

Instrumentation and Control

Calendar: 5th day semester

Contact Hours: T 22,5h; PL 22,5h; OT 7,5h

Scientific Area: Processes in Chemical and Biological Engineering

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

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

Evidence of the syllabus coherence with the curricular unit's intended learning outcomes:

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.

References:

1. Silva, Gustavo – Instrumentação Industrial 2ª Edição, 2 volumes, edição ESTSetúbal, 2004.
2. Chilton Book Measurements – Instruments Engineers Handbook, Vol I, Radner, Pennsylvania
3. Asch, George – Les Capteurs en Instrumentation Industrielle, Dunod, 1991
4. Dally, J. W.; Riley, W. F.; Mc Connel K. G. – Instrumentation for Engineering Measurements, Wiley, 1993
5. Curtis, D. Johnson – Controlo de Processos - Tecnologia da Instrumentação, Fundação Calouste Gulbenkian
6. Benedict, R. P. – Fundamentals of Temperature, Pressure and Flow Measurements, J. Wiley, 1983
7. Smith, Ernest – Principles of Industrial Measurement for Control Applications, ISA, Instrument Society of America, 198