Course title

ADVANCED TECHNICIAN FOR INDUSTRIALIZATION OF PROCESSES AND PRODUCTS

Course profile

Advanced Technicians for industrialization of processes and products manage CAD-CAE systems, test technologies using measuring instruments for the analysis of technical-design specifications relating to materials, components and product processing cycles, in order to calibrate production technologies and configure the production process.

They carry out tests on metallic, plastic and composite materials, whose processes are selected on the basis of the production technologies required. Technicians must produce 2D and 3D modelling of mechanical parts and components, optimize the production process by applying continuous improvement, program machine tools to achieve automated production, both by removal and with 3D printing.

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;
- Manage CAD-CAE systems;
- Carry out tests for the characterization of the mechanical properties of the materials;
- Use measurement technologies and instruments to carry out analysis of technical-design specifications relating to materials, components and product processing cycles;
- Use dimensioning production technologies and configuring the production process.

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 linguistic, communicative and relational field	Master the linguistic tools and information and communication technologies to interact in daily activities and work contexts.	Spreadsheets for personal productivity	Formulas, graphs and macros for recording, viewing and analysing quantitative data and obtaining significant information relating to work processes.	Being able to use Microsoft Excel application in its advanced features.	Method: PC practice test. Criteria: The student will have to demonstrate the use of advanced functions of Microsoft Excel.	Classroom / laboratory: 16 hours Individual study: 14 hours	1
		Digital tools for collaborative work, presentation and communication	Fundamental assets of collaborative work tools: speed, accessibility, usability, sharing and security E-mail as a contact and repository tool (risks and opportunities). Mobile and multi-channel work (access to content from 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 (co-editing, self-service analytics, personal archiving). Platforms and web promotion tools (Facebook Ads, Google AdWords) and organic positioning and search engine optimization (SEO).	Know how to use online collaboration tools; Know how to use presentation and communication tools; Know 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 presentation and communication.	Classroom / laboratory: 16 hours Individual study: 14 hours	1

	Use technical English (micro language), related to the technological area of reference, to communicate correctly and effectively in the contexts in which is required. Manage communication and relational processes inside and outside the organization both in Italian and in English.	Technical English I	Communication in English (written, oral) on technical-specialist subjects relating to the professional domain and the workplace.	Be able to communicate in English at both written and oral level using a specific language and terminology specific to the sector of reference.	Method: Written test multiple choice and oral interview in a foreign language. Criteria: The student will have to correctly demonstrate technical terminology and grammatical and syntactic structure, as well as fluency in language conversation.	Classroom / laboratory: 40 hours Individual study: 60 hours	4
	Arrange, negotiate and develop activities in working groups to face problems, propose solutions, help produce, order and evaluate results.	Team Working	Life cycle of a team; motivation, role of team leader; team building; team management; management of critical issues and conflicts; performance management (outdoor methodology at IAL Campus in Cervia - Cooking and collaborating in a lab environment; Orienteering in the city).	Identify leadership style and interpret the main motivational dynamics that favour active participation of members in a working group.	Method: Practice Test. Criteria: Placed in a team working situation, the student will have to demonstrate the exercise of collaborative skills, listening and proposing solutions.	Classroom / laboratory: 16 hours Individual study: 24 hours	1,5
General Scientific and technological field	Use statistical tools and models in the description and simulation of the different phenomenologies of the reference area, in the application and development of the appropriate technologies.	Mathematical analysis and descriptive statistics	Infinitesimal calculus, limit and continuity; local behaviour of a function; differential calculus and integral calculus. Elements of descriptive statistics: graphical representations and study of phenomena by frequency, distribution, average, variability and concentration indices.	Use statistical tools and models.	Method: PC practice test with business case analysis. Criteria: The student, starting from a given business case, will have to demonstrate knowledge of how to use descriptive statistics and quantitative analysis techniques.	Classroom / laboratory: 28 hours Individual study: 42 hours	3
	Use tools and methodologies specific to experimental research for the applications of the technologies of the reference area.	Analysis and performance management techniques	Experimental reports and analysis of real data: covariance, correlation, regression (least squares), linear interpolation. Series chaining. Chi-squared test. ISO standards for performance improvement and techniques for	Apply data analysis techniques for continuous performance improvement.	Method: Exercise. Criteria: Starting from a given business case, the student will have to demonstrate that	Classroom / laboratory: 32 hours Individual study: 48 hours	3

			continuous improvement of technologies (DOE).		he is applying the statistical techniques for measuring deviations between observed (real) and theoretical (expected) values of a process.		
General legal and economic field	Find sources and apply the regulations to the company and its external relations at national, European and international level.	Machine safety	Risk analysis and assessment: definition of machine limits, identification of hazards, risk assessment and reduction strategies. Security by design: the design of security functions and protective devices. Monitoring of safety signals: control systems (modules, configurators and safety PLCs). Functional Safety and Electrical Safety Related Control System (SRECS).	Be able to identify (notice) situations of potential danger in the operation of machines and plants and report them to the competent office.	Method: Multiple choice test. Criteria: The student must demonstrate knowledge of the current directives on the safety of machines and systems.	Classroom / laboratory: 24 hours Individual study: 36 hours	2,5
General organizational and management area	Manage relationships and collaboration within the organizational structure within the work context, evaluating their effectiveness. Manage external relationships and collaboration - interpersonal and institutional - evaluating their effectiveness. Recognize, evaluate and resolve conflicting situations and work problems of different nature: technical, operational, relational and organizational.	Communication and relationships at work	Negotiation situations and negotiation techniques; conflict situations and conflict management techniques; worker relationships: internal communication, meetings and use of corporate emails; the relationship between technical and emotional skills in determining business results.	Apply negotiation and conflict management techniques.	Method: Oral exam through simulations and role playing. Criteria: The student must demonstrate the use of effective communication techniques and/or negotiation and management of potentially conflicting situations.	Classroom / laboratory: 20 hours Individual study: 30 hours	2
	Organize and manage, with a good level of autonomy and responsibility, a working	The HSE model of workplace management	The company's HSE (Health Safety Environment) structure to safeguard workers; health and safety and environmental protection. Integrated	Apply company regulations and procedures for the prevention of accidents	Method: Multiple choice test.	Classroom / laboratory: 16 hours	1,5

	environment, workers relations and the technological system in order to achieve expected production results.		risk management; integrated management of plant safety and protection of the working environment. Technical and managerial governance of business continuity. Risk assessment for the user of machines and ISO / TR 14121-2 Safety of machinery.	and the safeguarding of health and safety conditions in the workplace, effectively managing general and specific risks.	Criteria: The student must demonstrate knowledge of the HSE model of integrated risk management.	Individual study: 24 hours	
	Know and help to manage the quality organizational models that encourage innovation of companies in the sector.	Quality management techniques	The evolution of quality management: from final testing of the finished product (artisan production), to production control (mass production), to quality assurance of the production system, to total quality and TQM. Deming cycle and PDCA approach to process management. The Japanese CWQC: total quality and lean production. The basic criteria of the TQM for World Class quality: Leadership, Strategic Planning, Human Factor Management, Staff Satisfaction, Management of Resources and Processes (Quality System), Customer Satisfaction, Business Results, Impact on the Company . The management system based on the UNI EN ISO 9000: 2015 standard.	Know and apply the procedures envisaged for the management of company processes.	Method: Open-ended questionnaire. Criteria: The student must demonstrate knowledge of the Quality Management System in accordance with the UNI EN ISO 9001: 2015 standard (Implementation, certification and maintenance).	Classroom: 32 hours Individual study: 48 hours	3
Common professional technical skills – Made in Italy Technologies Area - Mechanical system	Identify the materials, relative processes and the treatments suitable for various uses.	Characterization of materials	Classification of materials: metallic, ferrous and non-ferrous, polymeric, ceramic, amorphous, composites. Unified designation of steel and cast iron. Unified nomenclature of light alloys. Unification of copper alloys. Characterization of materials: structure and microstructure chemical composition, deformation and decomposition mechanisms of metallic materials, polymeric materials, composite materials and ceramic materials.	Recognize the characteristics and mechanisms of deformation and decomposition of metallic, polymeric, composite and ceramic materials.	Method: Multiple choice test. Criteria: The student will have to demonstrate knowledge of the classification, unified designation and chemical-physical and microstructural characterization of the main classes of materials (metallic, polymeric, composite and ceramic).	Classroom / laboratory: 24 hours Individual study: 12 hours	1,5
	Develop and implement design, manufacturing and	Reading and interpretation of	Basic elements of industrial technical drawing (sheets; lines; stairs; normal	Be able to read and interpret industrial	Method: Practice Test	Classroom / laboratory: 30	2

	prototyping techniques.	technical drawings	numbers) and related UNI and ISO standards (paper formats, definitions and principles concerning technical drawings, types of lines, units of measurement, dimensional scales; axonometries, orthogonal projections, sections , crosshatching, dimensioning, tolerances). Unified designations for the univocal identification of elements/objects: materials, unified mechanical components (screws, nuts, plugs, pins, profiles, etc.), electrical / electronic components (resistors, capacitors, transistors, etc.), graphics for elements and symbols. Representation and application rules based on the types and thicknesses of lines according to ISO 128-20: Line element and segment; Thickness of extra-large, thick and fine lines; Variations of the basic types; Priority rules. Drawing sheets (EN ISO 5457): Unified sheet sizes, Inscription box (UNI EN ISO 7200), Folding of sheets and orientation (UNI 938), Coordinate system and centering marks (UNI EN ISO 7200). Scales (UNI EN ISO 5455): natural, enlargement, reduction, recommended.	technical drawings.	Criteria: The student must demonstrate to uniquely identify unified designations of elements and technical drawing objects of mechanical and electrical/electronic components.	hours Individual study: 20 hours	
		2D CAD design and planning	Creating a 2D drawing: lines, points, circles and arcs. The drawing of a mechanical detail: dimensions, general manufacturing tolerances, surface, shape and position tolerances, couplings. 2D views of how products are manufactured and assembled. Dimension methods, tolerance and annotations based on ANSI, ISO, GD&T standards. Bill of materials and parts list. Standard checks and revisions	Being able to create a 2D drawing using CAD systems	Method: CAD practice test Criteria: The student will have to demonstrate an ability to perform technical drawing of components (i.e. the views in projection, the sections, the details, ...) starting from the reading of the solid model file	Classroom / laboratory: 24 hours Individual study: 9 hours	1

		3D CAD modelling	3D modelling of solids and surfaces: basic templates, construction by extrusion and revolution. Advanced constructions: sweep extrusion, loft construction, track revolution. Boolean operations; chamfers and fillets. Parametric solid modelling based on features of the machining applied on the solid model and construction tree. File management, libraries; rendering; simulation, control and validation of projects.	Realize 3D parametric solid modelling.	Method: CAD practice test. Criteria: The student will have to demonstrate an ability to perform 3D modelling of a solid.	Classroom / laboratory: 50 hours Individual study: 16 hours	2,5
		Fundamentals of mechanical design	Solid Mechanics: analysis of deformation, tension, compression and constituent bonds (linear elasticity, hints of nonlinear elasticity, elastoplasticity and viscoelasticity). Mechanics of isostatic and hyperstatic structures. Study of beams in elastoplastic material, subject to simple stresses (normal stress, bending, twisting, cutting). Effects of thermo-mechanical processes on the structural characteristics of metallic materials.	Develop design, prototyping and industrialization techniques.	Method: Exercise. Criteria: The student will have to demonstrate an ability to recognize the different types of stress in the structural study of the beam model.	Classroom / laboratory: 32 hours Individual study: 16 hours	2
	Research and apply the technical and safety regulations of the electrical, electronic and mechanical sector in the design and use of components.	Electromechanic sswitchboards and automation	DC circuits and networks, single-phase and three-phase alternating current; electrical machines, industrial electrical systems, legislation and regulations in the electrical sector, dangers of current for the human body and for electrical systems; building blocks of an automation system, auxiliary command and signalling devices, main types of on-off sensors, relays; contactors, electromechanical logic circuits (wired logic), transducers and actuators, PLC, typical industrial electrical diagrams. Electrical panels and plant engineering on the machine.	Know the principles of electromechanics and recognize the architecture of electrical panels and automation systems.	Method: Exercise. Criteria: The student must correctly demonstrate wiring an electrical panel on the machine.	Classroom / laboratory: 36 hours Individual study: 16 hours	2
		Hydraulic	Advantages and disadvantages of	Know how to recognize		Classroom /	1,5

		systems	hydraulic systems compared to electromechanical systems for power transmission. Components of a hydraulic system: actuator; servo valve (amplifier); regulator; power unit (pumps). Power supply: pump, electric motor, coupling, level switch, temperature alarm sensor, vent plug, filter, tank. Hydraulic movements: linear and rotary actuators, position and speed controls, through analogue and digital position transducers (potentiometric, inductive, magnetosonic, linear encoders). Pressure transducers for closed loop force or pressure controls. Fixed displacement pumps (gear; screw; vane) and variable displacement (axial piston; vane). Types of servo valves based on the relationship between the axial length of the piston and the width of the ports (with positive, negative and zero coverage). Dynamic study: flow rate, escape between cylinder and piston and return to the tank.	hydraulic systems and components.	Method: Exercise. Criteria: The student will have to demonstrate an ability to recognize and interpret functionality of the components of a hydraulic system.	laboratory: 24 hours Individual study: 11 hours	
	Choose the processing technologies and the relative machines on the basis of the technical-economic characteristics required.	Casting processes	Design of models and core boxes for transitional forms. Forming in synthetic earth, in the pit, in CO_2, in sand-cement, cold-box, shell-moulding, precision casting. Casting solidification: liquid, solidification and solid shrinkage. Cooling module of a jet and solidification time. Calculation and verification of sprues with directional solidification method. Calculation of the casting system and metal static thrust. Permanent and characteristic casting of shells: gravity and hot/cold chamber die-casting shells.	Know and apply machining technologies in the mechanical area (melting processes).	Method: Exercise. Criteria: Starting from a study case, the student must demonstrate a business case, know the fundamental sequence of the casting process and to correctly configure a foundry cycle.	Classroom / laboratory: 12 hours Individual study: 5 hours	1
		Plastic deformation	Magli and Presse: general characteristics. Calculation of the force	Know and apply machining technologies	Method: Exercise.	Classroom / laboratory: 12	1

		processes.	obtainable from an eccentric mechanical press. Mechanical friction press (screw). Hydraulic press. Monoaxial, biaxial and triaxial deformation. Crushing between parallel planes and the slab-analysis method. Flow-stress of materials in cold and hot deformations. Cold plastic deformation of the sheets: a) Blanking: punches, dies, blanking force, fine blanking; b) Bending: elastic return, crimping, calendering, roller profiling; c) Drawing: pressure of the blank holder, reduction ratio of drawing, drawing force and calculation of the template disc.	in the mechanical area (plastic deformation).	Criteria: Starting from a study, the student must demonstrate a business case, to know the fundamental sequence of the plastic deformation process of metallic materials (sheets).	hours Individual study: 5 hours	
		Rolling processes	Products laminated by rotating rollers: plates, sheets or plates. Workpiece speed and rolling power: Ekelund relation. Entry and drag conditions. Study of calibration. Cold rolling of the sheets. Seamless tubes: Mannesmann rolling mill and "The pilgrims pace".	Know and apply machining technologies in the mechanical area (lamination).	Method: Exercise. Criteria: Starting from a study, the student will have to demonstrate a business case, to know the fundamental sequence of the production process of steel pipes and laminates.	Classroom / laboratory: 12 hours Individual study: 5 hours	1
		Extrusion and drawing processes	Hot and cold extrusion. Direct, indirect, hydrostatic, impact extrusion. Matrices and extrusion ratio. Friction, extrusion speed and working pressure. Cladding. Drawing: dies, products, lubrication. Calculation of the lower opening angle of the die to minimize drawing tension. Calculation of the theoretical maximum reduction value. Drawing of pipes. Upsetting and electro-upsetting.	Know and apply machining technologies in the mechanical area (extrusion and drawing)	Method: Exercise Criteria: Starting from the study, the student must demonstrate a business case, to know the fundamental sequence of the extrusion process of pipes, bars, profiles, sheets	Classroom / laboratory: 12 hours Individual study: 5 hours	1
		Forging and forging processes	Design of the moulding cycle and characteristics of the moulded parts. Hot pressing: burr channel and its function. Calculation of the total moulding force. Burr plane, draft	Know and apply machining technologies in the mechanical area (moulding).	Method: Exercise. Criteria: Starting from the study, the	Classroom / laboratory: 12 hours Individual study:	1

			angles, fillet radii, oxidation, shrinkage. Massive forming of crankshafts, connecting rods and gears and turbine components (blades, discs).		student will have to demonstrate a knowledge of the fundamental sequence of the gear moulding process.	5 hours	
		Cutting and removal processes	Metal cutting mechanics, metal workability and chip formation and morphology mechanisms. Orthogonal and oblique cuts. Definition of cutting motions, of stalking feeds. Shear force and repulsion forces. Cutting pressures. Unified representation of the tool: cutting edge angles, profile angles, entering angles, tip radius. Phenomenological and unified wear criteria of tools. Tool life. The parallel lathe: machined surfaces and structure. Control schemes for longitudinal, transverse and thread motions. Hole machining: reamers and drills. Horizontal, vertical and universal milling machines. Slotting, broaching and grinding.	Know and apply machining technologies in the mechanical area (cutting and removal).	Method: Exercise. Criteria: Starting from the study, the student must demonstrate a business case, to know the fundamental sequence of the process of cutting, chip removal and metal drilling.	Classroom / laboratory: 12 hours Individual study: 5 hours	1
		Welding and joining processes	Autogenous and heterogeneous welds. Types of joints. Oxyacetylene welding and cutting. Electric arc welding with coated electrode. TIG welding. The MIG and MAG welds. Short-arc, spray-arc and pulsed-arc modes. Submerged arc welding. Welding for electrical resistance and pressure: spot, roller. Butt welds for glitter. Heterogeneous welds: soft and strong brazing; braze welding.	Know and apply machining technologies in the mechanical area (welding and joining).	Method: Exercise. Criteria: Starting from the study, the student must demonstrate a business case, to know the fundamental sequence of the metal welding and joining process.	Classroom / laboratory: 12 hours Individual study: 5 hours	1
	Intervene in all segments of the supply chain from production to marketing.	Test, certification and accreditation systems	Reference standards and ISO guides covering testing, certification and accreditation activities (UNI CEI EN 45000 series). Type tests and production surveillance. Verification on sample taken from the factory or from the free market. Acceptance tests of the production quality control system.	Check quality in production.	Method: Exercise. Criteria: Starting from the study, the student will have to demonstrate a company case, to know and correctly apply	Classroom / laboratory: 16 hours Individual study: 7 hours	1

			Monitoring and verification of control. Evaluation and acceptance of the factory control system. Batch tests. 100% tests.		the quality control procedures in production.		
Specific technical professional skills for the job		Metrology, product verification instruments and materials investigation techniques	General information on measurements: sensitivity, precision, repeatability, reproducibility. Roughness Ra: analytical and geometric definition. Sampling lengths. Unified symbolism. Workshop measuring instruments: the Caliper and the Vernier principle, small gauge, micrometre, clock comparators, bore gauges, Johansson blocks. Investigation techniques for materials: microstructural investigation of metals (optical microscopy, electron), X-ray diffractometry, visible UV spectrophotometry, IR spectroscopy, mass spectrometry, fluorescence and phosphorescence	Correctly use measuring and testing instruments and methods.	Method: Practical test in the laboratory. Criteria: The student must demonstrate to carry out tests and measurements correctly by using the workshop and laboratory equipment and tools correctly.	Classroom / laboratory: 40 hours Individual study: 18 hours	2
INTERNSHIP I			Alternatively, the following curricular objectives can be considered eligible: reading of the technical drawing, 2D/3D CAD drawing and design, characterization of materials, processes and treatments; metrology, product verification instruments and material investigation techniques.	Develop a greater awareness of a personal study path, consolidating the knowledge acquired in the classroom phase.	Method: Observation and verification of the work performance of the intern by evaluating their effective 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	Internship in the company: 400 hours Individual study: //	15

			constitutes the summary report of the experience, which will be one of the objects of the final exam.		

Total hours in classroom/laboratory in year I: 600 hours
Total internship hours in year I: 400 hours
Total sum of hours in year I: 1,000

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 linguistic, communicative and relational field	Use technical English (micro language), related to the technological area of reference, to communicate correctly and effectively in the contexts in which is required Manage the communication and relational processes inside and outside the organization both in Italian and in English	Technical English II	Communication in English (written, oral) on technical-specialist subjects relating to the professional domain and the workplace	Be able to communicate in English at both written and oral level using a specific language and terminology relevant to the sector	Method: Written test multiple choice and oral interview in a foreign language Criteria: The student will have to correctly demonstrate technical terminology and grammatical and syntactic correctness, as well as fluency in language conversation	Classroom / laboratory: 40 hours Individual study: 60 hours	4
	Prepare technical and regulatory documentation that can be managed through telematic networks	Documentation and technical manuals	Perspective and exploded drawings for use and maintenance manuals. Use and maintenance booklets; technical assistance manuals; process manuals; spare parts catalogues; instruction and training manuals. Technical files from Machinery Directive 2006/42/CE	Understand documentation and technical manuals	Method: Open-ended questionnaire Criteria: The student must argue the functional use of technical documentation	Classroom / laboratory: 16 hours Individual study: 24 hours	1,5
	Assess the implications of information flows with respect to the effectiveness and efficiency of the management of production or service processes, also identifying alternative solutions to	Problem solving techniques for continuous improvement	Continuous improvement and great innovations. Problem inventory, selection of priorities, project-based approach, creation of the project team and problem solving sequence. Pareto diagram and relevant problem. Flow chart and polar chart for problem solving. Cause-effect diagram, correlation diagram and stratification	Apply problem setting and problem solving techniques in the management of production processes	Method: Exercise Criteria: Starting from a business case, the student must demonstrate the correct application of statistical tools for process control	Classroom / laboratory: 28 hours Individual study: 42 hours	3

	ensure quality		for the research and analysis of the causes (diagnosis). Affinity diagram, schematic diagram and multi-criteria matrix for the choice of solutions (solving). Statistical and managerial tools for process control: control cards for attributes and variables, control cards for R and for the median				
		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 with 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 cryptolocker 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: 24 hours	1,5
General legal and economic field	Know the relevant rules governing the company and the impact for the company in a territorial context Use negotiation strategies and techniques with reference to the market in which companies in the sector also operate to strengthen their image	Industrial organization and market structure	Types of industrial organization and market structure in the industrial plant engineering sector. Supply chain organization, concentration and market competition. Evolution of demand. Main types of industrial production served according to the variety / volume matrix: work shop, discrete (lots), continuous (line)	Understand the main market dynamics and the forms of the productive organization of the mechanical engineering goods	Method: Open-ended questionnaire Criteria: The student will have to demonstrate knowledge of the main forms of organization in the field of instrumental mechanics and industrial plant engineering	Classroom / laboratory: 12 hours Individual study: 18 hours	1

	and competitiveness						
General organizational and management area	Know, analyse, apply and monitor, in specific contexts, management models of production processes of goods and services	Industrial production planning systems	Planned production of goods (commodity systems and service systems). Production systems: rigid/flexible automation and integrated production process. Production management as an integrated logistics component. Aggregate production planning. Requirements planning: MRP and JiT	Know how to distinguish the types of industrial production	Method: Exercise Criteria: Starting from a business case study, the student will have to demonstrate knowledge of the main forms of production planning	Classroom / laboratory: 24 hours Individual study: 36 hours	2,5
	Analyse, monitor and control competently, the production processes in order to formulate proposals / identify solutions and alternatives to improve the efficiency and performance of the technological and human resources used with a view to progressive continuous improvement	Configuration models of production technologies	Work-shop model (workshop with departments): criterion of technological order (by process). Transfer production line model: sorting criterion by work cycle (by product). Group Technology, production cells and Flexible Manufacturing System. Comparative advantages and disadvantages in terms of productivity, flexibility, planning, circulating material, balance, reliability	Evaluate the best configuration of industrial production technologies and layouts	Method: Exercise Criteria: Starting from a business case study, the student will have to demonstrate knowledge of the main forms of layout configuration	Classroom / laboratory: 24 hours Individual study: 36 hours	2,5
Common professional technical skills - Made in Italy Technologies Area - Mechanical system	Identify the materials, the relative processes and the treatments suitable for various uses	Metallurgy	Solidification of metals and alloys, diffusion laws with application to heat treatments, strengthening methods. Steel classification (UNI EN): special construction steels, maraging steels, tool steels, stainless steels, steels for use at high and low temperatures, 13% Mn steels, cast steels. Cast iron: white cast iron, grey cast iron, graphite shape and distribution, mechanical properties, pearlite cast iron, alloyed cast iron, nodular cast iron, cast iron. Aluminium and its alloys: designation, foundry alloys, machining alloys: heat treatment, work hardening. Magnesium and its alloys: designation, foundry and processing alloys. Titanium alloys	Recognize the characteristics of metallic materials and their properties in processing	Method: Multiple choice test Criteria: The student must demonstrate knowledge of classification, processes and uses of steel, cast iron and alloys of aluminium, magnesium and titanium	Classroom / laboratory: 12 hours Individual study: 8 hours	1

		Polymeric and composite materials	Classification, standards and physical-mechanical characterization of polymeric materials. Main properties and selection criteria: rigidity, strength, manufacturability. Injection moulding process (process modelling, moulds, feeding and cooling, process variables). Joining methods, snap fit. Addition and condensation polymers. Sol gel method for the synthesis of colloids. Gel, xerogel and aerogel. Polymer matrix composite materials (classification, standards, physical-mechanical characterization methods, main properties). Production technologies: autoclave lamination and moulding, micromechanical approach	Recognize the characteristics of polymeric and composite materials and their properties in processing	Method: Multiple choice test Criteria: The student will have to demonstrate knowledge of the classification, processes and uses of polymeric and composite materials	Classroom / laboratory: 16 hours Individual study: 11 hours	1
	Develop and implement design, manufacturing and prototyping techniques	Fundamentals of impact and fatigue design	Strength and surface damage criteria. Resilience: the Charpy pendulum and the calculation of the deformation work. Embrittlement with temperature. Fatigue strength, fatigue limit, elastic hysteresis cycle and its extension. Wöhler diagram	Recognize the impacts of different material stresses	Method: Exercise Criteria: Starting from a business case, the student will have to describe the fatigue cycle and the methods of failure of mechanical components	Classroom / laboratory: 32 hours Individual study: 21 hours	2
		Static and dynamic structural analysis with FEM methodology	Discretization and creation of the calculation grid; coded templates; basic/form functions and their combination for the solution of stress-deformation problems in the elastic field and of the plastic or viscoplasticity	Apply the Finite Element Method (FEM)	Method: CAD practice test Criteria: The student must be able to apply basic computer-aided structural calculation functions in solving problems related to fatigue and failure of mechanical components	Classroom / laboratory: 16 hours Individual study: 11 hours	1

		Multiphysics simulation of the product	Virtual prototyping and multiphysics simulation, with focus on the parametric analysis of the properties of materials. Mesh preparation for structural and fluid dynamics analyses by NX CAE. Conjugated Heat Exchange. Thermo-structural analysis. Fluid-Structure Interaction (FSI). Dynamic multi-body simulation (MBS). Eco-design solutions, to promote product repair, reuse and recyclability right from the design phase (for recycling)	Apply virtual prototyping and multiphysics simulation techniques	Method: Computer practice test Criteria: The student should be able to apply basic computer-aided dynamic simulation functions in solving product eco-design problems	Classroom / laboratory: 16 hours Individual study: 11 hours	1
		Design for additive manufacturing	Design for Manufacturing & Assembly (DFMA) approach. Virtual performance analysis; topology and shape optimization, performance maximization; synthesis of shape, size, hierarchical structure and composition of the material; undercuts, variable thicknesses, deep channels and complex/unlimited geometry; reduced number of parts and direct production assembled; break-even point according to production volume	Know and apply design techniques for Additive Manufacturing	Method: CAD tutorial Criteria: Starting from a business case, the student must be able to solve problems of optimization of shape and topology for the additive production of components previously made by removal	Classroom / laboratory: 20 hours Individual study: 10 hours	1
		Product industrialization	BOM structure and manufacturing cycles. The planning of the process: study of the working cycles, definition of cycle, phase, sub-phase, elementary operations. manufacturing and assembly of parts and components. Process selection: product-process matrix, identification of manufacturing technologies/assembly equipment and scheme of production layout strategies. Decoupling point between sales order and production for the determination of lead times and investment in stocks. Eco-design solutions, to encourage the reduction of the use of raw materials and energy, reuse and recyclability of waste or by-products of the processes during the production phase	Industrialize a product by configuring production cycles and sizing technologies	Method: Exercise Criteria: The student must be able to configure a production cycle starting from the bill of materials of the product	Classroom / laboratory: 20 hours Individual study: 16 hours	1,5

	Manage production flows in their programming, control and cost-effectiveness, also in relation to the logic for industrialization and continuous improvement	Production planning, execution and control	Types of production; pull and push systems; main and operational production plan; scheduling; order management; budgeting, analysis and determination of intermediate cost configurations, full cost and sales price Dispatching of production plans, progress control and management of production resources through manufacturing execution systems (MES) and control systems, supervision and data acquisition (SCADA)	Manage and control production, even with digital systems	Method: Exercise Criteria: Starting from a business case, the student must be able to organize the handling of an operational production plan	Classroom / laboratory: 24 hours Individual study: 16 hours	1,5
		Lean Manufacturing	Principles of lean manufacturing: mapping the value (VSM); identify and eliminate waste (7 muda); create a flow (produce one piece flow, visual management and kanban for replenishment of stocks); cadence (calculation of takt time) and levelling of volume and production mix (heijunka). Tools of lean manufacturing: poka yoke and zero defect objective; the 5S (Separation, Order, Cleanliness, Standardization, Discipline) to improve the work areas; SMED technique to reduce set up times; productive maintenance (TPM) and total efficiency of a plant (OEE)	Recognize the organizational, production and management principles of a Lean Manufacturing and continuous improvement techniques	Method: Written test with business case analysis Criteria: Starting from a given business case, the student will have to demonstrate the ability to classify the production system and propose alternatives to it in the perspective of Lean Production	Classroom / laboratory: 32 hours Individual study: 21 hours	2
	Choose the processing technologies and the relative machines on the basis of the technical-economic characteristics required	Additive manufacturing	Additive manufacturing processes: a) conversion of photosensitive polymers (stereolithography); b) the deposition of molten thermoplastic materials; c) lamination of sheets; d) powder fusion (Selective Laser Sintering and Powder Spraying). Stereolithography for rapid prototyping through: generation of STL files from CAD model or with reverse engineering; slicing; layer by layer	Recognize and apply additive manufacturing processes	Method: PC practice test Criteria: The student must be able to generate a STL file from a CAD model of the prototype to be made in 3D printing	Classroom / laboratory: 28 hours Individual study: 13 hours	1,5

			construction; post-treatment				
		Energy beam processing	Main energy beam processes: a) separation of materials or treatment of waterjet surfaces, with or without abrasive (Water Jet and Abrasive Water Jet) for cutting, drilling, milling, cold turning (ceramic and glass materials); b) die-sinking EDM (EDM) and wire EDM (WEDM) for the production of moulds; c) laser beam processing (LBM) for ablation, vaporization and erosion of material from high thermal resistance alloys or fibre-reinforced composites	Recognize processing technologies and related machines	Method: Exercise Criteria: The student, starting from the analysis of a business case, will have to demonstrate knowledge of the different functions of use of the energy beam processes for the different materials	Classroom / laboratory: 24 hours Individual study: 16 hours	1,5
		Surface treatments and coatings	Tribology of organs in relative motion and phenomena of wear, corrosion and high temperature degradation of materials. Surface protection and functionalization techniques. Mechanical metal treatments: shot peening, sandblasting. Chemical and electrochemical treatments in solution: anodizing, electroless deposition (Ni-P, Ni-B), electroplating (chromium plating, nickel plating, galvanizing). Conversion treatments (phosphating, chromate conversion therapy). Dipping coatings in liquid metals (hot dip galvanizing). Thermal spraying (plasma spray, HVOF, flame spray, wire-arc spray, cold spray). Thin film deposition from gas phase: chemical (CVD) and physical (PVD) deposition	Recognize processing technologies and related machines	Method: Exercise Criteria: Starting from the analysis of a business case, the student will have to demonstrate knowledge of the different functions of use of the different treatments and coatings	Classroom / laboratory: 24 hours Individual study: 16 hours	1,5
	Programming industrial automation systems (PLC, robots, CNC machines, communication networks, monitoring and diagnostics systems, etc.)	CAD/CAM programming	CAD/CAM applications to program the production processes of prototype and finished parts manufacturing. The generation of toolpaths for CNC machining starting from CAD models and assemblies. Virtual models applied directly on the production systems (design in the loop). Automatic	To plan the production processes for the production of prototypes and finished parts	Method: PC practice test Criteria: The student must be able to generate the tool paths of a MUCN on a CAM station starting from the CAD model	Classroom / laboratory: 32 hours Individual study: 13 hours	2

			management of machining tools (workpiece change mode). Advanced CAD/CAM solutions for manipulation and preparation of 5-axis mathematical machining models		of the piece to be machined		
		CNC machine programming	Tool card and machine preparation; address programming, CAD-CAM, customized. Programming a CNC cycle in ISO Standard language: N, M, T, G functions. Function syntax. Workpiece zero and workpiece diameter coordinate system for the X axis of the spindle and reel in mm for the Z axis of the diameters. Choice of cutting parameters (speed, feed). Standard ISO code tables. CNC simulators	Program the prototype and finished parts processing machines	Method: PC practice test Criteria: The student must be able to generate the program of a CNC machining cycle in ISO language	Classroom / laboratory: 24 hours Individual study: 11 hours	1,5
	Configure, calibrate, document and maintain automatic systems of different types	Industrial informatics	Advanced sensors and automatic data identification systems (AIDC), optical barcode readers, RFID tag readers. PLC and PC-based control systems. Fieldbus architectures and industrial ethernet and IoT telecommunication protocols. Platforms for statistical analysis of sensor data and the generation of graphics relating to forecasts on production trends and the quality of the process/product produced	Recognize the ICT systems applied to factory capital goods for data acquisition and analysis	Method: Exercise Criteria: Starting from the analysis of a business case, the student will have to demonstrate knowledge of the different functions of use of the ICT systems applied to factory capital goods for data acquisition and analysis	Classroom / laboratory: 24 hours Individual study: 11 hours	1,5
	Apply fault prevention, analysis and diagnostics methodologies on systems and plants and propose possible solutions	FMEA methodology	Probabilistic methodologies and parameters of reliability, availability, maintainability, safety (RAMS) of a component, availability in repairable systems and description of the life of the components; fault schematic, RCM approach: functional blocks and plate performance, predictive analysis (FMEA/FMECA) of the functional block failure conditions, tasks and maintenance policies	Apply the FMEA methodology for predictive failure analysis	Method: Exercise Criteria: Starting from the analysis of a business case, the student must correctly demonstrate an ability to apply the methods of predictive failure analysis	Classroom / laboratory: 16 hours Individual study: 11 hours	1

	Manage post-sales and maintenance needs	Maintenance techniques	Cyclic preventive maintenance: cycles of use and failures due to wear; classification of machines, the log and standards; maintenance on condition: potential failure and tolerable limit value; types of predictive monitoring; categories of predictive signals or emissions; vibration analysis, malfunctions of gearboxes and rolling bearings, inspections with thermal imaging camera, electrical measurements of AC/DC motors; ultrasound investigations; PHM approach and soft-computing techniques for the prognostic of residual useful life	Apply different maintenance techniques	Method: Exercise Criteria: Starting from the analysis of a business case, the student will have to correctly demonstrate an ability to apply predictive maintenance techniques	Classroom / laboratory: 12 hours Individual study: 8 hours	1
Specific technical professional skills for the job		Material characterization tests	Tests for the characterization of mechanical properties and stress/deformation diagrams. Mechanical characterization of metallic materials: a) Brinell, Vickers, Rockwell C and B hardness tests and test methods; b) tensile test: engineering stress-strain. Yield Point, breaking limit. Traction diagrams of different materials. The technological characteristics of the materials: Jominy hardenability test, Merkel castable test, Erichsen funnel test, bending, extrudability and weldability	Carry out tests for the characterization of the mechanical properties of the materials	Method: Practical test in an equipped laboratory Criteria: The student will have to correctly demonstrate an ability to perform characterization tests on the materials	Classroom / laboratory: 28 hours Individual study: 12 hours	1,5
		Accelerated product development test project	Test procedures for improving the reliability of a product. Stimulation and verification of failure mechanisms through simulation of conditions that greatly exceed normal operations. Project work of programming and planning of tests. Identification of the purposes, conditions and acceptability criteria for the test (test specifications)	Programming and planning of stress and fault tests	Method: Preparation of written procedures for performing the test. Documentation of the results. Evaluation of the results	Project Work: 40 hours Individual study: 14 hours	2

INTERNSHIP II	Internships with curricular objectives in areas of: a) Industrialization b) Production planning, execution and control c) Material characterization tests. This consists of individual or small group participation in the development of an existing or corporate project via an ad hoc project on industrialization of the mechanical process/product	Consolidate the technical-specialist knowledge acquired in the course	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 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: 10 hours	17

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

An initial REALIGNMENT course (120 hours) on: Mechanical processing technology; Mathematics (elements of linear algebra and a study of functions: limits, derivatives and integrals); Physics (specific heat, density, thermal and electrical conductivity), Chemical Composition of Materials; Technical Drawing (mechanical, electrical).

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

Forlì Headquarters