

Identification	Subject	ETR 460 Microprocessor Technique 6 ECTS credit
	Department	Physics and Electronics
	Program (Undergraduate, Graduate)	Undergraduate
	Term	Fall 2026
	Instructor	M.Sc. Muhammad Alizada
	Email:	malizada@khazar.org
	Classroom/hours	11 Mehseti Street, Baku, Azerbaijan (Neftchilar campus), Monday-Friday, 09:00-18:00
Prerequisites	None	
Language	English	
Compulsory/Elective	Compulsory	
Textbooks and course materials	Textbooks: 1. Introduction to Microprocessor, B Basavaraj – VIKAS® Publishing House Pvt Ltd, 2010. Optional Reference Texts: 2. A The 8051 Microcontroller and Embedded Systems: Using Assembly and C, 2nd ed., by Muhammad Ali Mazidi, Janice Gillispie Mazidi, Rolin D. McKinlay, 2013. 3. The Definitive Guide to ARM Cortex-M3 and Cortex-M4 Processors, 3rd ed., by Joseph Yiu, 2014. 4. Embedded Systems: Introduction to ARM Cortex-M Microcontrollers, by Jonathan W. Valvano, 2012. 5. STM32 ARM Programming for Embedded Systems, by Muhammad Ali Mazidi, Shujen Chen, Eshragh Ghaemi, 2018. 6. Embedded Systems with ARM Cortex-M Microcontrollers in Assembly Language and C, by Yifeng Zhu, 2015.	
Course description	This course provides a comprehensive introduction to the fundamental principles, architecture, programming, and applications of microprocessors and microcontrollers, with an emphasis on their role in modern electronic and embedded systems. It explores the key concepts and processes associated with microprocessor-based systems, including processor architecture, registers, arithmetic and logic units, memory organization, buses, input/output interfaces, and interrupt systems, providing students with a structured framework for understanding the operation and organization of digital processing systems. The course combines theoretical concepts with systematic analysis and programming methods, enabling students to examine microprocessor and microcontroller architectures, develop programming and problem-solving skills, and apply fundamental principles to practical engineering applications. The main topics include instruction sets, assembly language programming, memory and peripheral interfacing, interrupt systems, embedded system principles, and modern microcontroller architectures. Particular attention is given to ARM Cortex-M based systems and STM32 microcontrollers, including their architecture, programming, and peripheral interfaces. Together,	

	these topics provide a strong theoretical and practical foundation for the design, programming, analysis, and application of microprocessor- and microcontroller-based systems in embedded and electronic engineering applications.
Course objectives	The main objective of this course is to provide undergraduate students in Electrical and Electronics Engineering with a strong foundation in the fundamental principles, architecture, programming, and applications of microprocessors and microcontrollers. The course aims to: • Develop a clear understanding of microprocessor and microcontroller architecture, including registers, arithmetic and logic units, memory organization, buses, and input/output systems. • Introduce instruction sets, addressing modes, assembly language programming, and the fundamental principles of C programming for microprocessor- and microcontroller-based systems. • Develop students' ability to analyze and implement memory, peripheral, and input/output interfacing techniques. • Provide students with an understanding of interrupt systems and their role in microprocessor- and microcontroller-based applications. • Introduce modern embedded systems based on ARM Cortex-M architectures, with particular emphasis on STM32 microcontrollers and their peripheral interfaces. • Develop practical knowledge of commonly used microcontroller peripherals, including GPIO, timers, ADC, PWM, UART, SPI, and I²C. • Strengthen students' analytical, programming, design, and problem-solving skills through theoretical and practical activities involving microprocessor- and microcontroller-based systems. • Provide students with the essential theoretical and practical background necessary for the design, programming, analysis, and troubleshooting of embedded and electronic systems.
Learning Outcomes	By the end of the course, students will be able to: • Describe the role, importance, and applications of microprocessors and microcontrollers in modern electrical, electronic, and embedded systems. • Explain the architecture and operating principles of microprocessors, including the CPU, ALU, registers, buses, memory, and control unit. • Describe the organization and characteristics of memory, input/output systems, addressing modes, and instruction sets. • Explain the architecture, operating principles, and applications of microcontrollers and embedded systems. • Analyze microprocessor- and microcontroller-based systems and identify the functions of their main components. • Write, analyze, and debug basic assembly language and C programs for microprocessor- and microcontroller-based applications.

	• Apply appropriate techniques for memory, peripheral, and input/output interfacing in microprocessor- and microcontroller-based systems. • Configure and program common microcontroller peripherals, including GPIO, timers, ADC, PWM, UART, SPI, and I²C. • Interface microcontrollers with sensors, actuators, communication modules, and other external devices. • Explain the basic architecture and operating principles of ARM Cortex-M microcontrollers and their role in modern embedded systems. • Develop, program, and test basic embedded applications using ARM Cortex-M and STM32 microcontrollers. • Apply theoretical knowledge and practical programming skills to analyze, design, troubleshoot, and implement microprocessor- and microcontroller-based systems. Demonstrate an integrated understanding of the fundamental principles, architecture, programming, interfacing, and applications of microprocessors and microcontrollers through laboratory activities, programming exercises, quizzes, midterm assessment, and final examination.		
Teaching methods	Case analysis		☒
	Group discussion		x
	Lecture		☒
	Simulation		x
Evaluation Criteria	Methods	Date/deadlines	Percentage (%)
	Midterm Exam	TBA	30
	Quizzes	2 quizzes during the semester	10
	Practical Assignments	5 lab works during the semester	15
	Activity	-	0
	Attendance	At each lesson	5
	Final Exam	TBA	40
	Total		100
Class Policy	Preparation for class The pedagogical structure of this course necessitates diligent individual study and external preparation. Course sessions are designed to emphasize the primary theoretical frameworks introduced in the text. Pre-class engagement with assigned chapters is essential to facilitate a comprehensive understanding of the material. Subsequent to each session, students should synthesize their notes and resolve pertinent problems, case studies, and sample examination questions located at the conclusion of each chapter. Withdrawal (pass/fail) This course strictly adheres to the grading ordinances of the School of Science and Engineering. Consequently, students are required to achieve a minimum threshold of 60% to secure a passing grade. In the event of an unsatisfactory		

result, the student will be mandated to repeat the course in the following academic term or year. Cheating/plagiarism Any instance of academic dishonesty or plagiarism during Quizzes, Midterms, or Final Examinations will result in the immediate nullification of the assessment. In such cases, the student will automatically be assigned a score of zero (0) without further consideration. Generative AI Policy The use of Generative Artificial Intelligence (GAI) tools is partially permitted in this course. Students may use GAI tools for learning purposes, such as obtaining explanations of course concepts, organizing information, generating practice questions, and supporting their understanding of the course material. GAI tools may not be used to complete or generate answers for quizzes, midterm examinations, final examinations, or other assessed work unless explicitly authorized by the instructor. Students are responsible for the accuracy of any information obtained through GAI tools and must ensure that their submitted work reflects their own understanding, analysis, and intellectual contribution. Any use of GAI in accordance with the permitted purposes should be appropriately acknowledged by the student. Professional behavior guidelines Students are expected to conduct themselves in a manner that fosters a constructive academic and professional environment during instructional hours. Unauthorized discourse and unethical behavior are strictly prohibited. Attendance Students who maintain full attendance for the duration of the course will be awarded 5 marks. Conversely, for every four absences recorded, the student will incur a deduction of 1 mark. Quizzes Two quizzes will be administered throughout the semester, with formal announcements made in class two weeks prior to each assessment date. The content of each quiz will be based on assigned homework problems, which are curated from the questions and problems at the end of each chapter. Practical Assignments Students will complete 5 practical assignments during the semester. Each assignment will be evaluated based on the quality of the work, accuracy of the results, and understanding of the practical concepts. Each assignment is worth 3 points, for a total of 15 points.			
Tentative Schedule			
Week	Date/Day (tentative)	Topics	Textbook/Assignments
1		Introduction to Microprocessor Systems. Microprocessors and microcontrollers, applications of microprocessor-based systems, basic computer organization, CPU, ALU, registers, buses, memory and I/O. Introduction to embedded systems. <i>Questions and Exercises</i>	[1], p. 3-30

2		8085 Microprocessor Architecture. 8085 programming model, registers, flags, instruction format, memory organization, address and data buses, basic microprocessor operations. <i>Questions and Exercises</i>	[1], p. 31-56, 57-94
3		8085 Assembly Language Programming. Instruction classification, data transfer, arithmetic, logical and branch instructions, addressing concepts, writing and executing basic assembly programs. <i>Questions and Exercises</i>	[1], p. 175-226
4		Programming Techniques and Timing. Looping, counting, indexing, stack, subroutines, counters and time delays, pulse waveform generation. <i>Questions and Exercises</i>	[1], p. 227-322
5		Memory and I/O Interfacing. Memory interfacing, input/output devices, input and output displays, input devices, memory-mapped I/O and basic interfacing concepts. <i>Questions and Exercises</i>	[1], p. 95-172
6		Interrupts and Peripheral Interfacing. 8085 interrupts, vectored interrupts, interrupt processing, programmable interface devices, timers and programmable peripheral interfaces. <i>Questions and Exercises</i>	[1], p. 375-522
7		Data Converters and Microprocessor Applications. Digital-to-analog and analog-to-digital converters, principles of ADC/DAC interfacing, microprocessor-based measurement and control applications. <i>Questions and Exercises, Practical Assignment 1</i>	[1] – p. 403-424
		Midterm exam	
8		Microcontrollers and Embedded Systems. Microprocessors vs. microcontrollers, embedded processors, microcontroller architecture, 8051 family, CPU registers, memory organization and I/O ports. <i>Questions and Exercises, Quiz 1</i>	[2], p. 23-68
9		8051 Programming and Peripherals. Assembly language programming, jump and loop instructions, I/O port programming, timers and counters, serial communication and interrupt programming. <i>Questions and Exercises</i>	[1], p. 37-92, 93-160
10		ARM Cortex-M Architecture. Introduction to ARM Cortex-M processors, embedded software development, programmer's model, registers, memory system, exceptions and interrupts, system control and debugging. <i>Questions and Exercises, Practical Assignment 2</i>	[1], p. 601-688
11		ARM Cortex-M Programming and Interrupts. ARM instruction set, memory map, memory access, exceptions, interrupts, NVIC, SysTick timer and low-power features. <i>Questions and Exercises, Practical Assignment 3</i>	[1], p. 285-339

12		STM32 Microcontrollers and GPIO. STM32 architecture and family overview, STM32F4 microcontrollers, development environment, C programming, GPIO configuration, digital input/output, LED and switch interfacing. <i>Questions and Exercises, Quiz 2</i>	[1], p. 339-430
13		STM32 Peripherals and Communication Interfaces. Timers, PWM, ADC, DAC, UART, SPI and I ² C interfaces. Interrupt-based peripheral programming and sensor interfacing. <i>Questions and Exercises, Practical Assignment 4</i>	[1], p. 382-410
14		Embedded System Applications with STM32. Integration of GPIO, timers, ADC, PWM and communication peripherals. Basic embedded-system design. <i>Questions and Exercises, Practical Assignment 5</i>	[1], p. 382-410
15		STM32-Based Embedded System Design and Applications. Practical implementation and integration of microcontroller peripherals, system testing, debugging, troubleshooting, development of basic embedded applications. <i>Questions and Exercises</i>	[5], p. 22–55, 80–119, 120–159 [6], p. 429–643
	TBC	Final exam	