Course title

ADVANCED TECHNICIAN FOR CONTROL SYSTEMS FOR DIGITAL FACTORIES

Course profile

Advanced Technicians for control systems for digital factories manage data models (prepared by the design), assembly, configuration on the physical asset, testing in the company, testing at the customer site. They are responsible for subsequent updating during the life cycle of the IT components (hardware, software, interfaces, networks and communication protocols) required for the supervision, data acquisition and integration of information functional to the electronic monitoring of individual automatic machines and automated systems lines. In particular, they make use of techniques and methodologies for the installation, supervision, maintenance and support to users of IT applications for process control (SCADA / HMI). This occurs with reference to systemic integration in the infrastructure of the digital factory in order to facilitate data and information interoperability between the automation level of the physical asset (PLC and DSC), and functional management level of the factory assets (MES / MOM), up to the strategic management of information for the processes enterprise level (ERP). They will be required to make this data available in the cloud.

The profile reflects the national classification/standard of Advanced Technicians for methods and technologies in the development of software systems (belonging to the area of Information and Communication Technologies - area Methods and technologies for the development of software systems).

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)

0612 Database and network design and administration

Job title (national classification/standard)

Advanced technician for methods and technologies for the development of software systems

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 languages for the realization of systems and applications;
- Develop multimedia and multichannel interfaces;
- Render information, systems and applications usable by differentiating the communication according to recipients;
- Guarantee the safety and reliability of the service;
- Measure, evaluate and improve the level of service provided;
- Collaborate during the life cycle of innovation projects related to information and communication technologies;
- Plan the use of information and communication technologies and evaluate their impact;
- Apply communication standards and protocols between machines and systems for data acquisition and control in industrial automation;
- Configure, test and maintain cloud computing systems, control systems, supervision and data acquisition, systems for the optimization of the production function.

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	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 I	Communication in English (written, oral) on technical-specialist subjects relating to the professional domain and 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 foreign languages. Criteria: The student will have to demonstrate mastery of sector technical terminology and grammatical and syntactic correctness, as well as fluency in language conversation.	Classroom: 40 hours Individual study: 60 hours	4
	Master the linguistic tools and information and communication technologies to interact in daily activities and work contexts.	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,	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

			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).				
	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.	Identify the leadership style and interpret the main motivational dynamics that favour the active participation of members in a working group.	Method: Practice Test. Criteria: The student will have to demonstrate collaborative skills, listening and proposing solutions in a team working situation.	Classroom: 8 hours Laboratory: 16 hours Individual study: 16 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.	Theoretical computer science	Algorithms: procedure for solving a problem and implementation through programming and pseudo-code. Mathematical study models of an algorithm: synthesis and analysis. Computational complexity of an algorithm. Fundamental properties of the algorithm: executability, unambiguity, finiteness and other desirable properties (generality, efficiency, determinism).	Be able to translate a specification into an algorithm by describing it in a flow chart.	Method: Practical test with description of an algorithm in a flow chart. Criteria: The student will have to demonstrate knowledge of an algorithm.	Classroom: 20 hours Individual study: 30 hours	2
	Use tools and methodologies specific to experimental research for the applications of the technologies of the reference area.	Programming bases	The execution of an algorithm by computer based on representable data and interpretable instructions: problem, solution method, algorithm, programming language and program. Flow charts for the representation of algorithms: data (variable, constant), block or instruction (simple block, condition block), expressions and operators. Visibility of variables: global, local and temporary. Types of simple blocks: start and end, assignment, input, output. Control structures (alternative, repetition)	Be able to translate a flow chart into an executable code in one of the highest level IEC 1131 languages and know the basics of telecommunication.	Method: PC practice test. Criteria: The student will have to demonstrate the ability to translate an algorithm flow chart into a programming code.	Classroom: 10 hours Laboratory: 10 hours Individual study: 18 hours	1,5

		Telecommunica-tions	Classification of TLC systems: elements of signal theory, physical layer, link layer, internet network layer. Circuit and packet switching, ISO-OSI stack, IP protocol, TCP/UDP protocols, advanced network services, DNS, DHCP, Router, Firewall. Outline of application protocols and architecture of ICT applications.	Know the principles and protocols of data communication. Know the components of ethernet networks. Be able to configure a digital device to communicate within a network and subnet. Diagnose malfunctions.	Method: PC practice test. Criteria: The student will have to demonstrate the ability to configure a digital device to communicate within a network and subnet.	Classroom: 10 hours Laboratory: 18 hours Individual study: 20 hours	2
		Electrical design techniques and pneumatics bases	Electrostatic principles and magnetism. Ohm's law. Capacitance, inductance and impedance. Electric motors and drives, machine plant structures. Electrical and pneumatic diagrams.	Know the principles of electrostatics and magnetism. Know how to read an electrical and pneumatic diagram. Distinguish the main circuit functions of industrial electrical engineering applied to machines. Correctly check components with respect to the wiring diagram. Identify the causes of malfunction due to badly wired and/or defective components. Define an electrical system test method before it is turned on. Check the continuity of the equipotential circuit of the electrical protections.	Method: Multiple choice test. Criteria: The student must demonstrate knowledge of electrical and pneumatic diagrams.	Classroom: 60 hours Laboratory: 20 hours Individual study: 95 hours	7

General legal and economic field	Find sources and apply regulations that govern the business of a company and its external relations at national, European and international level.	Machine safety	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: 8 hours Individual study: 12 hours	1
General organizational and management area	Manage relationships and collaborations within the organizational structure and in work contexts, 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 natures: technical, operational, relational and organizational.	Communicating and relating in work: social intelligence	Negotiation situations and techniques; conflict situations and conflict management techniques; working relationships: internal communication, meetings and use of corporate emails; the relationship between technical and emotional skills in determining business results. Visits to companies and public speaking for the presentation of small projects are included.	Apply effective communication techniques for conflict prevention, meeting attendance and corporate mailing management.	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: 16 hours Individual study: 24 hours	1,5
	Organize and manage, with a good level of autonomy and responsibility, a working environment, workers relations and the reference technological system in order to achieve expected production results.	The HSE model of workplace management	The company's HSE (Health Safety Environment) structure to safeguard workers; health and safety and environmental protection. Integrated risk management; integrated management of plant safety and protection of the working environment.	Apply company regulations and procedures for the prevention of accidents and the safeguarding of health and safety conditions in the workplace, effectively managing general and specific risks.	Method: Multiple choice test. Criteria: The student must demonstrate knowledge of the HSE model of integrated risk management.	Classroom: 16 hours Individual study: 24 hours	1,5

	Know and help to manage the quality organizational models that encourage innovation in companies in the sector.	Quality management techniques	The concept of Quality, The phases of construction of a Quality Management System; Program planning and development; the quality policy; Preparation of flows and processes; Preparation of documentation (Procedures); Staff training; Introduction of procedures in corporate activities; Certification process; Monitoring Definition: UNI, EN, ISO References to the UNI EN ISO 9000 guidelines of which the 9001 standard is part: Purpose and scope of the UNI EN ISO 9001: 2015 standard. Statistical tools for process control: control charts for attributes and variables, control charts for R and for the median.	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: 8 hours Individual study: 12 hours	1
Common technical and professional skills - Information and communication technologies area	Organize and use information, data and their aggregations.	Relational and non-relational databases	Data model and representation of reality. Physical (of applications from the organization) and logical (of data) independence. Levels of data description: logical scheme, internal and external. Addressing of data through indexes: data files and index files. Coding of physical reality (conceptual design) and representation using a relational model (logical design). Entities, attributes, associations, relationships. Table or scheme: tuples, domains and keys. Not Only SQL Data Base: Column table, Document store, Graph, Key / Value. Description of some NRDBMS databases (Cassandra, SimpleDB, App Engine Data Store).	Know how to interface the DBs (ODBC, etc.) and be able to install, configure, query at least one relational DB and at least one non-relational DB and to backup them.	Method: PC practice test. Criteria: The student will have to demonstrate an ability to query a database, both relational and non-relational.	Classroom: 16 hours Laboratory: 12 hours Individual study: 15 hours	2
	Use languages for building systems and applications.	DOT NET programming languages	C# language, framework.NET and Visual C# code editor. Main, Types, Arrays, Strings, Instructions, Expressions and Operators, Classes and Structures, Properties, Interfaces,	Know the issues related to the SW life cycle and be able to use a SW configuration management tool	Method: PC practice test. Criteria: The student will have to	Classroom: 16 hours Laboratory: 12	2

			Indexers, Enumeration Types, Delegates, Events, Generics, Iterators, LINQ and Lambda Expressions, Name Spaces, Nullable Types, Unsafe Code and pointers. Interoperability Software configuration management tools (GIT).	(eg. GIT) and the Microsoft Visual Studio development environment to develop small programs. Being able to integrate subroutines in high level language (C#, visual basic, C++) in reference to "man-machine interface systems and applications".	demonstrate knowledge of how to use DOT NET programming languages for creating applications.	hours Individual study: 15 hours	
		SQL programming language	Standard language for the creation and interrogation of relational databases (Ansi standards). Commands (DDL, DML, DCL), propositions (From, Where, Group by, Having, Order by), operators (logical, comparison) and aggregation functions (AVG, COUNT, SUM, MAX, MIN).	Write the code for extracting data (defined in a specification) from a database.	Method: PC practice test. Criteria: The student will have to demonstrate knowledge of how to use the SQL programming language for creating applications	Classroom: 16 hours Laboratory: 12 hours Individual study: 15 hours	2
		Programming languages in PLC environment	IEC61131-3 standard languages: 1) Sequential flow chart (SFC); 2) Functional block diagram (FBD); 3) Contact language (Ladder Diagram); 4) Structured text (Pascal-like); 5) List of instructions. Software model and correspondence with real systems: a) single PLC; b) Multi-processor PLC; c) Program Organization Unit (POU). Identifiers, keywords, comments; predefined data types; types of derived data. Variables and syntax. The Codesys development environment (Controlled Development System) to implement automata for logical control. Development environments of the main PLC brands and examples of organizing a program.	Write an algorithm in "structured text"; know how to take care of the organization.	Method: PC practice test Criteria: The student will have to demonstrate knowledge of how to use programming languages in a PLC environment.	Classroom: 22 hours Laboratory: 12 hours Individual study: 20 hours	2

		PLC and PC-based control systems, motion control architectures	Automatic controls. Control systems for industrial automation. Levels (field, control and supervision) and components (sensors, processors, actuators) of an automatic system. Fundamental modules of the PLC based control architecture: processor, memory, I/O modules. Task management and distributed I/O. Examples of I/O modules: Degree of protection, Analogue output modules, Digital input modules. Examples of special I/O. Electric drives and motors, Absolute and incremental encoders, Resolver. Centralized and decentralized Motion Control architectures. Interaction between PLC and Motion Control system. The concept of axis in the programming of Motion Control systems. Motion control (Motion Control): Control architectures, The main types of motorcycles. Control implementation. Definition of trajectories, Examples. Types of movements. Synchronization of motions. Realization of motion paths. Interpolation. The open PLC for motion control: The state of a motor. Motion functions. Examples of positioning - Enable axis, Homing axis, Positioning axis, Stop axis - Axis commands - Speed axis, Synchronized axes. General aspects of function blocks. Function blocks for controlling a single axis. Main PLC and PC Based programming environments (Siemens, Allen Bradley, Schneider, B&R, Beckoff). Standard PackML for machine control of packaging machines. Electric drives for controlled handling. Troubleshooting techniques.	Know the concepts of automatic controls, reaction systems, their stability. Understand the meaning of the parameters that control stability, Follow its development, and organize tasks of an automation program, defining the cycle times. Use break points, track variables, debug locally and remotely. Define troubleshooting strategies, especially for motion control.	Method: Practice Test. Criteria: The student will have to demonstrate an ability to organize the tasks of an automation program.	Classroom: 30 hours Laboratory: 40 hours Individual study: 30 hours	4

	Develop multimedia and multichannel interfaces.	Human-machine interface systems and applications	The human-machine interface to act on the operation (commands) and observe the status (information) of a system (software and hardware). Visual, auditory and tactile input channels for people. Physical input and output devices (panels, lights, fields, buttons) used by the system. Terminal executable software for system visualization. Features of functionality and usability. Ergonomic systems, cognitive ergonomics and ergonomic software (usability engineering). Functions of use: operator information, parameter change, statistics (processing and return). Development environments (IDE): iFix, Wincc, Wonderware, Copadata's Zenon, Cimplicity Multi Device HMI.	Use the integrated development environment to develop interface applications, taking care of navigation and organization/ configuration of the data to be exchanged with the machine control and the communication protocol (protocols).	Method: PC practice test. criteria: The student will have to demonstrate that he can develop human-machine interface applications.	Classroom: 12 hours Laboratory: 8 hours Individual study: 10 hours	1
		Sensors and acquisition systems	Metrological definition of sensor: transformation of the input quantity into a signal. Classification: direct reading sensor, sensor connected to indicator instrument, sensor connected to recording instrument. Main types of sensors and respective applications: infrared, sound, acceleration, temperature, heat, electricity (resistance, current, voltage, power), pressure, movement, force, proximity/distance, biometric, chemical. Weight meters. Bidirectional sensors (receiver/transmitter), outline of the I/O Link protocol. Artificial vision systems. Advanced sensors with microelectronic technology (MEMS). Automatic identification technologies (AIDC); rfid, voice, 1D and 2D bar codes, machine and computer vision. Calibration	Know the calibration methods of the main sensors, be able to read the sensor data sheets and, based on the technical specifications, be able to verify their correct operation, applying troubleshooting techniques.	Method: Practice Test. Criteria: The student, placed in front of systems with sensors, will have to demonstrate his ability to read the sensor data sheets and verify their correct operation.	Classroom: 10 hours Laboratory: 22 hours Individual study: 13 hours	2

		Processing and analysis systems	Centralized systems (computer/terminals). Distributed systems connected by local LAN communication networks. System features: reliability, availability, safety and fault tolerance. Characteristic of the local network ("user background"): high data transmission speed and physical interconnection (cables, fibres, access studs). base, wide. Topology: bus, ring, tree, star. Properties of an open system: portability, consistency, interoperability, modularity. PC and workstation for local processing. Specialized computers (servers). Analytical systems for IoT. Analysis classes of an IoT platform: descriptive, diagnostic, predictive and prescriptive. Industrial IoT platforms for the integration of analytics and operations: Maximo from Ibm, Predix from GE Software, Software AG. Hadoop solutions for batch analysis. Proprietary platforms (Ibm, Informatica, Sap, Sas, Software AG, Tibco) and on public cloud (Kinesis, Cloud Dataflow, Azure Streaming Analytics) for real time analysis of deciduous data (streaming analytics).	Configure a local network and use the tools to verify the suitability of the network for the amount of data to be transferred, diagnosing any communication problems. Interfacing with customers; Interface with IT to integrate machine or line data with the corporate network and be able to configure HMI users within the domain. Know the data analytics programs and be able to configure the "Dashboard"; to adapt the display of results to the customers last minute requests. Be able to configure and verify the functioning of the reference cloud, both private and public.	Method: Practice Test Criteria: The student will have to demonstrate knowledge of Data Analytics programs.	Classroom: 16 hours Laboratory: 12 hours Individual study: 15 hours	2
		Sensor / actuator integration applications in production lines	Techniques for drawing, preparing, creating and installing the supports for mounting the sensors. Application of accelerometers, strain gauges, etc. and simple mechanical parts for actuation on the product.	Realize freehand, or using 2D, 3D CAD systems, the design of supports for sensors and mechanical parts for actuations. Realize the integration applications, choosing materials, performing tracing, punching and drilling, assembly.	Method: Practice Test. Criteria: The student must be able to perform and document the entire preparation and installation cycle of a sensor/actuator integration application.	Classroom: 10 hours Laboratory (lab area G9): 22 hours Individual study: 13 hours	2

		Client-server architectures	Client-server coordination model of the interaction. Client functions (interface, local execution, requests with SQL use, inter-process communication tools - IPC). Server functions (responses, communication with other servers, system structure). Functions of a client-server application: user interface, application programs, data management. Types of architecture: frontware, remote data management, distributed function processing. RPC, Server status information: stateless and stateful. Network designs.	Know and analyse the configuration and main functions of client-server architectures to manage access to resources.	Method: Practice Test. Criteria: The student will have to demonstrate an ability to analyse the configuration and main functions of client-server designs.	Classroom: 10 hours Laboratory: 8 hours Individual study: 10 hours	1
Specific technical professional skills for the job	Apply communication standards and protocols between machines and systems for data acquisition and control in industrial automation.	OPC standard of machine to machine communication	OPC (OLE for Process Control) standard for access to any data source (Server) by an OPC-based process (Client). Component Object Model (COM) technology for communication between local Windows applications and Distributed Component Object Model (DCOM) for communication and automatic updating of data between Windows applications across networks. The OPC Unified Architecture (OPC UA) multi-platform standard as M2M communication protocol for industrial automation: focus on communication between equipment and systems for data acquisition and control. Binary protocol and Web Service protocol (SOAP). Specifications. Implementation.NET. IEC 62541 as standard for OPC Unified design.	Know the potential of the OLE standard as a communication protocol and for the modelling of data of the communication and be able to configure and "dialogue" the objects with M2M communication.	Method: Practice Test. Criteria: The student will have to demonstrate an ability to apply communication standards and protocols between machines and systems for data acquisition and control in industrial automation.	Classroom: 8 hours Laboratory: 8 hours Individual study: 9 hours	1

INTERNSHIP I	Alternatively, the following areas can be considered eligible for inclusion: Electrical wiring; Configuration/Installation of machine control architectures, Verification and validation of automated system requirements. Some students can also enter the technical office to carry out maintenance and software updates (program).	Develop a greater awareness of personal study path, consolidating the 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 Individual study: 0 hours	15

Total hours in classroom/laboratory in year I: 610
Total internship hours in year I: 400
Total sum of 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 linguistic, communicative and relational field	Use technical English (micro language), related to the technological area of reference, to communicate correctly and effectively in the required contexts. Manage the communication and relational processes inside and outside the organization both in Italian and in English. Master the linguistic tools and information and communication technologies to interact in daily activities and work contexts. Prepare technical and regulatory documentation that can be managed through telematic networks.	Technical English II	Communication in English (written, oral) on technical-specialist subjects relating to the professional domain and the workplace. Interpretation and written drafts of technical documentation in English relating to standards for industrial automation and telecommunication.	Be able to communicate in English at both written and oral level using a specific language and terminology specific to the sector of reference Be able to interpret and write the technical documentation in English.	Method: Written test multiple choice and an 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: 40 hours Individual study: 60 hours	4

	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 ensure quality.	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: 14 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 and competitiveness.	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 (with particular reference to the packaging sector).	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: 4 hours Individual study: 8 hours	0,5

General organizational and management area	Manage relationships and collaboration within the organizational structure in a 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 natures: technical, operational, relational and organizational.	Communicating and relations in work: social intelligence	Negotiation and conflict situations; internal communication, meetings and use of corporate emails.	Apply negotiation and conflict management techniques.	Method: Role playing. Criteria: Placed in a simulated business meeting situation, the student will have to show communication and relational skills based on the proposal of solutions to a given organizational problem.	Classroom: 10 hours Individual study: 15 hours	1
	Know, analyse, apply and monitor, in specific contexts, management models of production processes of goods and services.	Industrial production management	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. Environmental focus: integrated product-service solutions (leasing, sharing, pay-per-use), which create the emerging business models in the circular economy.	Know and apply the main programming and management models of industrial production.	Method: Open / multiple choice questionnaire. Criteria: The student will have to demonstrate recognition of the main industrial production planning and management models.	Classroom: 4 hours Individual study: 6 hours	0,5
	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 workers resources used with a	Management of industrial plants	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. Environmental focus: integrated product-	Know and be able to orientate within the main configuration models of process technologies and production layouts	Method: Open / multiple choice questionnaire Criteria: The student will have to demonstrate recognition of the main configuration models of process	Classroom: 12 hours Individual study: 18 hours	1,5

	view to progressive continuous improvement.		service solutions (leasing, sharing, pay-per-use), which create the emerging business models in the circular economy.		technologies and production layouts.		
		Automatic industrial machines	Description of the operation of an automatic machine: machine phase diagram and relative speed. Structure of a machine-plant system: single group of one machine, single automatic machine, line of several machines and related accessories. Layout configurations: single machine and multiple machine line. Techniques and conventions of 2D and 3D graphic representation of components and mechanical parts for production or commercial and assembly /machine assemblies for assembly. Pneumatic schemes in 2D. CE machine certification and related technical file.	Be able to solve simple speed problems of belts and machine groups. Know how to create a simplified layout of a line of machines Be able to represent a tire pattern in CAD. Be able to represent simple mechanical parts in CAD. Be able to create the technical sheet of a machine module.	Method: Exercise. Criteria: The student must be able to document and represent the functioning of a machine module.	Classroom: 20 hours Laboratory: 24 hours Individual study: 24 hours	2,5
and professional skills - Information and communication	Organize and use information, data and their aggregations.	Data processing and business intelligence software applications.	Features and functionality of the main data visualization, data mining, decision support and business intelligence applications: SAS, IBM-SPSS, Access, SAP Business Objects, QLICK View). Elements of access/use of Big Data. Legislative and regulatory references regarding privacy and protection of personal data. Data processing during the entire data life cycle (collection, processing, cancellation)	Be able to configure applications to and acquire from different sources, and examine databases, to be processed for the purpose of analysing business processes and supporting decision-making	Method: PC practice test. Criteria: The student will have to demonstrate his ability to organize data and their aggregations.	Classroom: 8 hours Laboratory: 8 hours Individual study: 10 hours	1

	Making information, systems and applications usable by differentiating the communication according to the recipients	Fieldbus architectures and related device-bus protocols	ISO/OSI model for sending receiving interaction (symmetry, hierarchical structure and modularity). Fieldbus classification: Sensor-bus level, Device-bus level, Information & Control level. Fieldbus and motion control components configuration. Malfunction diagnosis. CAN protocol (Control Area Network) for the connection of sensors and motors. Protocol levels: Object (message filtering-interpretation), Transfer (fault isolation, error detection, error reporting, acknowledgement, arbitration, packetization, synchronization), Physical (binary representation, transmission of information beyond the level Data-Link of the ISO / OSI model. Common Industrial Protocol technologies: DeviceNet (device-bus level), ControlNet (control level). I/O link protocol as communication standard for sensors and actuators, dynamic modification of sensor parameters directly from the PLC and integrated diagnostics. Intelligent cabling system using ASI protocol (AS-Interface) for connecting binary sensors and actuators to the upper control levels Profibus standard: FMS (FieldBus Message Specification), DP (Decentralized Peripherals) and PA (Process Automation). Design levels: a) physical layer; b) data link layer; c) application layer. Protocol aspects: Master and Slave communication nodes, mono/multi master configurations. Communication services: telegram structure, data exchange	Know the different fieldbus classes and be able to interpret their configuration. Configure the fieldbus. Apply the rules of the main protocols in the configuration of communication architectures at the field and control level Understand the HW/SW protocol mechanisms. Be able to use the configuration tools to be able to easily modify the network in the field (in the workshop or as a customer) and diagnose malfunctions. Know the operating properties and be able to use a network analyser.	Method: Open/multiple choice questionnaire. Criteria: The student will have to prove that understand the HW/SW mechanisms of device-bus level communication protocols.	Classroom: 10 hours Laboratory: 10 hours Individual study: 10 hours	1

		Industrial ethernet communication protocols	Profinet IO: levels (TCP/IP, RT, IRT) and devices (controller, device, supervisor). Application report and communication reports for parameter transfer, cyclic data exchange and alarm management. Real time and isochronous communication. Powerlink (EPL): Managing Node and Controlled Nodes stations with exclusive TDMA-based access. Isochronous and asynchronous period in traffic scheduling. Network IP (addressing, resolution) level and UDP/TCP transport levels. Communication objects (NMT, SDO, PDO, Default Messages) and OBD dictionary. EtherCAT: real time master/slave architecture up to I/O level. Telegram pass-through and on-the-fly modification (extraction and insertion of editable process data on the fly). Management of process image and mapping configured in the device. Ethertype implementation and communication via UDP/IP (header). Synchronization and alignment of distributed clocks. SERCOS III. Line and ring topology. Intelligent sensors and a combination of centralized and distributed control. Hot-plug-in mechanism. Types of SERCOS and IP addressing. Frames and telegrams. Synchronization by master clock. IDN format of the parameterization data. EtherNet/IP: swith-ring topology and lan-switching infrastructure based on CIP protocol. Implicit message and explicit message. CIP Sync, CIP Motion and CIP Safety. MODBUS TCP: General specifications (Application Layer, PDU construction, data organization); SERIAL implementation (package construction), TCP/IP implementation (package construction).	Apply the rules of the main protocols in the configuration of industrial ethernet communication architectures. Understand the HW/SW mechanisms of the protocols. Be able to use the configuration tools to be able to easily modify the network in the field (in the workshop or as a customer) and diagnose malfunctions. Know the operating properties and be able to use a network analyser	Method: Practice Test. Criteria: The student will have to prove an ability to apply the rules of the main protocols in the configuration of communication designs at industrial ethernet level.	Classroom: 20 hours Laboratory: 20 hours Individual study: 20 hours	2,5

		TCP/IP communication protocol and IoT protocols	Internet protocols as the de facto standard of data networks. The TCP/IP levels: application, transport, network, network access. The IP protocol for the univocal addressing of the network terminal nodes: from IPV 4 with address space equal to 32 bits for a total of about 2^{32} addresses (sold out) a IPV6 of management of 2^{128} addresses. The protocol TCP for managing information between nodes. IT infrastructures for real time communication of critical data: Time sensitive networking (deterministic ethernet). MQTT protocol Publish-subscribe light messaging (low impact in low bandwidth situations) (MQ Telemetry Transport): asynchronous communication, message broker and message distribution to recipient clients. The IoT protocols: Open Interconnect Consortium (OIC), AllJoyn framework, Thread protocol. The sub-GHz networks for IoT; extended range WiFi connections with IEEE 802.11ah WiFi. ZigBee and Z-Wave. Edge computing in the IoT: computing resources located in remote locations near the user/data source and related design, implementation and management peculiarities compared to traditional data centres (ease of management, guarantees of security and resilience).	Apply the rules of the main protocols in the configuration of communication designs for the internet and IoT level.	Method: Practice Test. Criteria: The student will have to prove an ability to apply the rules of the main protocols in the configuration of communication architectures for the internet and IoT level.	Classroom: 20 hours Laboratory: 4 hours Individual study: 15 hours	1,5

	Guarantee the safety and reliability of the service.	Cyber security	Cyber security framework NIST, core macroprocesses and essential cybersecurity controls to reduce IT risk. IT asset protection objectives: confidentiality (controlled access to data, confidentiality of information), integrity (consistency, completeness, correctness of data), availability of data, non-repudiation. Passive physical security and active logical security. The ISO 27001 standard for the information security management system (ISMS). Program security (safety and reliability) and security models (semantics, language). Program errors: error, failure, fault. Communication security and network protocols (HTTPS, SSL, TLS, IPsec, SSH). Network security devices and systems: Firewall, Intrusion detection system (IDS), Intrusion prevention system (IPS), Network intrusion detection system (NIDS), Antivirus (on hosts).	Apply the procedures for installing and configuring devices, devices and systems to reduce IT risk.	Method: Multiple choice test. Criteria: The student will have to demonstrate knowledge of the Cyber Security elements necessary to guarantee the security and reliability of the system/service.	Classroom: 8 hours Individual study: 10 hours	0,5
	Measure, evaluate and improve the level of service provided.	Verification and validation of the IT infrastructure	Software testing techniques. Test plan, battery of tests and test scenarios. Check for malfunctions and defects. Probability of malfunction by type of application. Variety of input data, degree of solicitation and execution of the amount of code. Testing of digital systems: methodology and tools for verifying the correct functioning of network devices. Performance testing and validation of requirements. Troubleshooting: logical and systematic search for the causes of a malfunction.	Perform validation tests or final qualification of the supply of systems and systems (software product; operating infrastructure; user documentation), asserting their ability to pass the final test. Be able to define a test plan (test to be performed) starting from the functional specifications of the machine/line.	Method: Practice Test Criteria: The student must demonstrate knowledge of validation, qualification and final testing of systems	Classroom: 16 hours Laboratory: 8 hours Individual study: 15 hours	1,5

		Remote assistance and diagnostics	Remote technical support with direct interaction: forecast by design and availability of bi-directional data connection. Time lag effects. Remote assistance via internet on data processing systems and remote assistance on process controls through point-to-point connections. Indirect remote assistance with intermediation on the local side.	Carry out software updates, production data collection, video surveillance and diagnostics in the event of faults on the plant served, by connecting the production sites to be monitored to the Internet. Be able to configure the devices for the remote connection and the subnet to which the machines and the devices, integrated in them, must be monitored/updated belong.	Method: Practice Test Criteria: The student will have to demonstrate an ability to perform remote assistance	Classroom: 20 hours Laboratory: 4 hours Individual study: 15 hours	1,5
		Augmented reality for service	AR software and wearable devices to intervene in real time and remotely and to create supporting documentation for the assembly, maintenance and troubleshooting service. Creation of integrated animations with writings, schemes, pictograms, etc starting from 3D CAD CREO representations of groups, subgroups, components and for particular services. Solutions for the archiving of assistance and the creation of useful memory for assembly, maintenance and troubleshooting service interventions.	Be able to develop augmented reality animations in order to support the service intervention starting from the 3D CAD drawings of the assembly and/or maintenance and/or troubleshooting of objects.	Method: Exercise. Criteria: Starting from the analysis of a documented case, the student must prepare an animation to help carry out assembly and/or maintenance and/or troubleshooting operations.	Classroom: 10 hours Laboratory: 14 hours Individual study: 15 hours	1,5

	Collaborate in the realization of the life cycle of innovation projects related to information and communication technologies.	Digital revamping of machines and plants	Life cycle of a production system and digital revamping solutions (revision, regeneration/replacement, addition of new features): programs and techniques for extraordinary maintenance, updating, upgrading and replacement of electrical-electronic and IT components (electrical panels, PLC, drives, software and user interfaces) of machines and systems. Environmental focus: digitalization as an enabling factor for the extension of the useful life of the plant, which can regenerate itself, keeping components and materials at maximum possible usefulness and value (enhancement of the installed base of products of instrumental mechanics).	Being able to evaluate the opportunities for functional adaptation of existing communication infrastructures and automation systems in the face of updating solutions available for optimization.	Method: Business case analysis. Criteria: The student will have to solve a given industrial case by proposing digital revamping solutions for machines and production plants.	Classroom: 8 hours Laboratory: 8 hours Individual study: 10 hours	1
		Robot systems	The robot as a reprogrammable multifunctional manipulator. The industrial robot: 1) mechanical structure with actuators and sensors; 2) government unit. Mechanical system of the manipulator: links and joints; base, end effector and wrist. Control system: interface, trajectory planning; real time control of the motion of the joints; data storage; management of interaction with other machines; diagnostics, management, malfunctions. Kinematic structures: Cartesian manipulator, portal, cylindrical, spherical, SCARA, anthropomorphic. Direct, inverse and differential kinematics (Jacobian of the manipulator). Static and dynamic model of the manipulator. Trajectory planning (position, speed, acceleration and Jerk) in the joint space and in the operating space. Modular motion control architecture: 1) trajectory generation, 2) kinematic inversion, 3) axis control. Independent joint control and interaction control. Simulation tools to support programming. Teaching by practising mode.	Use simulated/real programming environments for the creation and activation of a robot system movement program. Be able to initialize and test a program. Be able to load a program, configure, backup and restore it. Be able to change the trajectories, calibrate and burn the axes of the robot. Know the line-tracking, the vision systems combined with the robot for the recognition and tracking of the pieces, the cooperative robots, safety systems that delimit the work area by managing the risk.	Method: Practice Test. Criteria: The student will have to demonstrate using simulated/real programming environments for the creation and activation of a robot system movement program.	Classroom: 24 hours Laboratory: 12 hours Individual study: 20 hours	2,5

		Robotic applications	Simulation in a programming environment of robotic handling operations for wrapping and packaging: picking up objects (conditioned by presence signal) from a stationary or variable position and release to another fixed or mobile position. Development of the program and loading onto the robot for testing and validation.	Be able to program a robot to carry out product handling operations with the appropriate typical motions of packaging.	Method: Practice Test. Criteria: The student will have to demonstrate an ability to program a robot to move products according to assigned paths.	Classroom: 8 hours Laboratory: 20 hours Individual study: 15 hours	1,5
	Plan the use of information and communication technologies and evaluate their impact.	RAMI 4.0	Introduction to the reference design for Industry 4.0 model. The integration between the product lifecycle approach (development, production and service), the IT infrastructure levels (asset, integration, communication, information, functional, business) and the functional hierarchy of the physical components (from the product to the connected world). The combination of assets and administration shell as a fundamental component of Industry 4.0.	Be able to place the digital applications and automation systems configured within the digital transformation model that integrates production in the factory, commercial company and the product/service market.	Method: Open/multiple choice questionnaire. Criteria: The student must demonstrate knowledge of RAMI 4.0 model of reference for the transition to Industry 4.0.	Classroom: 6 hours Laboratory: 6 hours Individual study: 10 hours	1
Specific technical professional skills for the job	Configure, test and maintain cloud computing systems	Cloud systems	Cloud Computing features: scalability, pay-per-use (on-demand) model, large access network, resource pool, rapid elasticity, virtualization, multi-tenancy and monitoring services. Enabling technologies of Cloud Computing: 1) Virtualization of HW resources; 2) Types and technologies of virtualization. Service models (SaaS, PaaS, IaaS), architectures (frontend, backend and network) and deployment models (public, private, hybrid). Development of multi-tenant SaaS applications (Business and BPM): platforms (SaleForce.com, Windows Azure, EC2) and metadata-driven architectures. Security and privacy for the Cloud.	Configure, test and maintain systems for the storage, processing or transmission of data with availability on demand within a shared resources pool.	Method: Practice Test. Criteria: The student will have to demonstrate knowledge of how to configure, test and maintain cloud computing systems	Classroom: 20 hours Laboratory: 12 hours Individual study: 20 hours	2

	Configure, test and maintain supervisory control systems and data acquisition.	HMI/SCADA systems	Electronic monitoring of physical systems through the distributed IT system. Components of SCADA systems (Supervisory Control and Data Acquisition): a) sensors for measuring physical quantities; b) controllers (PLC or microcomputer) for measurements and local storage of data continuously or at time intervals; c) telecommunication system between micro-controllers and supervisor; d) supervisor computer for data processing. System functionality: 1) data acquisition on process status; 2) supervision through data visualization and observation of the evolution of the states of a controlled process; 3) control through variation of characteristic parameters of the process after data processing. Real time control capability. System reliability and availability. HMI to facilitate operator/system interactions. Calibration in relation to the area to be checked. Advanced HMI: augmented and virtual reality systems. Main interface development environments (Siemens, Allen Bradley, Schneider).	Install, configure, test and maintain information systems for the monitoring and infrastructural control of field-level production processes in the industrial sector.	Method: Practice Test. Criteria: The student will have to demonstrate knowledge of how to configure, test and maintain supervisory control systems and data acquisition.	Classroom: 32 hours Laboratory: 16 hours Individual study: 30 hours	3
	Configure, test and maintain systems for the optimization of the production function.	MES/MOM management systems for the production function	Production execution systems (from the launch of orders, to the completion of finished products) based on the interface between supervision and data acquisition control systems (SCADA) and other data sources (ERP, CMMS). The functions of an MES / MOM system: 1) dispatching of production plans, 2) control and progress, 3) manpower management, 4) production resource management, 5) quality control, 6) product traceability and traceability and process, 7) warehouse management, 8) production performance analysis, 9) predictive diagnostics, 10) service and spare parts, 11) notifications for smart working.	Install, configure, test and maintain industrial production information systems for intermediate production between the sector and enterprise level	Method: Practice Test Criteria: The student will have to demonstrate knowledge of how to configure, test and maintain systems for the optimization of the production function	Classroom: 8 hours Laboratory: 8 hours Individual study: 10 hours	1

		Transversal module of Team Work	The training unit is carried out in an assisted Project Work laboratory, to be carried out in subgroups, to develop and test the functionality of IT applications intended for supervision, control and management of industrial plant engineering for packaging.	Be able to configure, program, install and test the IT infrastructure (HW and SW) for supervision, control and management of an automatic machine.	Method: Evaluation of Project Work results. Criteria: The student will have to demonstrate an ability to configure, test and maintain the IT infrastructure of supervision, control and management.	Classroom: 40 hours Laboratory: 52 hours Individual study: 40 hours	5,5
INTERNSHIP II			Work activity and structured study congruent with the development phases of a business application with the aim of providing the student with an in-depth study and integration of the technical-specialist disciplines developed by the course. As an alternative to joining a team responsible for following the entire development cycle of a specific application, the intern can be socialized according to the sequential and process logic to the various functional activities required by the development flow of a complete application: design, development/customization, configuration/installation and verification/validation of application requirements.	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 will include an evalua-tion 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 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

REALIGNMENT modules (80 hours) on the basic concepts of Computer Programming (20 hours), Studying Mechanical Technical Drawings (30 hours), Electronics and Electrotechnics (30 hours) are provided for all admitted students.

Realignment is mandatory for all participants. These hours are to be considered additional to the expected course 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

Bologna office

Via S. Bassanelli 9/11 - 40129 Bologna