CLIL Module Plan

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School	ITT “M. Buonarroti” Trento				
School Grade	○ Primary		○ Middle		◉ High
School Year	○ 1	○ 2	○ 3	◉ 4	○ 5
Subject	Altro - Electronics, Computer science, Electrotechnics.	**Topic**	Structure, operation and use of Microprocessors and Microcontrollers.		
CLIL Language	◉ English		○ Deutsch		

Personal and social-cultural preconditions of all people involved	The ITT “M. Buonarroti” Trento is a school that, over a period of five years, trains technicians in a variety of specializations: electrotechnical, mechanical, chemical, IT. Our technicians can immediately face the labor market in industry or public offices or continue with university studies. In general, the degree of motivation for the study of our students is not very high. In some classes the presence of foreign students is relevant and on average in each class there is a student with special educational needs. I hope that the lessons and laboratory activities conveyed in English increase the interest and motivation towards the chosen specialization. In this particular class 4° Electrotechics Automation A the teacher will be able to count on a great resource regarding the correct pronunciation and this is the presence of an English mother tongue student. The average level of knowledge of the English language of the other students can be assessed in level B1. The class has already had lessons in English last year, concerning an important chapter of Elecrotechnics and precisely the electrical networks powered by sine voltages. The experience was positive because I found a good understanding from the disciplinary point of view of a difficult and basic topic for the training of the electrical technicians. The lessons in English have increased attention in the class and every student, except for very few exceptions, has tried to use his language skills to take full advantage of the lessons. Another resource on which the class and I are able to count, both last year and this year, is the parallel English course, with the involvement of the teacher in some moments of the Clil lesson, such as checking the correctness of some translations from Italian into English and the resolution of some grammatical doubts. Given the purely professional nature of the school and the discipline Automatic System, my Clil lessons have a special emphasis on the disciplinary content.

Students' prior knowledge, skills, competencies	Subject	Language
	Ohm’s law, Kirchhoff’s principles, electrical networks structure, Boolean algebra, binary and hexadecimal numbering system, digital networks and integrated digital devices of small, medium and high integration scale, light emitting diode operation, bipolar junction transistor operation, relay operations, C++ programming language.	Classroom language: students should be able to understand simple sentences containing the explanation of the functioning of the electronic devices under examination, as well as to understand the explanation of the mathematical passages containing the most usual operations: sum, subtraction, multiplication, division, square root, exponentiation. They also must be able to ask for help or for clarifications. Skills: throughout the module students will be asked to independently repeat the concepts learned in order to strengthen and consolidate their understanding. They should also be able to quickly find on the Internet, read and understand the technical manuals (in English) of the studied devices. The grammatical level required is about B1. Vocabulary: the technical words used in the module are generally of immediate comprehension for students of electronics and electrotechnics specialization.

Timetable fit	◉ Module	Length 23h (1x8h lessons+3x2h lessons+ 3x3h lessons)

Description of teaching and learning strategies	The teacher introduces the topic of the lesson, motivates its importance and proceeds with the explanation, with the necessary precision and conciseness, urging the students to ask for clarification as soon as they find some difficulty. The students will be asked to carry out together with the teacher the exercises. During the lessons all will speak only in English and the students in difficulty with the language will be invited to find help each other to formulate correctly in English their requests. The basic tool will be the white board on which will be drawn with the use of coloured markers. Students will be sometimes invited to consult on the Internet, using their own smartphones, the technical manuals of the device under examination, in order to independently proceed with its configuration according to the requirements of the electronic system to be implemented. One aspect that I consider very important is the one that involves every student in the practical activity in the laboratory. The “group” activity is incentivized but everyone must then develop their own personal system, also in view of the test in which each student will be assessed individually for the work done. The lesson of three hours will obviously focus on laboratory activities. The lessons with only one and two hours will be used for the explanation of new topics and in the involvement of the students in the resolution of the proposed consolidation exercises.

Overall Module Plan

Unit: 1 Microprocessor and microcontroller systems. **Unit length:** 23h (8x1h lessons+3x2h lessons+3x3h lessons)	**Lesson 1** Internal structure of microprocessors.
	Lesson 2 Storage devices in microprocessors systems.
	Lesson 3 Block diagram of a microprocessor system.
	Lesson 4 Practical experience: writing and reading in specific computer peripherals using the Labview graphic
	Lesson 5 The structure of instructions of microprocessors.
	Lesson 6 Management of peripherals by polling and by interrupt.
	Lesson 7 Connection of Led diodes and relays to the system bus.
	Lesson 8 Practical experience: design and assembly of a delayed ignition system of a Led diode to simulate th
	Lesson 9 Review of topics in preparation for the verification test on microprocessor systems.
	Lesson 10 Verification test on microprocessor systems.
	Lesson 11 Delivery of the evaluated tests and collegial correction.
	Lesson 12 Block diagram of the internal structure of a microcontroller and main differences between microproce

	Lesson 13 Practical experience: programming, assembly of components and verification of operation of a timed f
	Lesson 14 The various types of internal memory of microcontrollers.

CLIL Lesson Plan

Unit number	1	**Lesson number**	1	**Title**	Internal structure of microprocessors.

Activity	Timing	Learning Outcomes	Activity Procedure	Language	Interaction	Materials	Assessment

1	30 min	Understanding: students must understand what the microprocessors are, how they work, what their internal structure is, where they are used, why they are so widespread. Remembering: the internal structure of the microprocessors is composed of previously studied digital devices like the finite state automata, the memories, the binary adder, the bistable elements, the counters, the registers, the clock signal generator. The inputs and outputs of a microprocessor still are the Boolean signals previously studied.	Introduction: the teacher welcomes the students and introduces the topic by recalling many examples in the daily reality of use of microprocessors. Students are invited to list the names of the most common microprocessors on the market and to define their performance.	**Skills** L S R W **Key vocabulary** Key vocabulary -CPU (Central Processing Unit) -ALU (Arithmetic Logic Unit) -MIPS (Mega Instrction Per Second) -Register set -Finite state Automata -Fetch and execute operations -Bus communication -Program memory **Communicative structures** -Who knows the name of the microprocessor of his own computer? -Who remembers how does the Moore finite state automata work?	☒ Whole class ☐ Group work ☐ Pair work ☐ Individual work	Textbook of Automatic Systems “Corso di Sistemi Automatici 2”, Fabrizio Cerri, Giuliano Ortolani, Ezio Venturi, HOEPLI, ISBN 978-88-203-7275-0 from page 64 to page 66 (General information on microprocessors). Whiteboard, colored markers.	None

2	60 min	Understanding: students must understand what the microprocessors are, how they work, what their internal structure is, where they are used, why they are so widespread. Remembering: the internal structure of the microprocessors is composed of previously studied digital devices like the finite state automata, the memories, the binary adder, the bistable elements, the counters, the registers, the clock signal generator. The inputs and outputs of a microprocessor still are the Boolean signals previously studied.	Activating of prior knowledge: the teacher draws on the whiteboard with the aid of colored markers a block diagram of the internal structure of the microprocessor in order to highlight the blocks already known and studied previously. Students are invited to request clarifications where necessary.	**Skills** L S R W **Key vocabulary** All the previous key vocabulary **Communicative structures** All the previous communicative structures	☒ Whole class ☐ Group work ☐ Pair work ☐ Individual work	Textbook of Automatic Systems from page 84 to page 87 of the textbook (Internal architecture of the CPU, fetch and execute phases). Whiteboard, colored markers.	None
3	10 min	Understanding: students must	Summary of the learned	**Skills**		Textbook of	None

		understand what the microprocessors are, how they work, what their internal structure is, where they are used, why they are so widespread. Remembering: the internal structure of the microprocessors is composed of previously studied digital devices like the finite state automata, the memories, the binary adder, the bistable elements, the counters, the registers, the clock signal generator. The inputs and outputs of a microprocessor still are the Boolean signals previously studied.	concepts and assignment of consolidation exercises. Students are invited to request clarifications where necessary. The consolidation exercises are: - Draw and explain the structure of a register composed of D type flip flops. - Draw and explain the structure of a shift register composed of D type flip flops. - Draw and explain the structure of an asynchronous counter composed of JK type flip flops. - Draw and explain the structure of an Arithmetic Logical Unit. - Draw and explain the structure of the three-state logical gates. - Draw and explain the structure of an automata controlling a traffic light system. - Proposition of the verification tests n°1,2,3 (page 91 of the textbook). - Proposition of the verification tests n°1,2 (page 73 of the textbook).	L S R W **Key vocabulary** All the previous key vocabulary **Communicative structures** All the previous communicative structures	☑ Whole class ☐ Group work ☐ Pair work ☐ Individual work	Automatic Systems page 27 (Summary on the automata), page 72 (Summary on microprocessor structure), and page 90 limited to the topics “registers” and “fetch and execute phases” of the textbook. Whiteboard, colored markers.	

CLIL Lesson Plan

Unit number	1	**Lesson number**	2	**Title**	Storage devices in microprocessors systems.

Activity	**Timing**	**Learning Outcomes**	**Activity Procedure**	**Language**	**Interaction**	**Materials**	**Assessment**
1	10 min	Understanding: students must understand what the storage devices are, how many different types of memory there are, how they work, what their internal structure is, where they are used, how can their expansion be done to increase both the capacity and the length of the stored data. Remembering: the internal structure of the storage devices is composed of previously studied digital devices like the decoder, the buffers, the bistable elements, the	Introduction: the teacher introduces the topic recalling the usual operation of increasing the RAM memory that almost all computer owners do, and recalls that the amount of RAM and the storage capacity of the Hard Disk are important computer performances indexes. Students are invited to remember the capacity of the DRAM, cache, and Hard Disk of their computer.	**Skills** L S R W **Key vocabulary** -SRAM Memory -Cache Memory -DRAM Memory -EPROM Memory -EEPROM Memory -FLASH Memory -NOVRAM Memory -Hard Disk -Storage capacity in KByte, MByte, GByte -Word lenght -Random Access Memory -Word and capacity expansion -Access time -Chip Select and Output Enable controls	☑ Whole class ☐ Group work ☐ Pair work ☐ Individual work	Textbook of Automatic Systems from page 52 to page 53 of the textbook (Structure of a SRAM memory register). Whiteboard, colored markers.	None

		elements, the fundamental gates AND, OR, NOT, the resistor, the diode. Creating: students must be able to construct a memory of greater capacity and data length with smaller memory devices available.		**Communicative structures** -Who knows the DRAM capacity of his own computer? -Why does the performance of a computer increase as the DRAM quantity increases? -Who remembers the differences between SRAM and DRAM? -Who remembers the differences between ROM, PROM and EPROM ? -What is the different behavior of a DRAM memory and a EPROM memory in case of the bias voltage of the computer shuts down? -How is defined the access time of a memory module ?			
2	30 min	Understanding: students must understand what the storage devices are, how many different types of memory there are, how they work, what their internal structure is, where they are used,	Activating of prior knowledge: the teacher draws on the whiteboard with the aid of colored markers the external pin-out and the detailed internal structure of a SRAM memory module of only four words of three bits each. He	**Skills** L S R W **Key vocabulary** All the previous key vocabulary	☑ Whole class ☐ Group work ☐ Pair work ☐ Individual work	Textbook of Automatic Systems from page 54 to page 59 of the textbook (Structure and	None

		how can their expansion be done to increase both the capacity and the length of the stored data. Remembering: the internal structure of the storage devices is composed of previously studied digital devices like the decoder, the buffers, the bistable elements, the fundamental gates AND, OR, NOT, the resistor, the diode. Creating: students must be able to construct a memory of greater capacity and data length with smaller memory devices available.	then proceeds with the explanation of the operations of storing and reading a data and to highlight the elements already known and studied previously. In the same way the teacher traces the external pinout and the simplified internal scheme of a ROM and PROM memory module and explains how they work. Then he explains the basic scheme of the operation of the EPROM and EEPROM memories. Then he proceeds with the construction of a memory module of greater capacity and word length by suitably connecting through previously studied devices, like decoders, some memory module of small capacity. Finally he shows how to program the EPROM memory module to realize many complex combinational logic functions, such as the functions that make up a binary to 7 segment converter.	**Communicative structures** All the previous communicative structures		operation of memories). Whiteboard, colored markers.	
3	10 min	Understanding:	Summary of the learned				None

		students must understand what the storage devices are, how many different types of memory there are, how they work, what their internal structure is, where they are used, how can their expansion be done to increase both the capacity and the length of the stored data. Remembering: the internal structure of the storage devices is composed of previously studied digital devices like the decoder, the buffers, the bistable elements, the fundamental gates AND, OR, NOT, the resistor, the diode. Creating: students must be able to construct a memory of greater capacity and data length with smaller memory devices available.	concepts and assignment of consolidation exercises. Students are invited to request clarifications where necessary. The consolidation exercises are: - Draw the internal structure and the external pinout of a SRAM memory composed of 4 words of 4 bits each and explain in detail how the write and read operations take place. - Draw the internal structure and the external pinout of a ROM memory composed of 8 words of 4 bits each and explain in detail how the read operations take place. - Draw the internal structure and the external pinout of a PROM memory composed of 8 words of 4 bits each and explain in detail how the program and read operations take place. - Draw and explain the connections to be made in order to obtain an 8Kbyte SRAM memory starting from 4 SRAM memory chips each with the capacity of 2Kbyte. - Proposition of all the verification tests (page 61, 62 and 63 of the textbook).	**Skills** L S R W **Key vocabulary** All the previous key vocabulary **Communicative structures** All the previous communicative structures	☑ Whole class ☐ Group work ☐ Pair work ☐ Individual work	Textbook of Automatic Systems, summary at page 60 of the textbook. Whiteboard, colored markers.	

CLIL Lesson Plan

Unit number	1	**Lesson number**	3	**Title**	Block diagram of a microprocessor system.

Activity	**Timing**	**Learning Outcomes**	**Activity Procedure**	**Language**	**Interaction**	**Materials**	**Assessment**
1	10 min	Understanding: students must understand the structure and operation of microprocessor systems, such as computers, and how the various devices which make it up are connected to the internal communication bus. Remembering: the internal structure of the computer is composed of elements previously studied such as the microprocessor (CPU) and the SRAM and DRAM memory modules that will be appropriately recalled.	Introduction: the teacher introduces the topic by recalling many examples in the daily reality of use of computer. Students are invited to list the names of the most common peripheral connected to their computers and the way in which they are connected. He also asks if anyone has ever opened his computer and what he saw inside.	**Skills** L S R W **Key vocabulary** -CPU (Central Processing Unit) -Address Bus -Data Bus -Control Bus -Program Memory -Mass memory -Peripherals -Instruction -Address decoding network -RD and WR controls	☑ Whole class ☐ Group work ☐ Pair work ☐ Individual work	Textbook of Automatic Systems page 66 of the textbook (Block diagram of a microprocessor system). Whiteboard, colored markers.	None

		Creating: students must be able to design the logical network for decoding the address of each device involved in the data transfer (DRAM and SRAM memory modules, Hard Dish, keyboard, monitor, printer, modem and so on) and defining in detail the sequence of control signals activated by the CPU for the normal read and write operations that are continuously performed in a microprocessor system.		**Communicative structures** -What are the similarities between the internal communication BUSes of a computer and the autoBUS we take to come to school? -Who knows the bit size of the data bus and the address bus of his own computer? - Why only one unit at a time can be involved in data transfer with the CPU?			
2	30 min	Understanding: students must understand the structure and operation of microprocessor systems, such as computers, and how the various devices which make it up are connected to the internal communication bus. Remembering: the	Activating of prior knowledge: the teacher draws on the whiteboard with the aid of colored markers a block diagram of the internal structure of the computer in order to highlight the blocks already known and studied previously. The students are invited to request clarifications where necessary. He	**Skills** L S R W	☒ Whole class ☐ Group work ☐ Pair work ☐ Individual work	Textbook of Automatic Systems from page 66 to page 71 of the textbook (The bus communication technique between the units of a microprocessor system).	None

		internal structure of the computer is composed of elements previously studied such as the microprocessor (CPU) and the SRAM and DRAM memory modules that will be appropriately recalled. Creating: students must be able to design the logical network for decoding the address of each device involved in the data transfer (DRAM and SRAM memory modules, Hard Dish, keyboard, monitor, printer, modem and so on) and defining in detail the sequence of control signals activated by the CPU for the normal read and write operations that are continuously performed in a microprocessor system.	draws then the connection scheme of the central memory, the mass memory (HD), and the various peripherals to the CPU through the communication buses (ADDRESS, DATA and CONTROL buses) and by giving fictitious addresses to the various units. He traces the logical decoding networks so that at each address only one unit is involved in the data transfer. Finally he lists in detail the sequence of operations that the CPU must perform for reading from or writing to a specific memory location or in a device (like the keyboard, the printer, the modem and so on).	**Key vocabulary** -CPU (Central Processing Unit) - Address Bus -Data Bus - Control Bus -Program Memory -Mass memory -Peripherals -Instruction -Address decoding network -RD and WR controls **Communicative structures** -What are the similarities between the internal communication BUSes of a computer and the autoBUS we take to come to school? -Who knows the bit size of the data bus and the address bus of his own computer? - Why only one unit at a time can be involved in data transfer with the CPU?		Whiteboard, colored markers.	
3	10 min	Understanding: students must understand the	Summary of the learned concepts and assignment of	**Skills**	▣ Whole class	Textbook of Automatic	None

		structure and operation of microprocessor systems, such as computers, and how the various devices which make it up are connected to the internal communication bus. Remembering: the internal structure of the computer is composed of elements previously studied such as the microprocessor (CPU) and the SRAM and DRAM memory modules that will be appropriately recalled. Creating: students must be able to design the logical network for decoding the address of each device involved in the data transfer (DRAM and SRAM memory modules, Hard Dish, keyboard, monitor, printer, modem and so on) and defining in detail the sequence of control signals activated by the CPU	consolidation exercises. Students are invited to request clarifications where necessary. The consolidation exercises are: - Draw the connection to the system Bus of the CPU, the DRAM memory, the Hard Disk, the keyboard, the monitor, the printer, all with a specified address, and explain in detail how the CPU transfers a data read in a specific memory location to the printer. - Draw the connection to the system Bus of the CPU, the DRAM memory, the Hard Disk, the keyboard, the modem, all with a specified address, and explain in detail how the CPU transfers a character read in a specific memory location to the modem to be sent. - Proposition of the verification tests 4,5,6,7 (page 73 of the textbook). - Proposition of all the verification tests (page 74 of the textbook)	L S R W **Key vocabulary** -CPU (Central Processing Unit) - Address Bus -Data Bus - Control Bus -Program Memory -Mass memory -Peripherals -Instruction -Address decoding network -RD and WR controls **Communicative structures** -What are the similarities between the internal communication BUSes of a computer and the autoBUS we take to come to school? -Who knows the bit size of the data bus and the address bus of his own computer? - Why only one unit at a time can be involved in data transfer with the CPU?	☐ Group work ☐ Pair work ☐ Individual work	Systems from page 66 to page 71 of the textbook (The bus communication technique between the units of a microprocessor system). Whiteboard, colored markers.	

		for the normal read and write operations that are continuously performed in a microprocessor system.	textbook).				

CLIL Lesson Plan

Unit number	1	**Lesson number**	4	**Title**	Practical experience: writing and reading in specific computer peripherals using the Labview graphic

Activity	**Timing**	**Learning Outcomes**	**Activity Procedure**	**Language**	**Interaction**	**Materials**	**Assessment**
1	40 min	Understanding: the students, thanks to the functions of the Labview graphic programming language (already known), can set an address in various formats (hexadecimal, binary, decimal) corresponding to a specific computer device (keyboard, system timer, system speaker, parallel port, serial port) and perform on it a reading if the device is an input one or a writing if the device is an output one. In this way the understanding of the data transfer mechanism by BUS in microprocessor systems is facilitated. Remembering: in this laboratory activity that	Introduction: the teacher introduces the laboratory activity by proposing a practical verification of the way in which data are exchanged between the various peripherals and the CPU. Students will use the Labview software to design the program that instructs the CPU to perform reading or writing operations in certain devices identified by a specific address. Each system device	**Skills** L S R W **Key vocabulary** -CPU (Central Processing Unit) -Address Bus -Data Bus -Control Bus -Reading and Writing operations -System peripherals addressing.	☑ Whole class ☐ Group work ☐ Pair work ☐ Individual work	Whiteboard, colored markers. Computers. Internal computer database to know the specific addresses of the various peripherals contained in the computer (keyboard, system timer, system speaker, mouse, parallel port, serial ports, modem etc.) through	None

		laboratory activity that sees the students engaged to interact with the peripherals inside the computer, it will be remembered the functioning of the microprocessor systems and the communication mode of the various devices with the CPU through the three buses: Address Bus, Data Bus and Control Bus, and in particular it will be remembered the system of decoding of the address that allows only one device at a time to be involved in the data transfer with the CPU. Creating: students must be able to design the Labview program that allows to enter the address of a given device and to activate the reading or writing operation on it by entering the data to be written or by displaying the read data.	Each system device (keyboard, timer, speaker, serial and parallel ports) has a unique address within the computer. Changing the address we will see that the data read will no longer be the same as before because the device to read from is changed.	**Communicative structures** -Let's try to read the data of the system Timer whose address is 40H. - Let's try to write in the system Speaker whose address is 61H. - Let's try to write in the system Parallel PORT whose address is 378H and verify the written data on the led connected to it.		the path: control panel-system properties-device management-specific device properties-resource.	
2	40 min	Understanding: students thanks to the functions of the Labview graphic programming language (already known) can set an	Activating of prior knowledge: the teacher draws on the whiteboard with the aid of	**Skills** L S R W	☒ Whole class ☐ Group work	Textbook of Automatic Systems from page 66 to	None

		address in various formats (hexadecimal, binary, decimal) corresponding to a specific computer device (keyboard, system timer, system speaker, parallel port, serial port) and perform on it a reading if the device is an input one or a writing if the device is an output one. In this way the understanding of the data transfer mechanism by BUS in microprocessor systems is facilitated. Remembering: in this laboratory activity that sees the students engaged to interact with the peripherals inside the computer, it will be remembered the functioning of the microprocessor systems and the communication mode of the various devices with the CPU through the three buses: Address Bus, Data Bus and Control Bus, and in particular it will be remembered the system of decoding of the address that allows only one device at a time to be involved in the data transfer with the	colored markers a block diagram of the internal structure of the microprocessor system and in particular of the combinatorial decoding network of the address that allows only one device at a time to communicate with the CPU. Then he proceeds to design the graphical Labview program which, through its IN PORT and OUT PORT functions, allows us to enter an address and consequently read or write data in the addressed device. The students are invited to request clarifications where necessary.	**Key vocabulary** All the previous key vocabulary **Communicative structures** All the previous communicative structures	☐ Pair work ☐ Individual work	page 71 of the textbook (The bus communication technique between the units of a microprocessor system). Whiteboard, colored markers. Computers.	

		CPU. Creating: students must be able to design the Labview program that allows to enter the address of a given device and to activate the reading or writing operation on it by entering the data to be written or by displaying the read data.					
3	60 min	Understanding: students thanks to the functions of the Labview graphic programming language (already known) can set an address in various formats (hexadecimal, binary, decimal) corresponding to a specific computer device (keyboard, system timer, system speaker, parallel port, serial port) and perform on it a reading if the device is an input one or a writing if the device is an output one. In this way the understanding of the data transfer mechanism by BUS in microprocessor systems is facilitated. Remembering: in this laboratory activity that sees the students engaged to interact with the	The students write their own program on the Computer, enter the address of a particular device and read the data coming from it, or write in it a data. Particularly significant is the writing in the system speaker, which responds with a sound to the writing of a particular number on it, or even writing data on the parallel port appropriately connected to a series of LED diodes that displays the written	**Skills** L S R W **Key vocabulary** All the previous key vocabulary **Communicative structures** All the previous communicative structures	☐ Whole class ☐ Group work ☐ Pair work ☑ Individual work	Labview programming language installed on the lab computers. Electronic device to interface the parallel port of the computer to a group of LED diodes to display the written data on the parallel port. Whiteboard, colored markers. Computers.	None

		peripherals inside the computer, it will be remembered the functioning of the microprocessor systems and the communication mode of the various devices with the CPU through the three buses: Address Bus, Data Bus and Control Bus, and in particular it will be remembered the system of decoding of the address that allows only one device at a time to be involved in the data transfer with the CPU. Creating: students must be able to design the Labview program that allows to enter the address of a given device and to activate the reading or writing operation on it by entering the data to be written or by displaying the read data.	displays the written data.				
4	10 min	Understanding: students thanks to the functions of the Labview graphic programming language (already known) can set an address in various formats (hexadecimal, binary,	Summary of the learned concepts and assignment of consolidation exercises. Students are invited to request clarifications where	**Skills** L S R W **Key vocabulary** All the previous key vocabulary	☐ Whole class ☐ Group work ☐ Pair work ☐ Individual work	Whiteboard, colored markers.	None

decimal) corresponding to a specific computer device (keyboard, system timer, system speaker, parallel port, serial port) and perform on it a reading if the device is an input one or a writing if the device is an output one. In this way the understanding of the data transfer mechanism by BUS in microprocessor systems is facilitated. Remembering: in this laboratory activity that sees the students engaged to interact with the peripherals inside the computer, it will be remembered the functioning of the microprocessor systems and the communication mode of the various devices with the CPU through the three buses: Address Bus, Data Bus and Control Bus, and in particular it will be remembered the system of decoding of the address that allows only one device at a time to be involved in the data transfer with the CPU. Creating: students must be able to design the

necessary. The consolidation exercises are: - Design the LabView program to make the system speaker sound as soon as you write a certain value in its internal register, and verify that it works on your computer. - Verify that if the dialed address is not exactly that of the system speaker there is no longer any sound. - Design the LabView program to display on the screen via a waveform chart indicator the data read on the system timer and verify its operation on your computer. - Verify that if the dialed address is not exactly that of the system timer there is no longer any reading of its data.

Communicative structures
All the previous communicative structures

		Labview program that allows to enter the address of a given device and to activate the reading or writing operation on it by entering the data to be written or by displaying the read data.					

CLIL Lesson Plan

Unit number	1	**Lesson number**	5	**Title**	The structure of instructions of microprocessors.

Activity	**Timing**	**Learning Outcomes**	**Activity Procedure**	**Language**	**Interaction**	**Materials**	**Assessment**
1	30 min	Understanding: the students must understand how the microprocessor and in particular its control unit (CU) recognizes the orders to perform the intended tasks. Remembering: the instructions reside in the program memory (DRAM) and must be read (Fetch operation) by the CPU which stores the operating code in the Control Unit (CU) that then executes (Execute operation) the commands by involving if necessary the Arithmetic Logic Unit (ALU) and the accumulator register. Also the Program Counter, the Address register, the Data register and if necessary the Stack Pointer are involved in the fetch and	Introduction: the teacher introduces the topic by recalling that the microprocessor is a digital machine that only accepts commands in the form of binary numbers. The instructions that reside in the program memory (DRAM) are obviously binary numbers and therefore could be written in binary or hexadecimal code directly by the programmer, with great expenditure of time and high probability of making mistakes. Through appropriate programs, assemblers or compilers, the programmer can	**Skills** L S R W **Key vocabulary** -Central Processing Unit (CPU) -ALU (Arithmetic Logic Unit) -Accumulator -Control Unit (CU) -Instruction -Binary code -Hexadecimal code -Assembly language -Operative Code -Operand -Jump Instruction -Stack Pointer -Last in First Out (LIFO) Stack Memory -Program Counter -Register set -Address Bus -Data Bus -Control Bus -Finite state Automata -Program Memory -Peripherals	☒ Whole class ☐ Group work ☐ Pair work ☐ Individual work	Textbook of Automatic Systems page 75 and page 76 of the textbook (Machine and assembler languages). Whiteboard, colored markers.	None

involved in the fetch and execute operations, as well as the peripherals that must be read or written. It is evident that many topics of the previous lessons will be repeated and deepened. Creating: students must be able to recognize the meaning of the main instructions written in assembler, to distinguish the operative code from the operand, to evaluate their length in bytes.

programmer can proceed to write the instructions in a language more similar to human language, less burdensome to write and then will be the assembler or the compiler that will translate the written instruction into binary code understandable to the control unit.

Communicative structures
What are the operating code and the operand of the following instruction? What is the length in bytes of the following instruction? What is the sequence of operations performed by the CPU when it must execute the following instruction? What are the CPU’s registers involved in the fetch and execute phases of the following instruction?

2	30 min	Understanding: students must understand how the microprocessor and in particular its control unit (CU) recognizes the orders to perform the intended tasks. Remembering: the instructions reside in the program memory (DRAM) and must be read (Fetch operation) by the CPU which stores the operating code in the Control Unit (CU) that then executes (Execute operation) the commands, involving if	The structure of the possible assembler instructions will be examined by recognizing the part of the Operative Code and the part of the Operand and their extension in bytes. We will examine the structure of the consecutive instructions, which are the majority and the structure that involves a jump. We will examine in detail the	**Skills** L S R W **Key vocabulary** All the previous key vocabulary **Communicative structures** All the previous communicative structures	☒ Whole class ☐ Group work ☐ Pair work ☐ Individual work	Textbook of Automatic Systems pages 77, 78 and 84, 85, 86 of the textbook (Structure of instructions and internal architecture of the CPU). Whiteboard, colored	None

		necessary the Arithmetic Logic Unit (ALU) and the accumulator register. Also the Program Counter, the Address register, the Data register and if necessary the Stack Pointer are involved in the fetch and execute operations, as well as the peripherals that must be read or written. It is evident that many topics of the previous lessons will be repeated and deepened. Creating: students must be able to recognize the meaning of the main instructions written in assembler, to distinguish the operative code from the operand, to evaluate their length in bytes.	role of the Program Counter and Stack Pointer registers.			markers.	
3	30 min	Understanding: students must understand how the microprocessor and in particular its control unit (CU) recognizes the orders to perform the intended tasks. Remembering: the instructions reside in the program memory (DRAM) and must be read (Fetch operation) by the CPU which stores the operating	Activating of prior knowledge: the teacher draws on the whiteboard with the aid of colored markers a block diagram of the internal structure of both the Central Processing Unit and the whole microprocessor system in order to follow in	**Skills** L S R W **Key vocabulary** All the previous key vocabulary	☑ Whole class ☐ Group work ☐ Pair work ☐ Individual work	Textbook of Automatic Systems pages 77, 78, 79 and 84, 85, 86 of the textbook excluding from page 79 the part	None

		code in the Control Unit (CU) that then executes (Execute operation) the commands, involving if necessary the Arithmetic Logic Unit (ALU) and the accumulator register. Also the Program Counter, the Address register, the Data register and if necessary the Stack Pointer are involved in the fetch and execute operations, as well as the peripherals that must be read or written. It is evident that many topics of the previous lessons will be repeated and deepened. Creating: students must be able to recognize the meaning of the main instructions written in assembler, to distinguish the operative code from the operand, to evaluate their length in bytes.	detail the sequence of activation of the various BUS signals involved in the fetch and execute phases of certain instructions written in assembler.	**Communicative structures** All the previous communicative structures		related to polling and interrupt (High and low level languages, internal architecture of the CPU, fetch and execute phases). Whiteboard, colored markers.	
4	10 min	Understanding: students must understand how the microprocessor and in particular its control unit (CU) recognizes the orders to perform the intended tasks. Remembering: the	Summary of the learned concepts and assignment of consolidation exercises. Students are invited to request clarifications where necessary. The	**Skills** L S R W **Key vocabulary** All the previous key vocabulary	☒ Whole class ☐ Group work ☐ Pair work ☐ Individual work	Textbook of Automatic Systems summary at page 81 of the textbook	None

		instructions reside in the program memory (DRAM) and must be read (Fetch operation) by the CPU which stores the operating code in the Control Unit (CU) that then executes (Execute operation) the commands, involving if necessary the Arithmetic Logic Unit (ALU) and the accumulator register. Also the Program Counter, the Address register, the Data register and if necessary the Stack Pointer are involved in the fetch and execute operations, as well as the peripherals that must be read or written. It is evident that many topics of the previous lessons will be repeated and deepened. Creating: students must be able to recognize the meaning of the main instructions written in assembler, to distinguish the operative code from the operand, to evaluate their length in bytes.	necessary. The consolidation exercise are: - Given a fragment of assembler code, e.g. LD A,2F and the addresses of the program memory locations in which it is contained, explain in detail the sequence of operations and Bus signals involved in the fetch and execute phases. - Proposition of the verification tests 1,2,3,4,5,6 (page 82 of the textbook). - Proposition of the verification tests 7,8,9 (page 82 and page 83 of the textbook).	**Communicative structures** All the previous communicative structures		Whiteboard, colored markers.	

CLIL Lesson Plan

Unit number	1	**Lesson number**	6	**Title**	Management of peripherals by polling and by interrupt.

Activity	**Timing**	**Learning Outcomes**	**Activity Procedure**	**Language**	**Interaction**	**Materials**	**Assessment**
1	15 min	Understanding: the students must learn the possible ways in which the microprocessor manages the exchange of data with the peripheral devices (keyboard, printer, mouse, parallel and serial ports, modems, hard disk, system timer, and so on), and the advantages of using the interrupt instead of the simple polling. The bus controls will be completed with the IRQ (Interrupt Request) signal that allows the peripherals to report to the CPU, only when necessary, the data exchange	Introduction: the teacher introduces the topic by assuming a real situation in which the CPU has to manage a complex system made by many peripherals (keyboard, printer, mouse, parallel and serial ports, modems, hard disk, system timer, and so on). With the use of the polling mode the CPU must periodically suspend the main program and call all the devices to check if one or more of these is ready to exchange data. In the case, frequent, in which none of them is ready to talk with the CPU this suspension is useless and time-consuming. The	**Skills** L S R W **Key vocabulary** -CPU (Central Processing Unit) -Peripherals -Polling -Address Bus -Data Bus -Control Bus -Stack Pointer -Stack Memory -IRQ (Interrupt Request) -ISR (Interrupt Service Routine)	☑ Whole class ☐ Group work ☐ Pair work ☐ Individual work	Textbook of Automatic Systems page 79 and page 80 of the textbook (Polling and Interrupt techniques). Whiteboard, colored markers.	None

		the data exchange request. Remembering: it will be remembered the functioning of the microprocessor systems and the communication mode of the various devices with the CPU through the three buses: Address Bus, Data Bus and Control Bus.	consuming. The management of devices with Interrupt mode allows the CPU to suspend the main program only if actually one or more devices are ready to exchange data with the microprocessor, avoiding the idle laps and therefore increasing the efficiency of the microprocessor system.	**Communicative structures** -Why is peripheral management more efficient by Interrupt? -What happens if at the same time two or more devices require Interrupt? -How does the Interrupt Controller device work? -What are the Interrupt Service Routines?			
2	25 min	Understanding: students must learn the possible ways in which the microprocessor manages the exchange of data with the peripheral devices (keyboard, printer, mouse, parallel and serial ports, modems, hard disk, system timer, and so on), and the advantages of using the interrupt instead of the simple polling. The bus controls will be completed with the IRQ (Interrupt Request) signal that allows the peripherals	Activating of prior knowledge: the teacher draws on the whiteboard with the aid of colored markers a block diagram of the structure of the microprocessor system in order to highlight the blocks already known and studied previously and on this scheme the teacher explains how to manage in polling and in interrupt the peripherals. Students are invited to request clarifications where necessary.	**Skills** L S R W **Key vocabulary** All the previous key vocabulary **Communicative structures** All the previous communicative structures	☑ Whole class ☐ Group work ☐ Pair work ☐ Individual work	Textbook of Automatic Systems from page 66 to page 71 (Data, Address and Control Buses and techniques for the communication between peripherals and CPU), pages 79, 80 (Polling and Interrupt techniques) and a repetition of the registers Program	None

		to report to the CPU, only when necessary, the data exchange request. Remembering: it will be remembered the functioning of the microprocessor systems and the communication mode of the various devices with the CPU through the three buses: Address Bus, Data Bus and Control Bus.				Counter and Stack Pointer on page 85 of the textbook. Internal computer database to know the specific IRQ (Interrupt ReQuest) number of the various peripherals contained in the computer (keyboard, system timer, system speaker, mouse, parallel port, serial ports, modem etc.) through the path: control panel-system properties-device management-specific device properties-resource. Whiteboard, colored markers.		

3	10 min	Understanding: students must learn the possible ways in which the microprocessor manages the exchange of data with the peripheral devices (keyboard, printer, mouse, parallel and serial ports, modems, hard disk, system timer, and so on), and the advantages of using the interrupt instead of the simple polling. The bus controls will be completed with the IRQ (Interrupt Request) signal that allows the peripherals to report to the CPU, only when necessary, the data exchange request. Remembering: it will be remembered the functioning of the microprocessor systems and the communication mode of the various devices with the CPU through	Summary of the learned concepts and assignment of consolidation exercises. Students are invited to request clarifications where necessary. The consolidation exercises are: - Draw the connection to the system Bus of the CPU, the DRAM memory, the Hard Disk, the keyboard, the monitor, the printer, all with a specified address, and explain in detail what happens when you type a character on the keyboard. - Proposition of the verification tests 10,11,12 (page 83 of the textbook).	**Skills** L S R W **Key vocabulary** All the previous key vocabulary **Communicative structures** All the previous communicative structures	☑ Whole class ☐ Group work ☐ Pair work ☐ Individual work	Textbook of Automatic Systems page 79 and page 80 of the textbook (Polling and Interrupt techniques). Whiteboard, colored markers.	None

		the three buses: Address Bus, Data Bus and Control Bus.					

CLIL Lesson Plan

Unit number	1	**Lesson number**	7	**Title**	Connection of Led diodes and relays to the system bus.

Activity	**Timing**	**Learning Outcomes**	**Activity Procedure**	**Language**	**Interaction**	**Materials**	**Assessment**
1	15 min	Understanding: students will study how to expand the functionality of a microprocessor system by connecting a group of signaling LED diodes to the system BUS, or a group of relays to activate motors, light systems, alarms etc. The electronic interfacing devices will consist of latches such as those contained in the 74ls374 integrated circuit. Similarly the system will be designed to interface a group of switches by which with a simple reading operation, data can be introduced into the microprocessor system.	Introduction: the teacher introduces the topic by recalling the importance of the expansion operation of a computer with new peripherals. He will remember the utility of the expansion slot on the motherboard that allow the insertion of additional hard disks, video or audio cards, wifi modules, or, as in the current case, a group of simple switches, to read some data entered through them, or LED diodes to control a display, or relays to activate some loads (fans	**Skills** L S R W **Key vocabulary** -CPU (Central Processing Unit) -Address Bus -Data Bus -Control Bus -Relay -LED diode -Electronic interfacing device -Latch -Buffer three state -Combinatorial network for address decoding -Reading and writing in devices	☒ Whole class ☐ Group work ☐ Pair work ☐ Individual work	Textbook of Automatic Systems from page 66 to page 68 of the textbook (Data, Address and Control Buses and techniques for the communication between peripherals and CPU). Whiteboard, colored markers.	None

The electronic devices for interfacing the switches will be the three state buffers, like those contained in the 74ls244 integrated circuit. Remembering: it will be remembered the communication mode of the various devices in a microprocessor system with the CPU through the three buses: Address Bus, Data Bus and Control Bus and in particular it will be remembered the system of decoding of the address that allows only one device at a time to be involved in the data transfer with the CPU. Creating: students must be able to design the logical network for decoding the address of each electronic interfacing device (buffers 74ls244 and latches 74ls374) involved in the data transfer (operations for reading from the switches and for writing in the LEDs and relays), and defining in detail

some loads (fans, motors, alarms etc.)

Communicative structures
-Who ever opened their computer to add a new video card or a new Hard Disk? -If we can add the board with the relays to the normal peripherals, we will be able to control a complex system of actuators for controlling the temperature and lights of an apartment. -Who would be able to trigger an alarm by reading the status of an input bit and writing on an output bit that controls a relay?

		the sequence of control signals activated by the CPU during these operations.					
2	25 min	Understanding: students will study how to expand the functionality of a microprocessor system by connecting a group of signaling LED diodes to the system BUS, or a group of relays to activate motors, light systems, alarms etc. The electronic interfacing devices will consist of latches such as those contained in the 74ls374 integrated circuit. Similarly the system will be designed to interface a group of switches by which with a simple reading operation, data can be introduced into the microprocessor system. The electronic devices for interfacing the switches will be the three state buffers, like those contained in the 74ls244 integrated circuit. Remembering: it	Activating of prior knowledge: the teacher draws on the whiteboard with the aid of colored markers a detailed scheme of a microprocessor system, tracing wire by wire (assuming for simplicity an address and data bus with a reduced number of bits) the connection of the group of switches, LED diodes and relays to the system buses through the appropriate electronics devices, in the way to highlight the blocks already known and studied previously and in particular the combinatorial decoding network of the address that allows only one device at a time to	**Skills** L S R W **Key vocabulary** All the previous key vocabulary **Communicative structures** All the previous communicative structures	☒ Whole class ☐ Group work ☐ Pair work ☐ Individual work	pages from the Book “Microprocessori Sistemi Teoria e Progetto”,Marco Coppelli, Bruno Stortoni, La Sovrana editrice from page 253 to page 259 and from page 264 to page 266. (Techniques for connecting input and output devices to the system BUS). Whiteboard, colored markers.	None

		will be remembered the communication mode of the various devices in a microprocessor system with the CPU through the three buses: Address Bus, Data Bus and Control Bus and in particular it will be remembered the system of decoding of the address that allows only one device at a time to be involved in the data transfer with the CPU. Creating: students must be able to design the logical network for decoding the address of each electronic interfacing device (buffers 74ls244 and latches 74ls374) involved in the data transfer (operations for reading from the switches and for writing in the LEDs and relays), and defining in detail the sequence of control signals activated by the CPU during these operations.	communicate with the CPU. In this case the devices are the buffers 74ls244 and the latches 74ls374 involved in the reading from the switches and in the writing in the LEDs and relays group. The steps for reading from the switches and writing in the relays will be illustrated in detail by repeating the activation sequence of the BUS signals involved in the read and write operations already studied previously. The students are invited to request clarifications where necessary.				
3	10 min	Understanding: students	Summary of the learned concepts	**Skills**		Page 70 and	None

will study how to expand the functionality of a microprocessor system by connecting a group of signaling LED diodes to the system BUS, or a group of relays to activate motors, light systems, alarms etc. The electronic interfacing devices will consist of latches such as those contained in the 74ls374 integrated circuit. Similarly the system will be designed to interface a group of switches by which with a simple reading operation, data can be introduced into the microprocessor system. The electronic devices for interfacing the switches will be the three state buffers, like those contained in the 74ls244 integrated circuit. Remembering: it will be remembered the communication mode of the various devices in a microprocessor system with the CPU through the three buses:

learned concepts and assignment of consolidation exercises. Students are invited to request clarifications where necessary. The consolidation exercises are: - Draw the connection to the system Bus, designing the appropriate address decoding networks and using the necessary interface devices, of 4 switches and 4 relays that command some loads, and explain the activation sequence of the Bus signals made by the CPU to read the data of the switches and to activate one or more specific relays. - Draw the connection to the system Bus, designing the appropriate address decoding networks and using the necessary interface devices, of 2

L	S	R	W

Key vocabulary
All the previous key vocabulary

Communicative structures
All the previous communicative structures

- ☑ Whole class
- ☐ Group work
- ☐ Pair work
- ☐ Individual work

page 71 of the textbook (Techniques for connecting memory module and input/output devices to the system BUS) and the same pages used in the activity 2 from the book “Microprocessori Sistemi Teoria e Progetto”. Whiteboard, colored markers.

		Address Bus, Data Bus and Control Bus and in particular it will be remembered the system of decoding of the address that allows only one device at a time to be involved in the data transfer with the CPU. Creating: students must be able to design the logical network for decoding the address of each electronic interfacing device (buffers 74ls244 and latches 74ls374) involved in the data transfer (operations for reading from the switches and for writing in the LEDs and relays), and defining in detail the sequence of control signals activated by the CPU during these operations.	devices, of 2 switches and 4 relays R1, R2, R3, R4 respectively controlling the lighting system, the washing machine, the electric oven and the boiler according to the binary number made with the switches 00,01,10,11 and explain the activation sequence of the Bus signals made by the CPU to read the number dialed with the switches and to activate the correct load.				

CLIL Lesson Plan

Unit number	1	**Lesson number**	8	**Title**	Practical experience: design and assembly of a delayed ignition system of a Led diode to simulate th

Activity	**Timing**	**Learning Outcomes**	**Activity Procedure**	**Language**	**Interaction**	**Materials**	**Assessment**
1	30 min	Understanding: students have to understand the meaning of the reset operation that normally takes place in microprocessor and microcontroller systems when the system is turned on, and how this is done by means of a simple delay circuit. In particular the Program Counter register after the reset operation will point to the starting location of the program memory, in which must be found the first instruction that the CPU must read and execute. Remembering: the internal structure of the microprocessors is composed of previously	Introduction: the teacher introduces the topic by recalling the importance of the reset operation of microprocessor systems, which can be carried out with appropriate manual control, if the system stops working, but also automatically at the time of ignition (the classic shutdown-switch on operation).	**Skills** L S R W **Key vocabulary** -Register set -Resistor -Capacitor -Led diode -Charging process -Time constant -Delay time	☒ Whole class ☐ Group work ☐ Pair work ☐ Individual work	“Microprocessori Sistemi Teoria e Progetto”, Marco Coppelli, Bruno Stortoni, La Sovrana editrice from page 163 to page 165 (Importance of the reset signal). Whiteboard, colored markers.	None

		composed of previously studied digital devices and in particular the registers. The structure of the memory registers made with type D flip-flops with their asynchronous preset and clear inputs will be repeated and the diagram and operation of a simple delay circuit based on the well known charge time of a capacitor will be repeated. Creating: students must be able to understand how to choose the parameters R (resistance) and C (capacity) of the delay electric network and to proceed autonomously to the creation of the planned delay, checking with a stopwatch its value.		**Communicative structures** -What happens in microprocessor systems by manually activating the reset operation? - How do you have an automatic reset when the system is turned on? -What is the mathematical law of charge of a capacitor? - How does a D type flip flop work? What are its asynchronous Preset and Clear inputs?			
2	40 min	Understanding: students have to understand the meaning of the reset operation that normally takes place in microprocessor and microcontroller systems when the system is turned on, and how this is done by means of a simple delay circuit. In particular	Activating of prior knowledge: the teacher draws on the whiteboard with the aid of colored markers a simple RC network with the voltage signal across the capacitor placed in input to the	**Skills** L S R W **Key vocabulary** All the previous key vocabulary	☒ Whole class ☐ Group work ☐ Pair work ☐ Individual work	“ELETTRONICA 2 Componenti e tecniche circuitali”, E. Cuniberti, L. De Lucchi, B. De Stefano, Petrini Editore from page 20 to page 22 and pages	None

		the Program Counter register after the reset operation will point to the starting location of the program memory, in which must be found the first instruction that the CPU must read and execute. Remembering: the internal structure of the microprocessors is composed of previously studied digital devices and in particular the registers. The structure of the memory registers made with type D flip-flops with their asynchronous preset and clear inputs will be repeated and the diagram and operation of a simple delay circuit based on the well known charge time of a capacitor will be repeated. Creating: students must be able to understand how to choose the parameters R (resistance) and C (capacity) of the delay electric network and to proceed autonomously to the creation of the planned delay, checking with a stopwatch its value.	circuit that powers the LED diode with delayed ignition. Only when the capacitor's voltage exceeds a certain threshold the circuit will be able to turn ON the LED and the time taken to overcome the threshold depends on the R and C values through a formula that will be well reminded.	**Communicative structures** All the previous communicative structures		26 and 27 (Capacitor charge and discharge process). "ELETTRONICA Componenti e sistemi digitali", E. Cuniberti, L. De Lucchi, Petrini Editore pages 172, 177, 178 excluded in this last page the monostable mutivibrators. (Techniques for interfacing LED diodes to CMOS logical gates and for the generation of the reset signal). Whiteboard, colored markers.	

3	60 min	Understanding: students have to understand the meaning of the reset operation that normally takes place in microprocessor and microcontroller systems when the system is turned on, and how this is done by means of a simple delay circuit. In particular the Program Counter register after the reset operation will point to the starting location of the program memory, in which must be found the first instruction that the CPU must read and execute. Remembering: the internal structure of the microprocessors is composed of previously studied digital devices and in particular the registers. The structure of the memory registers made with type D flip-flops with their asynchronous preset and clear inputs will be repeated and the diagram and operation of a simple delay circuit based on the well known charge time of	In this laboratory experience the students will build with their hands a signaling system with two LED diodes where the first one will turn on immediately when the system is powered, while the other, by means of a suitable delay electronic circuit, will delay its switching on, and this to simulate the operation of the reset command which in the microprocessors during this delay automatically loads a well defined starting value into the internal registers and then, after the delay time is finished, the microprocessor is ready to start its normal	**Skills** L S R W **Key vocabulary** All the previous key vocabulary **Communicative structures** All the previous communicative structures	☐ Whole class ☐ Group work ☐ Pair work ☒ Individual work	Whiteboard, colored markers. Bread board on which to mount the electronic components (resistors, capacitor, LED diodes, switch, power supply, digital multimeter) for the construction of the delayed ignition circuit.	None

		a capacitor will be repeated. Creating: students must be able to understand how to choose the parameters R (resistance) and C (capacity) of the delay electric network and to proceed autonomously to the creation of the planned delay, checking with a stopwatch its value.	operations.				
4	20 min	Understanding: students have to understand the meaning of the reset operation that normally takes place in microprocessor and microcontroller systems when the system is turned on, and how this is done by means of a simple delay circuit. In particular the Program Counter register after the reset operation will point to the starting location of the program memory, in which must be found the first instruction that the CPU must read and execute. Remembering: the internal structure of the microprocessors is composed of previously	Summary of the learned concepts and assignment of consolidation exercises. Students are invited to request clarifications where necessary. The consolidation exercise is: - Design the reset circuit at power on for a microprocessor with a power supply voltage of 5V, built with CMOS technology, and with a minimum command duration of 20ms.	**Skills** L S R W **Key vocabulary** All the previous key vocabulary **Communicative structures** All the previous communicative structures	☑ Whole class ☐ Group work ☐ Pair work ☐ Individual work	Whiteboard, colored markers.	None

		studied digital devices and in particular the registers. The structure of the memory registers made with type D flip-flops with their asynchronous preset and clear inputs will be repeated and the diagram and operation of a simple delay circuit based on the well known charge time of a capacitor will be repeated. Creating: students must be able to understand how to choose the parameters R (resistance) and C (capacity) of the delay electric network and to proceed autonomously to the creation of the planned delay, checking with a stopwatch its value.					

CLIL Lesson Plan

Unit number	1	**Lesson number**	9	**Title**	Review of topics in preparation for the verification test on microprocessor systems.

Activity	**Timing**	**Learning Outcomes**	**Activity Procedure**	**Language**	**Interaction**	**Materials**	**Assessment**
1	20 min	Remembering: in this lesson the topics studied in previous lessons will be reviewed in preparation for the written test. The written test will be in english and the students must be able to understand the text, answer the theoretical questions in english, perform and explain in english the graphic	Introduction: the teacher introduces the topic by drawing on the whiteboard with the aid of colored markers the detailed list of the topics required in the test, and the criteria for their evaluation both from a disciplinary and a linguistic point of view.	**Skills** L S R W **Key vocabulary** -Written test -Review of topics -Resolution of exercises -Request for clarifications	☒ Whole class ☐ Group work ☐ Pair work ☐ Individual work	From page 53 to page 86 of the textbook (Hardware and Software of microprocessors). From page 253 to page 259 and from page 264 to page 266 from the Book “Microprocessori Sistemi Teoria e Progetto”, Marco Coppelli, Bruno Stortoni, La Sovrana editrice (Techniques for connecting input and output devices to the system BUS). Whiteboard,	None

		graphic interconnection diagrams for the realization of the requested microprocessor system.		**Communicative structures** -Let’s start with the resolution of this exercise concerning the connection to the system bus of some devices. -Let’s continue with the definition of the detailed sequence of operations performed by the CPU to read the data of the keyboard, increase it and then send it to the printer.		colored markers. Calculators.	

2	20 min	Remembering: in this lesson will be reviewed the topics studied in previous lessons in preparation for the written test. The written test will be in English and the students must be able to understand the text, answer the theoretical questions in English, perform and explain in English the graphic interconnection diagrams for the realization of the requested microprocessor system.	The teacher will pass to the collegial resolution of exercises similar to those that will be proposed in the test and all the students will contribute to the carrying out of the calculations and wiring diagrams. All the knowledge acquired previously will now be used for the successful preparation for the test.	**Skills** L S R W **Key vocabulary** All the previous key vocabulary **Communicative structures** All the previous communicative structures	☑ Whole class ☐ Group work ☐ Pair work ☐ Individual work	Whiteboard, colored markers. Calculators.	None
3	10 min	Remembering: in this lesson will be	Summary of the learned concepts and assignment of	**Skills**	☑ Whole class	Whiteboard, colored markers.	None

		reviewed the topics studied in previous lessons in preparation for the written test. The written test will be in English and the students must be able to understand the text, answer the theoretical questions in English, perform and explain in English the graphic interconnection diagrams for the realization of the requested microprocessor system.	consolidation exercises. Students are invited to request clarifications where necessary. The consolidation exercises are: - Draw the connection to the system Bus of the CPU, the DRAM memory, the Hard Disk, the keyboard, the monitor, the printer, all with a specified address, and explain in detail how the CPU executes the program fragment that means: transfer the data present in the Hard Disk to the FBBC and FBBD hexadecimal address locations first on the monitor and then to the printer. - Draw the connection to the system Bus, designing the appropriate address decoding networks and using the necessary interface devices, of 4 switches and 4 relays R1, R2, R3, R4 respectively controlling the anti-theft system, the lifting roller shutters, the stereo system and the ventilation system according to the binary number made with the switches 0001, 0010, 0100, 1000 and explain the activation sequence of the	L S R W **Key vocabulary** All the previous key vocabulary **Communicative structures** All the previous communicative structures	☐ Group work ☐ Pair work ☐ Individual work	Calculators.	

			Bus signals made by the CPU to read the number dialed with the switches and to activate the correct load. - Design the reset circuit at power on for a microprocessor with a power supply voltage of 5V, built with CMOS technology, and with a minimum command duration of 500µs.				

CLIL Lesson Plan

Unit number	1	**Lesson number**	10	**Title**	Verification test on microprocessor systems.

Activity	Timing	Learning Outcomes	Activity Procedure	Language	Interaction	Materials	Assessment

1	50 min	The one-hour test aims to verify the degree of both disciplinary and linguistic learning of lessons held so far, with a stronger accent on the disciplinary content.	Students will be given a sheet with the text of the test in English and they will have to design the microprocessor system required and motivate in English their choices. They will also have to list in detail the basic operations carried out by the CPU to carry out the transfer of data and explain in detail the operation of the electronics devices that interface the peripherals to the system Bus. During the test everyone must remain focused on their test and only individual requests (in English) for clarification to the teacher are allowed.	**Skills** L S R W **Key vocabulary** -CPU (Central Processing Unit) -ALU (Arithmetic Logic Unit) -Register set -Address Bus -Data Bus -Control Bus -Program Memory -Instructions -Peripherals -Reading and Writing operations -Fetch and execute phases -Data transfer -Led Diode -On and Off Led Diodes switching **Communicative structures** -Draw the block diagram of…….. -Draw the detailed Bus connections of…. -Explain in detail the operations performed by the CPU to……	☐ Whole class ☐ Group work ☐ Pair work ☑ Individual work	• U1_L10_ALL1.jpg Attached text of the written-graphic test.	Written test.

CLIL Lesson Plan

Unit number	1	**Lesson number**	11	**Title**	Delivery of the evaluated tests and collegial correction.

Activity	**Timing**	**Learning Outcomes**	**Activity Procedure**	**Language**	**Interaction**	**Materials**	**Assessment**

1	20 min	An important moment in the learning path is the evaluation of the test, both from a disciplinary and linguistic point of view, and their correction in class, through which each student sees how the questions proposed in the test were resolved and realizes the errors committed and the reason for his evaluation.	The teacher gives each student his corrected and assessed test and left time for a careful check of the correction marks. Each student can compare his test with that of the others and discuss his evaluation with the classmates.	**Skills** L S R W **Key vocabulary** -Assessment -Score -Error -Imprecision -Request for clarification -Collegial correction **Communicative structures** -Can I know the correct answer? -Why this score? -Can I go out on the blackboard to solve the exercise of the test?	☒ Whole class ☐ Group work ☐ Pair work ☐ Individual work	From page 53 to page 86 of the textbook (Hardware and Software of microprocessors). From page 253 to page 259 and from page 264 to page 266 from the Book “Microprocessori Sistemi Teoria e Progetto”, Marco Coppelli, Bruno Stortoni, La Sovrana editrice (Techniques for connecting input and output devices to the system BUS). From the Book “ELETTRONICA Componenti e sistemi digitali”, E. Cuniberti, L. De Lucchi, Petrini Editore pages 172, 177, 178 excluded in this last page the monostable mutivibrators (Techniques for interfacing LED diodes to CMOS logical gates). Whiteboard, colored markers.	None

2	30 min	An important moment in the learning path is the evaluation of the test, both from a disciplinary and linguistic point of view, and their correction in class, through which each student sees how the questions proposed in the test were resolved and realizes the errors committed and the reason for his evaluation.	The teacher calls some students on the blackboard to proceed to the collegial correction of the test during which the students can formulate in English requests for clarifications on the right answers and on the evaluation obtained, if it does not seem coherent.	**Skills** L S R W **Key vocabulary** All the previous key vocabulary **Communicative structures** All the previous communicative structures	☒ Whole class ☐ Group work ☐ Pair work ☐ Individual work	From page 53 to page 86 of the textbook (Hardware and Software of microprocessors). From page 253 to page 259 and from page 264 to page 266 from the Book “Microprocessori Sistemi Teoria e Progetto”, Marco Coppelli, Bruno Stortoni, La Sovrana editrice (Techniques for connecting input and output devices to the system BUS). From the Book “ELETTRONICA Componenti e sistemi digitali”, E. Cuniberti, L. De Lucchi, Petrini Editore pages 172, 177, 178 excluded in this last page the monostable mutivibrators (Techniques for interfacing LED diodes to CMOS logical gates). Whiteboard, colored markers.	None

CLIL Lesson Plan

Unit number	1	**Lesson number**	12	**Title**	Block diagram of the internal structure of a microcontroller and main differences between microproce

Activity	Timing	Learning Outcomes	Activity Procedure	Language	Interaction	Materials	Assessment
1	20 min	Understanding: students must understand what the microcontrollers are, how they work, what their internal structure is, where they are used, why they are so widespread. Remembering: the internal structure of a microcontroller is in many respects similar to that of the microprocessor that has been studied in previous lessons and which will now be repeated.	Introduction: the teacher introduces the topic by recalling many examples in the daily reality of use of microcontrollers: control of the functioning of the washing machine, with its multiple washing programs, control of the functioning of a car, from the optimal injection of fuel to the ABS brake system, control of air conditioning systems, and so on.	**Skills** L S R W **Key vocabulary** -CPU (Central Processing Unit) -ALU (Arithmetic Logic Unit) -Register set -Von Neumann and Harward architecture -Instruction Bus -Data Bus -Control Bus	☑ Whole class ☐ Group work ☐ Pair work ☐ Individual work	Textbook of Automatic Systems general presentation of microcontroller on page 100 of the textbook. Whiteboard, colored markers.	None

				Communicative structures -Has anyone ever dismantled a television or a washing machine? -Who could identify the microcontroller among these components? - What are the advantages and disadvantages of Von Neumann and Harward architectures? -Has anyone already thought of a system to be implemented in the laboratory using the microcontroller?			

2	20 min	Understanding: students must understand what the microcontrollers are, how they work, what their internal structure is, where they are used, why they are so widespread. Remembering: the internal structure of a microcontroller is in many respects similar to that of the microprocessor that has been studied in previous lessons and which will now be repeated.	Reflection activity: pause for reflection in which students divided by groups think and discuss possible areas of use of the microcontroller and then a representative of each group reports to the class in English.	**Skills** L S R W **Key vocabulary** All the previous key vocabulary **Communicative structures** All the previous communicative structures	☐ Whole class ☒ Group work ☒ Pair work ☐ Individual work	None	None

3	20 min	Understanding: students must understand what the microcontrollers are, how they work, what their internal structure is, where they are used, why they are so widespread. Remembering: the internal structure of a microcontroller is in many respects similar to that of the microprocessor that has been studied in previous lessons and which will now be repeated.	Activating of prior knowledge: the teacher draws on the whiteboard with the aid of colored markers a block diagram of the internal structure of the microcontroller in order to highlight the blocks already known and studied previously.	**Skills** L S R W **Key vocabulary** All the previous key vocabulary **Communicative structures** All the previous communicative structures	☑ Whole class ☐ Group work ☐ Pair work ☐ Individual work	Textbook of Automatic Systems page 84 (internal architecture of a microprocessor) and page 103 (internal architecture of a microcontroller) of the textbook. Whiteboard, colored markers.	None

4	30 min	Understanding: students must understand what the microcontrollers are, how they work, what their internal structure is, where they are used, why they are so widespread. Remembering: the internal structure of a microcontroller is in many respects similar to that of the microprocessor that has been studied in previous lessons and which will now be repeated.	Description of the general operation: microcontrollers, unlike microprocessors that require numerous external components to operate, are devices that contain all the necessary peripherals and memory and therefore, once programmed, they can perform their function autonomously. The general operation and the internal architecture of the microcontroller will be described and the differences with the microprocessor will be highlighted.	**Skills** L S R W **Key vocabulary** All the previous key vocabulary **Communicative structures** All the previous communicative structures	☒ Whole class ☐ Group work ☐ Pair work ☐ Individual work	Textbook of Automatic Systems from page 100 to page 104 of the textbook. Whiteboard, colored markers.	None

5	10 min	Understanding: students must understand what the microcontrollers are, how they work, what their internal structure is, where they are used, why they are so widespread. Remembering: the internal structure of a microcontroller is in many respects similar to that of the microprocessor that has been studied in previous lessons and which will now be repeated.	Summary of the learned concepts and assignment of consolidation exercises. Students are invited to request clarifications where necessary. The consolidation exercises: proposition of the verification tests 1,2,3 (page 108 of the textbook).	**Skills** L S R W **Key vocabulary** All the previous key vocabulary **Communicative structures** All the previous communicative structures	☒ Whole class ☐ Group work ☐ Pair work ☐ Individual work	Textbook of Automatic Systems summary at page 107 of the textbook. Whiteboard, colored markers.	None

CLIL Lesson Plan

Unit number	1	**Lesson number**	13	**Title**	Practical experience: programming, assembly of components and verification of operation of a timed f

Activity	**Timing**	**Learning Outcomes**	**Activity Procedure**	**Language**	**Interaction**	**Materials**	**Assessment**
1	40 min	Understanding: with this practical laboratory experience the students will understand how the microcontroller is programmed to be able to carry out the function assigned to it, how is powered, how the blinking LED diodes are connected to its output pins, how to start the internal program through the reset resistor. Understanding: with this practical laboratory experience the students will	Introduction: the teacher introduces the topic by recalling many examples in the daily reality of the use of LED diodes to signal the occurrence of certain events, such as for example the blinking of a car's fuel tank warning light, or the engine oil warning, or the not well-closed doors warning or the lack of paper in a printer and so on. The teacher then draws on the	**Skills** L S R W **Key vocabulary** All the previous key vocabulary **Communicative structures** All the previous communicative structures	☑ Whole class ☐ Group work ☐ Pair work ☐ Individual work	Block Diagram of the PIC18F1320 microcontroller shown on page 7 of the MICROCHIP PIC18F1220/1320 Data Sheet. Pin Diagram of the PIC18F1320 microcontroller shown on page 2 of the MICROCHIP PIC18F1220/1320 Data Sheet. Properties and parameters of the input and output ports of the PIC18F1320 microcontroller shown from page 87 to page 98 the MICROCHIP PIC18F1220/1320 Data Sheet.	None

		students will understand how the microcontroller is programmed to be able to carry out the function assigned to it, how is powered, how the blinking LED diodes are connected to its output pins, how to start the internal program through the reset resistor. Remembering: the internal structure of the microcontroller, its operation, its external pinout, the method of connecting the LED diode to an output pin will be recalled. The structure of the instructions, seen in the case of microprocessors, and very similar to that of microcontrollers will also be recalled. Creating: students must be able to use the manual of the device for the choice of the reset resistor, for the choice of the	then draws on the whiteboard with the aid of colored markers a block diagram of the internal structure of the microcontroller PIC18F1320 available in the laboratory and its external pinout and writes the general structure of the program instructions that will be used to manage the outputs pin to which the LED diodes will be connected. Students are invited to request clarifications if necessary.			Whiteboard, colored markers.	

		diodes' current, for the choice of the internal clock frequency of the microcontroller. They must be able to write the C++ program to flash the LEDs connected to the microcontroller with the established frequency.					
2	20 min	Understanding: with this practical laboratory experience the students will understand how the microcontroller is programmed to be able to carry out the function assigned to it, how is powered, how the blinking LED diodes are connected to its output pins, how to start the internal program through the reset resistor. Understanding: with this practical laboratory experience the	Reflection activity: break in which the students divided by groups try to write and discuss possible C++ programs able to generate the blinking of the LED diodes connected to the assigned pins with the expected frequency. Students are invited to speak to each other in English. Then a representative of each group reports to the class in English.	**Skills** L S R W **Key vocabulary** Key vocabulary - Programmable Interface Controller (PIC). -Design of microcontroller based systems. -Project of a timed flashing system of LED diodes. - MPLAB X IDE software for develop application for Microchip microcontrollers. - MPLAB XC compilers. - PICkit In-Circuit Debugger-Programmer.	☐ Whole class ☒ Group work ☒ Pair work ☐ Individual work	Block Diagram of the PIC18F1320 microcontroller shown on page 7 of the MICROCHIP PIC18F1220/1320 Data Sheet. Pin Diagram of the PIC18F1320 microcontroller shown on page 2 of the MICROCHIP PIC18F1220/1320 Data Sheet. Properties and parameters of the input and output ports of the PIC18F1320 microcontroller shown from page 87 to page 98 the MICROCHIP PIC18F1220/1320	None

		students will understand how the microcontroller is programmed to be able to carry out the function assigned to it, how is powered, how the blinking LED diodes are connected to its output pins, how to start the internal program through the reset resistor. Remembering: the internal structure of the microcontroller, its operation, its external pinout, the method of connecting the LED diode to an output pin will be recalled. The structure of the instructions, seen in the case of microprocessors, and very similar to that of microcontrollers will also be recalled. Creating: students must be able to use the manual of the device for the choice of the reset resistor,	Supervised by the teacher follows a collegial discussion of the different proposals and the choice of the best.	**Communicative structures** -Pay attention to the pinout of the microcontroller. -Connect the supply voltage correctly. -The LED diodes must have the cathode connected to the ground. -After writing the program, proceed to its compilation and recognition of any error reported. -Use the Pickit3 device to transfer the program to the microcontroller memory. -Use a stopwatch to test the correct blinking frequency of the system you have built.		Data Sheet. Whiteboard, colored markers.		

		for the choice of the diodes' current, for the choice of the internal clock frequency of the microcontroller. They must be able to write the C++ program to flash the LEDs connected to the microcontroller with the established frequency.					
3	70 min	Understanding: with this practical laboratory experience the students will understand how the microcontroller is programmed to be able to carry out the function assigned to it, how is powered, how the blinking LED diodes are connected to its output pins, how to start the internal program through the reset resistor. Understanding: with this practical laboratory	Start and development of the practical experience: the students go to their work stations where they will find the electronic components necessary for the realization of the flashing system: the resistors, the LED diodes, the microcontroller, the mounting plate, the connecting wires, the power supply, the tester, the computer to write the program, the	**Skills** L S R W **Key vocabulary** All the previous key vocabulary **Communicative structures** All the previous communicative structures	☐ Whole class ☐ Group work ☐ Pair work ☒ Individual work	Resistors, LED diodes, connecting wires, the microcontroller PIC18F1320, the mounting plate, the power supply, the tester, the computer to write the program with the MPLAB XIDE development tool installed, the device PIC KIT3 to transfer the program inside the microcontroller memory, the bread board on which to mount the electronic components to display the flashing of the LEDs diode. Whiteboard, colored	None

		experience the students will understand how the microcontroller is programmed to be able to carry out the function assigned to it, how is powered, how the blinking LED diodes are connected to its output pins, how to start the internal program through the reset resistor. Remembering: the internal structure of the microcontroller, its operation, its external pinout, the method of connecting the LED diode to an output pin will be recalled. The structure of the instructions, seen in the case of microprocessors, and very similar to that of microcontrollers will also be recalled. Creating: students must be able to use the manual of the device for the choice	the program, the kit to transfer the program inside the microcontroller memory. During the work the students are invited to ask the teacher for help if necessary, trying to speak in English. In this phase the students can talk to each other but the experience must be individual: each one must be able to write the program, to assemble the system, to transfer the program to the microcontroller, to check its operation, to correct any errors. Students are warned that during the test in which the practical skills will be evaluated, and which will be			markers.	

		of the reset resistor, for the choice of the diodes' current, for the choice of the internal clock frequency of the microcontroller. They must be able to write the C++ program to flash the LEDs connected to the microcontroller with the established frequency.	similar to this one, everyone will have to work independently, without the help of his teammates.				
4	20 min	Understanding: with this practical laboratory experience the students will understand how the microcontroller is programmed to be able to carry out the function assigned to it, how is powered, how the blinking LED diodes are connected to its output pins, how to start the internal program through the reset resistor. Understanding: with this practical laboratory	Analysis of the results: at the end of the lesson a collegial analysis of the progress of the practical experience will be made, which will count how many students have been able to complete the work, if there have been malfunctions of the laboratory equipment, if the time available was adequate. Each student is invited to provide his	**Skills** L S R W **Key vocabulary** All the previous key vocabulary **Communicative structures** All the previous communicative structures	☒ Whole class ☐ Group work ☐ Pair work ☐ Individual work	• U1_L13_ALL1.jpg Attached text containing the possible structure of a future laboratory test.	None

		experience the students will understand how the microcontroller is programmed to be able to carry out the function assigned to it, how is powered, how the blinking LED diodes are connected to its output pins, how to start the internal program through the reset resistor. Remembering: the internal structure of the microcontroller, its operation, its external pinout, the method of connecting the LED diode to an output pin will be recalled. The structure of the instructions, seen in the case of microprocessors, and very similar to that of microcontrollers will also be recalled. Creating: students must be able to use the manual of the device for the choice	opinion (in English). At the end of the lesson, the text of a possible laboratory test is provided to the class so that students can prepare for the future practical test in good time.					

		of the reset resistor, for the choice of the diodes’ current, for the choice of the internal clock frequency of the microcontroller. They must be able to write the C++ program to flash the LEDs connected to the microcontroller with the established frequency.					

CLIL Lesson Plan

Unit number	1	**Lesson number**	14	**Title**	The various types of internal memory of microcontrollers.

Activity	**Timing**	**Learning Outcomes**	**Activity Procedure**	**Language**	**Interaction**	**Materials**	**Assessment**
1	10 min	Understanding: students must know the various types of memory inside the microcontroller, their capacity and their specific use. Remembering: the internal memory of microcontrollers, in its various types, is the same used by microprocessors. The difference is that most of the memory used by the latter is not internal but external. Regarding its operation	Introduction: the teacher introduce the topic by recalling the operation of the various types of memory used in microprocessors: flash memory, EEPROM memory, SRAM memory, DRAM memory, Hard Disk memory.	**Skills** L S R W **Key vocabulary** Key vocabulary - Random Access Memory -Read Only Memory -Programmable Read Only Memory - Erasable Programmable Read Only Memory - Electrically Erasable Programmable Read Only Memory -Flash Memory -Non Volatile Random Access Memory	☑ Whole class ☐ Group work ☐ Pair work ☐ Individual work	Whiteboard, colored markers. From page 104 to page 106 of the textbook (microcontroller memory structure). From page 41 to page 52 of the MICROCHIP PIC18F1220/1320 Data Sheet (specific to PIC18F1320 microcontroller memory structure). Block Diagram of the PIC18F1320 microcontroller shown on page 7 of the	None

		operation, however, we will repeat what we saw in the lessons on microprocessors.		**Communicative structures** -Has anyone ever increased the memory capacity of a computer? -What is the advantage of having a high capacity of ram memory? -Which type of memory is the USB stick? -How were the EPROM memories deleted?		MICROCHIP PIC18F1220/1320 Data Sheet.	

2	10 min	Understanding: students must know the various types of memory inside the microcontroller, their capacity and their specific use. Remembering: the internal memory of microcontrollers, in its various types, is the same used by microprocessors. The difference is that most of the memory used by the latter is not internal but external. Regarding its operation, however, we will repeat what we saw in the lessons on microprocessors.	Activating of prior knowledge: the teacher draws on the whiteboard with the aid of colored markers a block diagram of the internal structure of the microcontroller in order to highlight the location of the various memory blocks and their interconnection to the internal BUS.	**Skills** L S R W **Key vocabulary** All the previous key vocabulary **Communicative structures** All the previous communicative structures	☑ Whole class ☐ Group work ☐ Pair work ☐ Individual work	Whiteboard, colored markers.	None
3	20 min	Understanding: students must know the various types of memory inside the	Description of the general operation: microcontrollers, unlike microprocessors, contain	**Skills** L S R W	☑ Whole class ☐ Group work	Whiteboard, colored markers.	None

		microcontroller, their capacity and their specific use. Remembering: the internal memory of microcontrollers, in its various types, is the same used by microprocessors. The difference is that most of the memory used by the latter is not internal but external. Regarding its operation, however, we will repeat what we saw in the lessons on microprocessors.	within them the memory necessary for their operation, divided into a part of FLASH memory, which contains the program instructions and not frequently variable data, a part of EEPROM memory, which contains data that can vary frequently and the SRAM memory, part used for the creation of the FILE SYSTEM and part for the creation of the STACK memory. The steps to save the return addresses from the interrupt routines to the stack memory will be described in detail. The memory capacity of the microcontrollers is necessarily limited and of variable capacity depending on the microcontroller computational power. The steps for writing and reading data in the various types of memory will also be described.	**Key vocabulary** All the previous key vocabulary **Communicative structures** All the previous communicative structures	☐ Pair work ☐ Individual work		

4	10 min	Understanding: students must know the various types of memory inside the microcontroller, their capacity and their specific use. Remembering: the internal memory of microcontrollers, in its various types, is the same used by microprocessors. The difference is that most of the memory used by the latter is not internal but external. Regarding its operation, however, we will repeat what we saw in the lessons on microprocessors.	Summary of the learned concepts and assignment of consolidation exercises. Students are invited to request clarifications where necessary. Consolidation exercises: proposition of the verification tests 4, 5 and 6 (page 108 of the textbook).	**Skills** L S R W **Key vocabulary** All the previous key vocabulary **Communicative structures** All the previous communicative structures	☒ Whole class ☐ Group work ☐ Pair work ☐ Individual work	Textbook of Automatic Systems summary on page 107 and page 108 of the textbook. Whiteboard, colored markers.	None