General information	**Title and code of subject, number of credits**	ETR234, Analog and Digital Electronics, 6 ECTS	
	Department	Physics and Electronics	
	Program	Bachelor	
	Academic semester	Spring 2026	
	Lecturer	M.Sc. Muhammad Alizada	
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	Phone number:		
	Lecture room/Schedule	11 Mehseti Street, AZ1096 Baku, Azerbaijan (Neftchilar campus)	
	Consultations		
Prerequisites			
Course language	English		
Type of the subject	Major		
Textbooks and additional materials	***Textbooks*:** 1. Microelectronic Circuits, 8th Edition by by Adel S. Sedra, Kenneth C. (KC) Smith, Tony Chan Carusone, Vincent Gaudet, 2019. 2. Electrical Engineering: Principles and Applications, Allan R. Hambley, Pearson, 7th Edition 2021. 3. Digital Electronics, Digital Electronics, GATE Wallah (Physics Wallah), Abhishek Bharatiya, PW Publications, 1st Edition 2023/2024. 4. Electronic Devices, Electron Flow Version, Ninth Edition by Thomas L. Floyd, 2012. 5. The Essential Guide to Digital Signal Processing by Richard G. Lyons, D. Lee Fugal. 2014		
Teaching methods	**Case analysis**		x
	Group discussion		x
	Lecture		x
	Simulation		x
Evaluation Criteria	**Components**	**Date/ Deadline**	**Percent (%)**
	Practical Assignments	5 lab works during the semester	15
	Quizzes	2 quizzes during the semester	10
	Attendance	At each lesson	5
	Midterm exam		30
	Final exam		40
	Final		**100**
Course description	This course introduces students to the principles and concepts of analog and digital electronics. It covers fundamental topics related to electronic circuits, semiconductor devices, analog circuit applications, and digital logic systems. Throughout the course, students will study the behavior and application of key electronic components and their role in modern electronic systems. Furthermore, students will be introduced to Proteus schematic capture and simulation software, which facilitates the design, simulation, and analysis of analog and digital		

	electronic circuits. The course emphasizes practical applications, hands-on experience, and problem-solving techniques relevant to electrical and electronics engineering.
Course objectives	The objective of the Analog and Digital Electronics course is to provide undergraduate students in Electrical and Electronics Engineering with fundamental knowledge and practical skills in the analysis, design, and implementation of analog and digital electronic circuits. The course aims to develop students' ability to analyze both steady-state and time-varying electronic circuits using theoretical methods and simulation tools. This course primarily focuses on the principles and applications of analog and digital electronics. It is organized into the following main sections. The first section introduces the basic concepts and laws of electronic circuits, including semiconductor fundamentals. The second section covers the analysis and design of analog circuits such as amplifiers and filters. The third section focuses on electronic components including diodes, capacitors, inductors, transistors, and operational amplifiers, along with their practical applications. The final section introduces digital electronics topics, including logic gates, combinational and sequential circuits, and data conversion techniques. In addition, throughout the course, students will gain hands-on experience with Proteus, a schematic capture and simulation software, to design, simulate, and analyze analog and digital electronic circuits.
Learning outcomes	Upon completing this course on Analog and Digital Electronics, students should be able to achieve the following learning outcomes: • Understand the fundamental principles of analog and digital electronic systems, including voltage, current, power, and frequency concepts. • Analyze and design analog circuits using diodes, BJTs, MOSFETs, and operational amplifiers. • Explain and analyze the operation of amplifiers, including gain, bandwidth, frequency response, and stability. • Design and evaluate analog filters such as low-pass, high-pass, band-pass, and band-stop filters. • Understand semiconductor device physics and the behavior of PN junctions in electronic circuits. • Analyze digital logic circuits using Boolean algebra, logic gates, and truth tables. • Design and analyze combinational and sequential digital circuits, including multiplexers, flip-flops, counters, and registers. • Understand the principles of analog-to-digital (ADC) and digital-to-analog (DAC) conversion. • Use simulation and laboratory tools to test, verify, and troubleshoot analog and digital electronic circuits. • Develop problem-solving, analytical, and critical thinking skills applicable to modern electronic system design. • Apply electronic design principles to real-world engineering applications while considering reliability and safety.
Class Policy	**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 orally 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. **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 exams 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 2 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. **Practical Assignments** Will be held 5 times during the semester. Each laboratory activity carries 3 points. Tasks are assigned in accordance with the topics covered in the course. **Attendance** Students who attend the whole classes will get 5 marks. For two absents student loses 1 mark.

Tentative Schedule

Week	Dates (planned)	Subject topics	Textbook/ Assignments
1.		*Analog and Digital Signals:* Characteristics of analog signals, Characteristics of digital signals, Basic comparison of analog and digital systems *Questions and Exercises*	[5], p. 15-20

2.		*Diodes and Applications:* Diode Operation, Voltage-Current (V-I) Characteristics, Diode Models, Half-Wave Rectifiers, Full-Wave Rectifiers, Power Supply Filters and Regulators, Diode Limiters and Clampers, Voltage Multipliers. *Questions and Exercises*	[2], p. 480-486 490-505
3.		*Special-Purpose Diodes:* Zener diode and applications, varactor diode, optical diodes, other types of diodes *Questions and Exercises*	[2], p. 483-490
4.		*Bipolar Junction Transistors:* Bipolar junction transistor (BJT) structure, Basic BJT operation, BJT characteristics and parameters, The BJT as an amplifier, The BJT as a switch. *Questions and Exercises*	[1], p. 136-140 [2], p. 619-657
5.		*BJT Amplifiers:* Amplifier Operation, Transistor AC Models, The Common-Emitter Amplifier, The Common-Collector Amplifier, The Common-Base Amplifier, Multistage Amplifiers, The Differential Amplifier. *Questions and Exercises*	[1], p. 551-560 [2], p. 624-627
6.		*Field-Effect Transistors (FETs):* The JFET characteristics and parameters, JFET biasing, MOSFET characteristics and parameters, MOSFET biasing, IGBT *Questions and Exercises*	[2], p. 577-611
7.		*Thyristors:* The Four-Layer Diode, The Silicon-Controlled Rectifier (SCR), SCR Applications, The Diac and Triac. *Questions and Exercises,* ***Quiz 1***	[4], p. 565-578
8.		*Active Filters:* Basic Filter Responses, Filter Response Characteristics, Active Low-Pass Filters, Active High-Pass Filters, Active Band-Pass Filters, Active Band-Stop Filters. *Questions and Exercises*	[1], p. 546-550 [4], p. 764-785
9.		*The Operational Amplifier*: Introduction to Operational Amplifiers, Op-Amp Input Modes and Parameters, Negative Feedback, Op-Amps with Negative Feedback, Effects of Negative Feedback on Op-Amp Impedances, Bias Current and Offset Voltage, Open-Loop Frequency and Phase Responses, Closed-Loop Frequency Response. *Questions and Exercises*	[2], p. 665-698
10.		***Mid term exam***	
11.		*Voltage Regulators:* Voltage Regulation, Basic Linear Series Regulators, Basic Linear Shunt Regulators, Basic Switching Regulators, Integrated Circuit Voltage Regulators, Integrated Circuit Voltage Regulator. *Questions and Exercises*	[4], p. 852-875
12.		*Logic Circuits:* Number systems. Boolean algebra. Boolean logic gates. *Questions and Exercises*	[3], p. 4-15
13.		*Combinational and Sequential Digital Circuits:* Multiplexers and digital circuit design techniques, Flip-flops, counters, and registers. *Questions and Exercises,* ***Quiz 2***	[3], p. 34-40

14.		*Data Conversion Systems:* Analog-to-digital (ADC) conversion, Digital-to-analog (DAC) conversion *Questions and Exercises*	[3], p. 82-85
15.		*Electronic Circuit Analysis and Design:* Practical analysis of analog and digital circuits, Design considerations for electronic systems. *Questions and Exercises*	[1], p. 20-54
		Final Exam