General information	**Title and code of subject, number of credits**	ETR 330 Electrical and electronic devices 6 ECTS	
	Department	Physics & Electronics	
	Program	Bachelor	
	Academic semester	Fall, 2024	
	Lecturer	PhD. Elvin Alizade	
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	Lecture room/Schedule	11 Mehseti Street, AZ1096 Baku, Azerbaijan (Neftchilar campus)	
	Consultations		
Course language	English		
Type of the subject	Major		
Textbooks and additional materials	***Textbooks*:** 1. Electronic Devices and Circuit Theory Eleventh Edition Robert L. Boylestad Louis Nashelsky Pearson Education, 2009 2. Microelectronics: Circuit Analysis and Design Fourth Edition Donald A. Neamen University of New Mexico, 2010 3. The Electrical Engineering Handbook Series Series Editor Richard C. Dorf University of California, Davis, 2005 4. "Internet of Things: Information Processing in an Increasingly Connected World" by Leon Strous and Vinton Cerf, 2018		
Teaching methods	**Lecture**		+
	Solving exercises		+
Assessment	**Components**	**Date/ Deadline**	**Percent (%)**
	Active participation	At each lesson	10
	Quizzes	During the semester	10
	Attendance	At each lesson	10
	Mid-term exam		30
	Final exam		40
	Final		**100**
Course outline	This course provides undergraduate students with a comprehensive understanding of electrical and electronic devices, focusing on their fundamental principles and practical applications. Students will explore essential concepts such as semiconductor devices (diodes, transistors, and operational amplifiers), digital logic, and microcontrollers. Additionally, the course covers electrical energy systems, machines, and power systems, equipping students with the knowledge necessary to analyze, design, and apply these devices in various electrical and electronic systems. The course emphasizes both theoretical knowledge and practical skills, ensuring students gain a well-rounded understanding of modern electronic engineering.		
Course objectives	The primary goal of this course is to introduce students to the principles of electrical and electronic devices and their applications in circuits and systems. Key topics include Basic circuit analysis: Understanding electrical quantities, components, and circuit analysis laws, including Kirchhoff's laws, series/parallel circuits, and Thevenin's theorem. Semiconductor devices: Exploring diodes, transistors, and operational amplifiers and their roles in power supplies, amplifiers, and signal processing. Digital electronics: Introduction to digital logic, microcontrollers, and their applications in modern electronics.		
Learning outcomes	Upon successful completion of this course, students will be able to: LO-1: Understand the fundamental properties of semiconductor materials and p-n junctions, including their ideal current-voltage characteristics. LO-2: Apply DC and small-signal AC analysis techniques to diode circuits using both linear and nonlinear equivalent circuit models. LO-3: Analyze diode applications in rectifier circuits and voltage regulation systems. LO-4: Describe the physical principles, construction, characteristics, and limitations of field-effect transistors (FETs) and bipolar junction transistors (BJTs). LO-5: Perform DC and small-signal AC analysis of transistor circuits, including biasing techniques, and demonstrate an understanding of key applications in amplification and switching.		

Rules (Educational policy and behavior)	▪ **Preparation for class** The structure of this course makes your individual study and preparation outside the class extremely important. The lecture material will focus on the major points introduced in the text. Reading the assigned chapters and having some familiarity with them before class will greatly assist your understanding of the lecture. After the lecture, you should study your notes and work relevant problems and cases from the end of the chapter and sample exam questions. • **Withdrawal (pass/fail)** This course strictly follows grading policy of the School of Humanities, Education and Social sciences. Thus, a student is normally expected to achieve a mark of at least 60% to pass. In case of failure, he/she will be required to repeat the course the following term or year. ▪ **Cheating/plagiarism** Cheating or other plagiarism during the Quizzes, Mid-term and Final Examinations will lead to paper cancellation. In this case, the student will automatically get zero (0), without any considerations. ▪ **Professional behavior guidelines** The students shall behave in a way to create a favorable academic and professional environment during the class hours. Unauthorized discussions and unethical behavior are strictly prohibited. **Attendance** 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. Students who attend the whole class will get 5 marks. for three absence student loses 1 mark. ▪ **Quizzes** There will be a quizzes per two weeks. The quizzes will be announced in the classroom two weeks before and will relate to homework. ▪ **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		Introduction to Electrical and Electronic Devices: • Overview of electrical and electronic devices categories. • Control systems in electronic devices. • Key components of electrical devices (resistors, capacitors, inductors, and switches). *Questions and Exercises*	[1]
2		Semiconductors and Diode Theory • Atomic structure and charge carriers in semiconductors. • p-n junction theory. • Ideal diode. • Characteristics and operation of diodes. • Diode resistance and capacitance • Diode equivalent circuits. • Load-line analysis	[1]
3		Diode Applications • Series and parallel diode configurations with dc inputs • Diode-based circuits (rectifiers, clippers, and clampers). • Zener diodes and voltage regulation. • Special purpose diodes (LEDs, photodiodes, varactor diodes). • Diode arrays – diode based Integral Circuit	[1,2,3,4]
4		Bipolar Junction Transistors (BJTs) • Structure and operation of BJTs. • BJT biasing methods: fixed, emitter-stabilized, and voltage-divider bias. • DC load lines and operating point. • Analyzing and designing BJT amplifier circuits.	[1,2,3]

5		Field Effect Transistors (FETs) • JFET and MOSFET structure and operation. • Characteristics of n-channel and p-channel MOSFETs. • FET biasing and small-signal models. • Exercises: Designing simple FET-based circuits.	[1,2,3]
		Quiz 1(Lec1-Lec4)	
6		Amplifiers and Frequency Response • BJT and FET amplifier configurations: CE, CB, CC, and CS, CD, CG. • Frequency response of amplifiers. • Coupling, bypass capacitors, and high-frequency effects. • Exercises: Analysis of frequency response in amplifier circuits.	[1,3]
7		Amplifiers and Frequency Response • BJT and FET amplifier configurations: CE, CB, CC, and CS, CD, CG. • Frequency response of amplifiers. • Coupling, bypass capacitors, and high-frequency effects. • Analysis of frequency response in amplifier circuits.	[1,3]
8		***Mid-term exam***	
9		Digital Electronics: Logic Gates and Boolean Algebra • Diode based logic • Transistor based logic • Binary number system and Boolean algebra. • Logic gates: AND, OR, NOT, NAND, NOR XOR, XNOR. • Combinational logic circuit design.	[1,2]
10		Sequential Logic and Memory Devices • Registers, Counters, Decoder • Flip-flops (SR, JK, D, and T flip-flops). • Registers, counters, and shift registers. • Memory devices: ROM, RAM, and EEPROM. • Exercises: Design a simple counter circuit using flip-flops.	[1,3]
11		Analog to Digital and Digital to Analog Conversion • Introduction to ADC and DAC. • Sampling theorem and quantization. • Types of ADC (flash, successive approximation, etc.) and DAC (R-2R ladder, weighted resistor). • Exercises: Design basic ADC and DAC circuits.	[1,3]
12		Microcontrollers and Digital Signal Processing (DSP) • Introduction to microcontrollers and embedded systems. • Overview of DSP and its applications in electronics. • Programming basics for microcontrollers. • Exercises: Implement simple control systems using microcontrollers.	[1,2,3,4]
13		Emerging Technologies in Electronics • Internet of Things (IoT) and smart electronics. • Energy-efficient and sustainable electronics. • Artificial Intelligence applications in electronics. • Exercises: Research and discuss the impact of emerging technologies in the field.	[4]
14		**Course Recap and Review** • **Review of key topics: diodes, transistors, amplifiers, logic gates, microcontrollers.** • **Discussion of difficult concepts and practice problems.** • **Quiz 4: Covering Weeks 11-13 topics.**	
15		Solving problems and ambiguities of students about the course Solving extra examples	
		Final Exam