

# PROCESS CONTROL SYSTEMS

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## Course Description and Learning Outcomes

The goal of the course «Process control systems» is to introduce the key concepts in automation and control systems of industrial processes. The course describes the most innovative automation solutions. The issues to be covered include FCE-analysis, sensing (including remote sensing) and transmission.

The objectives of this course are to help the student to:

- understand, describe and be able to make calculations on the dynamic behavior of the process systems;
- learn the fundamental principles of classical control theory, including different types of controllers and control strategies;
- describe quantitatively the behavior of simple control systems and to design control systems;
- use computer software to describe and design control systems;
- use computer software to operate and maintain the equipment;
- tune a control loop;
- give examples on applications of control systems in different industries;
- use control terminology in English.

The course is delivered through a combination of lectures and laboratory work with *DeltaV distributed control system*, which is one of the most common automation solutions currently used in industries.

Upon completion of the course, the student will be able to design control systems, define system capabilities, define nodes, configure continuous and sequential control strategies, operate control systems, identify and/or predict the potential system failures. The student will gain the most up-to-date technical knowledge and skills required for the efficient management, design, control and operation of industrial control systems.

### Scope and types of study, the contents of the discipline

The course is worth 1 ECTS credit or 36 hours (which include 18 hours of the lectures, and 18 hours of the laboratory practical classes).

### Categories of the discipline, the types and scope of training

Module number	The titles of the modules	Workload		
		Totally	Lectures	Lab Work
1	Introduction	6	6	-
2	Control Loops	6	6	-
3	Controller Algorithms and Tuning	24	6	18
Overall total		36	18	18

### Lectures

Module number	Titles of the modules	Contents of the modules
1	Introduction	Foundations of Control Theory: process variables, setpoint, measured variables, process variables and manipulated variables, error, offset, load disturbance, control algorithm, manual and automatic control, closed and open control loops
2	Control Loops	Components of Control Loops Control Loop Equipment and Technology Primary Elements/Sensors Transducers and Converters Transmitters: Basic Transmitter Types, Limitations Signals: pneumatic signals, analog signals, digital signals Indicators Recorders Controllers Correcting Elements/Final Control Elements Actuators Field Wiring and Communication Protocols – Traditional, HART, FF , WirelessHART
3	Controller Algorithms and Tuning	Controller Algorithms Discrete Controllers Multistep Controllers Continuous Controllers Manual and automated tuning techniques

### Lab practice (LP)

Number of LP	Module number	Title and summary of the lesson	Workload (hours)
1	3	Configuration basics <ul style="list-style-type: none"> <li>– System Overview</li> <li>– DeltaV Explorer</li> <li>– DeltaV Diagnostics</li> <li>– Control Modules</li> <li>– Control Studio</li> <li>– Motor Control with Interlocking and Permissive Conditions</li> <li>– Cascade Control</li> <li>– Regulatory Control</li> <li>– DeltaV Operate</li> <li>– System Operation</li> <li>– Alarms &amp; Process History View</li> <li>– Alarm Help</li> </ul>	8

		<ul style="list-style-type: none"> <li>– Sequential Function Charts</li> <li>– Configure Theme Dynamos</li> </ul>	
2	3	The Control Foundation: Traditional Tools <ul style="list-style-type: none"> <li>– Function Block Structures &amp; Status Values</li> <li>– Analog Control Palette Blocks – Bias/Gain, Deadtime, Limit, Ratio, Signal Characterizer, Splitter</li> <li>– Unit Alarms</li> <li>– DeltaV Tune with InSight</li> <li>– Device Control Options</li> <li>– Class Based Control Modules</li> </ul>	10
Total			18

### Literature:

Terrence Blevins, Mark Nixon *Control Loop Foundation: Batch and Continuous Processes.* – International Society of Automation, NC, 2011.

Шестаков А.Л., Бизяев М.Н., Шаинский И.В. Распределенные интеллектуальные автоматизированные системы управления технологическими процессами (distributed automated process control systems)// Изд-во ЮУрГУ, Челябинск, 2011

### Grading policy

#### Forms of Control:

Type of assessment	%
Continuous assessment (lectures):	20
Continuous assessment (lab practice)	65
Final Exam (oral answer)	15

### Grading Scale

<b>Chinese-Russian system</b>	
5+	98-100
5	93-97
5-	90-92
4+	87-89
4	83-86
4-	80-82
3+	77-79
3	73-76
Failing	72 and below