Course title

Advanced Technician for mechatronic systems

Course profile

Advanced technicians for mechatronic systems work in the design and industrialization of the mechatronic system in agricultural machines, machines for lifting and moving earth, automatic systems, industrial robotic devices and in logistics. They combine different technologies for control, programming, regulation, as well as managing the continuous improvement of the efficiency of the system, the machine or an automatic device. They use representation and simulation software, identify electrical/electronic operations, IT, hydraulic, fluidic, pneumatic, and engine operations to optimize the performance of the mechatronic system and encourage the development of innovative solutions, and develop the prototyping and the production of innovative solutions. Technicians test, carry out installations and perform maintenance. They check the quality and efficiency of products with diagnostic and measuring instruments.

Organization (main teaching, training and verification methodologies)

The main learning activities include:

- General courses in linguistic, communicative, relational, scientific, technological, legal, economic, organizational and managerial fields;
- Teachings of a technical-professional nature both common to the reference area (Made in Italy Technologies - Mechanical System) and specialist/distinctive of the profile.

The course is carried out in 2 full-time annuities, which constitute a student workload total of 1,500 hours.

The workload includes all the training methods:

- In the classroom;
- In didactic laboratories in offices equipped with software, systems and tools for exercises and checks, also installed at member companies/partners;
- Project Work/Research Project;
- Internship;
- Individual study.

Most of the teaching hours are entrusted to member companies or partners, who provide experts and/or in the company setting with related technological equipment, laboratories, plants and technical documentation.

40% of the work takes place in the company through an internship and establishing a strong link in the production fields.

Guided visits are also provided to leading companies and to laboratories and research centres both in and outside the Region. Visits to events or fairs abroad may also be possible.

Methodologies and verification criteria

At the end of the course there will be a final exam for the release of the Advanced Technician diploma. The assessment of learning outcomes is also carried out at the end of each training unit, with the following criterion:

- Practical exercises to verify and evaluate the learning outcomes of the training units which provide for the prevalence of active and laboratory teaching methodologies and/or learning focused on the technologies in use;
- Written exercises to verify and evaluate the learning outcomes in theoretical training units which involve the use of traditional teaching methods.

Disciplinary area of reference (ISCED - F)

0715 Mechanics and metal trades.

Job title (national classification/standard)

Advanced technician for the innovation of processes and mechanical products.

Level

QF - EHEA: short cycle qualification

EQF: level 5

Total ECTS credits

120

Learning outcomes of the study course

At the end of the training path the student will be able to:

- Manage communication and relational processes within and outside the organization both in Italian and in English;
- Master the linguistic tools and information and communication technologies to interact in the workplace;
- Arrange, negotiate and develop activities in working groups to tackle problems, propose solutions, help in production, order and evaluate collective results;
- Organize and use information, data and their aggregations;
- Use statistical tools and models in the description and simulation of the different scenarios of the reference area;
- Develop and implement design, prototyping and industrialization techniques;
- Intervene in all segments of the supply chain from production to marketing;
- Manage production flows in programming, control and cost-effectiveness, also in relation to the methods of industrialization and continuous improvement;
- Configure, calibrate, document and maintain automatic systems of different types;
- Use measuring and acquisition instruments;
- Design and program acquisition, supervision and control systems;
- Choose and configure PLC/Pneumatic Robots controlled by PLC.

Year I

Area/ Range	Competence objectives for national classification/ standard	Module	Main contents	Learning outcomes of the unit	Methods and criteria for verifying results	Learning methodologies, contexts and related workload (hours)	ECTS credits
General skills in organizational and management fields	Recognize, evaluate and resolve conflicting situations and work problems of a different nature: technical-operational, relational, organizational. Manage external relationships and collaboration: interpersonal and institutional, and evaluate their effectiveness. In specific contexts learn, analyse, apply and monitor management models of production processes for goods and services. Analyse, monitor and control the production processes in order to formulate proposals/ identify solutions and alternatives. Overall aim is to improve the efficiency and performance of	Elements of design and visual communication - dynamics of interpersonal and group communication	"Communicating" simulation work contexts, collaborative work (outdoor at IAL, Teambuilding in the commercial kitchen and in the classroom); Manage communication in a professional and corporate context: organise collaborative projects with company personnel.	Communicate and develop activities in working groups, connect with company representatives and start sharing the dynamics of organizational and corporate communication.	Method: Debriefing of outdoor activity. Briefing and Debriefing of the collaborative project with company personnel. Criteria: The student will have to demonstrate the ability to work in a group by communicating effectively and appropriately with respect to interlocutors and in context.	Classroom / laboratory: 28 hours Project Work: 8 hours Individual study: 44 hours	3

	technological and human resources used to enable continuous improvements.						
General skills in communicative and relational linguistic field	Use technical English (micro-language), related to the technological field, to be able to communicate correctly and effectively in the contexts in which technicians operate. Manage communication and relational processes inside and outside the organization both in Italian and in English.	Technical and professional English – basic level	Micro language. Technical English. Revision of basic grammatical language.	Use English in a technical and organizational context.	Method: Language assessment tests. Criteria: The student will have to demonstrate mastery of the technical terminology in the field and grammatical and syntactic correctness, as well as fluency in language conversation.	Classroom / laboratory: 30 hours Project Work: 6 hours Individual study: 54 hours	4
	Prepare technical and regulatory documentation to be managed through the telematic networks. Organise, negotiate and develop activities in working groups for problem solving, propose solutions, help produce, order and evaluate collective results.	Coding, Modelling and Solving	Analysis, synthesis, abstraction and problem solving, class diagram, sequence diagram, flow diagram, pseudocode, UML, C ++, user stories, agile methodologies and waterfall. SW applications for the digitalization of business processes and the efficiency of standardisable and programmable tasks. Automatic algorithms aimed at energy efficiency and reduction of the environmental impacts of production plants.	Analyse, synthesize, abstract, and solve problems of efficiency/ reduction of environmental impact and standardization of processes. Modelling reality in classes. Read and produce sequence and flowcharts. Write and read pseudocode. Learn programming in C ++ and UML. Interpret usage stories related to standardization and efficiency/reduction of the environmental impact of business processes and design SW solutions with agile and cascade methods. Solve problems of	Method: Exercise. Criteria: Starting from the analysis of a business case, the student will have to demonstrate the ability to solve problems related to efficiency/reduction of environmental impact and standardization of processes through programming.	Classroom / laboratory: 44 hours Individual study: 49 hours	4

				efficiency and standardization of processes by programming.			
	Master the linguistic tools and information and communication technologies to interact in daily activities and in a work context.	Digital tools for collaborative work, presentation and communication	Fundamental assets of collaborative work tools: speed, accessibility, usability, sharing and security. Using e-mail as a contact and repository tool (risks and opportunities). Mobile and multi-channel work (access to content from a PC, notebook, smartphone or tablet). Collaborative exchange applications (video collaboration platforms, Whatsapp, WeTransfer and Skype). Transparent and traceable management tools for company workflows: technological solutions for the convergence of office automation, document management and management systems (coediting, self-service analytics, personal archiving). Platforms and web promotion tools (Facebook Ads, Google AdWords) and organic positioning and search engine optimization (SEO).	Learn how to use online collaboration tools; how to use presentation and communication tools; how to intervene in digital communication activities: digital marketing, positioning and optimization on search engines (SEO).	Method: PC practice test. Criteria: The student must demonstrate the use of online collaboration tools and/or via presentation and communication.	Classroom / laboratory: 16 hours Individual study: 14 hours	*1*

General skills in science and technology	Use mathematical and statistical tools and models in the description and simulation of different phenomenologies in the specialist field, in the application and development of appropriate technologies.	Applied Mathematics	Elementary functions and their graphs. Derivatives and optimization problems. Applications to the mechatronics of the modules of algebraic formulas. Analytical geometry: straight lines, parabola, hyperbola. Protractor and trigonometry matrices and linear systems.	Learn: elementary functions, derivatives; how to solve optimization problems. Recognize and use mathematical models in solving application problems in the mechatronic field.	Method: Written exercises. Criteria: Ability to apply the following mathematical concepts: elementary functions, derivatives, algebraic formulas, analytical geometry, protractor and trigonometry, matrices and linear systems.	Classroom / laboratory: 20 hours Individual study: 30 hours	*2*
General skills in legal and economic fields	Know the relevant rules governing the company and the impact for the company in a territorial context. Find the sources and apply the regulations that regulate the life of the company and its external relations at national, European and international level.	Safety in the workplace	Learn the law on Health and Safety in the company	Learn and apply the legislation on mandatory safety in the workplace and in the technological-production field system	Method: Written test Criteria: The student will have to demonstrate knowledge of the regulatory provisions on health and safety in the workplace	Classroom / laboratory: 16 hours Individual study: 24 hours	*1*
	Use negotiation strategies and techniques with reference to the market in which companies in the sector also operate to strengthen their image and competitiveness.	Management methods as business processes (method: ‘Lean production’)	Business process quality, SAG, Lean Organization - Prevention and Protection, Environmental quality, UNI EN ISO 14031: 2000.	Manage the improvement of the quality of the production processes, also with a view to Lean production.	Method: Business case analysis. Criteria: The student must demonstrate the knowledge and ability to apply quality management systems with a Lean approach to business processes.	Classroom / laboratory: 32 hours Individual study: 48 hours	*3*

Skills common to the Technical-Professional Area	Research and apply technical and safety regulations of the electrical, electronic and mechanical sector in the design and use of components.	Machinery directive and CE marking of electrical and electronic products	Machinery directive and CE marking of electrical and electronic product, RED directive (Radio Equipment Directive). User manuals, instruction manuals, catalogues, technical files.	Apply the Machinery Directive and related standards. Apply the Product Directive with particular attention to the CE marking of electrical and electronic products, the EMC Directive, the Low Voltage Directive, the RED Directive on the CE marking of radio devices. Understand and draw up technical documentation.	Method: Project work evaluation, laboratory exercises, written test. Criteria: The student must demonstrate knowledge of the Machinery Directive and CE marking of electrical and electronic product, RED Directive and related standards.	Classroom / laboratory: 34 hours Project Work: 8 hours Individual study: 24 hours	*3*
	Develop and implement design, manufacturing and prototyping techniques.	Graphic representation techniques and international rules for technical drawing	Infographic methods and techniques in the analysis of technical representation. ISO, CEN, UNI regulatory bodies. Basic technical drawing standards (EN ISO 128). Dimensioning systems. Dimensional and geometric tolerances, surface state and roughness. Designation of metals. Composition and table setting of parts and assemblies.	Ability to read and codify technical drawings to correctly and effectively document an industrial product from design to manufacture	Method: Theoretical and practical verification of reading technical tables Criteria: The student will have to demonstrate they are able to interpret mechanical technical drawings	Classroom / laboratory: 30 hours Individual study: 16 hours	*2*
		Technical and mechanical drawing with 3D CAD systems	Work areas, spaces and interfaces. Management of 2D and 3D geometric and graphic primitives. Parameterization, relationships and functional dimensions. Simple and advanced solidification functions. Editing and completion. Views and renders. Assembled bound. Table setting and layouts. Fixed and mobile connecting parts. Threads, screws and bolts. Riveted. Solders. Motion transmission - Rigid and elastic joints.	Use CAD systems for the 3D graphic representation of single parts, mechanisms, machines and mechanical assemblies complete with technical charts.	Method: Practice Test. Criteria: The student must demonstrate their ability to use 3D CAD systems for the realization of a complete mechanical technical drawing.	Classroom / laboratory: 24 hours Individual study: 11 hours	*1*

	Identify the materials, relative processes and treatments suitable for the various uses in the field.	Mechanical design elements and strength of the BASIC materials	Elements of Mechanics applied to machines, rigid materials, strength criteria, stresses and simple stresses, stresses and compound stresses, examples and studies of motion transmission mechanisms.	Knowledge of static of rigid materials and in the most common mechanisms, as well as the technological and mechanical strengths criteria of metallic materials. Knowledge of the basic problems associated with mechanical design. If requested: ability to calculate (check or design) a section of beam with a straight axis.	Method: Problem solving, final written test. Criteria: The student will have to demonstrate knowledge of the basic problems associated with mechanical design and resistance characteristics of materials.	Classroom / laboratory: 38 hours Project Work: 8 hours Individual study: 24 hours	*3*
	Choose the processing technologies and relative machines on the basis of the required technical-economic characteristics.	Programming of CNC machine tools with ISO language	Structure, technical characteristics and commands of a CNC machine tool; exercises on CNC; drawing up of programs (from design) and video graphic verification; practical execution of some artefacts.	Learn how to use and program numerical control machines, to intervene profitably within industrial processes in the CNC field. Learn how to deal with problems in the CNC field and creating programs for various processes.	Method: Written test (ISO programming). Criteria: The student will have to demonstrate an ability to program numerical control machines.	Classroom / laboratory: 28 hours Individual study: 15 hours	*2*
		Motion technology in agriculture	Diesel engines. Electronic controls management. Applied hydraulics. Mechanical and hydraulic transmissions (first part). Universal communication protocol Tractor SAEJ derivation tool 1939.	Learn how to recognize the fundamental parts of engines most used in agriculture; how to recognize and choose the most appropriate mechanical and hydraulic transmissions according to its purpose, in the agricultural sector; how to choose and use the most suitable electronic and control components to	Method: Written test. Criteria: The student must demonstrate knowledge of the engines most used in agriculture, transmission components, control components and the logic of application and verification of the tractor-implement communication protocol	Classroom / laboratory: 20 hours Individual study: 10 hours	*1*

				manage power transmissions in the agricultural sector. Learn the application logic of the ISOBUS communication protocol.			
	Configure, calibrate, document and maintain different types of automatic systems.	Electric actuators and drives	Electric motors (continuous, asynchronous, step-by-step, brushless), static power converters, drives with electric motors and servomotors, contactors, relays. Efficiency classes of electric motors and IEC 60034-30: 2008 standard.	Learn how to recognize and choose electric actuators by applying principles and devices to the base of electric drives, to choose and use the main command and protection devices. Learn how to evaluate the energy savings deriving from the increase in the efficiency class of motors and/or from the use of frequency converters.	Method: Written test with open and closed answer questions. Criteria: The student must demonstrate knowledge of electric actuators and drives and the efficiency criteria of electric motors	Classroom / laboratory: 38 hours Project Work: 8 hours Individual study: 24 hours	*3*
		Automatic pneumatic systems	Power and command circuits, power and control devices, basic pneumatic symbology, emergency methods.	Configure, calibrate and document automatic pneumatic power and control systems.	Method: Written examination with closed, open questions, application exercises and laboratory tests. Criteria: The student will have to demonstrate knowledge of automatic pneumatic systems.	Classroom / laboratory: 36 hours Individual study: 20 hours	*2*
	Program industrial automation systems (PLC, robots, CNC machines, communication networks, monitoring and diagnostics systems, etc).	PLC programming with BASIC ladder graphic language	Ladder language Siemens S7 Lite development interface. PLC Ladder programming.	Perform PLC programming via ladder.	Method: Written verification of content and programming. Criteria: The student will have to demonstrate they can perform PLC programming via Ladder.	Classroom / laboratory: 38 hours Individual study: 22 hours	*3*

		Connection and IoT	Hardware Features, Development Environment, Rebooting and Shutdown, Connecting to a LAN, Creating a project, LED blinking, GPIO port programming, I2C communication, SPI protocol, UART port usage, Testing and Debugging of programs.	Learn the Raspberry PI platform, developing environment and using programming language. Learn how to recognize and program the input and output ports; how to apply devices to real problems of automation, supervision and control.	Method: Written verification and laboratory test on practical cases. Criteria: The student will have to demonstrate an ability to recognize the factory interconnections enabled by the IoT.	Classroom / laboratory: 20 hours Individual study: 10 hours	*1*
	Intervene in all segments of the supply chain, from production to marketing.	Strategic operational planning and industrial production management	Different types of systems: production, systems, data collection and management. The definition of production cycles, material use coefficients and sizing of a production system.	Apply industrialization logics aimed at reducing costs, increasing product quality, collecting, controlling and managing data related to production processes.	Method: Written verification open questions and simulations. Criteria: The student will have to demonstrate understanding of the industrial production planning and management processes.	Classroom / laboratory: 30 hours Individual study: 20 hours	*2*
Specific skills of the job		Measurement tools	Metrology, Testing, acquisition, sensors.	Use measuring and acquisition instruments - use of transducers for the main physical quantities.	Method: Written verification. Criteria: The student must demonstrate recognition of the main mechatronic measuring instruments.	Classroom / laboratory: 30 hours Individual study: 20 hours	*2*
		Basic programming with graphic language	LabVIEW programming language.	Implement LabVIEW code using the fundamental elements of the development environment	Method: Written verification and laboratory test related to simple problems. Criteria: The student must demonstrate knowledge and use of the LabVIEW programming language.	Classroom / laboratory: 20 hours Individual study: 11 hours	*1*

INTERNSHIP I	Curricular objectives referable to the areas of: a) mechanical design, technical bill of materials and production, planning and production schedule; b) configuration of power, command and control circuits of automatic systems; c) management of programming, control and maintenance of automated systems.	Develop a greater awareness of one's study path, consolidating knowledge acquired in the classroom phase.	Method: Observation and verification of the intern's performance by evaluating their effective exercise of knowledge and skills. Self-evaluation and reworking of the experience by the student. Criteria: The chosen evaluation will include an evaluation judgment of the company tutor and subsequent feedback with the student's self-evaluation by the agency's educational. The result of the combination of hetero and self-evaluation constitutes the summary report of the experience, which will be one of the objects of the final exam.	Internship in the company: 400 hours	16

Total hours in classroom/laboratory/PW in year I: 610
Total internship hours in year I: 400
Total sum hours in year I: 1,010

Year II

Area/ Range	Competence objectives for national classification/ standard	Module	Main contents	Learning outcomes of the unit	Methods and criteria for verifying results	Learning methodologies, contexts and related workload (hours)	*ECTS credits*
General skills in organizational and management fields	Manage relationships and collaborative projects in the organizational structure according to context, evaluating their effectiveness. Organize and manage, with a good level of autonomy and responsibility, the working environment, the human context and technological field in order to achieve the expected production results. Arrange and help to manage the quality organizational models that encourage innovation of companies in the field.	Project communication and business communication strategies	Methodologies for problem solving, group communication in a functional workplace with shared objectives. Communication.	Communicate and develop activities in working groups with the participation of companies, sharing objectives with a functional approach to innovation dynamics. Sharing thoughts on leadership styles.	Method: Debriefing and evaluation on the basis of shared items in relation to the learning objectives Criteria: The student will have to demonstrate an ability to communicate and develop activities in work groups with the participation of companies.	Classroom / laboratory: 12 hours Individual study: 18 hours	*1*

Skills common to the Technical-Professional Area	Master the linguistic tools and information and communication technologies to interact in daily activities and work context.	Technical and professional English - Advanced	Enhancement of communication skills (debating strategies, presentation strategies).	Use technical English of the sector, enhance the use of language skills in the technical and professional fields.	Method: Language assessment tests. Criteria: The student will have to correctly demonstrate technical terminology and grammatical and syntactic correctness, as well as fluency in language conversation.	Classroom / laboratory: 26 hours Individual study: 39 hours	*2*
		Networks	Topologies, operating principles, routing, device configuration, services, design, virtual machines. Packet and circuit switching. Transmission of signals on: copper, fibreoptics, laser, radio waves, WiMAX and WiFi. Choice of the most suitable transmission medium. Learn more about WiFi and related security issues. Study different network topologies. IP addresses and classes. Features of: hubs, repeaters, switches and routers. Client/Server networks and main services: FTP, HTTP, SMTP, IMAP with secure and SSH versions. How DHCP and DNS work. VM virtualization. Firewall devices and charts. Network security issues. NAT and PAT. Operating, use and types of VPN. Reading the network schematics. Examples and design.	Recognize, design, configure, restore networks and main services for the transmission of information between different devices.	Method: Rubric evaluation simulations of significant learning. Criteria: The student will have to demonstrate an ability to recognize, design, configure, restore networks and main services.	Classroom / laboratory: 38 hours Individual study: 47 hours	*3*

	Assess the implication of information flows with respect to the effectiveness and efficiency of the management of production or service processes, also to identify alternative solutions to ensure quality is maintained.	Analysis, use and protection of digital data	Introduction to complex predictive models (inferential statistics and nonlinear systems) based on nonlinear data sets, raw data and large amounts of data to reveal relationships and dependencies and make predictions of results and behaviours. Presentation of analysis and data mining tools for emerging technologies based on cloud computing and distributed computing: Hadoop, MapReduce and NoSQL databases. Data protection: General regulation for the protection of personal data n. 2016/679 and the data protection organizational structure. Corporate network and data protection plan: device configuration, backup and cybersecurity processes against the dangers of device theft and crypto-locker virus.	Analyse, manage, interpret big data and open data. Know and apply the right level of protection to the data (Reg. EU 679/2016 - GDPR). Know and adopt different copyright and license rules to apply to data, digital information and content. Apply different behavioural rules and know-how in the use of digital technologies and in the interaction with digital environments.	Method: Open-ended questionnaire. Criteria: The student must describe the application potential of complex predictive models based on large amounts of non-linear data and the use function of data protection systems in the company.	Classroom / laboratory: 16 hours Individual study: 19 hours	*1*

General skills in science and technology	Use mathematical and statistical tools and models in the description and simulation of the different phenomeno-logies of the sector, in the application and in the development of the appropriate technologies. Use tools and methodologies specific to experimental research for the applications of the technologies of the sector.	Applied statistics	Descriptive statistics, sampling techniques Experimental design and sampling. Types of data and measurement scales: nominal or classification, ordinal or rank, interval, and ratio. Classification tables. Graphical representations of univariate distributions. Measures of central tendency or position: median, mode. Dispersion or variability measures: variation interval, interquartile difference, absolute mean deviation from the mean, absolute mean deviation from the median, deviance, variance, standard deviation, standard error, coefficient of variation, variance in grouped data (Sheppard correction). Shape indices: symmetry and kurtosis. Methods for calculating a generic quantile from a data series. Semi-graphical representation of distributions: Box-and-Wisker, Stem-and-Leaf diagrams.	Use statistical models in describing phenomenologies.	Method: Simulations. Criteria: The student will have to demonstrate knowledge and use of descriptive statistics and sampling techniques.	Classroom / laboratory: 12 hours Individual study: 18 hours	*1*

Skills common to the Technical-Professional Area	Develop and implement design, manufacturing and prototyping techniques.	Drawing and design of machines with 3D CAD systems	Mechanics of machines. Elementary machines. Shafts and systems assembled on the hub. Plain and rolling bearings. Toothed wheels, cogs and gears. Differentials, exchanges, clutches. Three-dimensional technical design of machines and mechanisms with 3D CAD drawing systems and study of movement and transmissions. Table setting with graphic specifications.	Identify the geometric, mechanical and functional specifications of parts and assemblies of mechanisms and machines using 3D CAD systems.	Method: Practice Test. Criteria: The student will have to demonstrate their ability to create a machine drawing using 3D CAD systems.	Classroom / laboratory: 26 hours Individual study: 14 hours	*2*
		Static and dynamic structural analysis with FEM methodology	Matrix calculation: matrices, operations on and with matrices. FEM: FEM methodology for a lattice structure, general structure of a finite element calculation program, example of modelling and analysis of results. Generative Design criteria.	Know the potential and purposes of the FEM calculation programs; Set up a static and dynamic analysis problems; Correctly generate FEM models; Transpose a CAD model into a FEM model; Read and analyse the results of the FEM analysis.	Method: Written verification, laboratory test. Criteria: The student will have to demonstrate an ability to apply the finite element method (FEM, from the English Finite Element Method).	Classroom / laboratory: 26 hours Individual study: 14 hours	*2*
		Fluid dynamics and heat transmission	Fluid dynamics: fundamental concepts of fluid kinematics, dynamic thrusts to a flow tube. Pressure currents in permanent motion, dynamics of viscous fluids, Navier-Stokes equations. Heat transmission: conduction equations, steady-state thermal conduction, convection, global heat transmission, exchangers, thermal radiation, acoustic principles, FEM models applied to the study of fluid dynamics problems, heat	Learn the fundamental concepts of fluid dynamics and heat transmission; learn how to apply the FEM method to heat transmission and fluid dynamics models; learn how to implement a real problem of fluid dynamics analysis or heat transmission or sound propagation using the finite element methodology; learn how to read and interpret the results obtained from an	Method: Written test. Criteria: The student will have to demonstrate knowledge of the principles of fluid dynamics and heat transmission.	Classroom / laboratory: 30 hours Individual study: 18 hours	*2*

			transmission and acoustics.	FEM analysis performed with simulation programs.			
		Design to cost, design for manufacturing and design for assembly techniques	Analysis of the main types of production systems, mutual influence between technology, product, production process and production system; product development; design for X, DFA - design for assembly, DFM - design for manufacture, DFP (design for production); design with a view to saving polluting materials and maximum eco-sustainability: as a design approach for 'Circular Economy'. Eco-design solutions to promote product repair, reuse and recyclability from the design phase (for recycling).	Know the main technological development techniques of the product. Be able to solve design problems with the DFMA, DFE and DFP techniques. Know how to analyse the design choices according to the most suitable production technologies for eco-sustainability, both product and process. Evaluate the convenience of the design choices in terms of costs and quality.	Method: Written test. Criteria: The student must demonstrate knowledge of the main technological development techniques of the product.	Classroom / laboratory: 24 hours Individual study: 14 hours	*2*
		Additive manufacturing techniques and rapid prototyping	Three-dimensional printers: study and analysis of the different types; Selective laser sintering (SLS), Digital Light Processing (DLP), fused deposition modelling (FDM), multi-jet fusion and related materials. The point of convenience (Break Even Point) between traditional and additive manufacturing processes: analysis of material costs, volume dimensions, process speed, reliability, performance, acceptability. 3D component design techniques based on additive manufacturing technology (DFAM).	Select and apply additive manufacturing techniques based on geometric complexity, customization and production volume of the product to be made. Adopt suitable design solutions aimed at optimizing additive production.	Method: Written test + Practical test. Criteria: The student will have to demonstrate their ability to choose the appropriate types of production in Additive Manufacturing, evaluating its convenience. They will also have to demonstrate an ability to redesign new or existing components, adopting optimized construction solutions for rapid prototyping and additive production.	Classroom / laboratory: 18 hours Individual study: 10 hours	*1*

	Identify the materials, relative processes and the treatments suitable for various uses.	Mechanical design elements and ADVANCED material resistance	General information on machines and mechanisms, friction and efficiency, notes on fatigue strength, transmission shafts, sliding and rolling bearings, organs for transmitting motion, tabs, grooved profiles, threads, belts and pulleys, toothed wheels, couplings.	Knowledge of operating principles of the most common transmissions (flexible organs, gear wheels of various types). Knowledge of the main problems associated with mechanical design. Ability to make design choices aimed at the best outcome when proportioning a power transmission system mechanical. Ability to verify or calibrate the main mechanical parts.	Method: Problem solving. Criteria: The student must demonstrate the ability to verify or calibrate the main mechanical parts.	Classroom / laboratory: 30 hours Individual study: 11 hours	*2*
		Materials, processes and treatments in an LCA perspective and elements of Robust Design	Selection of materials and process: use of the CES software, forming processes, chip removal and plastic deformation processes, jointing processes (welding, brazing, gluing), non-traditional mechanical processing, heat and thermochemical treatments on metallic materials, technology of polymeric and composite materials, robust design: analysis of variance (ANOVA), experimentation, LCA: industrial environmental risk management and reference standards. Focus green: technological use of biological polymeric materials. Optimization of mechanical processing methods aimed at minimizing waste and to facilitate repair, reuse and recyclability of the product with a view to the	Identify the properties of the materials in relation to the use, production processes and treatments; identify the necessary processes of the project; assess the need, criticality and the cost-effectiveness of the processes to be carried out between the semi-finished and finished product status; be able to evaluate and make changes to optimize production; identify the MU, from traditional to CNC, for the different types of processing to be carried out; assess the need, criticality and the economy of heat treatments to be carried out.	Method: Written verification. Criteria: The student will have to demonstrate the ability to identify materials, processes and treatments by evaluating the entire life cycle of the product.	Classroom / laboratory: 30 hours Individual study: 11 hours	*2*

			'Circular economy'.				
	Choose the processing technologies and the relative machines on the basis of the technical-economic characteristics required.	Motion technology in agriculture II	Mechanical and hydraulic transmissions (Part 2): Kinematics Robotic and Semi-Powershift transmissions, relationship between mechanical and hydraulic components, continuously variable transmissions. Electro-mechanical diagnostic methods: methods of diagnosis and troubleshooting, diagnosis tools in relation to hydraulic systems, diagnosis tools in relation to electrical-electronic systems, reports and comparison of values between the various diagnostic methods.	Learn how to recognize and choose the most appropriate mechanical and hydraulic transmissions according to its purpose in the agricultural sector; learn how to choose and use the most suitable methods of diagnosis and troubleshooting according to the area of competence; learn how to analyse and critically evaluate the results.	Method: Written verification. Criteria: The student must demonstrate how to choose the most suitable methods of diagnosis and troubleshooting.	Classroom / laboratory: 14 hours Individual study: 9 hours	*1*
		Internal Combustion and Hybrid Propulsion Systems	The workings of internal combustion engines; operating principles; performance and characteristic curves; thermodynamics of internal combustion engines; the combustion process; notes on polluting emissions. The main systems: crank mechanisms, distribution, lubrication, cooling, supercharging, materials and manufacturing technologies of engine components, instruments and equipment for measuring performance and operating parameters, power supply and electronic control systems for spark ignition engines, injection systems and	Knowledge of how internal combustion engines work on the basis of the physical and chemical phenomena that underlie them (thermodynamics and combustion). Learn how to grasp the relationship between performance and polluting emissions of internal combustion engines and the technologies used for their optimization. Ability to identify the most suitable materials and manufacturing technologies for the main engine components	Method: Written verification. Criteria: The student will have to demonstrate recognition of the Internal Combustion and Hybrid Propulsion systems.	Classroom / laboratory: 50 hours Individual study: 29 hours	*3*

			mechanical control of diesel engines, injection systems and electronic control of diesel engines, characteristic curves of MCI, engine / machine coupling. Performance of the machines; characteristic curves of electric motors. Layout of the hybridization: series and parallel arrangement of thrusters, coupling of the thermal and/or Electric propulsion units for "Off-Road" use.	based on the most used types. Learn the characteristics of a mechanical and electronic control system of an engine and of the principles of operation and regulation. Learn methods of coupling between internal combustion engine and electric motor in order to obtain the degree of hybridization required, especially in 'Off-road' use. Ability to evaluate the characteristic curves of an internal combustion engine and an electric motor. Learn the principles and methods of measuring performance and the main operating parameters of an engine in a laboratory test: the equipment and test instruments.			
	Configure, calibrate, document and maintain automatic systems of different types.	PLC configuration	Siemens TIA Portal development environment configuration for automation and drives systems.	Configure, calibrate, document and maintain automatic systems; maintain electronic control, supervision, plant monitoring and process execution systems.	Method: Written verification of content and programming - ongoing evaluation of practical cases assigned during the course. Criteria: The student will have to demonstrate an ability to configure automatic systems.	Classroom / laboratory: 38 hours Individual study: 22 hours	*2*
	Programming industrial automation systems (PLC, robots, CNC	PLC programming in ladder - advanced graphic	Siemens TIA Portal development environment programming, commissioning	Perform PLC programming with ladder and instruction list;	Method: Practical laboratory verification of content and	Classroom / laboratory: 40	*3*

	machines, communication networks, monitoring and diagnostics systems, etc.).	language	and maintenance of automation and drive systems.	debug and modify the PLC program online.	programming through the definition and construction of a real project. Criteria: The student will have to demonstrate his ability to program PLC with ladder language.	hours Individual study: 23 hours	
		Design and development of electrical diagrams.	Structure of a project, electrical symbols and articles, management of a project on a company order, connections and wiring, terminal blocks and PLC.	Development of electrical diagrams according to IEC 81346.	Method: Practical verification and ongoing evaluation of practical cases assigned during the course. Criteria: The student will have to demonstrate an ability to draw and develop electrical diagrams.	Classroom / laboratory: 18 hours Individual study: 10 hours	*1*
	Manage production flows in their programming, control and cost-effectiveness, also in relation to the logic of industrialization and continuous improvement.	Industrial cost analysis	Classification and management of industrial and production costs. The financial statement: the items on the account and their distribution; the contribution margin; BEP determination.	Learn how to collect and manage product and process costs in a manufacturing company.	Method: Simulations and case analysis. Criteria: The student will have to demonstrate an ability to recognize and analyse industrial costs.	Classroom / laboratory: 16 hours Individual study: 9 hours	*1*
		Application of the FMEA methodology for the analysis of failures or defects of a process, product or system	Project/process FMEA; FMEA analysis as part of the PPAP (Production Part Approval Process) and within the Six Sigma and WCM systems.	Apply fault prevention and diagnostic methods.	Method: Simulations of real cases related to the activity in the company. Criteria: The student will have to demonstrate that s/he can apply failure prevention and diagnostic methods.	Classroom / laboratory: 16 hours Individual study: 11 hours	*1*
	Apply fault prevention, analysis and diagnostics	Maintenance and functional testing	Frequent problems, methods of intervention in the field of	Operate in the maintenance	Method: Simulations and case analysis	Classroom /	*2*

	methodologies on systems and plants and propose possible solutions. Manage post-sales and maintenance needs.	of automated systems	maintenance and functional testing in industrial systems and plants.	management system, identifying the different types of action and related costs.	Criteria: The student will have to demonstrate an ability to intervene in the maintenance and functional testing of automated systems.	laboratory: 30 hours Individual study: 18 hours	
Specific skills of the job		Hydraulic circuits	General characteristics of hydraulic systems, basic principles of hydraulics: static and dynamic, ISO standards and symbols in hydraulic, main generator groups, tank, exchangers, filters, accumulators, pressure, flow and directional valves, load sensing and regenerative circuits, actuators linear, gear, vane, piston pumps, interface with dedicated electronics, kinematics and operation of applied hydraulic systems, hydraulic fluids: classification and characteristics, pipes, fittings and flanges.	Learn how to apply the fundamental principles of hydraulics with insights into different fields of application and the different characteristics of the individual components.	Method: Written verification. Criteria: The student will have to demonstrate an understanding of the hydraulic systems.	Classroom / laboratory: 36 hours Individual study: 22 hours	*2*
		Acquisition, supervision and control systems	In-depth study of LabVIEW programming language, creation of data acquisition and control systems, management of supervision systems.	Design and program measurement and control systems.	Method: Written verification and laboratory test on practical cases. Criteria: The student will have to demonstrate an ability to create data acquisition and control systems.	Classroom / laboratory: 16 hours Individual study: 9 hours	*1*

		Choice and configuration of electro/pneumatic robots controlled by PLC.	Electro-pneumatic robot for handling objects during automated work cycles, devices for integrated safety.	Operate manipulator robots via PLC.	Method: Verification based on practical exercises. Criteria: The student will have to demonstrate an ability to configure robots via PLC.	Classroom / laboratory: 28 hours Individual study: 15 hours	*2*
INTERNSHIP II			Development of a customized project for the integration of a fundamental application (sensor/measuring instrument; electronic control system; electromechanical, oil-hydraulic, pneumatic actuator; mechanical kineto-dynamic system) within a mechatronic system, with innovation objectives/ functional improvement and eco-sustainability (referable curricular areas: hydraulics, motors, automation).	Consolidate the technical-specialist knowledge acquired in the course.	Method: Observation and verification of the work performance of the intern with evaluation of the effective exercise of knowledge and skills. Self-evaluation and reworking of the experience by the student. Criteria: The chosen evaluation approach foresees the evaluation judgment of the company tutor and the subsequent feedback with the student's self-evaluation by the educational tutor of the agency. The result of the combination of hetero and self-evaluation constitutes the summary report of the experience, which will be one of the objects of the final exam.	Internship in the company: 400 hours Individual study: 100 hours	*20*

Total hours in classroom/laboratory/PW year II: 590
Total internship hours in year II: 400
Total sum of hours in year II: 990

Progression rules (prerequisites)

Successful completion of the first year is necessary to access the second year of the course and only upon obtaining 60 credits.-

At the end of the course in year II, the diploma of Advanced Technician is obtained after passing a final test. The diploma stipulates the technological field and the national classification/standard, which allows access to public competitions and universities with the recognition of university credits. The EUROPASS certificate is also issued in Italian and English.

Internship abroad

Participants are given the opportunity to carry out part or the entire internship period in foreign companies. Credits are recognized without any further activity or learning verification being requested from the student.

Flexibility/customization

A form of has been identified for selected candidates REALIGNMENT (total 170 hours) which involves the following topics: Mechanics (24h); Mechanical Technology (34h); Mathematics (20h); Computer Science (34h); English (36h); Electronics and Electrical Engineering (22h). These hours are to be considered in addition to the expected number of course hours. Further extracurricular preparation courses for the following technical certifications are also planned: CAD 3D Solidworks (14 hours), Labview (16 hours), Trinity (20 hours) for a total of 50 hours.

Credit calculation criteria

The calculation criterion applied is the following:

1 credit = sum of classroom hours / laboratory / enterprise / internship + individual study hours / 25 hours (except for rounding up).

Course location

ITS MAKER Foundation

Reggio Emilia headquarters