# NATIONAL EDUCATIONAL PROGRAM FOR

# SPECIALISED UNDERGRADUATE TECHNOLOGY DEGREE

## in *Electrical Engineering and Industrial Computing (EEIC)*

Montpellier Institute of Technology
University of Montpellier – France

**two-year course degree (4 semesters)**

## DETAILS OF THE MODULES

| 1st SEMESTER<br>30 ECTS | ECTS | 2nd SEMESTER<br>30 ECTS | ECTS |
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| Components, Systems and Application - Introduction<br>UE11 | 12 | Components, Systems and Application - Development<br>UE21 | 12 |
| **Ener1 Energy: electrical networks**<br>Ability to conduct measurements of an electrical distribution system, particularly three-phase current.<br>Simple and complex dimensions, Coupling, Power, Distribution networks.<br>Selection and dimensioning of cables and protection for low voltage (<1000V), calculating short-circuit currents in low-voltage, Earthing system, electrical certification B2V | 3 | **Ener2 Energy: conversion**<br>Materials used in electronic technology<br>Magnetic materials: characteristics and uses of classic magnetic circuits, permanent magnets, applications,<br>Sinusoidal coiling, pressurized flow, Boucherot's theorem, Carrying out an induction, air gap,<br>Transformers: Schematized diagram, tests, power reading.<br>Introduction to electromechanical converters:<br>basic principles of rotary motors, direct current motors, basic parameters (emf, speed, coupling), reversibility, Introduction to speed control and coupling,<br>Single-phase rectifiers:the purpose of direct – alternating current conversion, building non-controlled voltage rectifiers, filtering and smoothing and regulation circuits. | 3 |
| **SIN1 Digital Systems**<br>Knowing how to organize a function into its constituent assembly blocks and sequences,<br>Knowing how to select and set up a standard or programmable digital circuit,<br>Knowing how to use a development sequence (simulation and synthesis),<br>Knowing how to program, simulate and test a programmable logic circuit.<br>Basic operators of the combinational and sequential logic,<br>Digital information: electricity levels, logic conventions, immunity from noise, codes<br>Circuits : electrical aspects, logic families, voltage levels, current fluxes, dynamic parameters, decoupling rules, types of outputs, energy use and speed<br>Synthesis methods: hierarchical visualization, combinational and sequential logic, synchronous finite state machines,<br>User programmable devices (CPLD,FPGA …) : architectures and technologies<br>Language for describing the material: general principles, simulation of functions, synthesis. | 3 | **Auto2 Industrial Automatism**<br>Structure of industrial automation,<br>Architecture of a programmable industrial automat,<br>*Input / Output of industrial systems for a programmable logic controller (PLC): specialized boards, sensor*<br>*cables, pre-actuators (standardized diagram),*<br>Analysis and criteria of technological choices for industrial needs,<br>Standardized programming language IEC 1131-3 and GRAFCET and set up techniques,<br>*Analysis and industrial process commands from specification sheets*<br>*Start and stop modes for a logic controller* | 3 |

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| **Info1 information technology**<br><br>Use of a micro-computer: file system, user rules, using computers in networks<br>The process involved in creating a simple computer application:<br>Identify the objects for processing and characterizing them (everything involved with the kinds of variables and especially the simple ones, user parameters, organization),<br>Identify the required processing and its logical organization (everything involving command functions),<br>Organize the application (with regard to all aspects of functions: results, parameters, prototypes),<br>Using an integrated program development environment: project management, publishing and documentation of source files, compilation, using basic libraries, editing links, and adjustments. | 3 | **Info2 Embedded industrial computing**<br><br>The material assembly of a microcontroller.<br>Study of the addressing for a given component, the type of memory and its place in the architecture of the processor,<br><br>communication serial (I2C, SPI, RS232) or parallel interfaces<br>Use of timers, capture/compare/PWM<br>Interrupts (sources, priority, vectors, stack...)<br>Langage C, microchip tools (MPLAB) | 3 |
| **SE1 Electronic systems**<br><br>General electricity laws<br>Current and voltage sources<br>Description of the baseline signals and their characteristic dimensions<br>Analysis of electrical circuits in both sinusoidal and continuous systems<br>Complex impedances<br>Analysis of the Fundamental systems of the first order<br>Time and frequency factors in first order systems<br>Bode diagrams<br>Diagram of units and their associations<br>Transfer functions, gain, passband, …<br>Definition of the basic functions of Electronics<br>Electronic components and their use: Operational amplifiers, diodes, transistors, Principles, Applications. | 3 | **SE2 Electronic systems**<br><br>Introduction to spectral analyses<br>The concept of filtering and its applications.<br>Fundamentals of second order systems: description of the time and frequency domains, introduction to higher-order systems, use of CAD tools (filters).<br>Amplification, input - output impedances, bandpass,<br>Integrated circuit components in amplification, Power amplifiers<br><br>Generating non sinusoidal signals:<br>Operational amplifiers (Op-amp) and non-linear imperfections,<br>Feedback loop, triggers,<br>Astable circuit in op-amps and logic gates,<br>Generation of triangular signals. | 3 |
| **Innovation through Technology & Projects - Introduction**<br>**UE12** | **10** | **Innovation through Technology & Projects - Development**<br>**UE22** | **9** |
| **OL1 Software tools**<br><br>Knowing how to plot a function (trigonometric functions, exponential, logathitmic) with a software. How to exploit it (symetry, frequency, advance or delay/leading phase)<br>Polynomial approximation, solving equation, Bode diagrams (Matlab) | 2 | **OL2 Software tools**<br><br>Numerical integration, Numerical solution to differential equations using the Euler method and using Laplace Transform | 1.5 |

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| **ER1 Studies and Projects**<br><br>Objectives:<br>Setting up an industrial technical project,<br>Making use of the knowledge and know-how from the EEIC in order to handle a specification sheet,<br>Learn a systematic work process: functional, operational, technological approach to a given system,<br>Learn the quality factors and project management.<br><br>Course Content:<br>Analyze an existing technical case solution,<br>Research documentation and use information,<br>Manage a project: specification sheet, technical choices, costs, schedules, industrial constraints and handling of a quality management system,<br>Use the material elements and software with the help of the manufacturer's documentation,<br>Design all or part of a functional or structural chart of an algorithm and its associated code, including a sequencer and its associated code,<br>Set up a prototype,<br>Validate a technical solution (measurements or simulations) with respect to the specification sheet,<br>Draft technical documents associated with a project. | 2 | **ER2 Studies and projects**<br><br>See ER1 "Studies & Project"<br><br>Same goals but "Development" | 3 |
| **R1 Projects**<br>continuation of ER1 objectives and methodology | 2 | **PT2 Tutored Projects**<br><br>in continuation with ER2 "studies & Project" , this module helps the students to become self-sufficient.<br>Application to a small project of the project management methodology. Writing of a Report and Oral presentation. | 2 |
| **PPP1 Personal and professional project**<br>**Discovery of professions and professional environments**<br><br>Objectives<br>To enter into a dynamic relationship in regard to training (knowing oneself better in order to be more successful),<br>To encounter the workplace and its environment in order to examine and improve one's motivation,<br>To become familiar with the jobs in a given sector and more generally with the placement available to holders of a UDT EEIC diploma,<br>To assess the requirements that these jobs demand,<br>To contrast one's prior attitudes towards these EEIC jobs with their reality.<br><br>Course Content<br>Documentary research about jobs, regional businesses in this sector,<br>Establishing an initial contact with professionals from this sector,<br>Explore the knowledge base and skills needed for these jobs, educational/training requirements. | 1 | **PPP2 Personal development focus on the entreprise training**<br><br>Objectives<br>Refine personal and professional goals based on the exploration of the job market undertaken in PPP1,<br>Pursue the definition of educational curriculum,<br>Plan Internship<br><br>Content<br>Personal assessment: personal capacities, strong points, weak points, etc<br>Job search techniques: classical tools (cover letters – Résumé), phone communication, tests,<br>Training for the job interview,<br>Methods for drafting professional correspondence (executive summary),<br>Efficient communication: assessing yourself and being assessed by others on the efficiency of your communication skills are. | 1 |

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| **CP1 Introduction to project management**<br><br>Understanding of a project in its environment and the differents partners. Sequencing, partners, team, how to communicate, documentation to edit, ...Application to “Studies & Project” module | 1 | **CP2 Project management**<br><br>Ability to read and to write a specification sheet<br>Functionnal analyses, tasks, sequencing... | 1.5 |
| **PT1 Tutored Project Methodology**<br><br>Information and searching for documents<br>Documenting oneself, collecting and analyzing information,<br><br>Producing documents, summarizing oral presentations. | 2 | | |
| **Human Development & Scientific Training - Introduction**<br><br>**UE13** | **8** | **Human Development & Scientific Training - Development**<br><br>**UE23** | **9** |
| **MA1 Fundamentals of Analysis ,**<br>**Fundamentals of algebra and trigonometry, complex numbers**<br><br>Study of usual functions, continuous functions using intervals, odd and even parity, peridicity, derivatives.<br><br>Trigonometry and trigonometric functions,<br><br>Complex numbers (module, argument, square root, cubic root, Euler formulae), Second degree equations with complex coefficients | 2 | **MA2 Mathematics :Integral calculus, differential equations**<br><br>Integral calculation techniques<br><br>Differential linear equations of first and second order, with constant coefficients<br><br>Decomposing rational fractions into simple components<br><br>Laplace transfom | 3 |
| **EC1 Expression for communication : fundamentals**<br><br>Mastering key elements of communication,<br><br>Using verbal and non verbal communication,<br><br>Understand how to breakdown and analyze communication, vocabulary enrichment, note taking, drafting methods and techniques, awareness of cultural environment | 2 | **EC2 Information, communication, argumentation**<br><br>Documenting oneself, collecting and analyzing information,<br>Knowing and analysing medoa for general public and specialized media<br>Techniques for argumentation<br>Structuring one’s personal outlook<br>Producing documents with respect to various standards. | 2 |
| **AN1 General English for everyday use**<br><br>To continue the language acquisition of secondary education, to introduce students to simple English that is useful for their studies, at the workplace and in their personal life, improve the oral comprehension of standard English | 2 | **AN2 English for general and professional communication, reinforcing oral comprehension and expression.**<br><br>Continue the language acquisition in module An 1 so that the students can reach a level of comfort using simple English in personal or professional communication<br>Reinforcing the comprehension of standard oral English<br>Reinforcing oral expression. | 2 |

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| **P1 Physics: Thermics – Mechanics: fundamentals**<br><br>Thermal phenomena<br>Heat transmission: conduction, convection, radiation,<br>Thermal calculations (resistance and thermal capacity: schematized renderings).<br>Concept of transitory states using a simple case study.<br>Fundamental comcepts in machanics: kinematics, dynamics, energy | 2 | **P2 Physics: Introduction to Electromagnetism and Sensors**<br><br>Electromagnetism: Concepts in electrical fields and charges, concepts in magnetic fields, Induction and self-induction, Laplace force<br>Sensors: Measuring chain and gauging, Metrology, temperature, position, pressure sensors, mechanical dimensioning. | 2 |

| **3rd SEMESTER**<br>**30 ECTS** | **ECTS** | **4th SEMESTER**<br>**30 ECTS** | **ECTS** |
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| **Components, Systems & Application – Deepening**<br>**UE31** | **11** | **Industrial internship**<br>**UE41** | **12** |
| **Ener3 Energy: conversion**<br><br>Static phase circuit breakers :<br>DC-DC : choppers, switched-mode power supply,<br>DC-AC : Inverters for high voltage applications and PWM (pulse-width modulation)<br>Organization and principles of alternating current motors (rotating field, generator, asynchronous motors)<br>Association asynchronous motors, inverters. | 2 | **ST4 10-week training placement** | 12 |
| **Au3 Automatics: Servo-systems, Regulation**<br><br>Time and frequency features of the systems, pure delay effect, integration systems<br>Closed loop system: Direct sequence and return sequence. Calculation of the transfer function in a closed loop, stability<br>Experimental identification procedures<br>Role and general structure of correctors (P, PI, PD, PID), synthesis of correctors (phase margin...)<br>Ziegler and Nichols procedures<br>Validation of a corrector with CAD. | 2 | | |
| **Res3 Networks**<br><br>Concepts and classifications of communication networks,<br>Basic understanding of transmission,<br>Hardware and cabling, | 2 | | |

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| Organization and exchange of network grids,<br>Access pathways,<br>The OSI model,<br>Network standardization,<br>Study of industrial networks on the market, Ethernet (TCP/IP),CAN, KNX) | | | |
| **SE3 Electronic systems**<br><br>Generating sinusoidal signals:<br>Conditions for oscillation in a closed circuit, Piezoelectric resonators (quartz)<br>Phase lock loops (PLL) : Structure and near-static functioning,<br>Linear analysis of locked loops: modeling and responses to varying stimulus,<br>Applications : frequency synthesis.<br>Basic principles of analog modulation and demodulation (analog(AM/FM) | 2 | | |
| **MC-POO Object-based programming**<br><br>To think in terms of objects : define a class, define an object, establish links between objects, constructors, destructors, interfaces, methods, properties, internal objects<br>Build a Java, in C++ application<br>Standard PLC, especially graphic PLCs. | 1.5 | | |
| **MC-EnR Renewable Energies: production & storage**<br><br>General information on Energy (definition, measurements, power, energy, evolution of energetical needs), the different types of Energy, their transformation, main sources for the production of electricity (fossil, renewable)<br>Study of rotating machines as generators<br>Principles of electricity supply from solar power, wind power, hydraulic<br>Devices for storing electrical energy | 1.5 | | |
| **Innovation through Technology & Projects - Deepening**<br>**UE32** | **11** | **Innovation through Technology & Projects – Strengthening**<br>**UE42** | **12** |
| **OL3 Software tools**<br><br>Spectral analyses, Fourier transform, sampling | 2 | **I&C Instrumentation and Sensors**<br><br>Electronics for sensors, programmable instrumentation, introduction to LABVIEW | 1.5 |
| **ER3 Studies and projects**<br><br>See ER1 “Studies & Project”<br>Same goals but “Deepening”<br>robotics, microprocessor and communication (USB, I2C, SPI, UARI) | 3 | **ER4 Studies and projects**<br><br>See ER1 “Studies & Project”<br>Same goals but “Strenghning”<br>robotics, national robot contest, home automation, multi-technique systems | 2 |

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| **PPP3 Setting up a personal project**<br>Refining personal and professional goals based on the exploration of the job market undertaken in PPP1,<br>Pursuing the definition of educational curriculum,<br>Learning about the financial and time implications of the educational plan,<br>Be informed about the educational requirements necessary for one's project,<br>Adapting one's curriculum to the industries particularities and personal wishes and abilities.<br>Educational offer from the various departments: possible supplemental modules, Post-UDT education. | 1 | **PPP4 Internship : an asset to integrate the professional world**<br>How to use the internship for future professionnal integration | 1 |
| **CP3 Project management: product lifecycle**<br>Understanding principles for entrepreneurship<br>Understanding product lifecycle, financial aspects, environmental impacts, marketing | 1 | **FPGA Complex programmable logic devices**<br>architecture, programming, interfacing, applications | 1.5 |
| **C1 Digital Signal Processing**<br>he processing tools for digital signal processing :<br>Review of the Z transform, Passing from the Z transfer function to a computer program (difference equation), Use the Z transform, delay theory.<br>Structure of a digital system, Synthesizing simple digital filters, synthesizing RIF and RII filters, DSP realisation. | | **TELECOM Telecommunication & Hyperfrequency**<br>Supplemental material on propagation phenomena,<br>Standing waves and progressive waves,<br>Methods and tools used in the analysis and synthesis of circuits and radiofrequency systems: Smith diagram<br>Antennas :<br>The role of antennas in a transmission system,<br>Distant field behavior: electrical and magnetic fields, radiation chart, gain, directivity, radiation power, transmission measurements<br>The different types of antennas: wire, parabolic, patch,<br>Analog frequency modulation and demodulation,<br>Transmission in baseband, NRZ, RZ, manchester<br>digital modulation and demodulation , ASK, FSK, PSK, QPSK, QAM<br>Scrambling, spread spectrum | 1.5 |
| **PT3 Tutored Projects**<br>same goals as PT2 | 2 | **PT4 Tutored Projects**<br>same goals as PT2 | 1.5 |
| | 2 | **SupV Supervision**<br>The place and rôle of supervision in businesses, the funcions filled by supervision: operation, maintenance, quality, production management,<br>Processes and man-machine interfaces, graphic presentations,<br>Standardization,<br>Study, configuration and set up of an industrial supervision software system,<br>Software interface techniques for the acquisition and sharing of information, | 1.5 |

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| | | Coupling of databases and supervision, Concepts in remote supervision via Internet, safety<br>Sofwares: UNITY , PC View …. | |
| | | **OS Embedded Programming with Operating Systems**<br>Embedded linux , web server, RASPBERRY Pi | 1.5 |
| **Human Development & Scientific Training - Deepening**<br>**UE33** | **8** | **Human Development & Scientific Training - Strengthening**<br>**UE43** | **6** |
| **MA3 Math**<br>Fourier series, Dirac pulse, convolution, matrices: definition ans elementary properties | 2 | **STAT Statistical Process Control – Reliability**<br>Knowing the principles and basic laws of probability and their application in statistical descriptions. Understand the concepts associated with reliabilityproblems.<br>Random variables,Usual probability laws, Reliability, Hypothesis testing. | 2 |
| **EC3 Communicating & Integrating the professional world**<br>Job search techniques: classical tools (cover letters – Résumé), websites tools for companies ans job searching,<br>Training for the job interview, Methods for drafting professional correspondence (executive summary),<br>methodology for internship report and oral defence. | 2 | **EC4 Buisness communication**<br>Communicating efficientlty at the workplace, the importance of professional networks, teamwork skills, leading a meeting | 1 |
| **AN3 Perfecting general, professional and specialised English**<br>Continue with the language acquisitions from module An1 and An2 so that the student can be proficient using English in varied personal and professional situations,<br>Reinforce oral expression in order to be handle a growing number of situations, both professional and other ones, where communication is required,<br>To become familiar with the language of the specialized program. | 2 | **AN4 English: communication tools, public speaking abilities in the professional world**<br>Get a thorough knowledge of communication tools (meeting, group work, video-conference...) and develop public speaking abilities in the professional world, Prepare interns for their internships in English-speaking countries | 2 |
| **P3 Physics: Propagation & EMC**<br>Propagation in cables: line in pulse mode, reflection phenomena, impedance matching, attenuation in a line.<br>Electromagnetic compatibility : concepts of electromagnetic waves, the types of noises, coupling processes, mass-derived and potential reference problems, shielded and unshielded cables, regulatory aspects<br>Optical electronics : Fundamental concepts in geometrical optics, photometric dimensions, Basic concepts in semi-conductor Physics, Emitting devices (LED, LASER), Photoreceptors, solar cells, CCD ... | 2 | **CDE4 Understanding companies**<br>The organization of the corporate structure: characteristics, organization and internal functions, the company-employee relation, management<br>Business unit: the economic activity of the firm, accounting documents, cost prioritization, marketing<br>The internal dimension of a company: corporate culture and image, Introduction to competitive intelligence. | |