UNIVERSITÀ DEGLI STUDI DI PALERMO

Department: Engineering

A.Y. 2021/2022

DEGREE COURSE IN ELECTRONICS ENGINEERING

- BIOELECTRONICS -

Characteristics

Class of Master's Degree (MSc) on Electronic engineering (LM-29)	2 YEARS	PALERMO	FREE ACCESS	2234

Educational objectives

The 2nd cycle degree course in Electronics Engineering is characterized by a broad spectrum setting, providing full training in the various sectors of specific interest in electronics, supplemented by further studies in the fields of electric and electronic measurements, telecommunications and automation.

The educational programme is characterized by a number of mandatory common teachings providing students knowledge in the three complementary fields of Electronics, Electric and Electronic Measurements and Telecommunications, covering the variety of use of Electronics, in purely Electronic fields as well as for the integration of the world of the Internet and information transport and processing technologies with modern electronic systems and technologies. Particular emphasis is placed on applied electronics, optoelectronics and telecommunications and automation measurements, and finally on the study of circuits and systems exploiting the propagation of electro-magnetic waves in frequency fields ranging from radiofrequency to microwaves.

After this common path, the course is divided into different curricula, enabling students to deepen, respectively, the aspects of Modern Electronics, Telecommunication, Bioelectronics or Robotics and Mechatronics, choosing the profile which best fits their attitudes as well as the professional and market contexts.

The "Modern Electronics" curriculum provides a high level of knowledge in the field of micro/nano electronic systems, heterostructure devices, microwave equipment and measurements, as well as of issues related to the implementation of electronic systems based on processors and high speed electronic interfaces.

The "Telecommunications" curriculum aims at training experts in telecommunications systems and digital infrastructures, with respect in particular to the emerging scenarios of Internet-of-things systems and broadband access in mobility. The course will provide solid groundings in modelling and interfacing techniques to the electromagnetic transmission medium, on the main modulation and coding techniques for the protection of information from disturbances and interference, on the techniques of access to the medium used in radio communication systems, on the modern architectures of transmission networks, with particular attention to the aspects of safety and confidentiality of information, and on the design and management of services on the Internet-of-things.

The "Bioelectronics" curriculum aims at educating professionals with solid basic groundings in the electronics sector, with highly specialized skills in the following fields: diagnostic, electronics and Internet of Things (IoT) sensors and equipment for biomedical applications (acquisition, storage, processing and transfer of biomedical data and signals) and for the analysis, modelling and post-processing of medical-biological signals, images and data.

Finally, the "Electronics for Robotics and Mechatronics" curriculum aims at training professionals, capable of performing the analysis of systems of various physical nature, the planning of objectives to be achieved, and the mathematical formulation of a control problem taking into account the aforementioned objectives, the solution of this problem also using the available software tools and, finally, its practical implementation.

Professional opportunities

Profile:
Electronic Engineer, specialised in Modern Electronics
Functions:
The 2nd cycle Degree in Electronics Engineering enables trains professionals capable of covering a wide variety of roles in different work contexts, thanks to the theoretical education received during the course, also supported by more general and interdisciplinary knowledge and laboratory experience.
Graduates will be able to apply the specific skills acquired not only in the electronic field, but also with respect to the methodological-operational aspects of basic sciences and engineering, in various sectors ranging from micro/nano electronics to electronic radiofrequency design, up to electronics for industry, energy and the car, and to ICT in general.
More specifically, the training enables graduates in Electronics Engineering to work not only in technical-organizational environments, but also in planning and research contexts. In detail, graduates know the methods and techniques to design electronic devices, components, systems, lasers, communication systems, submicrometric integrated circuits and of the related manufacturing processes and applications. Therefore, they may find employment in the fields of design, development, engineering, production, operation and maintenance of electronic systems, but also in the ICT sector, as well as in sectors actively using electronics, such as industry, automotive, energy, bioelectronics.

Thanks to the aforementioned competences, 2nd cycle graduates in Electronics Engineering will also be able to take on positions of responsibility in high technology scientific and industrial fields, and will also be able to continue their studies in high specialization and research contexts (master, PhD).
Finally, the 2nd cycle Degree in Electronics Engineering allows access - after passing the national qualification exam - to Section A of the Register of Engineers - Information Sector.
Skills:
The skills of a 2nd graduate in Electronic Engineering (Modern Electronics curriculum) range from the semiconductors and materials physics used in microelectronics, to manufacturing technologies of devices and integrated circuits, to their design techniques, up to and including characterization methods by means of electronic measuring and testing equipment.
In detail, the educational profile of the Degree in Electronic Engineering provides high-tech skills in all typical electronic fields, and in particular in:
- the design and production of micro and nanoelectronic devices, sensors and actuators;
- the design and production of analog, digital or mixed (A/D) circuits, also for radiofrequency applications;
- the design of integrated circuits and systems (system on chip): this activity includes the design of the board and its layout, the organization of production, and the final inspection;
- the design and production of electronic components, subsystems and systems;
- the design, operation and maintenance of electronic systems for applications in different fields, such as automotive, energy, the environment, bioengineering and in the medical field (image diagnostics, genetic diagnostics and molecular medicine)
- the evaluation and installation of electronic equipment and components for communications networks;
- the electronic control of equipment, machines, industrial production chains;
- The operation of measurement systems, laboratories and production lines.

Professional opportunities:
The employment areas typical of graduates in Electronics Engineering (Modern Electronics curriculum) are numerous, for example:
- in the industry, for the design or development of semiconductors, integrated circuits, components, electronic devices and systems, electronic instrumentation for consumer applications (such as audio, video, telephony, IT) or for biomedical, automation and robotics industries, telecommunications, transport, aeronautics, energy;
- companies producing, marketing and distributing electronic, IT and biomedical products and devices;
- manufacturing and service companies using electronic technologies and infrastructures for automation and control;
- productive and operational facilities that employ electronic technologies and infrastructures for signals processing in the civil, industrial and information fields;
- public administrations;
- electronic design consulting companies;
- national and international scientific and technological research agencies;
- research and development laboratories;
- regulatory and control bodies;
- freelance activities for the design and implementation of electronic systems.

Finally, it should be noted that graduates, thanks to their advanced competences, may access higher responsibility positions than first-cycle graduates, and therefore access more quickly high technical-managerial positions.

Profile:
Electronics Engineer – specialisation in Telecommunications
Functions:
The educational profile of the 2nd cycle Degree in Electronics Engineering - curriculum Telecommunications enables graduates to operate, even autonomously, in the sectors of design, engineering, production, operation and maintenance of telecommunications systems, as well as in adjacent sectors of information engineering. Graduates also deepen the study of telecommunication systems and information coding. The training is completed and supplemented by laboratory experiences and elements of interdisciplinary culture ranging from Telecommunications and Automotive to Energy and Optoelectronics

sectors.
The typical professional fields for graduates are public and private companies, not only those in Information and Communications Technology, but also in manufacturing, services and technical-commercial sectors.

Skills:
The organization of the training path and the individual teaching modules have been designed to provide graduates with adequate and up-to-date training in the various areas of telecommunications: broadband communication systems, advanced modulation techniques, signal processing, networking and inter-networking technologies, systems management.

Finally, the training provides the tools and skills to carry out professional activities of technical "support" and operation of network structures in all those sectors whose productivity is now strongly connected to the capacity and efficiency of telecommunications networks (e.g.: airports, air traffic control bodies, banking groups or insurance companies, distribution companies, public administration).

The skills provided by the course include:
- planning of ICT infrastructure, systems and services;
- management of ICT infrastructures, systems and services;
- design of technologies and platforms for data acquisition, transport, distribution and analysis;
- analysis and sizing of telecommunications equipment, systems or networks;
- ability to experiment and develop new telecommunications technologies;
- ability to study and update telecommunications equipment, systems or networks;
- ability to create, modify or verify software and other applications related to the management and operation of telecommunications networks;
- ability to prepare reports or technical documents.

After qualifying for the profession of engineer, graduates can also deal with the issues related to the legislation, safety and testing of works in the ICT field.

Professional opportunities:
The main employment opportunities of graduates in Electronics Engineering with a specialization in Telecommunications include:

- Companies for the Design, production and operation of equipment, systems and infrastructures for the acquisition, processing and transport of information (data, voice and images) on fixed and mobile networks, remote observation and surveillance, performance monitoring of telecommunications networks and, in particular, of service quality;
- Healthcare companies, for the management of biomedical instrumentation and the design, implementation and management of innovative healthcare services;
- Manufacturing companies in the fields of online telematics and multimedia networks, such as e-commerce and electronic publishing, Internet services, telemedicine and remote surveillance;
- Public and private companies providing terrestrial or space telecommunications services;
- Public and private companies providing aggregation and distribution services for mono and multimedia content for both information and entertainment purposes, including customized ones;
- Companies providing telematic services;
- Regulatory bodies and public control bodies (e.g. market regulation or air, land and ship traffic control);
- Public bodies interested in environmental monitoring and protection;
- Public and private companies of different sectors, needing professionals for the development and use of telecommunications systems and services in the areas of internal organization, production and marketing, as freelancers in the fields of analysis, design and operation of telecommunications, health and telecommunications security systems;
- Specially established companies destined to build wireless networks to bridge the 'Digital Divide'

The typical employment opportunities for 2nd cycle graduates in Electronics Engineering with a specialization in Telecommunications may be found at companies designing and/or producing systems and equipment for telecommunications and at network companies operating complex telecommunications systems, at public and private companies and institutions, providing telecommunications, remote sensing and traffic control services. This is consistent with the objective of providing graduates with the widest employment perspectives on the national territory and in the EU.

Profile:
Electronic Engineer, specialised in Robotics and Mechatronics
Functions:
Graduates in Electronic Engineering, “Electronics for Robotics and Mechatronics” curriculum, have a cultural and professional profile focused on scientific and technological knowledge of Mechatronic engineering and is capable of identifying, formulating and solving, even in an innovative way, complex problems or those requiring an interdisciplinary approach. With the skills acquired, it acts as a catalyst in the management and logistics of large production systems and is able to conceive, plan, design and manage complex and/or innovative systems, processes and services, exploiting their knowledge of context and soft skills.
They possess in-depth knowledge of the analysis and design methods typical of Automation Engineering, enabling them to

introduce into a complex system the “intelligence” needed to manage its operation without human intervention (automatic control), optimizing in some sense its operation and dominating the interaction among the various components of the system as well as the one between the system and the surrounding environment.
Graduates in Electronics Engineering, "Electronics for Robotics and Mechatronics" curriculum, are also able to deal with complex problems in intrinsically multidisciplinary contexts being therefore capable of interfacing with the specialists of the process and systems to be automated, to suggest more effective operational and design solutions in technical and economic terms.
They are therefore endowed with specific skills enabling them to fit promptly into very different working environments, operating as systems engineers and/or designers and/or technicians in any application context where the technologies and principles of automation play an important role.

The functions performed by graduates in Electronics Engineering, "Electronics for Robotics and Mechatronics" curriculum in a work context can be summarized as follows:
1) process and system analyst;
2) designer of control systems;
3) technician for planning, programming, monitoring, management, maintenance and automation of complex processes and systems.
Skills:
The skills provided by the Degree in Electronic Engineering ,"Electronics for Robotics and Mechatronics", curriculum include:
- the identification of descriptive models of real processes and systems;
- the study of the properties of models aimed at studying the behaviour of real processes and systems (operating limits and potential);
- the identification of control methodologies starting from the models;
- the definition of project specifications for the control of processes and systems;
- the planning and evaluation of control laws and strategies, based on the model of the real process or system, in accordance with the project specifications;
- simulation of processes and systems, for their analysis and validation of the relative laws and control strategies;
- implementation on digital systems of rapid prototyping and ability to conduct experiments on such systems;
- theoretical and experimental development of innovative control methodologies and strategies;
- design, management and implementation of automatic data acquisition and processing, measurement and control systems in real time, typical of digital control systems;
- monitoring, management, maintenance and automation of complex processes and systems.
opportunities:
The main employment opportunities of graduates in Mechatronics include:
- electronic, mechanical, automotive, electromechanical, aerospace, chemical and industrial, mobile and underwater robotics companies;
- companies producing services (purification, transport, energy, civil and industrial automation);
- research and development centres and laboratories for the automation sector;
- public administration;
- freelancer.

Profile:
Electronic Engineer: specialization in Bioelectronics
Functions:
This curriculum enables graduates to operate, even independently, in the fields of design, engineering, production, use, testing and maintenance of sensors, instrumentation and biomedical software for diagnostic or therapeutic support, for monitoring healthy or ill subjects (even directly in their home, assisted living environments), but also for telemedicine. They also deepen the analysis and modelling of biomedical data and signals, as well as image processing and archiving systems. Their preparation is completed and integrated by laboratory experiences.
Skills:
end cycle graduates in Electronics Engineering, “Bioelectronics” curriculum, have a solid basic training in the disciplines concerning electronics and ICT, with highly specialized skills in the field of sensors and diagnostic instrumentation, electronics and Internet of Things (IoT) for biomedical applications (for the acquisition, storage, treatment and transfer of biomedical data and signals), and for the analysis, modelling, processing and storage of signals, images and medical-biological data.

The knowledge and skills provided in the course include:
- solid (common) basic training in the electronic sector;
- ability to analyse and process medical-biological signals, images and data;
- ability to apply electronic circuit design techniques, methodological tools and quantitative methods for the study of physiological systems;
- ability to extract, through adequate algorithms, physiological indexes starting from biosignals acquired on various districts (e.g. cardiovascular, cerebral) using suitable algorithms
- ability to experiment and develop new algorithms for the modelling and description of physiological phenomena;
- design, engineering, production, use and maintenance of biomedical sensors;

- design, engineering, production, use and maintenance of biomedical instrumentation for diagnostic or therapeutic support, but also for telemedicine,
- ability to design, develop and implement biomedical software;
- ability to draw up reports or technical documents concerning biomedical instrumentation.

Professional opportunities:
The main employment opportunities of the graduates in Electronics Engineering, “Bioelectronics” curriculum, are the following:
- Companies, healthcare facilities and specialized clinical laboratories for the management of biomedical instrumentation and the design, implementation and management of innovative healthcare services;
- Companies designing, manufacturing and operating biomedical sensors, instrumentation or software;
- Companies designing, developing and producing systems and infrastructures relating to the acquisition, processing and transport of biomedical data and signals;
- Scientific institutions of hospitalization and care, to carry out clinical research activities, as well as management of health services;
- national and international scientific and technological research bodies;
- research and development laboratories;
- regulatory and control bodies;
- freelance activity for the design and construction of electronic systems for biomedical applications.

Final examination features

The final examination of the 2nd cycle Degree Course in “Electronic Engineering” consists of the discussion of a written dissertation, written by the student under the guidance of an academic supervisor. The dissertation, whose topic must be previously approved by the Board of the Degree Course, investigates issues of high scientific content, normally related to studies or plans highlighting innovative aspects of the typical Electronics research sectors.

Subjects 1 ° year	CFU	Sem.	Val.	SSD	TAF
20516 - APPLIED AND INDUSTRIAL ELECTRONICS - INTEGRATED COURSE	15	1	V		
- APPLIED ELECTRONICS AND LABORATORY *Lullo(PA)*	*9*	*1*		*ING-INF/01*	*B*
- INDUSTRIAL ELECTRONICS AND LABORATORY *Vitale(IE)*	*6*	*1*		*ING-INF/01*	*B*
20515 - ELECTRONIC INSTRUMENTS AND MEASUREMENTS FOR AUTOMATION AND TELECOMMUNICATIONS *Cataliotti(PO)*	9	2	V	ING-INF/07	B
20513 - ELECTRONIC PROGRAMMABLE SYSTEMS *Giaconia(PA)*	9	2	V	ING-INF/01	B
20525 - MICROWAVE ELECTRONICS - INTEGRATED COURSE	12	2	V		
- MICROWAVE CIRCUITS *Stivala(PA)*	*6*	*2*		*ING-INF/01*	*B*
- MICROWAVE COMPONENTS *Stivala(PA)*	*6*	*2*		*ING-INF/01*	*B*
21234 - STATISTICAL ANALYSIS OF BIOMEDICAL SIGNALS *Faes(PO)*	6	2	V	ING-INF/06	C
Optional subjects	6				C
	57				

Subjects 2 ° year	CFU	Sem.	Val.	SSD	TAF
20251 - ELECTRONICS AND IOT FOR BIOMEDICAL APPLICATIONS - INTEGRATED COURSE	12	1	V		
- BIOMEDICAL ELECTRONICS *Rossano(PC)*	*6*	*1*		*ING-INF/01*	*B*
- PERSONAL AREA NETWORK *Tinnirello(PO)*	*6*	*1*		*ING-INF/03*	*C*
20510 - INDUSTRIAL ROBOTICS *D'Ippolito(PO)*	6	1	V	ING-INF/04	C

Legenda: Per. = periodo o semestre, Val. = Valutazione (V=voto, G=giudizio), TAF= Tipologia Attività Formativa (A=base, B=caratterizzante, C=Affine, S=stages, D=a scelta, F=altre)

Subjects 2 ° year	CFU	Sem.	Val.	SSD	TAF
21237 - SENSORS AND SIGNAL CONDITIONING FOR DIGITAL MEASUREMENTS *Artale(RD)*	6	1	V	ING-INF/07	B
05917 - FINAL EXAMINATION	24	2	G		E
Stage and others	6				F
Free subjects (suggested)	9				D
	63				

OPTIONAL SUBJECTS

Stage and others	CFU	Sem.	Val.	SSD	TAF
21235 - APPLIED MATHEMATICS INSIGHTS	4	1	G		F
21167 - INTERNSHIP 2 CREDITS	2	1	G		F
11033 - INTERNSHIP 3 CREDITS	3	1	G		F
15458 - INTERNSHIP 4 CREDITS	4	1	G		F
11351 - INTERNSHIP 5 CREDITS	5	1	G		F
11028 - INTERNSHIP 6 CREDITS	6	1	G		F
11034 - OTHER EDUCATIONAL ACTIVITIES - 1 CREDIT	1	1	G		F
11035 - OTHER EDUCATIONAL ACTIVITIES - 2 CREDITS	2	1	G		F
11036 - OTHER EDUCATIONAL ACTIVITIES - 3 CREDITS	3	1	G		F
11037 - OTHER EDUCATIONAL ACTIVITIES - 4 CREDITS	4	1	G		F
11038 - OTHER EDUCATIONAL ACTIVITIES - 5 CREDITS	5	1	G		F
11039 - OTHER EDUCATIONAL ACTIVITIES - 6 CREDITS	6	1	G		F
Optional subjects	**CFU**	**Sem.**	**Val.**	**SSD**	**TAF**
17883 - EMBEDDED SYSTEMS ELECTRONICS *Giaconia(PA)*	6	2	V	ING-INF/01	C
17878 - MACHINE LEARNING *Tinnirello(PO)*	6	2	V	ING-INF/03	C
20512 - OPTOELECTRONIC DEVICES *Mosca(PA)*	6	1	V	ING-INF/01	C
19641 - PHOTOVOLTAIC DEVICES AND TECHNOLOGIES *Crupi(PA)*	6	1	V	ING-INF/01	C
Free subjects (suggested)	**CFU**	**Sem.**	**Val.**	**SSD**	**TAF**
13510 - ELECTRIC CONVERTERS AND DRIVES *Miceli(PO)*	9	1	V	ING-IND/32	D
18063 - ELECTRIC DRIVES LABORATORY *Di Tommaso(PA)*	6	1	V	ING-IND/32	D
01751 - ELECTROMAGNETIC FIELDS *Cino(PA)*	9	1	V	ING-INF/02	D

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