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

Course Unit Title	Electronics and Circuit Design
Course Unit Code	VTSS-B19
Type of Course Unit	Compulsory
Level of Course Unit	4th 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	4
Semester when the course unit is delivered	7
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:

Automated Design System of Instrumentation is a comprehensive course that explores the integration of automation tools and techniques into the design and development of instrumentation systems. The course delves into the principles of instrumentation, focusing on the use of cutting-edge software for automated design, simulation, and optimization. Students will learn how to leverage computer-aided design (CAD) tools, machine learning algorithms, and AI-driven methods to create efficient and reliable instrumentation systems across various fields, such as industrial automation, biomedical devices, and control systems. The course emphasizes hands-on experience with design software, allowing students to design, simulate, and optimize instrumentation systems, from simple sensor-based systems to complex, multi-layered automated systems.

Objectives of the Course:

Automated Design System of Instrumentation course is to equip students with the knowledge and skills needed to design, simulate, and optimize instrumentation systems through the use of automation tools and techniques. The course aims to: Bridge the gap between traditional and modern design methods by introducing students to automated tools that enhance accuracy, efficiency, and flexibility in instrumentation design. Prepare students for industry demands, where automated design systems are becoming increasingly critical for developing precise, reliable, and scalable instrumentation systems in sectors such as manufacturing, healthcare, and process control. Foster innovation by enabling students to integrate artificial intelligence and machine learning into the design process, driving advancements in smart and adaptive instrumentation. Provide hands-on experience with state-of-the-art software, enabling students to simulate and optimize real-world systems, ensuring that they are prepared for practical challenges in automated design environments.

Learning Outcomes

At the end of the course the student will be able to		Assessment
1.	Understand the integration of CAD/CAM in streamlining design-to-production for instrumentation systems.	1,3
2.	Develop skills in 3D modeling and simulation of instrumentation components using CAD	1,2,3

	software.	
3.	Apply Design for Manufacturing (DFM) principles to optimize instrumentation designs for CAM processes.	2,3
4.	Gain proficiency in CAM programming and CNC machining of instrumentation parts.	2,3
5.	Analyze and improve manufacturing workflows using CAD/CAM technologies.	1,3
6.	Understand toolpath generation and optimization for precision instrumentation manufacturing.	1,3
7.	Apply CAD/CAM software to automate and enhance the production of instrumentation systems.	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.1-3	**LECTURE:** Introduction to CAD/CAM **LAB-** AutoCAD workspace, toolbars, menus, and command-line interface	
2	[1], ch.3, p.1-4;	**LECTURE:** Computer Graphics for CAD/CAM **LAB-** Basic commands like line, circle, rectangle, and polygon, focusing on sensor layouts or circuit diagrams**.** **SEMINAR:** DDA algorithm calculations	

3	[1], ch.3, p.5-8	**LECTURE:** Transformation of Geometry **LAB-** Use snap, grid, and object tracking tools to create precise instrumentation diagrams, such as sensor placement layouts	
4	[1], ch.4, p.1-6;	**LECTURE:** Geometric Modelling **LAB-** Create 2D orthographic projections of a simple instrumentation system component, like a sensor housing. **SEMINAR:** Besenhauers Algorithm Calculations	
5	[1], ch.4, p.7-11	**LECTURE:** Curve Representation **LAB-** Learn dimensioning tools to annotate engineering drawings, applying tolerances and specifications relevant to measurement **systems**	
6	[1], ch.5, p.1-4	**LECTURE:** CAD standards **LAB**- Organize different parts of an instrumentation system into layers (e.g., sensors, wiring, mechanical housings) **SEMINAR:** CAD Standard specifications	
7	[1], ch.8, p.1-7,	**LECTURE:** Finite Element Analysis **LAB-** Practice editing commands such as move, copy, rotate, and mirror to modify existing designs, applying them to a circuit board or instrument case	Midterm
8	[1], ch.9,	**LECTURE:** Introduction to CNC tool **LAB-** Develop a detailed layout of an instrumentation system with multiple components **SEMINAR:** CNC machine types	
9	[1], ch.9, p.1-5	**LECTURE:** Introduction to CNC programming **LAB-** Layout of an instrumentation system with ensuring correct scaling and dimensioning	
10	[1], ch.10, p.1-6	**LECTURE:** CNC Hardware Basics **LAB-** Apply hatching techniques to section views, representing cross-sections of sensor housings or other components. **SEMINAR:** CNC machine parts reliability	
11	[1], ch.17, p.1-4;	**LECTURE:** Information requirements of Manufacturing **LAB-** Introduction to 3D Modeling in AutoCAD	
12	[1], ch.20, p.1-3	**LECTURE:** Communication Protocols **LAB-** Extrusion and Revolve for Instrumentation Parts **SEMINAR**: Manchester line Code	
13	[1], ch.20, p.3;	**LECTURE:** Communication Standards **LAB-** Solid Modeling for Complex Instrumentation Assemblies	
14	[1], ch.22, p.1;	**LECTURE:** Flexible Manufacturing Systems **LAB-** Rendering and Visualization of 3D Models **SEMINAR:** FMS calculations	
15	[1], ch.24,	**LECTURE:** Computer Integrated Manufacturing **LAB-** 3D Printing and Exporting for Prototyping	
16			Final exam

Recommended Sources

TEXTBOOK(S)

1. P Nageswara Rao. “CAD/CAM: Principles and Application”, third edition, The McGraw Hill, 2018.

2. CAD/CAM: Computer-Aided Design and Manufacturing" (2020) by Mikell P. Groover.
3. "Smart Machining Systems: Modeling and Control of the Machining Process" (2019) by B. Ravi Kumar

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

- 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 (includes midterm)	15	5	75
Presentation	1	7	7
Self-study	15	3	45
Tutorials	15	3	45
Midterm Examination	1	3	3
Preparation for midterm exam	1	7	7
Final Examination	1	3	3
Preparation for final exam	1	19	19
Total Workload			189
Total Workload/30(h)			6.3
ECTS Credit of the Course			6