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

Course Unit Title	Modern Information Measurement Systems
Course Unit Code	VTES-B06
Type of Course Unit	Elective
Level of Course Unit	4 th year INEN program
National Credits	8
Number of ECTS Credits Allocated	8
Theoretical (hour/week)	2
Practice (hour/week)	1
Laboratory (hour/week)	2
Year of Study	4
Semester when the course unit is delivered	7
Course Coordinator	Yusubov Elvin
Name of Lecturer (s)	Yusubov Elvin
Name of Assistant (s)	-
Mode of Delivery	Face to Face
Language of Instruction	English
Prerequisites	-
Recommended Optional Programme Components	-

Course description:

Modern information measurement systems are computerized data collection and processing facilities used in scientific experiments and production control, environmental protection, medicine, and other areas. Information-measuring systems include systems for measuring, optimizing, measuring, and improving the metrological characteristics of systems for measuring, automatic control, technical diagnostics, and object recognition systems.

Objectives of the Course:

The main objective and purpose of the course are to teach future instrumentation engineers the design, and operation of information-measuring systems, and to evaluate and improve the structure, and performance of information-measuring systems and their metrological characteristics.

Learning Outcomes

At the end of the course the student will be able to		Assessment
1.	The participants have a thorough knowledge and an in-depth understanding of the modern-information measurement systems. Classification of data acquisition systems.	1,3
2.	Understand the signal conditioning and noise reduction techniques within the context of the information measurement systems.	1,2,3
3.	Understand the analog to digital, digital to analog conversion techniques and sample and hold circuits within the context of the information measurement systems.	2,3
4.	Understand the principles of SCADA and telemetry systems within the context of the information measurement systems.	2,3
5.	Understand HART and Modbus protocols as well as fieldbust communication systems within the context of the information measurement systems.	1,3
6.	Establish interface between the microcontrollers and sensors	1,3

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 knowledge.	4
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 experience 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	[4], Ch. 6, p.1-2; [1], Ch. 1; [3], Ch. 1,p.1;	**LECTURE**: Fundamentals of information theory and data acquisition systems **LAB**-Development of Air Flow Data Acquisition Syste	
2	[1], Ch. 10	**LECTURE**: Noise sources and methods of reducing effects of noise and interference **LAB**- Development of a noise filtering circuit **SEMINAR**: Problem Solving on fundamentals of information theory and data acquisition systems and Noise Reduction Methods	
3	[1], Ch. 5; [3], Ch. 2, p.3;	**LECTURE**: Signal Conditioning **LAB-** Development of a signal conditioning circuit. Input signal amplification	
4	[2], Ch. 12, p.1; [4], Ch. 12, p.1;	**LECTURE**: Sample and Hold circuits **LAB-** Development of a sample and hold circuit **SEMINAR**: Problem Solving on Signal Conditioning and Sample and Hold circuits	
5	[1], Ch.3; [2], Ch. 13, p.5; [3], Ch. 2, p.9;	**LECTURE**: Time and Frequency Division Multiplexing and Structural Diagrams of Multiplexed Systems **LAB**- Development of a multiplexed system	
6	[2], Ch. 13, p.1-4; [7], Ch. 7	**LECTURE**: Telemetry Systems **LAB**- Development of a modulator and demodulator circuit **SEMINAR**: Problem-solving on Multiplexing	
7	[2], Ch. 12, p.2; [1], Ch. 2; [3], Ch. 2, p.4;	**LECTURE**: Analog to Digital Converters-Flash type **LAB**-Development of an Analog to Digital Converter	Midterm
8	[2], Ch. 12, p.2;	**LECTURE**: Analog to Digital Converters-Single and Dual slope **LAB**-Development of an Analog to Digital Converter	
9	[2], Ch. 12, p.3; [3], Ch. 2, p.5;	**LECTURE**: Methods of Digital-to-Analog Conversion **LAB**-Development of a Digital to Analog Converter **SEMINAR**: Problem-Solving on Analog to Digital Converters-Flash (Simultaneous) ADC	
10	[5], Ch. 2, p.1-7;	**LECTURE**: Remote Terminal Units (RTU) and Intelligent electronic devices (IEDs) of SCADA systems **LAB**-Development of an Automatic Light Measurement and Control System	
11	[5], Ch 2, p.8,11	**LECTURE**: Master station and Human-machine interface (HMI) of SCADA systems **LAB**- Development of a Capacitive Touch Sensor System **SEMINAR**: Problem-Solving on Analog to Digital Conversion-single	

		slope and dual slope ADC	
12	[7], Ch. 8,	**LECTURE**: Wireless Sensor Networks **LAB**- Development of a Fire Detection System	
13	[6], Ch 15, p.10;	**LECTURE**: HART protocol **LAB**- Development of a Light Detector System and battery monitoring circuit **SEMINAR**: Problem-Solving on Digital-to-Analog Conversion	
14	[6], Ch 15, p.11;	**LECTURE**: MODBUS protocol **LAB**- Development of an AC mains Monitoring System	
15	[6], Ch 16, p.1-4;	**LECTURE**: Fieldbus Communication **LAB**- Development of Dark and Light Detector System **SEMINAR**: Problem-Solving on Communication Methods	
16			Final exam

Recommended Sources

TEXTBOOK(S)

1. Measurement Computing Corporation, "Data Acquisition Handbook", 2012, https://files.digilent.com/reference%2Fdata-acquisition-handbook.pdf
2. Thomas Floyd,"Digital Fundamentals", Pearson Education, 11th edition, 2021 https://www.pearson.com/en-us/subject-catalog/p/digital-fundamentals/P200000001044/9780137506309
3. M. Di Paolo Emilio, Data Acquisition Systems. New York, NY: Springer New York, 2013. doi: https://doi.org/10.1007/978-1-4614-4214-1 .
4. Issam Abu-Mahfouz, Instrumentation: Theory and Practice, Part 1 Principles of Measurements, Springer Nature, Switzerland AG, 2022 https://doi.org/10.1007/978-3-031-15246-7
5. Mini S. Thomas, John D. McDonald, "Power System Scada and Smart Grids", CRC Press, Taylor & Francis Group, USA, 2015, https://doi.org/10.1201/b18338
6. Tony R. Kuphaldt, "Lessons In Industrial Instrumentation", licensed under the Creative Commons Attribution 4.0 International Public License, California, USA 2022. https://www.ibiblio.org/kuphaldt/socratic/sinst/book/liii.pdf
7. Miguel F. Acevedo, "Real-Time Environmental Monitoring-Sensor and Systems", Taylor & Francis Group, 2016, USA

Additional information will be distributed either electronically or delivered in printed forms.

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

1. Attendance of the course is mandatory.
2. Material presented in the lecture as well as assigned readings will be included in testing.
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

Activities	Number	Duration (hour)	Total Workload (hour)

Course duration in class	15	5	75
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
Total Workload			241
Total Workload/30(h)			8.03
ECTS Credit of the Course			8