General information	**Title and code of subject, number of credits**	ETR 320 Digital Electronics & Microprocessors, 6 ECTS	
	Department	Physics and Electronics	
	Program	Bachelor	
	Academic semester	2023 fall	
	Lecturer	Master of Science (Electronics Engineering) Sabuhi Ganiyev	
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	Lecture room/Schedule	11 Mehseti Street, AZ1096 Baku, Azerbaijan (Neftchilar campus), room	
	Consultations	Saturday 13:00 – 14:00	
Course language	English		
Type of the subject	Major		
Textbooks and additional materials	***Textbooks*:** 1. Digital Fundamentals, Thomas L. Floyd, Pearson Education , 11th edition, 2015 2. Intel Microprocessors, Brey, Barry B., Prentice Hall, 2014 Optional Reference Texts: 3. Digital Design, M. Morris Mano and Michael D. Ciletti, Pearson, 6th edition, 2021 4. Digital Electronics: Principles and Applications, Roger L. Tokheim, McGraw Hill, 9th edition, 2022 5. Fundamentals of digital logic with Verilog design, S.D. Brown, McGraw-Hill Education, 3 rd Edition, 2014		
Teaching methods	**Lecture**		+
	Group discussions at seminars		+
Assessment	**Components**	**Date/ Deadline**	**Percent (%)**
	Active participation	At each lesson	5
	Quizzes	During the semester	20
	Attendance	At each lesson	5
	Midterm exam		30
	Final exam		40
	Final		**100**
Course description	This course introduces the fundamental principles and applications of digital electronics. Students will gain knowledge of digital systems, logic gates, Boolean algebra, combinational and sequential circuits, memory technologies, and digital design methodologies. The course emphasizes both theoretical foundations and practical implementation through hands-on laboratory work.		
Course objectives	The main purpose of the subject "Digital Electronics and Microprocessors" is to study digital electronic devices and programmable integrated circuits, which are the main components of the control and management systems of production processes in the fields of energy production and consumption, by students studying "Radio engineering and telecommunication engineering" and to form their professional skills in this field. gaining knowledge and practical experience.		
Learning outcomes	**What students should know by the end of the course:** • Fundamentals of digital electronics and its applications. • Analyze and design combinational and sequential logic circuits. • Boolean algebra and logic simplification techniques. • Utilize computer-aided design (CAD) tools for digital circuit design. • Implementation of digital circuits using standard integrated circuits (ICs). • Structure of microprocessor: CPU, memory, and input/output peripherals. • Main components and working principles of the Intel 80x86 microprocessor. • Basics of assembly language. **They should be able to:** • Using digital electronic devices and programmable integrated circuits; • Determination of basic technical parameters of microprocessors; • Application of microprocessors in automation, monitoring and measuring devices, telecommunications; • Realization and application of combination devices, digital switches-multiplexers and demultiplexers in small and medium integrated microcircuits.		

Rules (Educational policy and behavior)	**Lesson organization** General information on the subject will be provided for the students during lectures. Student's knowledge on the previous topics will be evaluated and new topic will be explained by mins of visual aids during seminars. Student's knowledge level will be tested oraly and in written forms before midterm and final exams. Submission of the individual works by the end of course is obligatory. **Attendance** Participation of students at all classis is important. Students should inform dean's office about missing lessons for particular reasons (illness, family issues and etc.). Students, missing more than 25% of lessons, are not allowed to take the exam. **Students who attend the whole classes will get 5 marks. For two absence student loses 1 mark.** **Lates** Those students who are late for lessons for more than 15 minutes to class will be marked absent, despite this, the student can still attend the class. **Quizzes** Those students who have informed the teacher and the dean's office about missing the quiz in advance for particular reasons, are allowed to take the quiz next week. **Exams** All the issues related to the participation and admission to the exam are regulated by the faculty dean. Topics of midterm and final exams are provided for the students before the exams. The questions of midterm exam are not repeated in the final exam. **Violation of the rules of the exams** Disrupting the quiz and taking copy during midterm and final exams is forbidden. Quiz papers of the student who do not follow these rules are canceled and the students are expelled from the quiz by getting 0 (zero). **The rule for completing the course** In accordance with the University rules the overall success rate to complete the course should be 60% or above. The students who failed the exam would be to take this subject next semester or next year. **Rules of conduct for Students** Disruption of the lesson and not following ethical norms during the lesson, as well as conduction of the discussions by the students without permission and using mobile phones is forbidden. **Quizzes** Quizzes will be held 4 times during the semester The quizzes will be announced in the classroom two weeks before. Quiz is from homework problems. The homework problems will be selected from questions and problems in the end. of each chapter. The No. of homework problems will be announced after finishing each chapter. **Activity** Students who will be active during discussion of past lessons will be awarded with one activity mark.

Week	Dates (planned)	Subject topics	Textbook/ Assignments
1		*Introductory Concepts:* Digital and Analog Quantities, Binary Digits, Logic Levels, and Digital Waveforms, Basic Logic Functions, Combinational and Sequential Logic Functions, Introduction to Programmable Logic, Fixed-Function Logic Devices. *Questions and Exercises*	[1]
2		*Number Systems, Operations, and Codes:* Decimal Numbers, Binary Numbers, Decimal-to-Binary Conversion, Binary Arithmetic, Complements of Binary Numbers, Signed Numbers, Arithmetic Operations with Signed Numbers, Hexadecimal Numbers, Octal Numbers, Binary Coded Decimal (BCD), Digital Codes, Error Codes. *Questions and Exercises*	[1]
3		*Logic Gates:* The Inverter, The AND Gate, The OR Gate, The NAND Gate, The NOR Gate, The Exclusive-OR and Exclusive-NOR Gates, Programmable Logic, Fixed-Function Logic Gates. *Questions and Exercises*	[1]
4		*Boolean Algebra and Logic Simplification:* Boolean Operations and Expressions, Laws and Rules of Boolean Algebra, DeMorgan's Theorems, Boolean Analysis of Logic Circuits, Logic Simplification Using Boolean Algebra, Standard Forms of Boolean Expressions, Boolean Expressions and Truth Tables, The Karnaugh Map, Karnaugh Map SOP Minimization, Karnaugh Map POS Minimization,The Quine-McCluskey Method.	[1]

		Questions and Exercises	
5		*Combinational Logic Analysis:* Basic Combinational Logic Circuits, Implementing Combinational Logic, The Universal Property of NAND and NOR gates, Combinational Logic Using NAND and NOR Gates, Pulse Waveform Operation, Combinational Logic with VHDL. ***Quiz 1***	[1]
6		*Functions of Combinational Logic:* Half and Full Adders, Parallel Binary Adders, Ripple Carry and Look-Ahead Carry Adders, Comparators, Decoders, Encoders, Code Converters, Multiplexers (Data Selectors), Demultiplexers, Parity Generators/Checkers. *Questions and Exercises*	[1]
7		*Latches, Flip-Flops, and Timers:* Latches, Flip-Flops, Flip-Flop Operating Characteristics, Flip-Flop Applications, One-Shots, The Astable Multivibrator. *Questions and Exercises*	[1]
8		*Shift Registers:* Shift Register Operations, Types of Shift Register Data I/Os, Shift Registers, Shift Register Counters, Shift Register Applications, Logic Symbols with Dependency Notation . ***Quiz 2***	[1]
9		***Mid term exam***	
10		*Counters:* Finite State Machines, Asynchronous Counters, Synchronous Counters, Up/Down Synchronous Counters, Design of Synchronous Counters, Cascaded Counters, Counter Decoding, Counter Applications, Logic Symbols with Dependency Notation. *Questions and Exercises.*	[1]
11		*Programmable Logic:* Simple Programmable Logic Devices (SPLDs), Complex Programmable Logic Devices (CPLDs), Macrocell Modes, Field-Programmable Gate Arrays (FPGAs), Programmable Logic software, Scan Logic. *Questions and Exercises.*	[1] [1]
12		*Data Storage:* Semiconductor Memory Basics, The Random-Access Memory (RAM), The Read-Only Memory (ROM), Programmable ROMs, The Flash Memory, Memory Expansion, Special Types of Memories, Magnetic and Optical Storage, Memory Hierarchy, Cloud Storage. ***Quiz 3***	[1]
13		*Introduction to microprocessors:* Microprocessor. Evolution of microprocessors. Organization of microcomputers. Microprocessor programming. Timing diagram conventions. *Questions and Exercises*	[2]
14		*Intel 8086:* Internal architecture of Intel 8086. Flag Register. The BIU. Real Mode Memory Addressing. Introduction to protected mode memory addressing. Memory paging. Pin diagram of 8086. Clock generator. *Questions and Exercises*	[2]
15		*Intel 8086:* Instructions. ***Quiz 4***	[2]
		Final Exam