Analog and digital measuring instruments

Course Syllabus

This course contributes to the Degree of BSc in Instrumentation Engineering

Course title:	Analog and digital measuring instruments
Course code:	
Lecturer:	Prof. Fuad ALIEW
ECTS credits:	
Type of Course Unit	Area Elective
Level of Course Unit	First Cycle (Undergraduate)
Theoretical (hour/week)	2
Practice (hour/week)	
Laboratory (hour/week)	
Mode of Delivery	Face to Face
Language of Instruction	English
Prerequisites	-
Recommended Optional Programme Components	-

Course Description

In order to effectively work in various fields of electrical and electronic instrumentation , to effectively use analog and digital measuring devices, the role of the course “Analog and Digital measuring devices” in the formation of the future engineer is great.

All areas of Instrumentation Engineering: measurement of electrical and non-electrical quantities in the works carried out in the country is widely used. Various devices are involved in this processlor.Depending on the type of parameters being measured,the accuracy that is required, etc. depending on whether they use analog or digital measuring devices.

Goals and objectives of the course

The main goal of the discipline and its purpose in teaching is to familiarize future instrumentation engineers with electronic analog and figure measuring devices .

The main task in teaching the subject is to teach future instrumentation engineers the rules and laws of control of devices that perform measurements and experiments in Electrical and electronic circuits.

Learning Outcomes

At the end of the course the student will be able to		Assessment
1	have knowledge of a both theoretical and practical information about most widely used analog und digital instruments	1
2	understand how to measure analog and digital quantities	1,2,3
3	test different measuring equipment and plot output data of the instruments	1
4	solve problems with different analog instruments and digital instruments	1
5	design a useful measuring system and predict its behavior.	1,2
Assessment Methods: 1. Final Exam, 2. Presentation, 3. Midterm exam		

Course's Contribution to Program

	B.Sc. Instrument Engineering Course's Contribution to Program	Level of Contribution
1	Ability to develop as a specialist in the field of fundamental sciences and apply basic knowledge.	5
2	Ability to analyze and model functional and structural schemes of various purpose devices and systems.	4
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.	4
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.	3
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	3

	safety of production processes.	
10	Self-development ability to apply theoretical and experimental knowledge in solving modern engineering problems.	2
CL: Contribution Level (1: Very Low, 2: Low, 3: Moderate, 4: High, 5: Very High)		

Course Contents

Week	Chapter	Topics of the content of lectures	Exam
1	[1]: Chapter 1	**INTRODUCTION.** Basic concepts in the field of metrology.The concept of measurement. Classification of measurements.The concept of a measuring instrument.Classification of measuring instruments.	
2	[1]: Chapter 1	**MEASUREMENT ERRORS.** Systematic and random errors. Estimation of measurement errors with single observations.	
3	[1]: Chapter 4	**MEASUREMENT OF DIRECT CURRENTS AND VOLTAGES.** Measurement of direct current. Voltage measurement. Application of Kirghoff's laws to calculations in circuits. Capacitors in electrical circuits. RC circuits.	
4	[1]: Chapter 4	**MEASUREMENT OF DIRECT CURRENTS AND VOLTAGES**. General information about electromechanical measuring devices. Devices of magnetoelectric, electromagnetic, electrodynamic and electrostatic systems.	
5	[1]: Chapter 3	**MEASUREMENT OF ALTERNATING CURRENTS AND VOLTAGES.** Electromagnetic, electrodynamic, ferrodynamic, electrostatic and other converters. The dependence of the readings on the shape of the measured currents and voltages. AC voltmeters.	
6	[1]: Chapter 13	**MEASURING GENERATORS.** Generators of sinusoidal oscillations of the audio and radio frequency ranges. Generators of rectangular pulses.	
7	[1]: Chapter 9	**UNIVERSAL OSCILLOSCOPES.** Purpose, main characteristics. The main blocks and nodes are: a cathode ray tube, vertical and horizontal deflection channels, and a synchronization circuit. The main blocks and nodes of a two-channel oscilloscope.	Mid-term
8	[1]: Chapter 9	**SPECIAL OSCILLOSCOPES.** Memory, broadband,stroboscopic oscilloscopes.	

9	[1]: Chapter 6	**FREQUENCY RESPONSE METERS.** Purpose, main technical characteristics. The flowchart, the principle of operation.	
10	[1]: Chapter 10	**INTRODUCTION TO THE BASICS OF THE DIGITAL MEASUREMENT METHOD.** Natural continuous and discrete physical quantities. The advantages of measuring discrete physical quantities. Quantization and discretization of a physical quantity, the errors of these operations. The appearance of dynamic errors.	
11	[1]: Chapter 1	**CODING.** Number systems. Numeric codes. Coding methods.	
12	[1]: Chapter 10	**DIGITAL MEASURING INSTRUMENTS. DIGITAL VOLTMETERS** A block diagram of a digital measuring device. The functional purpose of the input device, the analog-to-digital conversion unit and the digital readout device. Universal voltmeter.	
13	[1]: Chapter 15	**DIGITAL COUNTING DEVICE.** Digital indicators, classification. The principle of operation and the main technical characteristics of gas-discharge, fluorescent, cathode-luminescent, LED, liquid crystal and incandescent digital indicators.	
14	[2]: Chapter 3	**ANALOG-TO-DIGITAL and DIGITAL-TO-ANALOG CONVERTERS.** Classification of analog-to-digital converters (ADCs). Time-pulse type ADCs, push-pull integration ADCs, frequency-pulse type ADCs, code-pulse type ADCs that deploy, monitor and pore-bit balancing. Digital-to-analog converters (DACs) with voltage summation and division. DAC with current summation	
15	[1]: Chapter 12	**DIGITAL PHASE METERS. DIGITAL FREQUENCY METERS AND TIME INTERVAL METERS** Methods of digital measurement of phase shift. Non-integrating and integrating digital phase meters.A typical block diagram of a universal frequency meter. Features of measuring frequency and time intervals.	
16			Final

Recommended sourses Textbooks and materials:	1. P. Purkait and autors, Electrical and Electronics Measurements and Instrumentation, McGraw Hill Education , ISBN (13): 978-1-25-902959-2 2. Nihal Kularatna. Digital and Analogue ,Instrumentation testing and measurement, Lightning Source UK, 2008 3. N.V. Raghavendra, L. Krishnamurthy. Engineering Metrology and Measurements, Oxford University Press, 2013 4. John P. Bentley, Principles of Measurement Systems, Fourth Edition,

	Pearson Education Limited 2005

Assessment

Method of assessment	Weight (%)	
Attendance	0%	At least 75% class attendance is compulsory
Mid-terms:	30	Written Exam
Presentation	20	Oral Exam
Final exam:	50	Written Exam
	Total weight: 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	3	42
Presentation	1	10	10
Tutorials	14	1	14
Self-study	14	5	70
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			**180**
Total Workload/30(h)			**180/30**
ECTS Credit of the Course			**6**