

Instrumentation and Control

Calendar: 5th semester

Contact Hours: T – 22,5; PL - 22,5; OT – 7,5

Scientific Area: Engenharia Química Industrial

Learning outcomes of the curricular unit

Acquire knowledge of industrial instrumentation by understanding the different primal elements associated with the conversion of the quantities. In particular, acquire the ability to select the different primal elements depending on the applications.

Describe the operation of the main constituents of a measuring instrument: transducer, signal conditioning circuit, indicator / logger and power supply.

Know the static and dynamic characteristics of a measuring instrument.

Know how to handle measuring instruments of physical / chemical quantities.

Understand the operation and advantages of pneumatic control systems used in industrial processes.

Describe the operation and pneumatic control elements known in the industrial context.

Understand and characterize the three actions of a Proportional, Integral and Derivative (PID). Learn to tune a PID controller using the Ziegler-Nichols rules.

Syllabus

Introduction to industrial processes, automatic control system. Measuring instrument. Chain of electrical measurement. Sensors and actuators and their static and dynamic characteristics. International System of Units (SI).

Industrial Instrumentation

Position and deformation: strain gauges.

Temperature sensors: International Temperature Scale.

Pressure Sensors: liquid column, Bourdon, diaphragm pressure and differential capacitive manometer ; pressure switch. Calibration.

Level Sensors: notions of hydrostatic; viewing tube; tank with float, variable displacement devices, level by hydrostatic pressure; conductivity and capacitive sensors.

Flow sensors: definition of volumetric flow and mass; fundamentals of hydrodynamics; unloaders; flowmeters: electromagnetic, based on variation of pressure and under entrainment.

Sensors pH.

Pneumatic PID Controllers

Negative feedback systems.

Pneumatic instrumentation: Controllers P, PI, PD and PID

Demonstration of the syllabus coherence with the curricular unit's objectives

The program content is consistent with the goals expected for the UC, namely in the 1st chapter students will contact with the basics of signals and systems. In the 2nd chapter students will learn about instrumentation and industrial control, including several sensors used.

Finally in the 3rd chapter students will learn about pneumatic PID controllers. The contents are discussed based on a dynamic display of matter and solving practical examples of the laboratory and industry.

Teaching methodologies:

Theoretical exposure of the UC syllabus. Solving practical exercises. Conducting laboratory work illustrative of exposed contents. Laboratory experiments are:

Lab nr 1 - Temperature measurement with thermocouples (ESTSetúbal)

Lab nr 2 - Level sensor for measuring differential pressure with SMART sensor (ESTSetúbal)

Lab nr 3 - Combined pH Electrode Sensor (ESTBarreiro)

The written test has a weight of 80% in the final grade, and is constituted by an examination (E) or both tests (T).

Demonstration of the coherence between the teaching methodologies and the learning outcomes.

The teaching methods are consistent with the objectives of the curricular unit because: 1 - exposure of contents by the teacher will allow the acquisition of solid knowledge; 2 - Exercise solving will instill students with the knowledge and autonomy. 3 - conducting laboratory activities to consolidate knowledge. The evaluation system was designed to measure the extent to which skills have been developed by students.