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

Course Unit Title	The physical basis of obtaining information, modern sensors and transducers
Course Unit Code	VTSS-B20
Type of Course Unit	Compulsory
Level of Course Unit	3rd year INEN program
National Credits	0
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	5
Course Coordinator	Fuad Aliew
Name of Lecturer (s)	Fuad Aliyew
Name of Assistant (s)	-
Mode of Delivery	Face to Face, Seminar.
Language of Instruction	English
Prerequisites	-
Recommended Optional Program Components	-

Course description:

In this course the methods and means of obtaining measuring information are considered. The physical foundations of the construction of sensors and information converters, metrological characteristics of measurements are given. Physical phenomena and methods of measuring geometric, mechanical, thermal quantities are considered; measurement of time, parameters of natural and artificial fields, acoustic noise, electric and magnetic quantities. The issues of building information measuring systems are outlined - visual systems, collecting and processing information in them, building telemetry systems, automatic control, technical diagnostics and image recognition.

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	to have knowledge of a both theoretical and practical information about most widely used sensors and actuators	1
2	understand how physical effects and laws such as piezoelectric, thermoelectric, optoelectric, piezoresistive, Newton's laws, electromagnetic, capacitive and others are exploited to make sensors and actuators.	1,2,3
3	compare sensing of a measurand using sensors based on different physical effects	1
4	test and plot sensor data to obtain sensor characteristics	1
5	design a useful device containing a sensor or actuator and predict its behavior	1,2

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.	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	4

	and information technology tools and modern devices and equipment.	
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 safety of production processes.	3

CL: Contribution Level (1: Very Low, 2: Low, 3: Moderate, 4: High, 5: Very High)

Course Contents

Week	Chapter	Topics	Exam
1	[1]: Chapter 1,2	Information. Signal. Message. Physical quantity, its definition, measurement. Measuring conversion and measuring transducer. Structural elements of measuring transformation. Physical phenomena	
2	[1]: Chapter 4	Mechanical physical phenomena and effects used to obtain measurement and control information.	
3	[1]: Chapter 4	Electrical and magnetic physical phenomena and effects used to obtain measurement and control information.	
4	[1]: Chapter 5	Optical physical phenomena and effects used to obtain measurement and control information.	
5	[1]: Chapter 4	Chemical and nuclear physical phenomena and effects used to obtain measurement and control information.	
6	[1]: Chapter 6	Technical implementation of physical effects	
7	[1]: Chapter 6	The concept of a converter of influence, interaction into information	Midterm
8	[1]: Chapter 7	Measurement of physical quantities of various nature	
9	[1]: Chapter 7,8	Statement and methods for solving problems of information retrieval, analysis and synthesis of physical phenomena and effects for the creation of measuring instruments, control, diagnostics and control	
10	[1]: Chapter 8,9	Space-time phenomena and converters. Parameters of space-time phenomena: length, angle, time, linear and angular displacements, velocities and accelerations, frequency of periodic events, relationships between parameters of space-time phenomena.	
11	[1]: Chapter 10	Mechanical phenomena and converters. Mechanics of liquids and gases. Parameters and characteristics. The amount of substance, flow rate, pressure, fluid velocity, compressibility, elasticity, viscosity. Mechanics of deformable bodies. Parameters and characteristics: elasticity, plasticity, deformation, stress, hysteresis.	
12	[1]: Chapter 11	Electrical and magnetic, phenomena and converters. Resistive phenomena and converters.Thermo, tenzo, photo, light, magnetoresistive effects. Hall phenomena. Converters based on these effects and phenomena.	
13	[1]: Chapter 12	Electrostatic phenomena and transducers. Capacitive phenomena	

		and converters. Ferroelectric phenomena. The relationship between the parameters of ferroelectrics.	
14	[2]: Chapter 13	Piezoelectrics. Reversibility of the phenomenon . Properties of piezoelectrics: natural and artificial. Piezoceramics.	
15	[1]: Chapter 14	Electromagnetic phenomena and converters. Inductive, transformer magnetoelastic, current-vortex, induction, phenomena, converters	
16			Final

Recommended Sources

TEXTBOOK(S)

1. Jacob Fraden, Springer, Handbook of modern sensors : physics, designs, and applications, 3rd. Edition, ISBN 0-387-00750-4
2. by John G. Webster The Measurement, Instrumentation and Sensors Handbook (Electrical Engineering Handbook) 1st Edition, CRC Press 1999
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
5. Sensors and Transducers. Third Edition. Ian R. Sinclair.Newnes Publisher, ISBN 0 7506 4932 1

Assessment

Attendance	0%	At least 75% class attendance is compulsory
Presentation	10%	Written Exam
Quiz	10%	Oral Exam
Lab. works	10%	Written Exam
Midterm Exam	20%	
Final Exam	50%	
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 (including midterm)	9999999	3	42
Presentation	1	10	10
Tutorials	14	1	14
Preparation for midterm exam	14	5	70
Final Examination	1	3	3
Preparation for final exam	1	10	10
Self-study	1	3	3
Total Workload			**180**
Total Workload/30(h)			**180/30**
ECTS Credit of the Course			**6**