MERCURY

Industrial Instrumentation and Modern Control Systems

27 September – 8 October 2027
Lisbon (Portugal)



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Ref: 6005_1054702 **Date:** 27 September – 8 October 2027 **Location:** Lisbon (Portugal) **Fees:** 11100 Euro

Introduction to Industrial Instrumentation and Control

In industrial environments, the fields of industrial instrumentation and control are critical for ensuring processes are measured and controlled accurately and efficiently. Industrial instrumentation involves the use of instruments and devices to monitor and manage various process variables such as temperature, pressure, flow, and level. Control systems, on the other hand, are integral for maintaining the desired state within a process through the use of feedback loops and advanced control strategies.

This industrial instrumentation and control systems course provides a comprehensive overview of industrial instrumentation and the modern control systems integral to the operation of industrial processes.

The industrial instrumentation and control systems course delves into the fundamentals of industrial instrumentation and process control, equipping engineers and technicians with the necessary skills to solve complex measurement and control problems. By exploring various industrial instruments and controls alongside hands-on activities, participants will gain the ability to design, develop, build, test, and evaluate instrumentation systems.

Targeted Groups

- Plant Management Personnel.
- Engineers from all disciplines.
- Processing Control Technicians.
- Instrumentation Artisans.
- Supervisors.
- People involved in projects.
- People dealing with Instrumentation Equipment Selection.
- Representatives from the Safety Department.
- Representatives from Purchasing Departments.
- This industrial instrumentation and control systems course is for anyone with a keen interest in industrial instrumentation.

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Course Objectives

At the end of this industrial instrumentation and control systems course, the participants will be able to:

- Understand the principles and practice of a range of sensors and transducers.
- Using a hands-on approach enables the delegate to investigate the operation of an instrumentation system through designing, building, and testing typical sensors combined with appropriate signal conditioning circuits.
- Become familiar and confident with a range of measurement techniques.
- Understand the concepts of Process Control and acquire the knowledge relating to the characteristics and properties of a process variable being measured.
- Disseminate and share experience and knowledge with other delegates through open session discussions, hence broadening the knowledge base of all.
- Become familiar and knowledgeable with PID control and develop the ability to 'tune' a process control system using PID control.
- Have the confidence and knowledge to apply the above techniques and principles to solve an unfamiliar and bespoke measurement situation in the workplace
- Evaluate and select the most appropriate sensor technology for a given instrumentation system.
- Design, build, and test using a given specification and censor, their instrumentation system
- Identity components and features of a Process control system
- Calibrate and signal condition the above system and take measurements from the system

Targeted Competencies

Upon the end of this industrial instrumentation and control systems course, the target competencies will be able to improve the following abilities:

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- Introduction to instrumentation systems and process variables.
- Temperature measurement techniques.
- Strain measurement.
- Understand the investigation of pressure and flow measurement.
- Learn about ultrasonic techniques for non-invasive process measurement.
- Practical activities to design, build, calibrate, and signal condition a sensor application.

Course Content

Unit 1: Introduction to Sensors, Transducers, and Instrumentation Systems

- Course schedule and layout.
- Learn about introduction to sensors, transducers, and instrumentation systems.
- Examples.
- Terms and definitions associated with Instrumentation systems, including:

  - Maximum error.
  - Hysteresis.
  - Repeatability.
  - Sensitivity.
  - Resolution.
  - Span.
  - Response time.

- Process variables.
- Mass flow.
- Volumetric flow rate.
- Pressure.
- Viscosity.
- Turbidity.

Unit 2: Strain, Pressure, and Flow Measurement

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- What is The principle of strain measurement - tension, compression, stress, strain, and Young's modulus?
- Understand the Principles of operation, application, and installation considerations.
- Gauge types - the principle of operation and configurations.
- Principles of pressure measurement.
- The principle of operation, application, and installation considerations of:

  - Diaphragms.
  - Bellows.
  - Capacitive devices.
  - Fibre Optic pressure measurement techniques.

- Principles of flow measurement.
- Reynolds number.
- Understand the principle of operation, application, and installation considerations of invasive types.
- Coriolis flowmeter.
- Differential pressure type flowmeters.
- Orifice plate.
- Venturi tube.
- Flow nozzle.
- Dall flow tube.
- Electromagnetic flowmeters.

Unit 3: Temperature, Level, and Non-Invasive Ultrasonic Measurement Techniques

- Temperature scales.
- The principle of operation, application, and installation considerations of:

  - Resistance Temperature Detectors RTD's.
  - Thermistors.
  - Thermocouples.
  - Radiation pyrometers.
  - Understand the principle of single-point and continuous-level measurement techniques.
  - Learn about direct and indirect level measurement techniques.

- The principle of operation, application, and installation considerations of:

  - Ultrasonic techniques.
  - Capacitive techniques.
  - Pressure techniques.
  - Understand principles and applications of ultrasonic techniques for non-invasive measurement.
  - Learn about Doppler shift and transit techniques.
  - Ultrasonic flowmeters.

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Unit 4: Introduction to Process Control Engineering

- Control strategies.
- Block diagram representation.
- Control components.
- Servomechanisms and regulators.
- Open and closed-loop systems.
- Negative feedback NFB.
- Transfer functions.
- 1st and 2nd order systems.
- Transfer functions and closed-loop systems
- Learn about On/off control.
- Two-step control action.
- Proportional control.
- Proportional band vs. proportional gain.
- Proportional offset.
- Reset.
- Integral action.
- Integral windup.
- Derivative action.
- PID control.

Unit 5: Tuning PID Controllers

- Stability.
- System response.
- Bode plot.
- Nyquist plot.
- Understand load disturbances and offset.
- Empirical methods of setting controllers.
- Learn about the open-loop reaction curve method Ziegler-Nichols.
- What are the default and typical settings?
- Understand the closed-loop continuous cycling method Ziegler-Nichols.
- Fine-tune PID controllers.

Throughout this industrial instrumentation training course, participants will gain not only theoretical knowledge but also practical skills that are applicable to their roles as industrial instrumentation technicians, engineers, and managers in a variety of industrial sectors.