Bachelor program,
Instrumentation Engineering (INEN) program, "Instrumentation Engineering" department

Course Unit Title	Design of DCS based systems in technological processes
Course Unit Code	VTES-B05-1
Type of Course Unit	Elective
Level of Course Unit	4 th year INEN program
National Credits	0
Number of ECTS Credits Allocated	7
Theoretical (hour/week)	2
Practice (hour/week)	2
Laboratory (hour/week)	0
Year of Study	4
Semester when the course unit is delivered	7
Course Coordinator	Stanislav Aghamatov
Name of Lecturer (s)	Stanislav Aghamatov
Mode of Delivery	Seminar, Face to face teaching
Language of Instruction	English
Prerequisites	-
Recommended Optional Program Components	Tia portal, Eco Struxure, GMT Suite

Course description:

The subject of "Design of DCS based systems in technological processes" includes computerized control system for a process or plant that consists of many control loops including temperature, pressure, level, flow, voltage, current, power ext, in which autonomous controllers are distributed throughout the system, but there is central operator supervisory control. DCS can be used to enhance reliability and reduce installation costs by localizing control functions near the process plant, with remote monitoring and supervision. Topic is about large continuous process plants where high reliability and security is required.

Objectives of the Course:

This course aims to bring the students to a level that will enable them fulfil the requirements of main courses of their departments.

- Basic feedback control principles
- Proportional-only control
- Steady-state process gain
- Basic process control strategies
- Techniques for analyzing control strategies.

Learning Outcomes

At the end of the course the student should be able to:		Assessment
1	Design simple DCS architectures: Students will be capable of developing a basic DCS configuration suitable for controlling and monitoring technological processes.	1,2,3,4
2	Understand the fundamental principles of Distributed Control Systems (DCS): Students will learn the basic structure, functionality, and applications of DCS in technological processes.	1,2.3,4
3	Identify the key components of DCS: Students will be able to name and describe the role of controllers, field devices, human-machine interfaces (HMI), and communication networks in DCS	1,2,4
4	Apply DCS in industrial automation systems: Students will understand how to integrate DCS in various industrial systems, focusing on its role in improving control and efficiency.	1,4

5	Understand communication protocols in DCS: Students will grasp the essential communication protocols used in DCS, such as Modbus, Profibus, and Ethernet/IP.	1,2,3,4
6	Analyze and troubleshoot DCS systems: Students will develop the skills to detect and solve common issues in DCS-based systems, enhancing their practical understanding.	4
7	Work cooperatively in teams for DCS project design: Students will collaborate in small groups to design, simulate, and present DCS solutions for selected technological processes.	4
8	Develop technical documentation for DCS systems: Students will practice writing clear and concise documentation for the DCS designs, including system specifications, diagrams, and operational guidelines.	4
Assessment Methods: 1. Final Exam, 2. Midterm exam, 3. Presentation, 4. Seminars		
Course's Contribution to Program		
		CL
1	Ability to develop as a specialist in the field of fundamental sciences and apply basic knowledge.	1
2	Ability to analyze and model functional and structural schemes of various purpose devices and systems.	2
3	Ability to use modern methods and tools, creation, selection, and application of engineering and information technology tools and modern devices and equipment.	2
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.	4
6	The ability to use modern software to process technical documents of devices, design their structures, and algorithmize processes.	3
7	The ability to apply artificial intelligence to improve the quality characteristics of measurement and control systems.	5
8	The ability to process information acquisition, processing, and transmission processes based on schematic and programmable logical integrated circuits.	3
9	Ability to use knowledge to improve quality indicators and environmental safety of production processes.	3
10	Self-development ability to apply theoretical and experimental knowledge in solving modern engineering problems.	4
CL: Contribution Level (1: Very Low, 2: Low, 3: Moderate, 4: High, 5: Very High)		
Course Contents		

Week	Chapter	Topics	Exams
1	[1], Unit 1 Pages 3-20	Introduction to Distributed Control Systems (DCS) Reference: Instrument Engineers' Handbook, Chapter 1,	
2	[1], Unit 2 Pages 45-67	Process Control Fundamentals	
3	[1], Unit 3 Pages 72-91	DCS vs. PLC: Key Differences and Applications	
4	[1], Unit 4 Pages 58-84	DCS Design and Implementation	
5	[1], Unit 5 Pages 121-140	Sensors and Instrumentation in DCS	
6	[1], Unit 6 Pages 115-136	Control Loop Configurations in DCS	
7	[1], Unit 7 Pages 234-259	HMI (Human-Machine Interface) in DCS	
8			Midterm exam
9	[1], Unit 8 Pages 145-168	Network Topologies for DCS	

10	[1], Unit 9 Pages 178-205	PID Control in DCS	
11	[1], Unit 10 Pages 185-207	DCS Communication Protocols	
12	[1], Unit 11 Pages 311-340	Redundancy and Fault Tolerance in DCS	
13	[1], Unit 12 Pages 212-238	Batch Control with DCS	
14	[1], Unit 13 Pages 252-274	DCS Integration with SCADA Systems	
15	[1], Unit 14 Pages 380-415	DCS in Oil and Gas Industry	
16			Final exam

RECOMMENDED SOURCES:

1. S7-1200 Programmable controller SIMATIC S7 S7-1200 Programmable controller Official Programming Manul From Siemens

SUPPLEMENTARY COURSE MATERIAL:

1. Bela G. Liptak, Instrument Engineers' Handbook: Process Control and Optimization, CRC Press, 2005 (Comprehensive reference for understanding DCS systems and process control.)
2. Michael P. Lucas, Distributed Control Systems: Their Evaluation and Design, Van Nostrand Reinhold, 1986 (A detailed guide on the design and implementation of DCS in industrial automation.)
3. Thomas A. Hughes, Measurement and Control Basics, Fifth Edition, ISA, 2015 (A fundamental book for beginners on industrial measurement and control systems, including DCS.)
4. Frank D. Petruzella, Programmable Logic Controllers, Fourth Edition, McGraw-Hill, 2010 (An introduction to PLCs, with connections to DCS-based systems.)
5. José A. Romagnoli and Ahmet Palazoglu, Introduction to Process Control, CRC Press, 2005 (Focuses on control systems for beginners, with examples related to DCS.)

Assessment

Attendance	0%	At least 75% class attendance is compulsory
Presentation	20%	
Midterm Exam	30%	Oral Exam
Final Exam	50%	Written Exam
Total	100%	

Assessment Criteria

Final grades are determined according to the Academic Regulations of Azerbaijan State Oil and Industry University Guidelines for Undergraduate Studies

Course Policies

- Attendance of the course is mandatory.
- Late assignments will not be accepted unless an agreement is reached with the lecturer.
- Cheating and plagiarism will not be tolerated. Cheating will be penalized according to the Azerbaijan State Oil and Industrial University General Student Discipline Regulations

ECTS allocated based on Student Workload

Activities	Number	Duration (hour)	Total Workload(hour)
Course duration in class	14	6	84
Presentation	1	10	10
Tutorials	14	1	14
Self-study	14	4	56
Midterm Examination	1	3	3
Preparation for midterm exam	1	10	10
Final Examination	1	3	3
Preparation for final exam	1	30	30
Total Workload			**210**
Total Workload/30(h)			**7**

ECTS Credit of the Course	**7**