Instrumentation engineering (INEN) program, "Instrumentation engineering" department

Course Unit Title	**Industrial Devices**
Course Unit Code	VTES-B15
Type of Course Unit	Elective
Level of Course Unit	3rd year INEN program
National Credits	6
Number of ECTS Credits Allocated	6
Theoretical (hour/week)	2
Practice (hour/week)	1
Laboratory (hour/week)	2
Year of Study	3
Semester when the course unit is delivered	6
Course Coordinator	Aliyev Kamran
Name of Lecturer (s)	Aliyev Kamran
Name of Assistant (s)	-
Mode of Delivery	Face to Face
Language of Instruction	English
Prerequisites	-
Recommended Optional Programme Components	-

Course description:

This course provides a comprehensive introduction to the field of industrial instrumentation, focusing on the role of sensors and instruments in modern manufacturing and industrial processes. Students will explore key components of industrial instrumentation systems, including sensors, transducers, signal conditioning, and data acquisition systems. The course covers various types of instruments, from traditional mechanical gauges to advanced digital and smart sensors, and their applications across industries such as oil and gas, chemical, pharmaceutical, and manufacturing. Key topics include process control, calibration techniques, instrumentation integration, safety protocols, and the use of artificial intelligence in instrumentation. Through practical labs and case studies, students will gain hands-on experience in the design, operation, and maintenance of industrial instrumentation systems, preparing them for careers in advanced process control and automation.

Objectives of the Course:

The purpose of this course is to equip students with a foundational understanding of industrial instrumentation and its essential role in modern process control and automation. By exploring the technical, practical, and theoretical aspects of instrumentation systems, students will develop the knowledge and skills necessary to design, operate, and maintain instrumentation in industrial environments. The course aims to foster problem-solving abilities, encourage innovation in measurement and control systems, and prepare students for careers in industries such as oil and gas, chemical, pharmaceutical, and manufacturing. Additionally, the course seeks to inspire students to embrace emerging technologies like AI, IoT, and smart sensors to enhance industrial processes and contribute to the future of intelligent automation.

Learning Outcomes

At the end of the course the student will be able to		Assessment
1.	Participants will possess a comprehensive understanding and deep knowledge of key terms and techniques in industrial instrumentation.	1,3
2.	Students will be capable of applying these techniques to solve tasks related to instrumentation engineering.	1,2,3
3.	Students will develop a practical approach necessary to address engineering challenges specific to industrial instrumentation.	2,3
4.	Students will be proficient in formulating technical concepts within the field of industrial instrumentation, resolving instrumentation-related issues, and critically assessing the outcomes.	2,3

Assessment Methods: 1. Final Exam, 2. Presentation, 3. Midterm exam

Course's Contribution to Program

		CL
1	Ability to develop as a specialist in the field of fundamental sciences and apply basic	4

	knowledge.	
2	Ability to analyze and model functional and structural schemes of various purpose devices and systems.	3
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 experINENce to achieve the set goal.	5
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.	4
7	The ability to apply artificial intelligence to improve the quality characteristics of measurement and control systems.	1
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.	4
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	Exam
1	[1], ch.7;	**LECTURE:** Introduction to industrial instrumentation and instrumentation drawings **LAB-** Strain gauge in Simulink with using Simscape library	
2	[1], ch.21;	**LECTURE:** Temperature measurement transmitters based on RTD and Thermocouple principal, Temperature switch **LAB-** Shaft encoder in Simulink with using Simscape library(contd) **SEMINAR:** Temperature Measurement and Calibration: RTD and Thermocouple Calculations	
3	[1], ch.19	**LECTURE:** Pressure measurement transmitters based on Strain gauge and Capacitance principal Pressure switch **LAB-** Shaft encoder in Simulink with using Simscape library	
4	[1], ch.20	**LECTURE:** Level measurement transmitters based on Radar and Ultrasonic principal, Level Switch. **LAB-** Thermistor in Simulink with using Simscape library **SEMINAR:** Pressure Transmitter Design: Strain Gauge and Capacitance Sensor Calculations	
5	[1], ch.20	**LECTURE:** Level measurement transmitters based on Hydrostatic pressure and Nucleonic principal **LAB-** Thermoelectric in Simulink with using Simscape library(contd)	
6	[1], ch.22	**LECTURE:** Volumatic flow measurement transmitters based on Ultrasonic **LAB-** Thermoelectric in Simulink with using Simscape library **SEMINAR:** Level Measurement: Hydrostatic Pressure Numerical Modeling	
7	[1], ch.22	**LECTURE:** Volumatic flow measurement transmitters based on Turbine principal, Flow switch **LAB-** Pressure Sensor in Simulink with using Simscape library	Midterm
8	[1], ch.22	**LECTURE:** Volumatic flow measurement transmitters based on Differential pressure, Venturi tube and Vortex principal **LAB-** Pressure Sensor in Simulink with using Simscape library **SEMINAR:** Volumetric Flow Measurement: Ultrasonic, Magnetic,	

		and Turbine Meter Calculations	
9	[1], ch.22	**LECTURE:** Mass flow measurement transmitters based on Coriolis and Thermal principal **LAB-** PID Controller Thermal System in Simulink with using Simscape library	
10	[1], ch.23;	**LECTURE:** Continuous analytical measurement transmitters – conductivity measurement, pH measurement and chromatography **LAB-** PID Controller Thermal System in Simulink with using Simscape library **SEMINAR:** Mass Flow Measurement: Coriolis and Thermal Flow Meter Computations	
11	[1], ch.23	**LECTURE:** Industrial gas, smoke, and flame detectors. **LAB-** PID Controller Thermal System in Simulink with using Simscape library	
12	[1], ch.23	**LECTURE:** Industrial leak and sand detectors**.** **LAB-** Level control system using Simscape library **SEMINAR:** Conductivity and pH Measurement: Analytical Sensor Calculations	
13	[1], ch.26	**ECTURE:** Industrial final control element - pneumatic control valves, IP converter and pneumatic ON/OFF valves **LAB-** Level control system using Simscape library	
14	[1], ch.27	**LECTURE:** Industrial final control element – electrical motor and speed control **LAB-** Position control system of the slider-crank mechanism using Simscape library **SEMINAR:** Pneumatic Control Valves and IP Converters: Numerical Simulation and Control	
15	[1], ch.12	**LECTURE:** Industrial controllers – Introduction to industrial PLC **LAB-** Position control system of the slider-crank mechanism using Simscape library **SEMINAR:**	
16			Final exam

Recommended Sources

TEXTBOOK(S)

1. Lessons In Industrial Instrumentation Kuphaldt, Tony R 2023 Version 3.01
2. N.B.Northrop, 2018,Introduction to Instrumentation and Measurements, 3rd Edition, CRC Press, Taylor@Francis Group

Assessment

Attendance	0%	Less than 75% class attendance results in NA grade
Presentation	10%	
Lab	10%	
Quiz	10%	
Midterm Exam	20%	Written Exam
Final Exam	50%	Written Exam
Total	100%	

Assessment Criteria

Final grades are determined according to the Academic Regulations of Azerbaijan State Oil and İndustry University for undergraduate studies

Course Policies

- Attendance of the course is mandatory.
- Material presented in the lecture as well as assigned readings will be included in testing.
- 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	15	4	60
Presentation	1	8	8
Self-study	15	3	45
Tutorials	15	3	45
Midterm Examination	1	3	3
Preparation for midterm exam	1	8	8
Final Examination	1	3	3
Preparation for final exam	1	18	18
Total Workload			190
Total Workload/30(h)			6.3
ECTS Credit of the Course			6