Degree: **electrical engineering**

International Private Higher Polytechnic School of Sousse (EPI)

The training in electromechanical engineering has an orientation or development council:

- Total number of members: 4
- Number of representatives from the economic world: 2
- Frequency of meetings: 2 to 3 meetings per semester

EPI-Polytec's Electrical Engineering course is multi-disciplinary, covering several areas of current interest and enabling graduate engineers to integrate the Tunisian or foreign industrial fabric and to apply their skills in various sectors, particularly in the medical field. Telecommunication, agricultural, textile, ... This multidisciplinary training is highly appreciated by the major national and international industrial groups and also by several international research laboratories where many of our students have prepared their graduation projects and have continued in Master, ... Among these laboratories, we quote:

• The Systems Analysis and Architecture Laboratory (LAAS), Toulouse - France.

• The Franche-Comté Institute Electronique Mécanique Thermique et Optique - Science and Technology, FEMTO-ST, UMR 6174, Besançon - France.

• Research Center in Acquisition and Treatment of Image for Health (CREATIS), CNRS Unit UMR 5220 - INSERM U1206 - University Lyon 1 - INSA Lyon - Jean Monnet University Saint-Etienne - France

• ESIEA: School of Engineers of Paris - France

• Embedded Systems and Electronics Research Institute IRSEEM, EA 4353, ESIGELEC, Rouen - France.

• MONS University in Belgium

Among the industrial groups that the EPI-Polytec electrical engineer can integrate, we quote:

• Electronic, professional and consumer systems, embedded systems, integrated circuit design,

• Information technology, telecommunications equipment, network operators.

• Biomedical instrumentation: The maintenance of medical instruments including autoclaves, scanners, ultrasounds, ...

• Medical robotics and e-health

• The automobile, aeronautics and electric traction.

• Textile industries

Repositories of skills

The Electrical Engineering Department of EPI-Polytec provides engineering training in Electrical Engineering which enables engineering students to grasp the complex problems that will constitute their future missions. This training is characterized by the imbrication of a basic scientific training, a specialized training in the fields of Electrical Engineering and cross-training. The training offered collaborates with the socio-economic sector by including modules oriented towards entrepreneurship, visits of industrial companies and dedicated industrial conferences, two internships of one month in company in 3rd and 4th year and a project of end of 5th year industrial studies. Thus the training provided is divided into three phases:

The first is a common core course that lasts two years and is reserved for the acquisition of theoretical and practical knowledge and skills in the fields of Analog and Digital Electronics, Electronics Embedded Systems, Power Electronics , Electrotechnics, Automation, Automation, Industrial Computing and Telecommunications.

The second is a specialization phase that lasts one semester and where the student is oriented to one of the following three options:

- Embedded networks and systems

- Biomedical instrumentation

- Industrial control

The third phase is the preparation of a graduation project generally of an industrial nature

Basic skills

• Knowledge and mastery of engineering methods and tools: identification and problem solving, data collection and interpretation, use of computer tools, analysis and design of complex systems, experimentation.

• Ability to integrate into an organization, commitment and leadership, project management and organization of events.

• Knowledge of company management procedures, including legal texts, etc.

• Taking into account industrial, economic and professional issues: competitiveness and productivity, innovation, intellectual and industrial property, compliance with quality procedures, safety.

• Openness to foreign countries: mastering foreign languages, economic training, knowledge of exchange protocols with foreign countries.

Scientific research skills

- Be able of to do a state of art of the works of research related has a thematic
- Se endows of the mind critical and of analysis of there literature
- Mastering deadlines and time management for an applied research project
- Working in a group

The skills of the specialty Electrical Engineering

Electrical engineering and power electronics

The student is supposed to acquire knowledge about alternating current, three-phase systems, AC / AC conversion via single-phase and three-phase transformers, DC electrical machines constitution, principle of operation, generator operation and operation as a motor, the synchronous machine and its operation in motor and alternator for the production of electricity. Finally the operation of the asynchronous machine in motor

and generator as well as some specific asynchronous motors. The study of electrical networks and machines is accompanied by components of diagrams and electrical installations and starting of electric motors.

Power electronics will have the mission of activating the control of electrical machines through the synthesis of static converters (chopper, inverter, dimmer, rectifier and transformer) and the design of control and power circuits. These circuits based on power components can be useful for the exploitation of renewable energies of the solar, wind, etc. type.

Electronics

The goal is to acquire the skills in analog and digital electronics in order to have the ability to analyze, design and implement electronic circuits for dedicated applications. To satisfy this the student is required to understand the operation and to use the linear and non-linear components (diodes, transistors) in the electronic circuits as well as the actual operational amplifiers and the different types of filters and the different oscillator structures. In addition, he is also required to have knowledge of integrated circuit manufacturing technologies including TTL technology and CMOS technology. He must know about programmable circuits such as memories and complex programmable circuits. In the numerical part, it is necessary to master the combinational and sequential logical functions and circuits as well as the embedded circuits of the SOC, FPGA type, the ARAM processors and the VHDL synthesis for the design of CPLDs, FPGAs and ASICs.

Automatic and informatic industrial

Students must acquire certain skills in analysis and synthesis of continuous industrial processes in order to satisfy certain performances in terms of accuracy, speed, stability, robustness, etc. on the behavior of these processes. These achievements will aim to design and implement the best control strategy with digital or analog systems. The control of continuous systems is combined with the ability to analyze, design and implement logical systems consisting of discrete electronic components, specific electronic circuits, programmable electronic components, PLCs (Programmable Logic Controllers) and their programming tools. Finally, the combination of continuous and discrete systems leads to so-called hybrid systems or discrete events that must be analyzed, designed and implemented their order. This component works with electronics for control circuit design and power electronics for power circuits.

Signal and Image Processing

In addition to applications related to the processing and transmission of information, the signal and image processing are of direct use in Biomedical Engineering, one of the options of our Electrical Engineering training. Thus the student will acquire skills related to the acquisition, analysis and processing of the signal, in analog form or in digital form. Mastery of the main usual mathematical functions of signal processing such as power, energy, spectrum, spectral density, correlation, sampling and modulation as well as transmission in both the analog domain and the digital domain. For the image the candidate will have to master two aspects the first one is interested in the image in a general way and

concerns the digital images in vectorial or matrix form where one is interested in the filtering, the enhancement and the restoration , segmentation, ... The second aspect concerns the medical image that touches the X-ray and the scanner.

OPTIONS

Biomedical Instrumentation

The future engineer Electrical Engineering option biomedical instrumentation will know general information about biology, anatomy, neurophysiology and physiology, biophysics and atomic and nuclear physics and combine the knowledge acquired in common core to master knowledge about to biomedical engineering. Thus he will have to know the principles and methods of choosing a medical device as well as the management and safety standards of medical equipment. He will have to master the maintenance of the electronic circuits of the various medical equipments such as the X-ray systems, the scanners, the MRI and the gamma cameras as well as the apparatuses of laboratory and automatons in the departments of biochemistry, hematology, biology etc. ... He will also be able to analyze medical imaging systems such as scintigraphy and gamma cameras, ultrasound and ultrasound and magnetic resonance imaging. It must be able to develop innovative technological care solutions by applying information and communication technologies (ICT) to all health-related activities. He must master the concepts of E-health, M-Health and telemedicine. He is required to become familiar with the electronics of nuclear equipment, including Cobalt
units60, linear accelerators and clinical dosimetry systems. The candidate will have extensive training in medical robotics including handling and micromanipulation in medical settings as well as safety, assistance with manipulation, rehabilitation, movement and surgical robotics.

Embedded systems

The future engineer Electrical Engineering option Embedded systems will have extensive knowledge in mobile development through the knowledge of Android programming, its development platform and the specificities of smartphone embedded development, the conception of artificial vision systems, Advanced coding information, advanced VHDL synthesis for the design of CPLDs, FPGAs and ASICs, SoC design

methodologies and their applications based on new generations of programmable FPGA circuits, ARM processors and applications, sensors intelligent architectures and applications of embedded systems and Radio Frequency Identification (RFID) systems.

Industrial Control

The future engineer Electrical Engineering option industrial control will be able to design the control strategy of any industrial system including electrical machines and mechatronic systems and using the latest techniques and tools by developing mobile applications dedicated to the supervision of industrial systems. Thus it will have to master tools such as industrial sensors and actuators, variable speed drives, classical and intelligent control strategies, Programmable Logic Controllers (PLC), diagnostic and safety methods of operation as well as industrial maintenance techniques. In addition, he is required to know the sources of energy used in order of the systems in particular the renewable energies (Aeolian, solar, ..) and the smartsgrids. Knowledge is complemented by training in production analysis and management for
scheduling and scheduling in addition to the required quality management skills to provide a simple and practical answer to the requirements of the ISO standard.

Matrix 1: Electrical engineering Common core (two academic years)

Families of skills	**Skills**	**Modules**
General skills	Communication, openness to the socio-economic environment, openness to the international, creativity, initiative, autonomy, self-training	English; French; Communication technique ; Entrepreneurship; HRM; work law; Traineeship ; EPP; PFA; PFE
Electrical circuit design	Simple electrical circuits, basic laws, dipoles, qudripoles, filters	Electrical circuit
Electrical installation	Electrical equipment, basic diagrams, lighting circuits, remote switches, timers, intercoms, gaches, ...	Electrical schemes, electrical installations
Computer and Industrial Informatics	- operating systems and object-oriented programming languages (C ++ and JAVA) - Architecture and programming microprocessors, addressing modes, memories, inputs and outputs - Programmable logic controllers and automated systems	Microprocessors and Assembler Programming, API and Automated Systems
Study and design of electronic circuits	- Basic analog electronics combining rectifying circuits such as diodes and amplification such as transistors, assemblies using operational amplifiers, oscillators and power amplifiers - Electronic Diagram: CAD in Electronics, PCB Design - Digital electronics that processes the numbering system, codes, basic logic functions, combinational logic circuits, sequential logic or scales, counters, down-counters and registers - Power electronics that process power electronics components (Thyristor, Diode Triac), rectifier, single and three phase dimmers. Static converters (chopper, inverter, rectifier, ..) - Special circuits: DSPs, microcontrollers, programmable circuits and VHDL synthesis and interfaces.	Analogical Electronics 1, Analogical Electronics 2, Combinatorial and sequential logic, CAD, Power electronics 1, Power electronics 2, DSP, interfacing techniques, VHDL synthesis, programmable circuits, micro-controllers
Study of Networks and Electrical Machines	- - Knowledge of electrical networks, voltage drop, active power, reactive and apparent.	Electrical Engineering 1, Electrical Engineering 2, Synchronous Machines, Asynchronous

	- - Knowledge of the transformers mon and three-phase - - Electrical DC machines, generator and motor, starting, torque, speed, runaway - - Synchronous ac electrical machines: Alternator and asynchronous motor - - Asynchronous AC Electric Machines: Motor and Generator	Machines
Control of industrial processes	- Continuous linear systems, responses, transfer function - Slave systems - Analysis of the enslaved systems: stability, precision, speed - Synthesis of the slave systems: PID correctors - Sampled systems, transformed into z, sampled transmittances - Sampling servo - Analysis of sampled servo systems: stability, accuracy, speed - Synthesis of sampled systems: PID, dominant poems, pole placement - Modeling in the state space - Commandability and Observability - Advanced Control Techniques: Predictive, Robust, Sliding Mode	Automatic 1, Automatic 2, System Analysis and Control.

Matrix 2 : Electrical Engineering Option Biomedical Instrumentation

Families of skills	**Skills**	**Modules**
General Skills	Basic knowledge in medicine	Physiology and Neurophysiology Biology, Biophysical Anatomy and Atomic and Nuclear Physics
Maintenance of medical equipment	Mastery of the principles of medical devices in medical imaging or radiography including scanners, MRI, gamma camera and X-rays, autoclaves	Equipment maintenance, sterilization safety and standards
Medical Technology	Master the techniques of medical imaging, electronic systems that equip medical devices, medical robotics and telemedicine (E-health).	Medical imaging techniques, electronics and nuclear instrumentation, medical robotics, E-health
Hospital management	Quality of equipment, acquisition of equipment (markets, cost,	Qualitology and Computer Aided Maintenance

	maintenance periodicity	Management
Biomedical Instrumetation	Measuring instruments used in maintenance, sensors	Biomedical Instrumetation

Matrix 3 : Electrical Engineering Option Embedded systems

Families of skills	Skills	Modules
Theory of Information and Embedded Systems Applications	Introduce advanced image processing techniques, Android programming, its development platform and the specificities of embedded smartphone development, know the basics of source and channel coding on the tools of information theory .	Mobile Development, Artificial and Industrial Vision, Advanced Coding of Information
Digital Systems	Master the VHDL language for the design of CPLDs, FPGAs and ASICs. Introduce SoC design methodologies and their applications based on new generation FPGAs.	Advanced VHDL: Architecture and Simulation Prototyping SOCs on FPGAs
Architecture and Design of Electronic Systems	ARM7TDMI heart-based microcontroller architecture, and more specifically those of the NXP LPC2xxx or STM32 family, intelligent sensor design	ARM Processors and Applications, Smart Sensors, RFID: Radio Frequency Identification
Introduction to embedded systems and real-time systems	Know the architecture and the design of an embedded system under Linux, Translate a given problem in hardware and software solution for an embedded system	Linux for embedded systems Embedded systems: architectures and applications

Matrix 4 : Electrical Engineering Option industrial control

Families of skills	Skills	Modules
Machine control	Master the control techniques of DC and AC electric machines for industrial needs. Use of renewable energies and speed controllers for the control	Control of electrical machinery, Renewable energies and Smart Grids, Variable speed drives

Systems maintenance	Detection of system malfunctions and knowledge of maintenance and maintenance techniques in view of the safety of their operation	Techniques and methods of industrial maintenance, Diagnosis and safety of operation
Control of systems	Piloting techniques for industrial processes including mechatronic systems and intelligent control studies including fuzzy control and neural control	Control of Industrial Systems by PLC, Sensors and Industrial Actuators, Intelligent Controls, Modeling and Control of Mechatronic Systems,
Industrial Process Management	Know the production management methods and methods in planning-scheduling.Respect of the ISO standard	Production Analysis and Management, Quality Management
Internet of Things and Mobile Development	Know the programming in Android, its development platform and the specificities of embedded development on smartphone.	Internet of Things and Mobile Development