**S Y L L A B U S**

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| **General information** | **Title and code of subject,number of credits** | ETR 545 Microprocessor and Digital Control Systems – 8 ECTS credits | |
| | **Department** | Physics & Electronics | |
| | **Program** | Graduate | |
| | **Academic semester** | Fall 2025 | |
| | **Lecturer** | Nicat Hajiyev | |
| | **E-mail:** | nicat.haciyev2022@khazar.org | |
| | **Phone number:** | | |
| | **Lecture room/Schedule** | 11 Mehseti Street, AZ1096 Baku, Azerbaijan (Neftchilar campus), room | |
| | **Consultations** | As scheduled | |
| **Prerequisites** | | | |
| **Course language** | English | | |
| **Type of the subject** | Major | | |
| **Textbooks and additional materials** | ***Textbooks*:**<br>1. Barry B. Brey, The Intel Microprocessors: 8086/8088, 80186/80188, 80286, 80386, 80486, Pentium, Pentium Pro Processor, Pentium II, Pentium III, and Pentium 4: Architecture, Programming, and Interfacing, Pearson, 8th Edition, 2008. (required)<br><br>2. Gene F. Franklin, J. Da Powell, Abbas Emami-Naeini, Digital Control of Dynamic Systems, Pearson, 8th Edition, 2019. (required)<br><br>Optional Reference Texts:<br>3. Katsuhiko Ogata, Discrete-Time Control Systems, Pearson, 2nd Edition, 2015.<br><br>Additional Resource Texts:<br>4. Raj Kamal, Microcontrollers: Architecture, Programming, Interfacing and System Design, Pearson Education, 2nd Edition, 2011.<br>5. The Intel Microprocessors: Pearson New International Edition, Barry B. Brey, Pearson Prentice Hall™, 8th edition, 2013.<br><br>**Auxiliary Web sources:**<br>https://www.youtube.com/watch?v=HyznrdDSSGM&list=PLowKtXNTBypGqImE405J2565dvjafglHU<br>https://www.youtube.com/watch?v=peX0rICizC0&list=PLX3mp7xUgnhLqbawZMuXrNSh4yHFuCD 4X<br>https://www.youtube.com/watch?v=liRPtvj7bFU&list=PL0E131A78ABFBFDD0 https://www.youtube.com/watch?v=RVNXZS-HOgw&list=PL_ApKxsfIQPFIVpFmCB9EjThyMk7_V5qI<br>https://www.youtube.com/watch?v=sLW1TptEJBQ&list=PLcYzlQJ999BkF-iyUxH3uevN-VGUwDAIF | | |
| **Teaching methods** | **Lecture** | | x |
| | **Group discussions at seminars** | | x |
| **Assessment** | **Components** | **Date/ Deadline** | **Percent (%)** |
| | **Activity** | At each lesson | 5 |
| | **Presentation** | 2 times during the semester | 10 |
| | **Quizzes** | 2 times during the semester | 10 |
| | **Attendance** | At the earth lesson | 5 |
| | **Midterm exam** | | 30 |
| | **Final exam** | | 40 |
| | **Final** | | **100** |
| **Course description** | This course provides graduate students with a comprehensive understanding of microprocessor systems and digital control. It covers Intel microprocessor architectures (8085, 8086, and advanced processors), assembly programming, memory and I/O interfacing, interrupts, and DMA. The course also introduces digital control theory, discrete-time system modeling, stability analysis, and digital controller design, with emphasis on microprocessor-based implementation and real-time applications. | | |

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| **Course objectives** | • Understand the fundamentals of microprocessors and their architectures.<br>• Analyze instruction sets and addressing modes of Intel processors.<br>• Develop and implement assembly language programs.<br>• Interface memory and I/O peripherals with microprocessors.<br>• Design and implement microprocessor-based digital control systems.<br>• Apply digital control theory to real-time microprocessor applications.<br>• Troubleshoot and optimize microprocessor and control system performance. |
| **Learning outcomes** | What students should know by the end of the course:<br>• Explain microprocessor architecture, including CPU, memory, and I/O.<br>• Describe Intel 8085, 8086, and advanced processor operation.<br>• Develop assembly language programs and implement memory/I/O interfacing.<br>• Apply interrupts, DMA, and microprocessor-based digital control.<br>• Model discrete-time systems, analyze stability, and design real-time controllers. |
| **Rules (Educational policy and behavior)** | ▪ **Preparation for class**<br>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. After the lecture, you should study your notes and work relevant problems and cases from the end of the chapter and sample exam questions.<br>• **Withdrawal (pass/fail)**<br>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.<br>▪ **Cheating/plagiarism**<br>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.<br>▪ **Professional behavior guidelines**<br>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.<br>**Attendance**<br>Students who attend the whole classes will get 5 marks. For two absence (1 week) student loses 1 mark.<br>• **Quizzes**<br>There will be a quizzes per two weeks. The quizzes will be announced in the classroom two weeks before and will relate to homework.<br>• **Presentation**<br>There will be a presentation per two weeks. The presentation works will be announced in the classroom two weeks before and will relate to homework.<br>• **Activity**<br>Students who will be active during discussion of past lessons will be awarded activity mark. |

This program reflects the comprehensive information about the subject and information about any changes will be provided in advance.

| Week | Dates (planned) | Subject topics | Textbook/ Assignments |
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| ***1*** | | *Introduction to Microprocessors:* Evolution of Intel microprocessors. Applications in control systems.<br>*Questions and Exercises* | [1] p. 1-30 |

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| ***2*** | | *Intel 8086/88 Architecture:* BIU and EU, registers, flag register, instruction cycle.<br>*Questions and Exercises* | [1] p.31-80 |
| ***3*** | | *Addressing Modes and Instruction Set:* Data transfer, arithmetic, logic, and control instructions.<br>*Questions and Exercises* | [1] p. 81-160 |
| ***4*** | | *Assembly Language Programming:* Structured assembly, procedures, macros, modular design.<br>*Questions and Exercises* | [1] p. 161–220 |
| ***5*** | | *Memory & I/O Systems:* RAM, ROM, cache interfacing. I/O mapped vs. memory-mapped I/O.<br>*Questions and Exercises,* ***Quiz 1*** | [1] p. 221–330 |
| ***6*** | | *Interrupts and DMA:* 8259A PIC, 8237 DMA controller, real-time applications.<br>*Questions and Exercises* | [1] p. 331–410 |
| ***7*** | | *Advanced Intel Processors I:* 80286 → 80386 architecture. Protected mode, paging, multitasking.<br>*Questions and Exercises.* | [1] p. 411–460 |
| ***8*** | | *Advanced Intel Processors II:* 80486 → Pentium 4. Performance enhancements, pipelining, cache hierarchy.<br>*Questions and Exercises.* ***Quiz 2*** | [1] p. 461–520 |
| ***9*** | | ***Midterm exam*** | |
| ***10*** | | *Introduction to Digital Control:* Sampling theorem, Z-transform review, difference equations.<br>*Questions and Exercises.* | [2] p. 1–40 |
| ***11*** | | *Modeling of Discrete-Time Systems:* Transfer functions, state-space representations.<br>*Questions and Exercises.* | [2] p. 41–96 |
| ***12*** | | *Stability Analysis:* Z-domain stability, Jury's test, root locus.<br>*Questions and Exercises.* ***Quiz 3*** | [2] p. 97–160 |
| ***13*** | | *Time and Frequency Response:* Transient response, steady-state error, frequency methods.<br>*Questions and Exercises* | [2] p. 161–220 |
| ***14*** | | *Digital Controller Design I:* Digital PID, direct design via root locus and frequency response.<br>*Questions and Exercises* | [2] p. 221–280 |
| ***15*** | | *Digital Controller Design II & Implementation:* Pole placement, state feedback, observers, real-time issues, microprocessor-based controller implementation.<br>*Questions and Exercises.* ***Quiz 4*** | [1] p. 521–560<br>[2] p. 281–380 |
| | | ***Final Exam*** | |