Think You Know Something About Process Control? As a leader in process control solutions, Control Station knows that effective control depends on sound knowledge and application of proven best-practices. And as common and essential as PID control is to today’s production facilities, there is a clear knowledge gap. Take our simple quiz – the results might surprise you.
Process Control 101

You know the market analysis. Poor control costs process manufacturers millions every year. Those losses come in the form of increased energy consumption and excessive use of production inputs. They hit your top-line in the form of reduced throughput as well as erode your bottom-line in the guise of production-related defects. But what about process dynamics and your facility’s workhorse — the all important PID controller?
When control of critical production processes is variable it wastes energy and production inputs. Quality slips and safety is compromised. Although the need for controller tuning may be clear, many practitioners were never given the formal training needed to achieve that objective effectively and efficiently. As a result many practitioners view the process of diagnosing and tuning an underperforming PID controller as nothing short of ‘black magic’.

Among their many attributes industry practitioners are resourceful. They develop simplified methods for evaluating the dynamics of their facility’s complex production processes. They formalize best-practices to assure that their analysis is both consistent and thorough, and they make certain their solutions are safe. Fortunately, many of those best-practices have been documented and made available for the next generation of operators, technicians, and engineers.

This quiz presents an opportunity to test the knowledge you’ve accumulated either inside the classroom or on the production floor. It may highlight information you apply on a regular or even on a daily basis. It might also expose some details that have slipped with the passage of time. Either way, enjoy!
Practical Process Control Provides the Knowledge and Skills Needed for Success

The following questions cover a range of topics associated with Process Control, ranging from the fundamentals of process dynamics to essential aspects of Proportional, Integral, Derivative (PID) control. Indicate your answers by circling the letter of your choice. The answer key can be found on the back page.

This is a simple self-assessment. Rest assured—no one will be watching and no one else will know your score. Even so, use the honor system and put your knowledge to the test. You can do what you will with the results!

**Question #1:** Controllers are designed and tuned based on the dynamic behavior of a process. What is meant by “the dynamic behavior of a process”?

a. How the measured process variable responds over time to changes in the controller output and disturbance variables.
b. How the controller output responds over time to changes to set point and tuning values.
c. How the measurement filter removes random error from the measured process variable signal over time.

**Question #2:** A PID controller computes corrections based on controller error. What is controller error?

a. Measured process variable minus controller output.
b. Controller output minus set point.
c. Set point minus measured process variable.

**Question #3:** Noise in the measured process variable is defined as:

a. The randomness of the measured process variable around its average value when the controller output is constant.
b. The largest peak and valley of the measured process variable signal when the controller tuning is correct.
c. The degree to which a controller responds when the measured process variable shows fluctuations.
Question #4: The time constant of a process is useful for determining:

a. Whether or not a dynamic matrix controller would prove beneficial.
b. An appropriate controller sample time.
c. The speed with which new tuning values will take effect.

Question #5: A process dead time of 10 minutes indicates that it would be difficult to achieve good control if:

a. The process time constant is equal to 10 minutes.
b. The process time constant is smaller than 10 minutes.
c. The process time constant is greater than 10 minutes.

Question #6: Which option includes two control strategies for improving disturbance rejection:

a. Cascade and feed forward control.
b. Adaptive and minimum variance control.
c. Multivariable and nonlinear control.
d. None of the above.

Question #7: Which of the following is not consistent with ‘best practice’ when collecting data for process modeling and PID controller tuning?

a. Starting data collection at steady state.
b. Including data with time stamps.
c. Including unexplained disturbance(s).
d. Bumping set point.

Question #8: Which of the following is not needed for tuning a controller?

a. Controller output-to-process variable data.
b. PID algorithm.
c. Bump test or doublet.
d. Previous tuning coefficients.
**Question #9:** Which controller would be best for controlling loops with large amounts of dead time?

a. PID controller.
b. Smith Predictor.
c. Feed Forward with Feedback Trim.
d. Ratio control.

**Question #10:** In a cascaded loop architecture, how should the inner loop process dynamics respond relative to the outer loop process dynamics?

a. Slower rate.
b. Same rate.
c. Faster rate.

**Question #11:** When tuning a non-self-regulating process, the same tuning correlations can be used as with a self-regulating process:

a. True
b. False

**Question #12:** Controller robustness can be defined as the controller’s ability to maintain good performance under varying process dynamics.

a. True
b. False

**Question #13:** A system is under PI control using the algorithm shown below. When the set point is bumped from 50% to 51%, the system oscillates. What adjustments should be made to the Controller Gain (KC) and Reset Time (TI) to eliminate the oscillations?

a. Controller Gain doubled, Reset Time doubled.
b. Controller Gain halved, Reset Time halved.
c. Controller Gain halved, Reset Time unchanged.
d. Controller Gain halved, Reset Time doubled.

\[ CO = bias + K_c e + \frac{K_C}{\tau_I} \int e dt \]
Question #14: Each of the graphs shown below represents the same process under different forms of PID control. Based on the closed loop set point responses, reorder the listed forms of the PID to correspond with the three graphs.

a. P-Only.
b. PI.
c. PID.
Control Station is in the business of equipping process manufacturers with solutions that improve production efficiency and throughput. One of our core offerings is training and skills development. Our workshops are hands-on and interactive. They focus on proven best-practices for diagnosing regulatory control loops and tuning PID controllers. They explain how PID controllers function and how they can be used to optimize production, utilizing real-world process simulations to both showcase critical concepts and to engage practitioners in the application of new knowledge.

**Evaluating Production Processes and Modeling Dynamic Behavior**

Understand the importance of a clear control objective and how it drives the tuning process. Learn essential requirements for capturing process data and assessing a process’ dynamics. Apply straightforward techniques for analyzing strip chart data and generating accurate model parameters.

**Understanding the PID Controller and Calculating Tuning Parameters**

Know the strengths and weaknesses of the three (3) terms within the PID controller: Proportional, Integral, and Derivative. Learn methods for adjusting parameters and achieving performance objectives. Explore best-practices for utilizing PID with both integrating and non-integrating production processes.

**Applying Advanced Control Strategies**

Understand the benefits of and approach for implementing adaptive control on non-linear processes. Apply other advanced applications of the PID controller, including the Feed-Forward and Cascade architectures, on simulated processes. Learn how to apply performance criteria as an objective evaluation tool.
Answer Key: Process Control 101

Answers to the quiz are provided on the opposite side. Use the following grading system to gauge your performance:

» **Guru** 100% - 90%
» **Master** 89% - 80%
» **Apprentice** 79% - 60%
» **Novice** 59% - 0%

If you wish to improve your score, consider taking one of the many Process Control workshops offered from Control Station or another qualified training services provider.

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#1 — A  #6 — A  #11 — B
#2 — C  #7 — C  #12 — A
#3 — A  #8 — D  #13 — D
#4 — B  #9 — B  #14 — PID, P-Only, PI
#5 — B  #10 — C
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