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

Course Unit Title	**Biomedical Electronics, micro- and nano-transducers**
Course Unit Code	VTES-B02-3
Type of Course Unit	Elective
Level of Course Unit	3 rd year INEN program
National Credits	0
Number of ECTS Credits Allocated	9
Theoretical (hour/week)	2
Practice (hour/week)	2
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:

The subject of "Biomedical Electronics, micro- and nano-transducers" includes the characteristics of biomedical electronics, biomedical instrumentations, biomedical measurement and origins of bipotential, biopotential electrodes, types of biopotential amplifier, sensor networks, biomedical sensor, their types, principle of operation. and analysis of functional capabilities, features, parameters and basic technical and operational characteristics, operating modes, calibration, areas of application, methods of increasing transducing accuracy and development directions, etc. describes.

Objectives of the Course:

The aim and purpose of the course is to provide future Instrumentation engineers with the methods and means of biomedical electronics, principles and structures of system installations, structures and algorithms based on them, evaluation and improvement of transducers, design, manufacture and installation of devices for biomedical measurement, medical diagnostics, therapeutic and drug delivery is to teach. At the same time, the purpose of teaching the subject is to instill in students the skills to conduct independent experimental research and biomedical electronics, to select and use modern appropriate equipment, to master the ability to serve them.

Learning Outcomes

At the end of the course the student will be able to		Assessment
1.	Understand the BM devices	1,3
2.	Explain Biopotentials	1,2,3
3.	Understand Biopotential Electrods and Amplifiers	2,3
4.	Explain Biosensor Network	2,3
5.	Explain applications Biosensors	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	[1], ch.1, p.1;	**LECTURE:** Basic concepts of medical electronics and measurement **LAB:** Taking basic measurements with multimeters, function generators and oscilloscopes. **SEMINAR:** Blood Pressure Monitoring Systems	
2	[1], ch.1, p.11;	**LECTURE:** Op-apm uses for biomedical electronics **LAB:** Operational Amplifiers for Biomedical Instrumentation **SEMINAR:** Cardiac Pacemakers and Defibrillators	
3	[1], ch.11	**LECTURE:** Signal processing **LAB:** Operational Amplifiers for Biomedical Instrumentation **SEMINAR**: Electrocardiogram (ECG) Signal Processing	
4	[1], ch.3;	**LECTURE:** Microcontrollers in medical instrumentation **LAB:** PWM-Pulse Width Modulation **SEMINAR:** Hemodynamic Monitoring	
5	[1], ch.3;	**LECTURE:** Selection of a microcontroller for BM applications **LAB:** UART Between Microcontrollers Using Proteus **SEMINAR**: Pulse Oximetry	

6	[1], ch.4;	**LECTURE:** The origin of biopotentials **LAB:** Nerv Stimulation Circuit **SEMINAR:** Respiratory Rate Monitoring Devices	
7	[1], ch.5;	**LECTURE:** Biopotential electrodes **LAB: EMG** Biopotential Circuit (contd) **SEMINAR:** Ultrasound Imaging Systems	Midterm
8	[1], ch.6;	**LECTURE:** Biopotential amplifiers **LAB: EMG** Biopotential Circuit **SEMINAR:** MRI Signal Acquisition and Reconstruction	
9	[3], ch.5;	**LECTURE:** Sensor networks **LAB:** Biosensor Network Design and Integration **SEMINAR:** Non-Invasive Blood Glucose Monitoring	
10	[2], ch.1	**LECTURE:** Biosensors **LAB:** Biosensor Signal Processing and Analysis **SEMINAR:** Cochlear Implants	
11	[2], ch.3;	**LECTURE:** Catalytic biosensors **LAB:** Multi-Analyte Detection with Catalytic Biosensors **SEMINAR:** Wearable Health Sensors	
12	[2], ch.4;	**LECTURE:** Affinity biosensors **LAB:** Affinity Biosensors in Drug Discovery and Testing **SEMINAR:** Biomechanics of Prosthetics	
13	[3], ch.5;	**LECTURE:** Nucleic acid biosensors **LAB:** Nucleic acid biosensors for Rapid Disease detection **SEMINAR:** Thermography in Medical Diagnostics	
14	[3], ch.5;	**LECTURE:** Cell and Tissue Biosensors **LAB:** Multi-Analyte Detection with Biosensors **SEMINAR**: Capnography Systems	
15	[3], ch.5	**LECTURE:** Nano-biosensors **LAB:** MEMS Sensors **SEMINAR:** Bioimpedance Analysis for Body Composition	
16			Final exam

Recommended Sources

TEXTBOOK(S)

1. 1. John G. Webster, Amit J. Nimunkar , Medical instrumentation Application and Design , 5th edition , Wiley, 2020
2. 2. Alberto Pasquarelli, Biosensor and Biochips, Springer, 2021
3. 3. Ping Wang, Qingjun Liu, Biomedical Sensors and Measurement, Prentice Hall, 2011

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 Industry 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	90
Presentation	1	8	45
Self-study	15	3	60
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			272
Total Workload/30(h)			9.3
ECTS Credit of the Course			9