JUPITER PRIME

Consulting • Training • Advisory

جوبيتر برايم للاستشارات والتدريب

COURSE BROCHURE

Advanced Process Instrumentation and Control Training Course

22 August – 2 September 2027
Muscat

jupiterprime.uk

info@jupiterprime.uk

Registered in the United Kingdom and Saudi Arabia

Advanced Process Instrumentation and Control Training Course

Ref: 168_4829 **Date:** 22 August – 2 September 2027 **Location:** Muscat **Fees:** 11700 GBP

Advanced Process Instrumentation and Control is a 2-week training course for instrument engineers, control engineers and process operations specialists who keep regulatory loops stable, and it ends with a control loop performance review listing tuning changes and instrument fixes. Many plants still run loops in manual or with factory tuning, quietly wasting energy and product quality. Jupiter Prime Training offers this course to instrument and control departments.

Why Process Instrumentation and Control Matters Now

Three pressures meet at the control loop. Plants push units closer to constraints, so poorly tuned loops cost more than before. Smart transmitters and digital valve positioners now report diagnostics that few sites actually read. Operations crews are smaller, so loops left oscillating or in manual add to alarm load and fatigue. A site that neglects its base layer sees off-spec product, valve wear and nuisance trips; one that maintains it frees margin for every higher control layer. The course rests on proportional-integral-derivative PID control, control loop performance monitoring CLPM and valve signature diagnostics.

Who Gains Most from Process Instrumentation and Control

- Engineers who specify and maintain transmitters, analysers and final elements
- Engineers who configure and tune loops in the distributed control system
- Specialists who judge whether a unit runs to its operating targets shift by shift
- Engineers who diagnose sticky valves, noisy signals and interacting loops
- Leads who rank instrument and control defects for maintenance windows

An instrument and control section that sends its field instrument engineer and its control engineer together gains most, because many tuning problems are really hardware problems.

Process Instrumentation and Control Capabilities

Participants leave able to tell a tuning fault from a sensor or valve fault and fix the right one.

- Specify transmitters and valves for range, accuracy and response — instrument selection decisions
- Test valve stiction, deadband and positioner response — maintenance priorities
- Calculate PID settings from step tests and process models — loop owners and operators
- Design cascade, ratio and feedforward schemes — unit performance targets
- Assess loop performance with variability and oscillation indices — control engineering backlog
- Communicate loop findings as a ranked fix list — operations and maintenance leads

Key Process Instrumentation and Control Terms

- PID controller — an algorithm combining proportional, integral and derivative action to drive a measured variable towards its set point.
- Stiction — static friction in a control valve that makes the stem stick and jump, causing loop oscillation.
- Dead time — the delay between a change in controller output and the first visible response in the measurement.
- Cascade control — a structure where an outer loop sets the set point of a faster inner loop.
- Feedforward control — control action calculated from a measured disturbance before it upsets the controlled variable.
- Loop performance index — a numeric measure, such as variance or oscillation score, used to rank how well a loop performs.

Process Instrumentation and Control Day by Day

Day 1: The Base Layer and Unit Performance

- Control Hierarchy from Field Device to Optimiser — Where Base Loops Fit
- Loop Inventory and Manual Mode Audit — Size of the Hidden Problem
- Process Variability and Economic Margin — Value of Tighter Regulation
- Alarm Load and Operator Interaction — Human Cost of Poor Loops
- Instrument Index and Loop Diagrams — Documents Behind Every Loop

Day 2: Pressure and Temperature Measurement

- Pressure Transmitter Ranging and Impulse Lines — Plugging and Freezing Risks
- Thermocouples Versus Resistance Thermometers — Accuracy and Response Choices
- Thermowell Design and Insertion Length — Lag and Vibration Trade-Offs
- Smart Transmitter Diagnostics — Using Device Alerts Before Failure
- Calibration and Verification Intervals — Drift Evidence and Maintenance Load

Day 3: Level and Flow Measurement

- Differential Pressure Level and Density Compensation — Interface and Foaming Errors
- Radar, Guided Wave and Nuclear Level Gauges — Matching Vessel Conditions
- Flow Element Selection for Control Duty — Repeatability Over Absolute Accuracy
- Signal Noise and Filtering — Damping Settings That Hide Process Behaviour
- Analyser Sample Systems — Delay and Reliability in Quality Loops

Day 4: Control Valves and Final Elements

- Valve Characteristic and Installed Gain — Selecting Linear or Equal Percentage
- Valve Sizing and Rangeability — Oversized Valves Running Nearly Closed
- Actuators and Digital Positioners — Response Speed and Fail Position
- Stiction, Deadband and Valve Signature Tests — Diagnosing Hardware Oscillation
- Cavitation, Flashing and Noise — Trim Selection for Severe Service

Day 5: Process Dynamics and Models

- Step Testing in Open Loop — Capturing Gain, Dead Time and Time Constant
- First-Order Plus Dead Time Models — Basis for Tuning Calculations
- Integrating Processes Such as Level — Different Rules for Tank Loops
- Nonlinearity and Operating Point Shifts — Gain Scheduling Decisions
- Disturbance Sources and Frequency — What the Loop Must Reject

Day 6: PID Tuning Methods

- PID Algorithm Forms and Scaling — Interpreting Vendor Parameter Units
- Lambda and Internal Model Tuning — Choosing Closed-Loop Speed
- Ziegler–Nichols and Its Limits — Why Aggressive Settings Oscillate
- Derivative Filtering and Set Point Weighting — Smooth Response to Operators
- Level Loop Tuning for Surge Capacity — Averaging Versus Tight Control

Day 7: Advanced Regulatory Control Schemes

- Cascade Loop Design and Tuning Order — Inner Loop Speed Requirements
- Ratio Control for Blending and Firing — Holding Proportions Under Load Change
- Feedforward from Measured Disturbances — Static and Dynamic Compensation
- Override and Selector Control — Constraint Handling Without Operator Action
- Split-Range and Valve Position Control — Sharing Duty Between Final Elements

Day 8: Loop Interaction and Special Cases

- Relative Gain Array — Pairing Variables in Interacting Loops
- Decoupling and Detuning Strategies — Reducing Loop Fighting
- Dead-Time Dominant Loops — Predictor Structures and Slow Tuning
- Reactor and Furnace Temperature Loops — Safety Margins in Tuning
- Compressor Anti-Surge and Pressure Loops — Fast Response Requirements

Day 9: Control Loop Performance Assessment

- Loop Performance Indices and Benchmarks — Ranking Hundreds of Loops Quickly
- Oscillation Detection and Root Cause Tracing — Valve, Tuning or Disturbance
- Historian Data Extraction for Loop Review — Sampling and Compression Pitfalls
- Operator Mode Change Tracking — Loops Abandoned to Manual
- Defect Classification and Fix Priority — Linking Findings to Maintenance Windows

Day 10: Practising the Control Loop Performance Review

- Unit Loop Inventory and Index Ranking — Selecting Loops for Review
- Valve and Transmitter Diagnostics on Bad Actors — Hardware Findings
- Retuning Calculations from Step Test Data — Proposed New Settings
- Scheme Upgrades with Cascade or Feedforward — Structural Improvements
- Control Loop Performance Review — Tuning Changes and Instrument Fix List

Applying Process Instrumentation and Control After the Course

- Rank the twenty worst loops on one unit by variability and time in manual, then present the list to the operations lead.
- Run a valve signature test on the worst oscillating loop and retune it from a fresh step test.

Process Instrumentation and Control Questions FAQ

What is process instrumentation and control, and why does it matter now?

Process instrumentation and control is the base layer of sensors, valves and PID loops that holds a plant at its targets. It matters now because units run closer to constraints with smaller crews, so weak loops cost more energy, quality and operator attention.

Which roles gain most from advanced process instrumentation and control training?

Instrument engineers, control engineers and operations specialists gain most. They are the people who select field devices, tune loops and decide which defects to fix first during maintenance windows.

How does advanced process instrumentation and control differ from a fundamentals instrumentation course?

It assumes measurement basics and focuses on loop behaviour. Participants diagnose valve stiction, derive tuning from step tests, design cascade and feedforward schemes and assess loop performance across a whole unit, rather than learning device principles alone.

What do you bring back from process instrumentation and control training?

You bring back a ranked review of loops on a unit you know. It lists hardware defects, proposed tuning settings and scheme upgrades, giving instrument and operations leads a clear order of work.

Process Instrumentation and Control: The Way Forward

The control loop performance review first informs which loops get valve repairs and which get retuning at the next opportunity. Instrument engineers, control engineers and shift supervisors use it to agree priorities. After its first use, revisit the performance indices, because process changes and seasonal conditions can bring new oscillations that the first ranking did not see.