

**Bachelor program,  
Instrumentation Engineering (INEN) program, “Instrumentation Engineering”  
department**

<b>Course Unit Title</b>	PLC and SCADA in process control and monitoring	
<b>Course Unit Code</b>	VTES-B04-3	
<b>Type of Course Unit</b>	Elective	
<b>Level of Course Unit</b>	4 <sup>th</sup> year INEN program	
<b>National Credits</b>	6	
<b>Number of ECTS Credits Allocated</b>	6	
<b>Theoretical (hour/week)</b>	2	
<b>Practice (hour/week)</b>	0	
<b>Laboratory (hour/week)</b>	2	
<b>Year of Study</b>	4	
<b>Semester when the course unit is delivered</b>	-	
<b>Course Coordinator</b>	Aghamatov Stanislav	
<b>Name of Lecturer (s)</b>	Aghamatov Stanislav	
<b>Name of Assistant (s)</b>	-	
<b>Mode of Delivery</b>	Face to Face	
<b>Language of Instruction</b>	English	
<b>Prerequisites</b>	-	
<b>Recommended Optional Programme Components</b>	-	
<b>Course description:</b> The discipline is included in the undergraduate curriculum in specialty 050624 - “Instrument Engineering”. The discipline is studied in the 1st semester. Input knowledge, skills and competencies required to study this course, are formed in the process of mastering a number of undergraduate disciplines, such as modules “Mathematics”, “Physics”, studied in 1st – 3rd semesters. The discipline belongs to the special disciplines of the professional cycle. It is directly related to the disciplines: “Computer Science”, “Discrete Mathematics”, “Electrical Engineering and Electronics”, “Electronic Devices”. Mastering this discipline is necessary for successfully completing research and pre-graduation internships, as well as for writing a final qualifying thesis.		
<b>Objectives of the Course:</b> The goals of mastering the discipline “Control and management of processes. PLC and SCADA” are: <ol style="list-style-type: none"> <li>1. Formation of knowledge about control and process management</li> <li>2. Study of the principles of PLC construction</li> <li>3. Training in PLC programming skills</li> <li>4. Training in SCADA system design skills</li> </ol>		
<b>Learning Outcomes</b>		
At the end of the course the student will be able to		Assessment
1.	Understand the fundamental architecture and operation of Programmable Logic Controllers (PLCs).	1,3
2.	Develop and troubleshoot ladder logic programs for industrial automation tasks	1,3
3.	Integrate sensors and actuators with PLC systems to perform real-time control functions.	1,3
4.	Design and configure Human-Machine Interfaces (HMIs) to visualize and control industrial processes.	1,3
5.	Design and implement basic SCADA systems for monitoring, data acquisition, and supervisory control of industrial processes.	1,3
6.	Analyze and optimize industrial control systems by applying principles of process control, communication protocols, and system integration.	1,3
Assessment Methods: 1. Final Exam, 2. Presentation, 3. Midterm exam		

<b>Course's Contribution to Program</b>			
		CL	
1	Ability to develop as a specialist in the field of fundamental sciences and apply basic knowledge.	3	
2	Ability to analyze and model functional and structural schemes of various purpose devices and systems.	5	
3	Ability to use modern methods and tools, creation, selection, and application of engineering and information technology tools and modern devices and equipment.	4	
4	The ability to use the strategy of team cooperation in the exchange of information, knowledge, and experience to achieve the set goal.	3	
5	As a result of training, the ability to use engineering knowledge, mathematical models, and basic concepts of physics and chemistry in production and technological processes, automation, measurement, and control systems.	5	
6	The ability to use modern software to process technical documents of devices, design their structures, and algorithmize processes.	5	
7	The ability to apply artificial intelligence to improve the quality characteristics of measurement and control systems.	2	
8	The ability to process information acquisition, processing, and transmission processes based on schematic and programmable logical integrated circuits.	5	
9	Ability to use knowledge to improve quality indicators and environmental safety of production processes.	4	
10	Self-development ability to apply theoretical and experimental knowledge in solving modern engineering problems.	3	
CL: Contribution Level (1: Very Low, 2: Low, 3: Moderate, 4: High, 5: Very High)			
<b>Course Contents</b>			
We ek	Chapter	Topics	Exam
1	[1], Ch. 1, p.1-20; [5], Ch. 1, p.10-25	<b>LECTURE</b> Overview of PLC and SCADA Systems <b>Lab:</b> Basic PLC Setup and SCADA Monitoring Configuration	
2	[2], Ch. 3, [7], Ch. 2, p.30-55	<b>LECTURE:</b> PLC Wiring Principles and Installation Techniques <b>Lab:</b> Digital and Analog I/O Wiring and Fault Diagnosis	
3	[1], Ch. 3, [8], Ch. 1,	<b>LECTURE:</b> Fundamentals of PLC Programming and Memory Structure <b>Lab:</b> Creating a PLC Project and Configuring Tag Tables	
4	[1], Ch. 6, p. [2], Ch. 5, [8], Ch. 3, p.50-75	<b>LECTURE:</b> Ladder Logic and Structured Control Language (SCL) Programming <b>Lab:</b> Development of Start/Stop Control Program Using Ladder and SCL	
5	[1], Ch. 7, [2], Ch. 7,	<b>LECTURE:</b> Timer Functions in PLC Systems <b>Lab:</b> Implementation of ON-Delay and OFF-Delay Timer Applications	
6	[1], Ch. 8, [2], Ch. 8,	<b>LECTURE:</b> Counter Functions in PLC Programming <b>Lab:</b> Design of a Product Counting System Using PLC Counters	
7	[1], Ch. 9, [2], Ch. 9,	<b>LECTURE:</b> Comparator and Arithmetic Instructions in PLC <b>Lab:</b> Temperature Limit Control Using Comparison and Math Functions	Midterm
8	[1], Ch. 10, [2], Ch. 10,	<b>LECTURE:</b> Advanced PLC Instructions and Data Manipulation <b>Lab:</b> Data Transfer, Conversion, and Bit-Level Operations Implementation	
9	[1], Ch. 11, [8], Ch. 4, p.80-105	<b>LECTURE:</b> PLC Program Organization: OB, FC, FB, and DB Blocks <b>Lab:</b> Structured Program Development Using Function and Data	

		Blocks	
10	[1], Ch. 12, [2], Ch. 12,	<b>LECTURE:</b> Analog Signal Processing and Scaling in PLC <b>Lab:</b> Reading and Scaling Analog Input Signals	
11	[9], Ch. 1, [4], Ch. 6,	<b>LECTURE:</b> Modbus RTU and Modbus TCP Communication Protocols <b>Lab:</b> Configuration of Modbus Communication Between Devices	
12	[6], Ch. 2, [4], Ch. 7,	<b>LECTURE:</b> PROFINET and PROFIBUS Industrial Networks <b>Lab:</b> Configuration of a PROFINET Network and Device Integration	
13	[1], Ch. 13 [8], Ch. 5,	<b>LECTURE:</b> PLC Data Exchange: PUT/GET and Send/Receive Functions <b>Lab:</b> PLC-to-PLC Data Communication Implementation	
14	[5], Ch. 3, p.50-80; [1], Ch. 14,	<b>LECTURE:</b> SCADA Systems and HMI Design <b>Lab:</b> Designing an HMI Screen with Alarm Configuration	
15	[1], Ch. 15, [8], Ch. 6,	<b>LECTURE:</b> PC Station Configuration and System Integration <b>Lab:</b> Establishing Communication Between PC Station and PLC	
16			Final exam
<b>Recommended Sources</b>			
<b>TEXTBOOK(S)</b>			
<ol style="list-style-type: none"> <li>1. Bolton, W. (2021). Programmable Logic Controllers (7th ed.). Newnes, Elsevier.</li> <li>2. Petruzella, F. D. (2020). Programmable Logic Controllers (5th ed.). McGraw-Hill Education.</li> <li>3. Boyle, G. (2013). Programmable Logic Controllers: An Emphasis on Design and Application. ISA.</li> <li>4. Stallings, W. (2018). Data and Computer Communications (10th ed.). Pearson.</li> <li>5. Boyer, S. A. (2016). SCADA: Supervisory Control and Data Acquisition (4th ed.). ISA.</li> <li>6. Galloway, B., &amp; Hancke, G. P. (2013). Introduction to Industrial Control Networks. IEEE Communications Surveys &amp; Tutorials.</li> <li>7. Siemens AG. (2023). SIMATIC S7-1200/S7-1500 System Manual. Siemens Documentation.</li> <li>8. Siemens AG. (2023). TIA Portal Programming Manual. Siemens Documentation.</li> <li>9. Modbus Organization. (2022). Modbus Application Protocol Specification. Modbus Organization.</li> <li>10. International Electrotechnical Commission. (2013). IEC 61131-3: Programmable Controllers – Programming Languages. IEC.</li> </ol>			
<b>Assessment</b>			
Attendance	0%	Less than 75% class attendance results in NA grade	
Presentation	10%		
Lab. works	10%		
Course work	0%		
Quiz	10%		
Midterm Exam	20%	Written Exam	
Final Exam	50%	Written Exam	
Total	100%		
<b>Assessment Criteria</b>			
Laboratory Work– Hands-on PLC programming using ladder logic; evaluation based on functionality, accuracy, and documentation.			
Midterm Exam– Written exam covering PLC and SCADA theory, architecture, and basic logic principles.			
Final Exam– Comprehensive exam including advanced PLC programming concepts, SCADA systems, and HMI configuration.			
<b>Course Policies</b>			
<ol style="list-style-type: none"> <li>1. Attendance of the course is mandatory.</li> <li>2. Material presented in the lecture as well as assigned readings will be included in testing.</li> </ol>			

3. Late assignments will not be accepted unless an agreement is reached with the lecturer.
4. Cheating and plagiarism will not be tolerated.
5. Cheating will be penalized according to the Azerbaijan State Oil and Industrial University General Student Discipline Regulations

**ECTS allocated based on Student Workload**

<b>Activities</b>	<b>Number</b>	<b>Duration (hour)</b>	<b>Total Workload (hour)</b>
<b>Course duration in class</b>	60	1	60
Presentation	1	10	10
Self-study	15	4	60
Tutorials	15	4	60
Midterm Examination	1	3	3
Preparation for midterm exam	1	10	10
Final Examination	1	3	3
Preparation for final exam	1	20	20
<b>Total Workload</b>			226
<b>Total Workload/30(h)</b>			6.03
<b>ECTS Credit of the Course</b>			6