

Online Certificate in Process Instrumentation and Control

Certificate Objectives

In this certificate program, attendees will learn to:

1. Understand the basics of process instrumentation and control (PIC), including different control functions, types of control loops, and continuous vs. discrete control.
2. Recognize the identifications and symbols used in PIC.
3. Identify the different types of field instrumentation, their principles of operation, their advantages and disadvantages, and the application of the different types of sensors for flow, level, pressure, and temperature measurements.
4. Describe the different models and implementation of alarm and trip systems.
5. Identify the different types of computer-based control systems, including PLCs and DCSs, as well as basic requirements for good operator interface.
6. Understand control loop types and the basics of tuning.
7. Summarize the requirements for control rooms and the design of control panels.
8. Explain the documentation required for PIC for front-end engineering and detail design.
9. Define the requirements for a successful installation, instrument checkout and controller tuning.
10. Understand the basics of PIC project implementation and project management.
11. Apply decision-making tools: auditing, evaluation of plant needs, justification, and control system evaluation.

Who Should Enroll

This certificate program is for those who want to learn about the PIC field in a condensed time frame and from a practical point of view and/or for those who simply want to communicate technically with PIC personnel. The program provides attendees with sufficient knowledge to move into the field of PIC. It is applicable to both technical and supervisory personnel. It is presumed that participants come from a setting where they can apply the knowledge received.

Session 1: Introduction

- Definition of instrumentation and control (PIC)
- Selection of measurement and control devices
 - Safety, equipment location, performance
- Air supply, electrical supply, grounding
- Installation and maintenance

Session 2: Identification Symbols

- Instrument identification and line symbols
- General instrument or function symbols (Per ISA Standards)

Session 3: Analyzer Systems

- Overview, comparison table
- Location, tagging, implementation
- Safety, code compliance
- Selection and documentation
- Sampling systems and enclosures
- Testing and startup, maintenance

Session 4: Flow Measurement

- Overview and comparison
- Differential pressure (orifice plate, venturi, flow nozzle, pitot tube, etc.)
- Magnetic and mass: Coriolis, thermal
- Turbine and positive displacement, vortex shedding
- Variable area (rotameter), ultrasonic: transit time and doppler
- Weir and flume, target

Session 5: Level Measurement

- Overview and classification
- Measurement of solids, comparison
- Mechanical: float, weight and cable, tape (float and tape)
- Buoyancy: displacement
- Hydrostatic: gage, diaphragm, bubbler (dip tube), differential pressure, elevation/suppression
- Electrical: capacitance, conductivity, resistance tape
- Waves & pulses: sonic/ultrasonic, radar, laser, beam breakers
- Others: Paddle wheel, vibration, thermal, radioactive (nuclear), load cells

Session 6: Pressure and Temperature Measurement

A. Pressure: Overview and comparison table

- Units of measurement
- Gages, transmitters, filled systems, and diaphragm seals
- Installation

B. Temperature: Overview and comparison table

- Thermowells
- Bimetallic
- Thermocouple, resistance temperature detector (RTD)

Session 7: Control Loops

- Overview and control function considerations
- Control modes (on-off, modulating, PID control)
- Control types (feedback, cascade, ratio, feedforward)
- Controller tuning (automatic, manual)

Session 8: Programmable Electronic Systems

- Overview and components
- Centralized vs. distributed (PLCs, PCs, DCSs)
- Control room instrumentation (controllers, recorders, relays, annunciators)
- Application of current loop resistors
- Programming languages (IEC)
- Fieldbus
- System specifications
- Operator interface (graphics, alarms, trends, reports)
- Special design considerations
- Vendor selection
- Testing and maintenance

Session 9: Alarm and Trip Systems

- Fail-Safe and de-energize-to-trip
- Elements (input, logic, output)
- Design and documentation
- Testing (Input, logic, output)
- Management of change

Session 10: Control Centers and Enclosures

A. Control Centers: Overview, design, and physical aspects

- Security, fire protection, air conditioning
- Electrical/electronic considerations, communication

B. Enclosures: Overview and general requirements

- Documentation and fabrication
- Protection and rating
- Electrical and pneumatics
- Temperature and humidity control
- Inspection and testing
- Certification and shipping

Session 11: Control Valves

- Overview and comparison table
- Valve shutoff, flashing and cavitation, valve pressure drop
- Installation notes and the CV
- Valve bodies and trim
- Actuators
- Valve positioners

Session 12: Engineering Design and Documentation—Part 1

- **Front-End Engineering:**
 - Process & instrumentation diagrams (P&IDs)
 - Control system definition
 - Logic diagrams

Session 13: Engineering Design and Documentation—Part 2

- **Detailed Engineering:**
 - Process data sheets, instrument index, and instrument specification sheets
 - Loop diagrams and interlock diagrams
 - Manuals for programmable electronic systems and PLC program documentation
 - Engineering contractor scope of work and packaged equipment scope of work

Session 14: Installation

- Overview, scope of work, and installation details
- Equipment identification and equipment storage
- Work specifically excluded and approved products
- Pre-installation testing, execution, wiring, tubing, and check-out

Session 15: Project Implementation and Management

- Overview, process control, communication, standards, and code compliance
- Control strategy, business strategy, and implementation of new control systems
- Scheduling and time management, cost estimate, and document control
- Engineering (front-end and detailed)
- Training, installation, commissioning, startup, and project closing

Session 16: Decision Making

- Overview
- Auditing
- Evaluation of plant needs

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- Justification
- Control system evaluation

Certificate Requirements

The certificate is awarded after completion of all 16 Sessions, including all quizzes and final exams. Participants must attain at least 75 percent in the program. The certificate amounts to approximately 72 classroom hours of instruction and assessment. The certificate will state that the recipient has earned 7.2 Continuing Education Units (CEUs) or 72 Professional Development Hours (PDHs). However, the course does not carry any college credits and cannot be used as part of a degree seeking program.

Course Materials

The latest edition of the course text is not included with registration, and will need to be purchased by the student upon registering for the course.

Title: *The Condensed Handbook of Measurement and Control*, 4th edition

Author: N.E. Battikha, Publisher: ISA

- **Print ISBN:** 9781945541384, 1945541385
- **eText ISBN:** 9781643310954, 164331095X

Additional course materials and copies of the lecture slides will be available for download from the class website.

Course Delivery

This online class will be delivered using the Blackboard Learning Management System. Each session has related reading material from the textbook, a number of 15-20 minute video recordings, and a short quiz. It is recommended that students read the corresponding chapter in the textbook and the assigned online notes provided before viewing the videos. The instructor can be directly contacted via email with any questions about class content. He will respond within 2 business days.

Students have six months to complete the entire course.

Instructor

Bill Battikha is a registered professional engineer with more than 30 years of experience in the field of Process Instrumentation and Control, working mainly in the U.S. and Canada. He holds a bachelor of science in engineering. He has produced and conducted Instrumentation and Control training courses for more than 10 years at many universities in the U.S. and Canada and also at the ISA.

Bill co-authored a patent and has written three books on Instrumentation and Control, all published by the ISA, with the last book being an ISA best-seller. He is also a member of many

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ISA committees that generate new standards. He has presented papers at many international conferences and has written numerous articles for major technical magazines.

Bill's engineering activities have covered the development of engineering standards and the generation of control philosophies and functional specifications. He has designed complete control systems, guided and inspected the work of engineering consultants, monitored contractors on-site, and personally carried on plant commissioning and startup. He has assisted plants in troubleshooting and resolving problems in engineering, construction and maintenance.

Refund and Cancellation Policy

No refunds will be granted for this class once the student has accessed the Blackboard class site. A full refund of registration fees, less a \$30 administrative fee, will be approved if requested in writing at lpe@ku.edu prior to accessing the course. Requests must be made within 60 days of payment.