UNIVERSITÀ DEGLI STUDI DI PALERMO

DEPARTMENT	Ingegneria		
ACADEMIC YEAR	2021/2022		
BACHELOR'S DEGREE (BSC)	CYBERNETIC ENGINEERING		
INTEGRATED COURSE	ELECTRONICS - INTEGRATED COURSE		
CODE	21109		
MODULES	Yes		
NUMBER OF MODULES	2		
SCIENTIFIC SECTOR(S)	ING-INF/01		
HEAD PROFESSOR(S)	GIACONIA GIUSEPPE COSTANTINO	Professore Associato	Univ. di PALERMO
OTHER PROFESSOR(S)	GIACONIA GIUSEPPE COSTANTINO	Professore Associato	Univ. di PALERMO
	CRUPI ISODIANA	Professore Associato	Univ. di PALERMO
CREDITS	15		
PROPAEDEUTICAL SUBJECTS			
MUTUALIZATION			
YEAR	3		
TERM (SEMESTER)	Annual		
ATTENDANCE	Not mandatory		
EVALUATION	Out of 30		
TEACHER OFFICE HOURS	**CRUPI ISODIANA** Tuesday 17:00 19:00 Viale delle Scienze, Building 9, 2nd floor, room U218 **GIACONIA GIUSEPPE COSTANTINO** Tuesday 12:00 13:30 Dipartimento di Ingegneria Edif. 9 stanza U011 - Enginering Dept. Builg. 9 room U011 Wednesday 12:00 13:30 Dipartimento di Ingegneria Edif. 9 stanza U011 - Enginering Dept. Builg. 9 room U011		

DOCENTE: Prof. GIUSEPPE COSTANTINO GIACONIA

PREREQUISITES	To address the topics covered during the course, the student should have knowledge of the analysis techniques for circuits acquired in the Electrotechnics course, good knowledge of Mathematics, Physics I and II.
LEARNING OUTCOMES	- Knowledge and comprehension capacity At the end of the course, the student will have acquired knowledge and comprehension capacity on: the fundamental characteristics and the working principle of the most widely used semiconductor devices; the operating principle of electronic circuits most widely employed in typical applications of automatic systems and communications; the employment of electronic systems in telecommunications and the field of automation; the physical principles and the mathematical physics useful to understand the electronic phenomena; a systematic vision of an electronic circuit; the multidisciplinary scientific context covering the Engineering Cybernetics fields. Moreover the course tends to focus the study of the instruction based programmable electronic systems (microprocessor and microcontrollers) The study will deepen the knowledge on electronic devices needed to understand functionalities of a processor based system (memory, I/O interfaces and communication techniques between them and the CPU) - Ability to apply the acquired knowledge At the end of the course, the student will be able to: identify, formulate and analyze the fundamental set of problems related to the use of electronic circuits, by means of up-to-date methods, techniques and tools; understand electronic phenomena, circuits and systems; be acquainted with the physical parameters and the terminology related to the electronics field; understand how to use electronic circuits with particular focus to the application of technologies to industrial automation problems. Furthermore student will mature knowledges on programming techniques of embedded systems through direct experience in the laboratory. The student will also acquire capabilities to analyze circuit aspects of a microprocessor system. - Ability to evaluate scenarios The student will have gained the autonomy required to correctly employ the basic electronic circuits. Moreover student will mature capability to autonomously analyze a medium complexity digital system, fully understanding its functionalities by starting from the board layout and the firmware description loaded into the memory of the designed system. - Communication skills The student will be able to: communicate and express problems related to electronics; be acquainted with the physical parameters and the terminology of the electronics fields; talk about the up-to-date subject matters applicable to electronic circuits; to competently talk about electronic cases also with the general public. Moreover student will be able to sustain a technical discussion, at intermediate level, on programmable electronic systems used in modern electronics, thank to his basic knowledge on circuit layout and firmware related matter - Learning ability The student will be able to: deal with the study of electronic circuits; recognize the need for an independent learning during all the lifetime; independently carry out bibliographical researches on electronic systems; independently read and understand a specialized text; attend seminars and workshops in the electronic fields and understand the oral speeches and the proceedings. Finally all the knowledge gained during the course are primarily aimed at providing students with the essential tools to autonomously work and understand complex issues, normally carried out within a second level course (laurea Magistrale) or that may be met in daily work.
ASSESSMENT METHODS	The assessment of learning will be assessed through an exam whose topics are inherent in the two modules. It therefore consists of two tests relating to the electronics part and to the part of embedded systems. For the test of Electronics Fundamentals there will be: Written exam, or midterm examinations, mandatory / oral exam optional The learning evaluation will be carried out by means of two midterm examinations, valid only for the three appeals immediately after the conclusion of the course (June-July session), or a written exam. The first midterm test, during the interruption of the didactic activity, will deal with exercises related to

	the part of the program carried out up to that moment and will allow the student to self-evaluate in the middle course; the second one, immediately after the conclusion of the course, will focus on the topics covered in the remaining part of the course. The student that will not attend the midterm examinations or will not reach a sufficient score (minimum 18 out of 30), will have to take a written examination that will also deal with topics covered during the course. Also in this case, the minimum score needed to pass the written test will be 18 out of 30. During the written exam students are allowed to consult books and notes and to use an electronic calculator for numerical work; mobile phones, tablets or any other device that is web-enabled must be turned off. The written exam will last 3 hours. The aim of the final examination will be to evaluate whether the student has a good knowledge and comprehension of basic electronic devices, circuits and systems and of their potential applications in the field of Cybernetics. Each exam session provides, only for the students who have successfully passed the written exam, the option of taking an oral exam if they want to improve their mark. The final oral examination consists of a series of questions, which are meant to assess whether the student has acquired the skills and subject knowledge expected from the course. For each question, the student will first have to contextualize the subject within the course, describe its meaning and importance, for example by means of formal definitions and scope of applications, and define the study methods and eventually the validity limits. Finally, the student will have to discuss the topic by a correct use of language and a fluent analytical treatment. At the end of the oral examination, students will receive a second evaluation with a score between -3 and +3. This score will be added to the one achieved in the written test and the sum will give the final evaluation. As for the Embedded Systems there will be: Lab assessment and oral examination, grading from 18 to 30 (out of 30). The student must primarily pass a laboratory assessment, usually at PC Lab of Polytechnic School, where in a predefined time interval (usually from 100 up to 150 minutes) he must use methods learned during the course and correctly solve a proposed design. This assessment must reach a minimum of 18 (out of 30) in order to get access to the oral examination, otherwise the student must repeat the lab assessment at later date. During the oral examination the student is asked to answer at least 3 questions chosen among the topics of the course syllabus. The exam is designed to test the acquired knowledge, the planning and solving ability, the presentation skills and the use of appropriate technical language of the student. The grades, expressed on a 30-point scale, are divided into: EXCELLENT (30 - 30 cum laude): the student demonstrates an excellent knowledge of the topics and mastery of the course contents, excellent mastery of language and high analytical capability; the student is able to apply his knowledge to solve the proposed problems. Laude is given to students who have taken the oral exam and have demonstrated a particular brilliance in the exposition and in the written test. VERY GOOD (28 – 29): the student demonstrates a very good knowledge of the subjects, a full mastery of language, analytical-synthetic ability and is able to apply knowledge to solve the proposed problems. GOOD (26-27): the student demonstrates good knowledge of the main topics and good analytical skills. The student is able to apply the knowledge to solve the proposed problems, but with some uncertainty. Communication skills may not be optimal. QUITE GOOD (24-25): the student demonstrates a fair knowledge of the main topics, a discrete command of language and a limited ability to independently apply the knowledge to the solution of the proposed problems SATISFACTORY (21 – 23): the student does not have full capabilities but has the knowledge, a satisfactory command of language and a poor ability to independently apply the knowledge SUFFICIENT (18 – 20): the student has minimal knowledge of topics and minimal technical language, very little or no ability to independently apply the knowledge INSUFFICIENT: the student does not have an acceptable knowledge of the topics and/or did not deliberately studied some topics of the subject.
TEACHING METHODS	Frontal or online lectures and tutorials.

MODULE
EMBEDDED SYSTEMS ELECTRONICS

Prof. GIUSEPPE COSTANTINO GIACONIA

SUGGESTED BIBLIOGRAPHY

Main references:
•Notes, handouts and other useful articles or web link given by the instructor through the student portal
•G.Baccolini C.Offelli: Microelaboratori, note di hardware. - Citta' Studi Edizioni. ISBN: 8870055582
(freely available at http://www.microatena.it/scheda_libro.php?id=6)
•M.M.Mano, C.R. Kime: Logic and computer design fundamentals. - Prentice Hall ed. - ISBN: 9788871924618

Other suggested references:
- A. Barkalov, L. Titarenko, M.Mazurkiewicz: Foundation of Embedded Systems - Springer ebook - ISBN 978-3-030-11961-4
(https://link.springer.com/book/10.1007%2F978-3-030-11961-4)
- D. S. Dawoud and R. Peplow: Digital System Design - Use of Microcontroller, River Publishers Series
(freely available at https://www.riverpublishers.com/book_details.php?book_id=54)

AMBIT	50287-Ingegneria elettronica
INDIVIDUAL STUDY (Hrs)	96
COURSE ACTIVITY (Hrs)	54

EDUCATIONAL OBJECTIVES OF THE MODULE

This part will focus on the analysis of the main programmable electronics systems: low end microprocessor and microcontroller for embedded applications. Student are introduced to methods and programming languages of microcontroller systems.

SYLLABUS

Hrs	Frontal teaching
4	Introduction to complex digital systems. Comparison between fixed digital logic design and programmable logic.
8	A classic microprocessor system. Bus structure description and functional bus partitioning. Analysis of dynamic signals in a bus. General Architecture of a CPU: pinout and control signals description. Timing of most important machine cycles. Internal registers characteristics and instructions set knowledge. Stack management, code generation and address modes
8	Introduction to memories: non volatile memories (ROM, PROM, EPROM, EEPROM, FLASH). Principles of operation, characteristics and features. Dynamic memories: working principle, reading writing cycles and refresh. Memory decoding granularity. Main memories decoding techniques.
8	I/O devices: definition of isolated I/O and mapped I/O. Introduction to handshake communication techniques. Peripheral management techniques: polling and interrupt schemes. parallel and serial communication of a microprocessor system.
10	general characteristics of a microcontroller and its comparison with a microprocessor. 8 bit microcontrollers for embedded application. Block diagram, memory organization and programming model. Instruction set and comparison between CISC and RISC architectures.

Hrs	Practice
16	Lab exercises on small programmable electronics system, through suitable demo board. Realization of simple coding with low level and high level languages in order to implement simple FSM and/or data filtering techniques.

MODULE
PRINCIPLES OF ELECTRONICS

Prof.ssa ISODIANA CRUPI

SUGGESTED BIBLIOGRAPHY

Materiale didattico di riferimento sugli argomenti svolti durante le lezioni e sulle applicazioni sviluppate nelle esercitazioni verra' reso disponibile dal docente sul sito del corso. I testi ausiliari sono:
“Microelectronics Circuits”, Adel S. Sedra and Kenneth C. Smith, Oxford University Press. (Italian edition by EdiSES – Napoli);
“Microelectronic Circuits Design”, Richard C. Jaeger, Travis N. Blalock, McGraw- Hill.

AMBIT	50287-Ingegneria elettronica
INDIVIDUAL STUDY (Hrs)	144
COURSE ACTIVITY (Hrs)	81

EDUCATIONAL OBJECTIVES OF THE MODULE

Analysis of a complex electronic system and its subdivision into several functional modules. The function, the realization and the interface characteristics of the various submodules are described. The course also includes the fundamental notions related to electronic equipment and measurements.

SYLLABUS

Hrs	Frontal teaching
2	Introduction to the course. History of microelectronics. Prerequisites for the study of electronics.
3	Semiconductor basics; doping and current mechanisms; pn junction
5	Semiconductor diode: characteristic of the semiconductor diode; models of the diode; rectifier circuits; diode logic circuits; Zener diodes, voltage regulator applications.
5	The field effect transistor MOSFET: general considerations; physical structure and principle of operation; i-v characteristics; large-signal model; small-signal model.
5	The bipolar junction transistor BJT: general considerations; physical structure and principle of operation; i-v characteristics; large-signal model; small-signal model.
10	Analog Circuits: general information on amplifiers; principle of operation of discrete amplifiers; operating limits of the discrete amplifiers; method of analysis of the amplifiers; static analysis: bias networks; analysis of dynamic amplification; configurations of amplifiers; multistage amplifiers; design criteria.
6	Operational Amplifiers: general information on amplifiers; ideal operational amplifier; inverting and non-inverting configurations; open- loop operation; closed-loop operation; linear circuits with operational amplifiers; negative feedback; active filters; characteristics of real operational amplifiers.
6	Logic families: MOSFET as a switch; general characteristics of the integrated logic families; CMOS family; CMOS inverter; special configurations.
3	Combinatorial and sequential circuits Encoders; decoders; multiplexer; demultiplexer; asynchronous and synchronous networks; latch; flip-flop
3	Semiconductor-based memories ROM; PROM; EPROM; EEPROM; FLASH; SRAM; DRAM.

Hrs	Practice
33	Exercises on the analysis and design of the circuits presented in the course.