Identification	**Subject (Code, title, credits)**	ETR232 – Analog and Digital Electronics - 6 ECTS credits
	Department	Physics and Electronics/ Radio and Telecommunication engineering
	Program	Undergraduate
	Term	Spring 2025
	Instructor	MSc, MIET, Alim Huseynov
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	Classroom/hours	11 Mehseti str. (Neftchilar campus)
	Office hours	Monday-Friday, from 9:00 to 18:00
Prerequisites	-	
Language	English	
Compulsory/Elective	Elective	
Required textbooks andcourse materials	Textbooks: 1. Electronic devices and circuit theory by Boylestad, Robert Nashelsky, Louis, 2014 2. Electronics Fundamentals. Circuits, Devices, and Applications by David M. Buchla, Thomas L. Floyd, 2014 3. Digital Electronics, Principles, Devices and Applications - Anil K.Maini, 2007 4. Digital Fundamentals - Thomas L. Floyd, Eleventh Edition, 2015 5. Modern Digital Electronics - R.P.Jain, 2010	
Course outline	The course on Analog and Digital Electronics provides a comprehensive understanding of fundamental electronic components, their practical limitations, and their applications in real-world circuits. Beginning with an introduction to basic electronic devices, students will gain insight into the scope and range of these components, helping them develop an appreciation for their functionality and constraints. The course delves into semiconductor physics, covering atomic bonding and the conduction process in semiconductors, laying the groundwork for understanding diodes and transistors. Through this, students will explore the operation of common semiconductor devices, analyze the behavior of p-n junctions, and grasp the significance of current and voltage polarities in transistors. A significant portion of the course focuses on operational amplifiers (op-amps), where students will learn about their ideal properties and how the virtual earth principle applies to various op-amp configurations. They will analyze different applications of op-amps, such as amplification and signal comparison, and understand their role in designing practical circuits. The course also introduces power supply design, covering the four essential stages of a DC power supply system. Students will perform transformer-related calculations, distinguish between half-wave and full-wave rectification, and analyze diode rectifiers with circuit diagrams. The evaluation of mean and RMS values of rectified waveforms will further enhance their understanding of AC-to-DC conversion. As the course progresses, students will examine the function of reservoir capacitors in rectified DC supply circuits and learn about ripple factors, along with methods to improve power supply smoothing using inductive components. Voltage regulation techniques will be explored, including the operation and analysis of Zener diode regulators, transistor stabilizers, and operational amplifier-based voltage regulators. Special attention will be given to three-pin integrated circuit voltage regulators and their practical applications. Moving towards power electronics, the course covers Switched-Mode Power Supplies (SMPS), focusing on step-down converters with secondary switching, duty cycle calculations, and their impact on output voltage. Step-up and inverter configurations will be introduced, along with a discussion on the advantages and drawbacks of SMPS in terms of efficiency, cost, size, ripple rejection, and electromagnetic interference. In the digital electronics section, students will develop a strong foundation in Boolean algebra, constructing truth tables for various logic functions and simplifying Boolean expressions through different techniques. They will learn to represent Boolean expressions as logic circuits and explore methods for simplifying complex logic systems. The role of transistors as electronic switches will be examined, leading to an understanding of different types of logic gates, their families, and the parameters influencing their selection for specific applications. The course also introduces sequential logic circuits, focusing on the circuit topology and operation of different bistable devices such as flip-flops. Students will analyze timing	

	diagrams, construct truth tables, and understand the behavior of edge-triggered and level-triggered circuits. Finally, the course covers counters and timing circuits, distinguishing between synchronous and asynchronous circuits while exploring the operation of asynchronous counters in various applications. By the end of the course, students will have acquired a solid theoretical and practical understanding of analog and digital electronics, preparing them for further studies or professional applications in electronics and electrical engineering.
Course objectives	• have a better appreciation of the scope and range of basic electronic components, understand some of the practical limitations of devices. • describe the atomic bonding found in semiconductors, describe the conduction process in a semiconductor • have a basic understanding of how common semiconductors work, have an appreciation of the polarities of currents and voltage in diodes and transistors. • state the properties of the ideal op-amp, apply the virtual earth principle to appropriate op-amp circuits, understand the use of op-amps as amplifiers and comparators, analyze simple op amp circuits. • describe the four stages of a DC power supply system, perform simple calculations involving the turns ratio of a transformer, explain and contrast half-wave and full-wave rectification, describe, with the aid of circuit diagrams, the operation of simple, diode rectifiers, evaluate mean and rms values of rectified sinusoidal waveforms. • explain the function of a 'reservoir' capacitor in a rectified DC supply circuit, define ripple factor and carry out simple related calculations, state the advantages of incorporating an inductive component into a 'smoothing' circuit • explain as analyze the action of a Zener diode voltage regulator, explain the enhanced action of a transistor stabilizer circuit, analyze the action of a voltage stabilizer employing an operational amplifier, explain and analyze the features of a three-pin integrated circuit voltage regulator. • select suitably rated components for a linear power supply, perform a thermal analysis to check for the need of a heat sink for the rectifier and regulator. • understand the operation of a step-down SMPS using secondary switching, calculate the duty cycle of a switching transistor, in a step-down SMPS using secondary switching, and use this to determine the output voltage, recognize step-up and inverter configurations of a switched-mode power supply and understand their uses, understand the operation of a switched-mode power supply using secondary switching, be aware of the advantages and disadvantages of a switched-mode power supply in terms of efficiency, cost, size, ripple rejection and interference. • construct the truth tables for various Boolean functions, simplify Boolean expressions using various techniques, represent Boolean expressions by logic circuits, be aware of some methods of simplifying logic circuits representing Boolean expressions. • appreciate the utility of a transistor as an electronic two state switch, understand the operation of the more common types of gates, distinguish the different types of logic families, describe the different parameters which may influence the selection of a type of logic. • recognize the circuit topology of different types of bistable, understand their operation, complete timing diagrams, draw up their truth tables. • understand the basic mechanism of counting, understand the difference between a synchronous and an asynchronous circuit, understand the operation of some asynchronous counters.
Learning outcomes	By the end of this course, students will: - Understand the scope, functionality, and limitations of fundamental electronic components. - Explain the atomic bonding and conduction process in semiconductors. - Analyze the operation of diodes, transistors, and their applications in electronic circuits. - Apply the virtual earth principle in operational amplifier circuits and analyze their use as amplifiers and comparators. - Design and evaluate DC power supply systems, including rectifiers, filters, and voltage regulators. - Understand the working principles of switched-mode power supplies (SMPS) and perform related calculations. - Construct and simplify Boolean expressions, represent them as logic circuits, and analyze logic gate operations.

	- Differentiate between various logic families and their characteristics. - Describe and analyze the operation of bistable circuits, including flip-flops, and complete timing diagrams. - Understand the principles of counting circuits and differentiate between synchronous and asynchronous counters. These outcomes will equip students with the necessary theoretical knowledge and practical skills to design, analyze, and troubleshoot analog and digital electronic circuits.		
Teaching methods	**Lecture**		☑
	Group discussion		☑
	Experiential exercise		☑
	Case analysis		☐
	Quiz, Classroom Exams		☑
	Course paper		☐
	Others		☑
Evaluation	**Methods**	**Date/deadlines**	**Percentage (%)**
	Midterm Exam		30
	Attendance	At each lesson	5
	Quiz	2 times during the semester	20
	Activity	During the semester	5
	Final Exam		40
	Total		100

Policy	▪ **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 pointsintroduced in the text. Reading the assigned chapters and having some familiaritywith them before class will greatly assist your understanding of the lecture. Afterthe 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 thefollowing 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 the way to create favorable academic and professional environment during the class hours. Unauthorized discussions and unethical behavior are strictly prohibited. **Attendance** Students who attend the whole classes 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.

Tentative Schedule			
Weeks	Date/Day	Topics	Reference to textbooks
1.	TBC	Introduction. Electronic technology. Semi-conductors.	[1] page 1 , Lecture notes provided by lecturer
2.	TBC	Transistors	[1] page 133, [2] page 767, Lecture notes provided by lecturer
3.	TBC	Simulation software. Introduction and implementation	Lecture notes provided by lecturer
4.	TBC	Operational amplifiers, basic operational amplifier circuits	[1] page 625, [2] page 835, , Lecture notes provided by lecturer
5.	TBC	Further examples on the application of op amps	[1] page 673, [2] page 877, , Lecture notes provided by lecturer
6.	TBC	Transformers and rectifiers	[1] page 103, , Lecture notes provided by lecturer
7.	TBC		
8.	TBC	Smoothing	[1] page 807, Lecture notes provided by lecturer
9.	TBC	Regulated power supplies	[1] page 815, Lecture notes provided by lecturer
10.	TBC	The design of a linear power supply	[1] page 815, Lecture notes provided by lecturer
11.	TBC	Switched-mode power supplies	[1] page 822, Lecture notes provided by lecturer
12.	TBC	Digital devices and circuits, logic gates and Boolean algebra	[3] page 1-115, [4] page 1-261, Lecture notes provided by lecturer
13.	TBC	Logic families	[3] page 115-187, Lecture notes provided by lecturer
14.	TBC	Bi stables	[3] page 357, [4] page 313, Lecture notes provided by lecturer
15.	TBC	Counters	[3] page 429, [4] page 497, Lecture notes provided by lecturer
	TBC	Final exam	

This syllabus is a guide for the course and any modifications to it will be announced in advance.