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|  | **ECTS Course Description Form** |
| **PART I ( Senate Approval)** |
| **Offering School**  | **Engineering** |
| **Offering Department** | **Electrical and Electronics Engineering** |
| **Program(s) Offered to** | **Electrical and Electronics Engineering** | **Elective** |
| **Computer Engineering** | **Elective** |
|  |  |
| **Course Code**  | EE441 |
| **Course Name** | Microprocessors |
| **Language of Instruction** | **English** |
| **Type of Course** | *Course* |
| **Level of Course** | **Undergraduate** |
| **Hours per Week** | **Lecture: 3** | **Laboratory:**  | **Recitation:** **0** | **Practical:**  | **Studio:****0** | **Other:****0** |
| **ECTS Credit** | **6** |
| **Grading Mode** | **Letter Grade** |
| **Pre-requisites**  | CS 221 (Digital Systems) |
| **Co-requisites** |  |
| **Registration Restriction** | *-* |
| **Educational Objective** | The course introduces the students to the fundamental hardware and software concepts necessary for the design of microprocessor-based systems. It exposes the students to various aspects of microprocessor engineering, including, applications, organization, architecture, interfacing, hardware debugging, and related techniques at the hardware and assembly language levels. |
| **Course description** | This course introduces the basic concepts Microprocessors: - Architecture and organization, - Bus architecture, types, and buffering techniques, - Memory and I/O subsystems, organization, timing, and interfacing, - Analysis of clocks and timing, - Interrupt handling, - Serial and parallel communication, - Peripheral controllers and programming, - Practice of the design of a microprocessor-based system design, testing, debugging and reporting.. |
| **Learning Outcomes** | **LO1** | Be able to explain in the internal structure of microprocessors and microcontrollers |
| **LO2** | Develop control software to control an application interface to the x86 family of microprocessors*.* |
| **LO3** | Be able to use 8086 and 8051 instruction set architecture for assembly language programming*.* |
| **LO4** | Be able to calculate the worst-case execution time of programs or parts of programs, and to design and build, or to modify, software to maximize its run time memory or execution-time behavior |
| **LO5** | Be able to interface a microcontroller or microprocessor to various devices |
| **LO6** | Design and implement a microcontroller-/microprocessor-based embedded system |
| **PART II ( Faculty Board Approval)** |
| **Basic Outcomes (University-wide)** | **No.** | **Program Outcomes** | **LO1** | **LO2** | **LO3** | **LO4** | **LO5** | **LO6** |
| **PO1** | **Ability** to communicate effectively and write and present a report in Turkish and English.  | 🗸 | 🗸 | 🗸 | 🗸 | 🗸 | 🗸 |
| **PO2** | **Ability** to work individually, and in intra-disciplinary and multi-disciplinary teams. | 🗸 | 🗸 | 🗸 | 🗸 | 🗸 | 🗸 |
| **PO3** | **Recognition** of the need for life-long learning and **ability** to access information , follow developments in science and technology, and continually reinvent oneself. | 🗸 | 🗸 | 🗸 | 🗸 | 🗸 | 🗸 |
| **PO4** | **Knowledge** of project management, risk management, innovation and change management, entrepreneurship, and sustainable development. | 🗸 | 🗸 | 🗸 | 🗸 | 🗸 | 🗸 |
| **PO5** | **Awareness** of sectors and **ability** to prepare a business plan. | 🗸 | 🗸 | 🗸 | 🗸 | 🗸 | 🗸 |
| **PO6** | **Understanding** of professional and ethical responsibility and **demonstrating** ethical behavior. | 🗸 | 🗸 | 🗸 | 🗸 | 🗸 | 🗸 |
| **Faculty Specific Outcomes** | **PO7** | **Ability to develop, select and use modern techniques and tools necessary for engineering applications and ability to use information technologies effectively.** | 🗸 | 🗸 | 🗸 | 🗸 | 🗸 | 🗸 |
| **PO8** | **Recognition of the effects of engineering applications on health, environment and safety in the universal and societal dimensions and the problems of the time and awareness of the legal consequences of engineering solutions.** | 🗸 | 🗸 | 🗸 | 🗸 | 🗸 | 🗸 |
| **PO9** | **Ability to identify, define, formulate and solve complex engineering problems; and electing and applying appropriate analysis and modelling methods for this purpose.** | 🗸 | 🗸 | 🗸 | 🗸 | 🗸 | 🗸 |
| **Discipline Specific Outcomes (program)** | **PO10** | **Gains comprehensive knowledge in mathematics, natural sciences, related engineering fields and general engineering subjects.** | 🗸 | 🗸 | 🗸 | 🗸 | 🗸 | 🗸 |
| **PO11** | **Able to identify complex engineering problems and solve them with appropriate methods of analysis.** | 🗸 | 🗸 | 🗸 | 🗸 | 🗸 | 🗸 |
| **PO12** | **Able to design a complex electronic system that meets the desired performance by using modern design techniques and taking real life conditions into account.** | 🗸 | 🗸 | 🗸 | 🗸 | 🗸 | 🗸 |
| **PO13** | **Able to develop new techniques and tools for solution of current engineering problems.** | 🗸 | 🗸 | 🗸 | 🗸 | 🗸 | 🗸 |
| **PO14** | **Able to use computer software and hardware technologies together with information technologies in an effective way.** | 🗸 | 🗸 | 🗸 | 🗸 | 🗸 | 🗸 |
| **PO15** | **Able to produce innovative solutions for solution of current engineering problems by gathering data through experiment design and interpretation of results.** | 🗸 | 🗸 | 🗸 | 🗸 | 🗸 | 🗸 |
| **PO16** | **Able to actively work individually or in teams where engineers from the same or different disciplines are involved.** | 🗸 | 🗸 | 🗸 | 🗸 | 🗸 | 🗸 |
| **PO17** | **Gains competency in effective written and verbal communication, presentation and preparation of technical reports in Turkish and English.**  | 🗸 | 🗸 | 🗸 | 🗸 | 🗸 | 🗸 |
| **PO18** | **Constantly increases knowledge with the awareness of lifelong learning by closely following the developments in science and technology .** | 🗸 | 🗸 | 🗸 | 🗸 | 🗸 | 🗸 |
| **PO19** | **Acts in accordance with scientific and ethical principles and the standards used in engineering practice at every stage of career** | 🗸 | 🗸 | 🗸 | 🗸 | 🗸 | 🗸 |
| **PO20** | **Able to describe concepts related to business life such as project management, risk management, change management, entrepreneurship and sustainability.** | 🗸 | 🗸 | 🗸 | 🗸 | 🗸 | 🗸 |
| **PO21** | **Gains awareness of the legal consequences of engineering solutions developed together with the effect of engineering applications on health, environment and safety on a universal and social scale.** | 🗸 | 🗸 | 🗸 | 🗸 | 🗸 | 🗸 |
| **PO22** | **Able to solve problems involving probability and statistics, derivative and integral calculations, multivariable mathematics, linear algebra, differential equations, and complex variables, and their electrical and electronics applications.** | 🗸 | 🗸 | 🗸 | 🗸 | 🗸 | 🗸 |
| **PO23** | **Able to organize projects and events for the social environment they live in with the awareness of social responsibility and implement them.** | 🗸 | 🗸 | 🗸 | 🗸 | 🗸 | 🗸 |
| **PO24** | **Able to plan and direct activities for employees under their responsibility to develop within the framework of a project.** | 🗸 | 🗸 | 🗸 | 🗸 | 🗸 | 🗸 |
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| **PART III ( Department Board Approval)** |
| **Course Subjects, Contribution of Course Subjects to Learning Outcomes, and Methods for Assessing Learning of Course Subjects** | **Subjects** | **Week** |  | **LO1** | **LO2** | **LO3** | **LO4** | **LO5** | **LO6** |
| **S1** | *1* | Background and Introduction:* Microprocessor history, types, and applications.
* General microprocessor architecture,

Review of number systems | A1/3/4/8 | A1/3/4/8 | A1/3/4/8 | A1/3/4/8 | A1/3/4/8 |  |
| **S2** | *2* | The Intel 80X86/88 Architectures and Programming* Registers and Internal Architecture
* Address generation and addressing modes

Instruction set and assembly language programming | A1/3/4/8 | A1/3/4/8 | A1/3/4/8 | A1/3/4/8 | A1/3/4/8 |  |
| **S3** | *3* | Microcontrollers and embedded processors* Inside the 8051
* 8051 assembly language programs
 | A1/3/4/8 | A1/3/4/8 | A1/3/4/8 | A1/3/4/8 | A1/3/4/8 | A4/8 |
| **S4** | 4 | Assembly language programming | A1/3/4/8 | A1/3/4/8 | A1/3/4/8 | A1/3/4/8 | A1/3/4/8 | A4/8 |
| **S5** | 5 | The Intel 80X86/88 Bus and Buffering* 80X86/88 Pin functions, states, bus cycles and signalling waveforms
* Clock generators (Intel 8284) and bus controllers (Intel 8288)
* Latches (74373) and bus transceivers (74245)

Wait states and bus timing | A1/3/4/8 | A1/3/4/8 | A1/3/4/8 | A1/3/4/8 | A1/3/4/8 |  |
| **S6** | 6 | **Memory Devices:** Memory pin connections, ROM memory (EPROM, EEPROM, flash), RAM memory (static, dynamic), memory organization, types of memory access, data alignment. | A1/3/4/8 | A1/3/4/8 | A1/3/4/8 | A1/3/4/8 | A1/3/4/8 |  |
| **S7** | 7 | **Memory Interface:** Memory interface and the three buses, interfacing the 8088 processor, interfacing the 8086 processor, interfacing the 386 and 486 processors, interfacing the Pentium processor, address decoding techniques (full, partial, logic gates, decoders). | A1/3/4/8 | A1/3/4/8 | A1/3/4/8 | A1/3/4/8 | A1/3/4/8 |  |
| **S8** | 8 | **Basic IO Interface:** I/O ports, I/O space VS memory space, 80x86 I/O instructions (direct, indirect, string), accessing I/O ports in 80x86 processors, designing a parallel input port, designing a parallel output port. | A1/3/4/8 | A1/3/4/8 | A1/3/4/8 | A1/3/4/8 | A1/3/4/8 | A4/8 |
| **S9** | 9 | **The 8255 Programmable Peripheral Interface (PPI):** Intel peripheral controller chips, basic description of the 8255, pin configuration of the 8255, block diagram of the 8255, interfacing the 8255 to the 8086 processor, programming the 8255, operating modes of the 8255. | A1/3/4/8 | A1/3/4/8 | A1/3/4/8 | A1/3/4/8 | A1/3/4/8 |  |
| **S10** | 10 | **The 8253 Programmable Interval Timer:** Basic description of the 8253, pin configuration of the 8253, block diagram of the 8253, system interfacing of the 8253, interfacing the 8253 to the 8086 processor, programming the 8253, operating modes of the 8253. | A1/3/4/8 | A1/3/4/8 | A1/3/4/8 | A1/3/4/8 | A1/3/4/8 |  |
| **S11** | 11 | **Interrupts:** Interrupt-driven I/O, hardware interrupts, responding to hardware interrupts, INTR and NMI, computing the ISR address, hardware interrupt timing, interrupt acknowledge cycles. | A1/3/4/8 | A1/3/4/8 | A1/3/4/8 | A1/3/4/8 | A1/3/4/8 |  |
| **S12** | 12 | **The 8259A Programmable Interrupt Controller (PIC):** Interrupts in microcomputer systems, programmable interrupt controllers, general description of the 8259A, pin configuration of the 8259A, block diagram of the 8259A, interrupt sequence, interfacing the 8259A to the 8086 processor, programming the 8259A, reading the status of the 8259A. | A1/3/4/8 | A1/3/4/8 | A1/3/4/8 | A1/3/4/8 | A1/3/4/8 |  |
| **S13** | 13 | **Direct Memory Access:** Introduction to DMA structures, Intel 8237 DMA Controller. | A1/3/4/8 | A1/3/4/8 | A1/3/4/8 | A1/3/4/8 | A1/3/4/8 |  |
| **S14** | 14 |  |  |  |  |  |  |  |
| **Assessment Methods, Weight in Course Grade, Implementation and Make-Up Rules**  | **No.** | **Type** | **Weight** | **Implementation Rule** | **Make-Up Rule** |
| **A1** | **Exam** | *55%* | *Midterm is 25% and final is 30% of the final mark.* | A make-up exam is provided in case of a legitimate reason with a proof. |
| **A2** | **Quiz** | *5%* | *At least three quizzes are taken* | No make-up |
| **A3** | **Homework** | *15%* | *There are four assignments.* | No make-up |
| **A4** | **Project** | *10%* | *Hardware-based or Emulation-based* | - |
| **A5** | **Report** |  | - | - |
| **A6** | **Presentation** |  | - | - |
| **A7** | **Attendance/ Interaction** |  | - | - |
| **A8** | **Class/Lab./****Field Work** |  |  |  |
| **A9** | **Other** |  |  |  |
| **TOTAL** | **100%** |
| **Evidence of Achievement of Learning Outcomes** | Students will demonstrate learning outcomes through midterm exams, homework assignments, a HW-based or SW-based project and the final exam. Every topic is tested with at least one exam or homework question. In order to pass, a student needs to accumulate at least 50 % of the total mark. |
| **Method for Determining Letter Grade** | The total mark is converted to a letter grade using the table below.

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Total points** | 100-95 | 94-90 | 89-85 | 84-80 | 79-75 | 74-70 | 69-65 | 64-60 | 59-55 | 54-50 |
| **Letter Grade** | A | A- | B+ | B | B- | C+ | C | C- | D+ | D |

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| **Teaching Methods, Student Work Load** | **No** | **Method** | **Explanation** | **Hours** |
| ***Time applied by instructor*** |
| **1** | **Lecture** | Lectures are given using the white board with the help of power point slides. Whenever necessary, numerical examples and sample questions are given to clarify theoretical concepts.  | *3x14* |
| **2** | **Interactive Lecture** |  |  |
| **3** | **Recitation** |  |  |
| **4** | **Laboratory** |  |  |
| **5** | **Practical** |  |  |
| **6** | **Field Work** |  |  |
| ***Time expected to be allocated by student*** |
| **7** | **Project** | In groups of threes, the students are asked to implement a microcontroller-based system. | *35* |
| **8** | **Homework** | The students get the solution to homework questions after submission. | *24* |
| **9** | **Pre-class Learning of Course Material**  | Next class’ material is read before the class | *28* |
| **10** | **Review of Course Material** | Review is conducted at the end of every chapter. | *28* |
| **11** | **Studio** |  |  |
| **12** | **Office Hour** | One hour per week is allocated for students’ questions. In addition, students can arrange for a meeting any time. | *28* |
| **TOTAL** | *185* |
| **IV. PART** |
| **Instructor** | **Name** | Mustafa İlker Beyaz |
| **E-mail** | mibeyaz@antalya.edu.tr |
| **Phone Number** | 0242 245 0367 |
| **Office Number** | 0242 245 0367 |
| **Office Hours** | *Determined during each semester, 2 hours per week* |
| **Course Materials** | **Mandatory** |  |
| **Recommended** | 1. Barry B. Brey, The Intel Microprocessors, Architecture, Programming and Interfacing. 8th Edition, Pearson/Prentice Hall (2009)
2. The 8051 Microcontroller and Embeded Systems Using Assembly and C, by M. Mazidi, J. Mazidi, and R. Mckinlay.
 |
| **Other** | **Scholastic Honesty** | Violations of scholastic honesty include, but are not limited to cheating, plagiarizing, fabricating information or citations, facilitating acts of dishonesty by others, having unauthorized possession of examinations, submitting work of another person or work previously used without informing the instructor, or tampering with the academic work of other students. Any for of scholastic dishonesty is a serious academic violation and will result in a disciplinary action. |
| **Students with disabilities** | Reasonable accommodations will be made for students with verifiable disabilities. |
| **Safety Issues**  | The course does not require any special safety precautions. |
| **Flexibility** | Circumstances may arise during the course that prevents the instructor from fulfilling each and every component of this syllabus; therefore, the syllabus is subject to change.  Students will be notified prior to any changes.  |