"> <li>• Describe the operation principles of various classes of sensors</li> <li>• Select sensors for a given application</li> <li>• Size, realise and characterise a complete instrumentation chain</li> <li>• Understand and use datasheets</li> <li>• Present a written report of the results of group project</li> </ul>
Evaluation methods	<p>In this course, the students are evaluated through:</p> <ul style="list-style-type: none"> <li>• a continuous formative group evaluation, which is not taken into account for the final grade and includes short summaries of the work sessions in group;</li> <li>• a continuous certificative project group evaluation, which includes an intermediary report and a final report, weighting 20% and 40% of the final grade respectively, to be delivered during and at the end of the semester, respectively;</li> <li>• an individual written exam, weighting 40% of the final grade, taken during the exam session.</li> </ul> <p>The grade of the continuous evaluation is individualized as a function of the implication of the student in the group during the semester (presence at the compulsory activities, active participation to the work, ...).</p>
Teaching methods	The course combines lectures to introduce the key concepts with problem-based learning with a practical group project and a few exercise sessions.
Content	<p>In this course course, we study the key basic concepts in sensor systems and their associated instrumentation.</p> <ul style="list-style-type: none"> <li>• Sensor definition, classification and characterisation</li> <li>• Noise, non idealities and calibration in sensor systems</li> <li>• Principles of transduction ruling the conversion from primary physical signals to electrical signals.</li> <li>• Analog signal conditioning (sensor interface, instrumentation amplifier, filters, instrumentation bridges).</li> <li>• Principles and techniques of sensor data acquisition</li> </ul>

	<ul style="list-style-type: none"><li>• Types of digital signal processing (denoising) and data processing (feature extraction, event detection, classification) in sensor systems.</li><li>• Some frequent applications in the industrial field will be considered: measure of displacement, speed, force, acceleration, pressure, temperature, light, acoustic.</li></ul>
Inline resources	Moodle <a href="https://moodle.uclouvain.be/course/view.php?id=680">https://moodle.uclouvain.be/course/view.php?id=680</a>
Bibliography	Livre de référence disponible à la BST : J. Fraden, Handbook of Modern Sensors: Physics, Designs, and Applications. 4th ed. Springer, 2010. ISBN: 9781441964656.
Faculty or entity in charge	ELEC

Programmes containing this learning unit (UE)				
Program title	Acronym	Credits	Prerequisite	Learning outcomes
Master [120] in Physical Engineering	FYAP2M	5		
Master [120] in Electrical Engineering	ELEC2M	5		
Master [120] in Electro-mechanical Engineering	ELME2M	5		
Master [120] in Biomedical Engineering	GBIO2M	5		