INDUSTRIAL ENGINEERING

First Cycle Degree

Access to further study.	- Second Cycle Degree (Master Degree) - First level Master
Title conferred	Laurea in Industrial Engineering
Years	3 years
Credits	180 CFU
Language(s) of instruction/examination.	ITALIAN, ENGLISH (first year)
Web site	http://www.ing.univaq.it/cdl/mostra_corso.php?codice=I3D
Email	ing.industriale@univaq.it

Course description

The First Cycle Degree in Industrial Engineering aims at providing graduates with a thorough knowledge of the basic disciplines, of the typical subjects of industrial engineering as well as of those which are transversal to different engineering applications, giving priority to the methodological approach.

The achievement of the learning outcomes is planned in a first year in which the basic scientific disciplines are taught. Then, in the second year includes the disciplines that typically characterize the training of any industrial engineer. The third year is oriented towards a specialization in some technological fields, in which engineering knowledge will be completed with different contents according to the curriculum chosen. To this purpose the degree course will be structured in six curricula:

- **Biomedical Engineering**
- **Chemical Engineering**
- **Electrical Engineering**
- **Industrial Electronic Engineering**
- **Management Engineering**
- **Mechanical Engineering**

The learning outcomes are in summary as follows:

- Knowledge of the mathematical tools, of the physical and chemical scientific bases necessary for the understanding of engineering applications. The related courses are taught in the first year, common to all curricula.

- Knowledge of engineering elements and operating methodologies used in the industrial engineering. They are taught mainly in the second year and train knowledges common between the several curricula.

- Knowledge in six different industrial fields of specialization offered in as many curricula. Such competencies aim at orienting the student to work as Junior Engineer or at carrying on in the following master's degrees:

- **Chemical Engineering**
- **Electrical Engineering**
- **Electronic Engineering**
- **Management Engineering**
- **Mechanical Engineering**
- **Biomedical Engineering** (Information technology)
- **Biomedical Engineering** (Mechanical Engineering)

Moreover, the following are essential part of the educational objective:

- Knowledge of technical vocabulary, command of technical language and capability to interact with professionals of different industrial sectors.

- Ability to address autonomously complex problems and to work in different industrial fields in which interdisciplinary skills are required.

- Ability to work in rapidly developing contexts with operational flexibility and with a good attitude towards a constant updating of knowledge and operational skills.

Other information to joint University of L'Aquila.

- International Mobility at University of L'Aquila
- Enrolment
- Practical Information
- Campus
- Website
- Tuition fees
- Welcome to the university of L'Aquila!

FIRST YEAR COURSES COMMON TO ALL CURRICULA

The courses of Mathematical Analysis I and II, Geometry, General Physics I and Chemistry in the first year pursue some of the general learning objectives of the
degree course in Industrial Engineering.

Knowledge and understanding

- Development of the ability to understand fundamental mathematical, physical and chemical principles and their application to the main technologies adopted in science and engineering.
- Provide students with a knowledge of mathematical, physical and chemical basics essential for understanding engineering applications.

Learning outcomes

- Know and understand logical and analytical arguments.
- Understand and explain the meaning of complex statements using mathematical, physical and chemical notation and language.
- Understand the fundamental concepts of mathematics, physics and chemistry and have an awareness of potential applications in other fields of study and research.
- Develop reasoning and mathematical calculation skills and the ability to understand and apply a theorem.
- Be able to read and understand scientific and engineering texts for subsequent years of the courses.

CURRICULUM IN BIOMEDICAL ENGINEERING

Professional profile and professional and career opportunities for graduates

Function in an employment context

The educational path in Biomedical Engineering aims to train engineers to be able to combine industrial engineering and biomedical knowledge, in order to be skilled to operate in private and public workplaces, with reference to:

- The ability to operate, at different levels, among the wide range of industrial activities that develop and use technology to improve health care;
- The ability to adapt the knowledge in biomedical and bionic fields to the continuous evolution of both industrial technologies and health sciences;
- The ability to interact with medical staff and qualified technicians;
- Basic skills for the study and use of biomaterials, devices and instrumentation for diagnosis, therapy and rehabilitation in medicine.

From their first employment, each graduate from Biomedical Engineering will play complementary roles in industry, with the ability to operate, in positions of initial responsibility and of coordination of medical/engineering activities, in biomedical contexts.

This path provides the knowledge to enable each graduate to access the Master's courses, where in-depth studies of a specialist nature are provided.

Career opportunities

Each graduate in Biomedical Engineering will find career opportunities in several professional fields that will address various type of stakeholders, for example, in the health, industry and services sectors.

Specifically, the main employment areas are:

- Industry for innovation, design, production and marketing of new technologies used for:
  - Factory equipment for the diagnosis, treatment, rehabilitation and monitoring;
  - Electromedical devices, where the use of sensors and bio-sensors is involved;
  - Implantable and wearable devices, prosthesis/orthosis, robotic systems for biomedical applications, artificial organs, functional support systems and aids for people with disabilities or for bionic uses.
- Hospitals and specialised clinical laboratories, in relation to the management of technical services, health information systems and biomedical data and images;
- Public and private healthcare facilities, in the sectors of sport, physical exercise and entertainment;
- Service companies for the development, marketing and management of devices and implants for biomedical uses;

- Pharmaceutical and biotechnology companies;
- Government for establishing safety standards for medical devices.

Description of educational path

The educational path for this course supplies biomedical engineers with a traditional preparation in the basic disciplines (mathematics, physics, chemistry and computer science), which will be integrated with the transversal skills of industrial engineering (science and the technology of materials, engineering drawing and design, applied mechanics, solid and structural mechanics, heat transfer and engineering thermodynamics, electrical engineering, management engineering). The academic preparation is completed with specific activities of biomedical and bionic engineering together with the fundamentals of medicine and biology. The broad-based training provided will enable each graduate to operate in a wide variety of settings and disciplines within industrial biomedical engineering.

The specific contents of the Biomedical Engineering educational path are:

- Properties of biomaterials and their interactions with biological tissues;
- Basic knowledge of human anatomy, biology and physiology;
- Electronic bioengineering, sensors and measurements for biomedical engineering;
- Mathematical models to study heat and mass transport in biological tissues;
- Mechanics and biomechanics;
- Information technologies for the treatment and processing of biomedical images;
- Interactions among electromagnetic fields and biological systems.

Graduates will have access to the Master's courses in Industrial Engineering, where they will be able to improve their training in biomedical-bionic fields, with specific curricula, which are planned in the Master's Degrees of Electronic Engineering and Mechanical Engineering.

- *Electronic Engineering*: equipment and devices designed for life-saving systems, circuits and apparatus design for rehabilitation and wellness, sensors and biosensors design, design of implantable devices and biomedical hospital equipment, interaction among electronic systems and human body, and signal analysis.
- *Mechanical Engineering*: design and development for treatment and rehabilitation equipment, implantable or portable devices, prosthesis/orthosis, design and development of methods for two- and three-dimensional biomedical analyses and for the development of customised prosthetic implants, robotic systems for biomedical and bionic applications, artificial organs, functional support systems and for mobility aids, integration of measuring equipment for certified devices and devices and methods for the heat and medical treatment of biological tissues.

Knowledge and understanding

At the end of the educational path in Biomedical Engineering, each student should acquire a wide-ranging knowledge to operate in the various sectors of industrial biomedical applications. Specifically, the training course in Biomedical Engineering will provide the following specific knowledge and comprehension abilities:

- Basics aspects of biology and medicine and their significance for biomedical technologies;
- Properties and technologies of materials to be used in biomedical applications and their interaction with biological tissues;
- Basic knowledge of human anatomy, biology and physiology;
- Electronic bioengineering, sensors and measurements for biomedical engineering;
- Technical physics, with reference to the diffusion of drugs and of heat in biological tissues;
- Mechanical and biomechanical principles of the movement of the human body;
- Information technology for biomedical image processing;
- Physical principles of the interactions between biological and electronic systems, with attention to the problematics of the interactions between electromagnetic fields and living beings.

Learning outcomes and ability to apply knowledge and understanding

At the end of the Biomedical Engineering path, each graduate will have the ability to apply the acquired knowledge and comprehension for:

- Identifying, formulating and solving problems of biomedical engineering using basic and established methods;
- Analysing biomedical applications, products, processes and methods;
- Choosing and properly applying analytical and modelling methods;
- Deepening specific issues of the discipline autonomously, with particular reference to engineering aspects of interest to medical and bionic fields, in the Master's degree studies as well as in employment;
- Adopting and understanding the language of biomedicine, as well as of technical-engineering fields, in order to provide the right argumentations for her/his technical decisions;
- Working with professionalism, also with people belonging to different professional fields, and facilitating the exchange of ideas and comprehension;
- Applying her/his own knowledge in solving problems in the main application areas of biomedical engineering.

These skills will derive from lectures in classroom, exercises and laboratory experimental sessions, able to stimulate also the ability to interact with other students.

The acquisition of knowledge is verified by means of exercises, examinations, training stages and a final exam.

Teachings and educational path in INDUSTRIAL BIOMEDICAL ENGINEERING Duration of the course: 3 years; 180 University Credits	
	Teachings
Generic area	MATHEMATICAL ANALYSIS I GEOMETRY ECONOMICS AND BUSINESS ORGANISATION GENERAL PHYSICS I CHEMISTRY MATHEMATICAL ANALYSIS II GENERAL PHYSICS II PRINCIPLES OF ELECTRICAL ENGINEERING MATERIALS SCIENCE AND TECHNOLOGY SOLID AND STRUCTURAL MECHANICS MECHANICS APPLIED TO MACHINES WITH SOFTWARE LAB FLUID MACHINES AND THERMAL POWER PLANTS
Specific area	MATERIALS SCIENCE AND TECHNOLOGY WITH BIOMEDICAL APPLICATIONS MECHANICS APPLIED TO MACHINES WITH BIOMECHANICAL COMPLEMENTS AND SOFTWARE LABORATORY ELECTRONICS AND BIOMEDICAL MEASURES HEAT TRANSFER AND ENGINEERING THERMODYNAMICS FOR BIOMEDICAL APPLICATIONS FUNDAMENTALS OF ANATHOPHYSIOLOGY METHODS OF TECHNICAL REPRESENTATION AND BIOMEDICAL IMAGING PRINCIPLES OF BIOMEDICAL ELECTRICAL ENGINEERING AND COMPLEMENTS

CURRICULUM IN CHEMICAL ENGINEERING

Professional profile and professional and career opportunities for graduates

Function in an employment context

The educational path in Chemical Engineering intends to train engineers able to combine knowledge of industrial engineering with the specific knowledge of chemical engineering, in order to operate in public and private work areas.

The graduates from the Chemical Engineering path will be able to operate in a wide range of industrial activities within chemical technologies.

Each graduate will be able to adapt his or her skills to the continuous evolution of industrial technologies and, in particular, to the evolution in the chemical sector. From their first employment, they will be able to work in complementary roles in the industrial sector, with the ability to operate in functions of initial responsibility and the coordination of activities of a technical/engineering content in engineering contexts.

This path provides the knowledge to enable each graduate to access the Master's courses where in-depth studies of a specialist nature are provided.

Career opportunities

The possible employment opportunities in the chemical industry are in the design, production and management of:

- Equipment for the production, separation and recovery of products in the chemical, food and pharmaceutical industries and in the energy sectors;
- Waste and wastewater treatment plants;
- Process quality control systems.

The graduates may also be employed in:

- Public companies, within the management of technical services, information and managerial systems;
- Chemical engineering services in public and private structures;
- Service companies for the development, marketing and management of equipment and plants;
- Engineering, oil and gas, chemical, pharmaceutical and biotechnology companies.

Description of educational path

This educational path intends to supply future industrial chemical engineers with a traditional preparation in basic disciplines (mathematics, physics, chemistry and computer science), integrated with the transversal skills of industrial engineering (materials, energy, electricity, electronics, mechanics and management). Academic preparation is completed with specific training activities of chemical engineering. The training provided is broad-based in order to enable each graduate to operate in vast sectors of industrial chemical applications.

The specific contents of the Chemical Engineering educational path are:

- Properties and characteristics of materials, production techniques and their applications;
- Basic principles of chemical engineering: materials, energy and momentum balances; chemical and phase equilibria; process kinetics;
- Principles of thermodynamics;
- Fundamentals of fluid behaviour;
- Principles of chemical process development;
- Principles of technical physics with reference to the matter and heat diffusion.

Graduates will have access to Master's courses in industrial areas and, in particular, to Master's degree in Chemical Engineering, where they will be able to improve training in chemical processes, plant design, process dynamics and control, materials science and technologies.

Knowledge and understanding

At the end of the Industrial Engineering path, each graduate in Chemical Engineering will have acquired a broad knowledge and will be able to operate within the vast sectors of industrial chemical applications. More specifically, graduates from the Chemical Engineering educational path will have a thorough understanding of:

- Basic principles of chemical engineering: matter, energy and momentum balances; chemical and phase equilibria; process kinetics (chemical reaction, transfer of matter, energy and momentum);
- Principles of thermodynamics, the thermodynamics of multiphase and reactive systems, chemical and physical equilibria;
- Fundamentals of fluid behaviour;
- Knowledge and understanding of production systems for the chemical industry and elements of materials resistance;
- Principles of transport phenomena and chemical plant engineering;
- Principles of the theory of the development of chemical processes;
- Principles of technical physics with reference to the needs of forecasting the diffusion of matter and heat in systems;
- Knowledge and understanding of the mechanical principles relating to the movement of machine parts.

Learning outcomes and ability to apply knowledge and understanding

At the end of the Industrial Engineering path, each graduate from the Chemical Engineering educational path will have acquired the ability to apply the knowledge acquired and his/her understanding to:

- Identify, formulate and solve chemical engineering problems using basic and consolidated methods;

- Analyse products for engineering applications, processes and methods of chemical engineering;
- Justify the choice of materials and equipment in production areas;
- Appropriately choose and apply the analytical and modelling methods learned;
- Autonomously study specific engineering topics in the chemical sector, both in the continuation of studies in a Master's degree and in the world of work;
- Use and understand the language used in chemical engineering to justify, support and argue their technical choices;
- Operate professionally by interacting with people from different backgrounds and facilitate communication;
- Apply their knowledge in solving problems in the main application areas of chemical engineering.

These skills will be acquired through classroom and laboratory activities, in which the ability to interact in groups with other students and through experimental laboratory activities will be stimulated.
The preparation is verified through exercises, profit exams, traineeship and a final exam.

Teachings and educational path in INDUSTRIAL CHEMICAL ENGINEERING Duration of the course: 3 years; 180 University Credits	
	Teachings
Generic area	MATHEMATICAL ANALYSIS I GEOMETRY ECONOMICS AND BUSINESS ORGANISATION GENERAL PHYSICS I CHEMISTRY MATHEMATICAL ANALYSIS II GENERAL PHYSICS II PRINCIPLES OF ELECTRICAL ENGINEERING SOLID AND STRUCTURAL MECHANICS TECHNICAL DRAWING AND CAD MECHANICS APPLIED TO MACHINES HEAT TRANSFER AND ENGINEERING THERMODYNAMICS FLUID MACHINES AND THERMAL POWER PLANTS
Specific area	MATERIALS SCIENCE AND TECHNOLOGY ORGANIC CHEMISTRY CHEMICAL ENGINEERING THERMODYNAMICS PRINCIPLES OF CHEMICAL ENGINEERING CHEMICAL PLANT THEORY OF THE DEVELOPMENT OF CHEMICAL PROCESSES

CURRICULUM IN INDUSTRIAL ELECTRONIC ENGINEERING

Professional profile and professional and career opportunities for graduates

Function in an employment context

The education path in Industrial Electronic Engineering intends to train engineers capable of operating in the field of industrial engineering, with a wide range of skills in such way to enable them to operate in the field of analogue/digital electronic circuits and systems, including knowledge in their cultural background of some of the most topical issues in the field of Electronic Engineering.
Each graduate within the educational path in Industrial Electronics will learn how to operate, at different levels, in the wide range of industrial activities in which electronic technologies are developed and used for components, devices, equipment and systems for automation.
Each graduate will be able to adapt his or her ability to operate in the industrial context to the continuous evolution of industrial electronic technologies with particular attention paid to the fields of telecommunications, avionics, space, robotics, automotive and home automation.
Starting from their first employment, each graduate will be able to play complementary roles in the industrial sector, with the ability to operate with working functions of initial responsibility and coordination of technical/engineering activities in contexts related to circuits and electronic systems for industry and industrial applications.
This course provides the knowledge to enable graduates to access the Master's degree program in Electronic Engineering.

Career opportunities

The professional figure of the graduate in the educational path in Industrial Electronic Engineering is characterised by qualified training in the field of industrial engineering integrated with electronic engineering. This type of training allows each graduate to enter the world of work in the operational areas of the design or production of electronic systems and equipment with a particular attention to industrial applications. Some of the most sought-after professional outlets for this course include:

- Companies operating in the industrial electronics field (production of microelectronic components and devices for domestic, industrial and telecommunications applications);
- Industrial and public laboratories;
- Companies operating in the avionics and space fields;
- Companies operating in the robotics field, in the production of equipment and automation systems for industrial processes (mechanical processing, metallurgical, chemical, pharmaceutical and food processes);
- Companies operating in the automotive field, home automation and related components;
- Companies and public entities for the design, planning, operation, control and management of highly complex automated systems, goods and services.

Description of educational path

This educational path aims to provide future industrial electronic engineers with a traditional preparation in the basic disciplines (mathematics, physics, chemistry and computer science) integrated with the more generic transversal skills of industrial engineering (materials, energy, electricity, electronics, mechanics and management). This general training is completed with specific training activities related to analogue and digital electronics engineering. The training given covers a broad spectrum, thus enabling each graduate to operate in a variety of fields related to circuits and electronic systems for industrial applications.

The specific contents of this educational path are:

- Analysis of signals and electromagnetic fields;
- Analogue and digital electronics;
- Computer science fundamentals;
- Electrical and electronic measurements.

Graduates will be able to access the Master's degree program in Electronic Engineering in which they can improve their training through three different paths: microwave systems for aerospace and wireless systems, industry and systems on a chip and biomedical electronics. These distinct paths deal, with different weights, with microwave systems and circuits, systems for industry and integrated electronics and electronic systems for biomedical applications, as detailed below:

- *Microwave systems for aerospace and wireless systems*: fundamentals of communications; antennas and microwaves; electronics of digital systems; electronic devices; signal integrity; microelectronics; microwave electronics; processing of data and measurement information; nanophotonics; electromagnetic design methods; measurements for automation and industry; design of integrated electronic systems; technologies and advanced electronic systems; embedded systems.
- *Industry and Systems on a Chip*: measures for automation and industry; motors and electric drives, control systems; electronics of digital systems; electronic devices; microelectronics; electric systems for handling; processing of data and measurement information; design of integrated electronic systems; nanophotonics; microwave electronics; electromagnetic design methods; technologies and advanced electronic systems; embedded systems.
- *Biomedical Electronics*: management of health systems and medical diagnostic equipment, measures for automation and industry; control systems; electronics of digital systems; signal integrity; microelectronics; sensors and interfaces for biomedicine; processing of data and measurement information, radio frequency systems for biomedicine; technologies and advanced electronic systems; fundamentals of anatomophysiology; image processing; electronic systems for mechatronics; environmental impact of EM fields; devices for electronics.

Knowledge and understanding

At the end of the educational path in Industrial Electronic Engineering, each student will have

acquired a broad spectrum of knowledge, thereby enabling them to operate in several fields of analogue/digital electronic circuits and systems for industrial applications. In particular, this educational path provides the following specific knowledge with the related ability to understand:

- Basic aspects and operating principles of the main analogue and digital electronic devices, circuits and systems;
- Design and implementation of analogue and digital electronic circuits and systems;
- Analysis, conditioning and analogue/digital processing of signals and data through basic configurations of circuits and systems;
- Laboratory instruments/equipment and main basic commercial discrete electronic devices;
- Design, simulation and analysis environments for electronic devices, circuits and systems.

Learning outcomes and ability to apply knowledge and understanding

At the end of the educational path in Industrial Electronic Engineering, each student will have acquired the ability to apply the acquired knowledge and the understanding to:

- Identify, formulate and solve electronics problems related to industrial engineering using basic and consolidated methods;
- Analyse the behaviour of analogue and digital electronic devices, circuits and systems in different areas of industrial engineering;
- Study, design and characterise basic analogue and digital electronic devices, circuits and systems;
- Consult technical/scientific documentation and specialist manuals for the development of electronic systems;
- Use basic and advanced electronic instruments and equipment;
- Analyse products for industrial applications, processes and methods of industrial engineering;
- Appropriately choose and apply the learned analytical and modelling methods;
- Autonomously study specific engineering topics of interest related to the industrial sector, both during the continuation of studies in a Master's degree course and in employment;
- Use and understand the language employed in industrial engineering, particularly related to technical-engineering aspects, to justify, support and argue technical choices;
- Operate with professionalism in the world of work, with people belonging to different areas, and facilitate communication between the latter;
- Apply their knowledge in solving problems in the main application areas of industrial engineering.

These skills will be acquired through experimental laboratory activities and by classroom activities and exercises, in which the ability to interact in a group and with other students is also stimulated. The acquisition of the skills is verified through exercises, profit exams, training courses and a final examination.

Teachings and educational path in INDUSTRIAL ELECTRONICS ENGINEERING Duration of the course: 3 years; 180 University Credits	
	Teachings
Generic area	MATHEMATICAL ANALYSIS I GEOMETRY ECONOMICS AND BUSINESS ORGANISATION GENERAL PHYSICS I CHEMISTRY MATHEMATICAL ANALYSIS II GENERAL PHYSICS II PRINCIPLES OF ELECTRICAL ENGINEERING MATERIALS SCIENCE AND TECHNOLOGY SOLID AND STRUCTURAL MECHANICS FUNDAMENTALS OF COMPUTER SCIENCE AND COMPLEMENTS TECHNICAL DRAWING AND CAD MECHANICS APPLIED TO MACHINES HEAT TRANSFER AND ENGINEERING THERMODYNAMICS FLUID MACHINES AND THERMAL POWER PLANTS
Specific area	ELECTRONICS I DIGITAL ELECTRONICS I SIGNAL ANALYSIS AND ELECTROMAGNETIC FIELDS ELECTRIC MEASUREMENTS DESIGN OF INDUSTRIAL ELECTRONIC SYSTEMS

CURRICULUM IN ELECTRICAL ENGINEERING

Professional profile and professional and career opportunities for graduates

Function in an employment context

The educational path for Electrical Engineering intends to train engineers to be able to combine their knowledge of industrial engineering with that of electrical engineering, focused on a vast knowledge of topics, including applied electromagnetism, electrical circuits and networks, electrical machines, power converters and variable speed drives, power systems and electrical measurements and instrumentation.

Graduates from the Electrical Engineering path will be able to operate, at different levels, in all the industrial activities in which technologies for the production, transmission and distribution of electrical energy are developed and adopted.

They will be able to adjust their knowledge for operating in industrial scenarios that rapidly change with respect to the management of electrical devices and components, electrical machines, power systems, power electronics, and electrical energy in the contest of the new technologies for renewable energies, smart grids, Industry 4.0 and systems for electrical mobility.

In detail, the knowledge acquired will allow each graduate to play roles in design, production, testing, management and maintenance of electrical apparatuses and power systems. The graduate industrial engineers from the Electrical Engineering path can be successfully employed in all industrial companies, as well as in electrical engineering ones.

This path also provides the knowledge to enable each graduate to access the master's courses in electrical engineering where in-depth studies of a specialist nature are provided.

Career opportunities

Each graduate from the Electrical Engineering educational path may be readily employed in electrical power companies, electrical manufacturing companies and automotive companies, within design and technical areas where technology and innovation elements in the field of electrical energy and automation coexist. He or she can carry out professional activities in the corporate functions concerning the design and management of electrical apparatuses and power systems, and he or she can also undertake private practice as an industrial engineer.

In more detail, graduates from this course can cover different roles in companies for the design and production of electrical devices, apparatuses and machines and industrial electronics devices, companies for the production, transmission and distribution of the electric energy, electromechanical companies, manufacturing and process companies, demotics, robotics and automation companies, testing and measurement laboratories and technical services management companies and energy supplying companies and state agencies and entities.

Description of educational path

This educational path intends to supply to industrial managerial engineers a traditional preparation in basic disciplines (mathematics, physics, chemistry, computer science, financial statements analysis and the financial appraisal of investments), integrated by the transversal skills of industrial engineering (engineering drawing and design, applied mechanics, solid and structural mechanics, science and technology of materials, heat transfer and engineering thermodynamics, machines and thermal power plants and electrical engineering). Academic preparation is completed with specific training activities of electrical engineering. The training provided is broad-based in order to enable the graduate to operate in vast sectors of electrical engineering.
The specific contents of the Electrical Engineering educational path are:

- Knowledge of electrotechnics.
- Knowledge of electrical measurements.
- Knowledge of electrical machines.
- Knowledge of electric power systems.

Graduates will have access to master's courses in the industrial area and, primarily, to the master's degree in Electrical Engineering, where they will improve their knowledge by selecting one of the paths that are available, in which they will acquire advanced skills in:

- Electrical Engineering "Energy" path: design of electrical machines, electrical apparatuses and electric power systems, with respect to renewable energies, variable speed drives and power electronics, electromagnetic compatibility, control systems, measurements and testing of electrical machines and power systems in civil and industrial environments.
- Electrical Engineering "Automation and Mobility" path: design of electrical machines, electrical apparatuses and power systems for automation, electric systems for the mobility, applied electrotechnics and electromagnetic calculus, control systems and measurements for industry and automation.

Knowledge and understanding

At the end of the Industrial Engineering path, each graduate will have acquired a broad knowledge and a robust culture in electrotechnics, electrical machines, electrical measurements and electric power systems.
More specifically, graduates of the Electrical Engineering educational path will have an in-depth understanding of:
- Operating methods of complex systems, such as electrical networks, electrical machines and electric power systems.
- Knowledge of electromagnetism and its application for the development of electrical devices, apparatuses and systems.
- Knowledge of electrical transformers, electrical motors and generators.
- Knowledge of the electrical measurements' theory, electrical transducers and their applications on electrical devices and apparatuses.
- Specific areas of action, including managing of electrical power systems and efficiency improvements.

Learning outcomes and ability to apply knowledge and understanding

At the end of the Industrial Engineering path, graduates will have acquired a broad-based knowledge in order to enable him/her to operate in different sectors of industrial engineering. Each graduate will have acquired the ability to apply the knowledge they have acquired and his/her understanding to:

- Identify, formulate and solve electric engineering problems using fundamental and consolidated methods.
- Analyse components, devices and apparatuses for industrial applications, processes and methods of electrical engineering.
- Appropriately choose and apply the analytical and modelling methods learned.
- Autonomously study the specific engineering topics of the electrical sector, both in the continuation of studies through a master's degree and in employment.
- Use and understand the language of electrical and technical engineering to justify, support and argue their technical choices.
- Operate professionally in employment by interacting with people from different backgrounds and facilitating communication.
- Apply their knowledge in solving problems in the main application areas of electrical engineering.
- Manage and control production and processes in contexts where electrical automation and energy-saving aspects are becoming increasingly important.
- Manage electric power systems oriented towards continuous innovation.
- Operate in situations where technical and technological problems are interconnected with automation and energetic ones.

The skills acquired must also be able to adapt to the ever-changing technical context of technological convergence. These skills will be acquired through classroom activities and exercises, in which the ability to interact in groups with other students and through experimental laboratory activities will be stimulated.
The preparation is verified through exercises, profit exams, traineeship and the final exam.

Teachings and educational path in ELECTRICAL ENGINEERING Duration of the course: 3 years; 180 University Credits	
	Teachings
Generic area	MATHEMATICAL ANALYSIS I GEOMETRY ECONOMICS AND BUSINESS ORGANISATION GENERAL PHYSICS I CHEMISTRY MATHEMATICAL ANALYSIS II GENERAL PHYSICS II MATERIALS SCIENCE AND TECHNOLOGY SOLID AND STRUCTURAL MECHANICS FUNDAMENTALS OF COMPUTER SCIENCE AND COMPLEMENTS TECHNICAL DRAWING AND CAD MECHANICS APPLIED TO MACHINES WITH SOFTWARE LAB HEAT TRANSFER AND ENGINEERING THERMODYNAMICS FLUID MACHINES AND THERMAL POWER PLANTS
Specific area	PRINCIPLES OF ELECTRICAL ENGINEERING ELECTRONICS I ELECTRICAL MEASUREMENTS ELECTRIC MACHINES ELECTRIC POWER SYSTEMS I

CURRICULUM IN MANAGEMENT ENGINEERING

Professional profile and professional and career opportunities for graduates

Function in an employment context

The educational path in Management Engineering intends to train engineers to be able to combine their knowledge of industrial engineering with that of managing complex processes, characterised by interconnected technological, organisational and economic needs, in order to operate in public and private work areas.
Graduate industrial engineers from the Management Engineering path will be able to operate in a wide range of industrial activities within business functions, including operation and supply chain management, business administration and management control, marketing, project management and manufacturing and machining technologies of traditional and innovative materials.
This path provides the knowledge to enable each graduate to access the Master's courses where in-depth studies of a specialist nature are provided.

Career opportunities

Each graduate from the Management Engineering educational path may be easily employed in manufacturing and service companies within organisational areas where technological, economic and innovation elements coexist. They will be able to carry out professional activities in different corporate functions (logistics, production, commercial and administrative) and, moreover, can profitably undertake private practice (as a business consultant) or entrepreneurship.
Such professional figures are also attractive for small- and medium-sized manufacturing companies, which increasingly need to manage complex processes characterised by interconnected technological, organisational and economic issues. In more detail, each graduate from the Management Engineering educational path will be able to find a position in operational contexts with different tasks in relation to the industrial sector (mechanical, electronics, textiles, clothing, wood, steel and so om) and organisational areas (production, quality, maintenance, safety, logistics, commercial, administration and so on). Each graduate from the Management Engineering path will be able to cover different roles, including the most relevant corporate functions, such as supplying and managing materials, business and production organisation, organisation and automation of production systems, logistics manufacturing and distribution, project management, management control and investment evaluation.

Description of educational path

This educational path intends to supply industrial managerial engineers with a traditional preparation in basic disciplines (mathematics, physics, chemistry, computer science and financial statements analysis and the financial appraisal of investments), integrated with the transversal skills of industrial engineering (engineering drawing and design, applied mechanics, solid and structural mechanics, science and technology of materials, heat transfer and engineering thermodynamics, machines and thermal power plants, and electrical engineering). The academic preparation is

completed with specific training activities of management engineering. The training provided is broad-based in order to enable each graduate to operate in vast sectors of management engineering.
The specific contents of the Management Engineering educational path are:

- Knowledge of production systems;
- Knowledge of business strategy and organisational design;
- Knowledge of technologies and manufacturing processes applied to traditional and innovative materials.

Graduates will have access to Master's courses in industrial areas and, in particular, to the Master's degree in Management Engineering, where they will be able to improve their training in business organisation and production, organisation and automation of production systems, manufacturing and distribution logistics, project management, management control, investment evaluation, plant safety, technological processes and quality management.

Knowledge and understanding
At the end of the Industrial Engineering path, the graduate in Management Engineering will have acquired a broad knowledge and a solid culture in production systems and in managerial, technological and organisational fields. More specifically, graduates of the Management Engineering educational path will have an understanding and skills of:

- Operating methods of complex systems, such as logistics, production and organisational systems;
- Quantitative approaches supported by attention to factors with a low degree of determinism and predictability, typical of the organisational systems in which they will be called to operate.
- Technological processes, production systems and related information and control systems, as well as industrial problems of production systems management, maintenance and energy.
- Specific areas of action, including supplying and management of materials, company and production organisation, organisation and automation of production systems, logistics, project management, management control, evaluation of investments and technological manufacturing processes.

Learning outcomes and ability to apply knowledge and understanding
At the end of the Industrial Engineering path, each graduate will have acquired a broad-based knowledge in order to enable them to operate in different sectors of industrial engineering. In particular, each graduate will have acquired the ability to apply their knowledge and understanding to:

- Identify, formulate and solve management engineering problems using basic and consolidated methods;
- Analyse products for industrial applications, processes and methods of management engineering;

- Appropriately choose and apply the analytical and modelling methods learned;
- Autonomously study specific engineering topics in the management sector, both in the continuation of studies in a Master's degree and in employment;
- Use and understand the language of management engineering and the technical engineering sector to justify, support and argue their technical choices;
- Operate professionally in employment by interacting with people from different backgrounds and facilitating communication;
- Apply their knowledge in solving problems in the main application areas of management engineering;
- Manage and control production and organisational processes in contexts where economic and financial aspects, as well as technical and technological ones, are becoming increasingly important;
- Manage complex production and organisational systems, oriented towards continuous innovation;
- Operate in situations where technical and technological problems are interconnected with economic, financial and organisational ones, guaranteeing an overall view that ensures the consistency of technological choices with the company strategies and the specificities of the sector to which they belong.

The skills acquired must also be able to adapt to ever-changing economic scenarios in the context of market globalisation and technological convergence. These skills will be acquired through classroom activities and exercises, in which the ability to interact in groups with other students and through experimental laboratory activities will be stimulated.
The preparation is verified through exercises, profit exams, traineeship and a final exam.

Teachings and educational path in INDUSTRIAL MANAGEMENT ENGINEERING Duration of the course: 3 years; 180 University Credits	
	Teachings
Generic area	MATHEMATICAL ANALYSIS I GEOMETRY ECONOMICS AND BUSINESS ORGANISATION GENERAL PHYSICS I CHEMISTRY MATHEMATICAL ANALYSIS II GENERAL PHYSICS II PRINCIPLES OF ELECTRICAL ENGINEERING MATERIALS SCIENCE AND TECHNOLOGY SOLID AND STRUCTURAL MECHANICS TECHNICAL DRAWING AND CAD FUNDAMENTALS OF COMPUTER SCIENCE AND COMPLEMENTS MECHANICS APPLIED TO MACHINES WITH SOFTWARE LAB HEAT TRANSFER AND ENGINEERING THERMODYNAMICS FLUID MACHINES AND THERMAL POWER PLANTS
Specific area	APPLIED ECONOMICS AND BUSINESS ADMINISTRATION BUSINESS STRATEGY AND ORGANISATIONAL DESIGN FUNDAMENTALS OF PRODUCTION SYSTEMS MANUFACTURING TECHNOLOGY NON TRADITIONAL MANUFACTURING TECHNOLOGIES

CURRICULUM IN MECHANICAL ENGINEERING

Professional profile and professional and career opportunities for graduates

Function in an employment context

Graduate industrial engineers from the educational path in Mechanical Engineering will be able to operate, at different levels, in the wide range of industrial activities, such as mechanical and electromechanical industries, companies and institutions for the production and conversion of energy, plant engineering companies, industries for automation and robotics, manufacturing companies in general for the production, installation and testing, maintenance and management of machines, production lines and departments, and complex systems. Each graduate will be able to adapt their ability to operate in these areas to the continuous evolution of industrial technologies. They will be able to operate in functions of initial responsibility and coordination of activities of technical/engineering content**.**

The course provides for the knowledge to enable the graduate to access the Master's degree courses in Mechanical Engineering (class LM-33) in which specialised in-depth studies are delivered.

Career opportunities

Graduate industrial engineers from the educational path in Mechanical Engineering are characterised by an in-depth knowledge of methods and tools for industrial engineering and engineering processes, thereby allowing them to operate in a wide range of production contexts in various industrial fields. The main employment opportunities of the graduate in the educational path in Mechanical Engineering can be identified as follows:

- Mechanical and electromechanical industries;
- Companies and organisations for the conversion of energy;
- Plant engineering companies;
- Industries for automation and robotics;
- Manufacturing companies;
- Installation, testing, maintenance and operation of machines,
- Production lines and departments, as well as complex systems.

Each graduate will be in an excellent position to find a place in typically operational areas with different tasks in relation to the industrial sector (mechanical, electronic, textile, wood, steel, paper production and so on) and to the area of intervention (production framework, maintenance, production services, technical offices, executive design, quality, safety, logistics and so on).

Description of educational path

This educational path aims to provide mechanical industrial engineers with a solid preparation in basic disciplines (mathematics, physics, chemistry and computer science) complemented by the transversal skills of industrial engineering. This preparation is complemented by training activities specific to mechanical engineering. The provided training will enable each graduate to apply the

appropriate techniques and use the appropriate tools to operate in the broad field of industrial applications.
The educational path is distributed over three years:

- In the first year, the basic teachings of Mathematical Analysis I and II, Geometry, General Physics I, Chemistry, Economics and Business Organisation are given, as well as the Italian language (level B2);
- In the second year, the lectures are dedicated to basic engineering disciplines characterising the training course in Mechanical Engineering, such as General Physics II, Technical Drawing, Electrical Engineering, Material Science, Heat Transfer and Engineering Thermodynamics, and Solid and Structural Mechanics;
- In the third year, the interest is directed to the most applied disciplines aimed at providing the cultural contents characterising the Master's degree in mechanical engineering, such as Applied Mechanics, Machines, Fluid Dynamics, Construction Elements of Machines, Manufacturing Technology and Industrial Plants.

The training course is completed with optional courses, also from other graduate programs, in order to deepen some aspects of the student interests, other activities (in the laboratories and internship in companies) and the final examination.
All lessons and exercises are given in the classroom. Practical activities will be carried out in the laboratories of the Department of Industrial and Information Engineering and Economics.

Knowledge and understanding
At the end of the educational path in Mechanical Engineering, each student will be able to work as a junior engineer in the fields of industrial design, energy conversion fluid machines and the production and management of industrial and mechanical plants. In particular, the educational path in Mechanical Engineering provides the following specific knowledge with the relative ability to understand:

- Drawing as a graphic language for the communication of technical information on industrial products or manufactured articles and modern computer-aided drawing systems for the design of industrial components;
- The methodological basis to set the analysis of mechanical systems from the kinematic, static and dynamic point of view and the functioning of mechanisms;
- The main thermodynamic processes and cycles and the fundamentals of heat transmission also with reference to the motion of fluids;
- The fundamental laws of fluid mechanics in terms of conservation of mass, energy and momentum, both for incompressible and compressible fluids;
- The real operation of the different mechanisms that make up machines;
- The methodology for the design of the construction elements of machines;
- The basics of electrical engineering and the operation of electrical machines;
- The basis of the structure of metallic materials, their properties of mechanical interest, primary production processes, heat, mechanical and surface treatments.

Learning outcomes and ability to apply knowledge and understanding

At the end of the educational path in Mechanical Engineering, each junior engineer will be able to:

- Interpret drawings of parts and assemblies and represent the most common machine parts even with the use of software;
- Perform the sizing and verification of simple structural components;
- Analyse the characteristics of materials to identify the most suitable for the realisation of components;
- Understand the effect of heat and surface treatments on the resistance of metallic materials;
- Solve problems of electrical circuits operating in stationary mode;
- Evaluate the problems related to the behaviour of compressible and incompressible fluids;
- Apply the principles of thermodynamics to simple systems and describe and understand the main thermodynamic cycles;
- Update oneself on methods, techniques and tools in the field of engineering;
- Interpret the main technical journals and national, European and international standards in the field.

These skills are acquired through classroom activities and exercises, in which the ability to interact in groups with other students is also stimulated, and through experimental laboratory activities.
The acquisition is verified through exercises, profit exams, training internships and the final three-year degree thesis.

Teachings and educational path in MECHANICAL ENGINEERING Duration of the course: 3 years; 180 University Credits	
	Teachings
Generic area	MATHEMATICAL ANALYSIS I GEOMETRY ECONOMICS AND BUSINESS ORGANISATION GENERAL PHYSICS I CHEMISTRY MATHEMATICAL ANALYSIS II GENERAL PHYSICS II PRINCIPLES OF ELECTRICAL ENGINEERING MATERIALS SCIENCE AND TECHNOLOGY SOLID AND STRUCTURAL MECHANICS TECHNICAL DRAWING AND CAD MECHANICS APPLIED TO MACHINES WITH SOFTWARE LAB HEAT TRANSFER AND ENGINEERING THERMODYNAMICS FLUID MACHINES AND THERMAL POWER PLANTS
Specific area	FLUID DYNAMICS MACHINE ELEMENT DESIGN MANUFACTURING TECHNOLOGY FUNDAMENTALS OF PRODUCTION SYSTEMS NUMERICAL ANALYSIS