Course unit English denomination	**How to write a scientific paper**
SS	GSD 09/IIND05 SSD IIND05/A
Teacher in charge (if defined)	Prof. Daria Battini
Teaching Hours	10
Number of ECTS credits allocated	2
Course period	Spring 2026
Course delivery method	☒ In presence ☐ Remotely ☐ Blended
Language of instruction	English
Mandatory attendance	☒ Yes (100% minimum of presence) ☐ No
Course unit contents	The creation of a written manuscript for submission to a peer-reviewed scientific journal requires significant effort. This effort can be optimized by following a few straightforward suggestions during the writing and preparation process. By adhering to recommended guidelines and avoiding common mistakes, the submission process can be streamlined, allowing even novice authors to navigate it successfully. The purpose of this invited commentary is to provide practical advice for achieving success when writing and submitting manuscripts. Some tips to select the right journal to submit the research work will be provided.
Learning goals	Achieve success when writing and submitting research outcomes.
Teaching methods	-
Course on transversal, interdisciplinary, transdisciplinary skills	☒ Yes ☐ No
Available for PhD students from other courses	☒ Yes ☐ No
Prerequisites	-

(not mandatory)	
Examination methods (if applicable)	-
Suggested readings	-
Additional information	-

Course unit English denomination	**Basics of CAD modeling and technical drawing: how to read and understand Technical Product Documentation**
SS	IIND-03/B
Teacher in charge (if defined)	Roberto Meneghello – Mattia Maltauro
Teaching Hours	15
Number of ECTS credits allocated	3
Course period	Winter 2026
Course delivery method	☒ In presence ☐ Remotely ☐ Blended
Language of instruction	English
Mandatory attendance	☒ Yes (100% minimum of presence) ☐ No
Course unit contents	1. General introduction to Technical Product Documentation 2. CAD fundamentals: solid, surface and mesh modeling 3. CAD lab with Solidworks: sketching, part and assembly 4. From 3D CAD modeling to technical drawing (2D) 5. Technical drawing types 6. How to Read (H2R) a technical drawing: a. Understanding representation issues from 2D to 3D b. Interpreting general information c. Reading the dimensioning scheme d. Converting the specification scheme into functional requirements 7. Application Examples
Learning goals	To achieve the ability to import or create basic 3D CAD models, of parts and assemblies, as well as the correct sequence of reading (and understanding at an elementary level) a 2D technical drawing.
Teaching methods	Traditional frontal lectures + laboratory experience
Course on transversal, interdisciplinary, transdisciplinary skills	☒ Yes ☐ No

Available for PhD students from other courses	☒ Yes ☐ No
Prerequisites (not mandatory)	No
Examination methods (if applicable)	Homework assignment
Suggested readings	
Additional information	

Course unit English denomination	**Application of anyLogistix software for Optimizing Digital Supply Chains**
SS	GSD 09/IIND05 SSD IIND05/A
Teacher in charge (if defined)	Niloofar Katiraee
Teaching Hours	10
Number of ECTS credits allocated	2
Course period	Winter 2025
Course delivery method	☒ In presence ☐ Remotely ☐ Blended
Language of instruction	English
Mandatory attendance	☒ Yes (100% minimum of presence) ☐ No
Course unit contents	This seminar will introduce PhD candidates to the use of anyLogistix software for optimizing and simulating supply networks. The seminar will begin by covering the fundamental concepts of supply networks, including common challenges and complexities faced in real-world scenarios. The focus will then shift to how the anyLogistix software enables managers and decision-makers to efficiently design and evaluate these networks. Attendees will gain insights into network optimization, simulation techniques, and performance testing, which are crucial for effective supply chain management. By the end of the seminar, participants will have a understanding of supply network fundamentals and will be able to apply anyLogistix to assess and optimize supply chain designs, enhancing their ability to develop efficient networks in their research or professional practice.
Learning goals	Supply chain design
Teaching methods	Frontal lecture
Course on transversal, interdisciplinary, transdisciplinary skills	☐ Yes ☒ No
Available for PhD students from other courses	☐ Yes ☒ No

Prerequisites (not mandatory)	-
Examination methods (if applicable)	Homework assignment
Suggested readings	-
Additional information	-

Course unit English denomination	**Resilient and inclusive workplaces in the Industry 5.0 era: Advanced methods and smart tools in the manufacturing work environment**
SS	GSD 09/IIND05 SSD IIND05/A
Teacher in charge (if defined)	Berti Nicola
Teaching Hours	10
Number of ECTS credits allocated	2
Course period	Fall 2025
Course delivery method	☒ In presence ☐ Remotely ☐ Blended
Language of instruction	English
Mandatory attendance	☒ Yes (100% minimum of presence) ☐ No
Course unit contents	The seminar will cover the transition from Industry 4.0 to Industry 5.0 in the manufacturing sector, examining the main characteristics of the two industrial revolutions and their differences. The seminar focuses on the technological aspect, describing the adoption of sensor-driven Digital Twin systems in operation and logistic applications and how managerial strategies have changed based on the availability of Big Data. PhD candidates will gain insight into practical adoptions and case studies concerning digitization. At the end of the seminar, participants will have an overview of the new technologies and strategies that currently help companies transition toward a more human-centered, resilient, and inclusive work environment. The seminar will explore the following aspects: • From Industry 4.0 to Industry 5.0: differences and future challenges. • Human-centered workplace: Integrating ergonomics and human factors in the workplace design process. • Technological advancements in human data capture for precise ergonomic assessment: New devices to monitor worker safety. • Human digital twin: strengths, weaknesses, opportunities, and threats of the system responsible for the assessment of human well-being for the future workforce.
Learning goals	Investigate the role of humans in the new manufacturing era
Teaching methods	Frontal lecture

Course on transversal, interdisciplinary, transdisciplinary skills	☐ Yes ☒ No
Available for PhD students from other courses	☐ Yes ☒ No
Prerequisites (not mandatory)	Homework assignment
Examination methods (if applicable)	-
Suggested readings	-
Additional information	-

Course unit English denomination	**Building and solving mathematical models for manufacturing and logistics systems**
SS	GSD 09/IIND05 SSD IIND05/A
Teacher in charge (if defined)	Finco Serena
Teaching Hours	10
Number of ECTS credits allocated	2
Course period	Spring 2026
Course delivery method	☒ In presence ☐ Remotely ☐ Blended
Language of instruction	English
Mandatory attendance	☒ Yes (100% minimum of presence) ☐ No
Course unit contents	Learn how to abstract real manufacturing and logistics problems into mathematical models. Understand types of models and the steps in the modeling process. Explore real-world case examples. Formulate and solve linear optimization problems for production and resource planning. Study the simplex method and sensitivity analysis. Apply LP to optimize operations in manufacturing and logistics. Model decisions involving yes/no choices and discrete variables. Use MIP for problems like facility location or lot sizing. Learn basic solution techniques like branch and bound.
Learning goals	Create a mathematical model according to the research topic the PHD student is working on.
Teaching methods	Frontal lecture
Course on transversal, interdisciplinary, transdisciplinary skills	☐ Yes ☒ No
Available for PhD students from other courses	☐ Yes ☒ No
Prerequisites (not mandatory)	-

Examination methods (if applicable)	-
Suggested readings	-
Additional information	-

Course unit English denomination	**Collaborative Robotics: towards smart manufacturing**
SS	GSD 09/IIND05 SSD IIND05/A
Teacher in charge (if defined)	Faccio Maurizio
Teaching Hours	10
Number of ECTS credits allocated	2
Course period	Spring 2026
Course delivery method	☒ In presence ☐ Remotely ☐ Blended
Language of instruction	English
Mandatory attendance	☒ Yes (100% minimum of presence) ☐ No
Course unit contents	Collaborative robotics is revolutionizing the landscape of smart manufacturing, offering new paradigms for efficient and flexible production systems. This seminar delves into the integration of human-robot collaboration (HRC) within assembly operations, highlighting the advantages of dynamic task allocation and the synergy between robots and human operators. Traditional assembly lines are being redefined by the deployment of collaborative robots (cobots), which work alongside humans to enhance precision, safety, and overall productivity. Key topics will include task allocation models, workspace sharing, and the influence of product characteristics on assembly efficiency. Through case studies, the seminar will explore assembly applications, offering insights into how collaborative robotics is poised to meet the demands of Industry 5.0 by improving both human well-being and production outcomes.
Learning goals	Investigate the role of cobots in new manufacturing systems
Teaching methods	Frontal Lecture
Course on transversal, interdisciplinary, transdisciplinary skills	☐ Yes ☒ No

Available for PhD students from other courses	☐ Yes ☒ No
Prerequisites (not mandatory)	-
Examination methods (if applicable)	Homework assignment
Suggested readings	-
Additional information	-

Course unit English denomination	**Discrete-Events and Agent-Based simulations with AnyLogic**
SS	GSD 09/IIND05 SSD IIND05/A
Teacher in charge (if defined)	N/D
Teaching Hours	10
Number of ECTS credits allocated	2
Course period	N/D
Course delivery method	☐ In presence ☐ Remotely ☒ Blended
Language of instruction	English
Mandatory attendance	☒ Yes (100% minimum of presence) ☐ No
Course unit contents	On this course you will learn how to develop simulation models using AnyLogic, with the paradigms of discrete-events, agent-based and the combination of both as multi-method simulations. You will learn the grand majority of the tools required to model advanced scenarios to solve complicated business questions. After the JAVA introduction, the course gets quite deep quite fast with assignments that are not easy to complete. This in order to stimulate this new ability in your brain and accelerate your progress. This course will also teach you the basics of JAVA, of course not to become a JAVA expert, but to be able to be fluent with its basic tools in order to be an autonomous JAVA developer. It's a good starting point to learn any programming language afterwards. This course also touches databases with the SQL API, Excel API, GIS integration and many other things that use the powerful AnyLogic Software to create amazing 3D animation models, generate statistics and data representation through different kinds of graphs and plots. You will be at the end of the course, capable of simulating complex system in many different industries including warehouses, supply chain networks, manufacturing facilities, people interactions and others. You will be able to generate the logical structure of this system and transform it into beautiful 3D animations.
Learning goals	Learn how to build a simulation model
Teaching methods	Online course

Course on transversal, interdisciplinary, transdisciplinary skills	☐ Yes ☒ No
Available for PhD students from other courses	☐ Yes ☒ No
Prerequisites (not mandatory)	-
Examination methods (if applicable)	Online assignment
Suggested readings	-
Additional information	-

Course unit English denomination	**System Dynamics Simulations with AnyLogic**
SS	GSD 09/IIND05 SSD IIND05/A
Teacher in charge (if defined)	N/D
Teaching Hours	10
Number of ECTS credits allocated	2
Course period	N/D
Course delivery method	☐ In presence ☐ Remotely ☒ Blended
Language of instruction	English
Mandatory attendance	☒ Yes (100% minimum of presence) ☐ No
Course unit contents	On this course you will learn how to develop simulation models using AnyLogic, with total focus on the System Dynamics paradigm. You will learn all the tools and concepts required to model advanced scenarios to solve complicated business questions from a System Dynamics perspective. This course doesn't require any previous knowledge and you will: Understand the mathematical background of the System Dynamics theory Learn how to develop conceptual models using causal loop diagrams Learn all the System Dynamic building blocks Good practice concepts to build robust models Generic structures and archetypes that you can apply directly for your particular problem Experiments to validate and optimize your models Learn functions to simplify model development and to understand the models behind these functions Integrate databases to populate your model Special AnyLogic techniques to improve the functionality of your SD models How to integrate System Dynamics with other simulation methods
Learning goals	System dynamics simulation
Teaching methods	Online course

Course on transversal, interdisciplinary, transdisciplinary skills	☐ Yes ☒ No
Available for PhD students from other courses	☐ Yes ☒ No
Prerequisites (not mandatory)	-
Examination methods (if applicable)	Online assignment
Suggested readings	-
Additional information	-

Course unit English denomination	**Data-Driven Science for Dynamical Systems**
SS	GSD 09/IIND-02 SSD IIND-02/A Meccanica applicata alle macchine
Teacher in charge (if defined)	Dr. Jason Bettega Department of Management and Engineering, University of Padova
Teaching Hours	10
Number of ECTS credits allocated	2
Course period	01/2025
Course delivery method	☐ In presence ☐ Remotely ☒ Blended
Language of instruction	English
Mandatory attendance	☒ Yes (50% minimum of presence) ☐ No
Course unit contents	The seminar will cover key techniques for signal processing and dynamic system analysis, including the Fast Fourier Transform, Wavelet and Gabor Transforms, Dynamic Mode Decomposition, and the Koopman Operator, highlighting their applications in frequency analysis and nonlinear system modeling.
Learning goals	The seminar dealt with some of the common data-driven techniques that are usually considered in the different engineering fields with the goal of achieving useful information from raw measurement data. In particular, the mentioned data-driven techniques can be exploited for several purposes, such as system identification, control and analysis of dynamical systems in the time/frequency domain. Therefore, the participants potentially gained a comprehensive overview of the mentioned data-driven techniques, allowing them to further enrich their skills in the presence of raw measurement data.
Teaching methods	Traditional frontal lessons, Numerical simulation lab
Course on transversal, interdisciplinary, transdisciplinary skills	☒ Yes ☐ No
Available for PhD students from other courses	☒ Yes ☐ No
Prerequisites (not mandatory)	

Examination methods (in applicable)	The examination will consist of a report on a seminar topic chosen by the participants, ideally related to their own research interests. The report may focus on applying a data-driven technique to a research test case or reviewing an existing paper from the relevant literature.
Suggested readings	• Brunton SL, Kutz JN. Data-Driven Science and Engineering: Machine Learning, Dynamical Systems, and Control. 2019 • P. A. Businger and G. H. Golub. Algorithm 358: Singular value decomposition of a complex matrix [F1, 4, 5]. 1969. • S. Cherry. Singular value decomposition analysis and canonical correlation analysis. 1996 • J. W. Cooley, P. A. Lewis, and P. D. Welch. Historical notes on the fast Fourier transform. 1967 • P. Holmes, J. L. Lumley, G. Berkooz, and C.W. Rowley. Turbulence, Coherent Structures, Dynamical Systems and Symmetry. 2012 • Chatterjee. An introduction to the proper orthogonal decomposition. 2000 • J. N. Kutz. Data-Driven Modeling and Scientific Computation: Methods for Complex Systems and Big Data. 2013. • K. K. Chen, J. H. Tu, and C.W. Rowley. Variants of dynamic mode decomposition: Boundary condition, Koopman, and Fourier analyses. 2012. • J.W. Cooley and J.W. Tukey. An algorithm for the machine calculation of complex Fourier series. 1965. • S. Qian and D. Chen. Discrete Gabor transform. 1993 • Torrence and G. P. Compo. A practical guide to wavelet analysis. 1998 • O. Semeraro, G. Bellani, and F. Lundell. Analysis of time-resolved PIV measurements of a confined turbulent jet using POD and Koopman modes. 2012 • S. Sharma, I. Mezi´c, and B. J. McKeon. Correspondence between Koopman mode decomposition, resolvent mode decomposition, and invariant solutions of the Navier–Stokes equations. 2016
Additional information	

Course unit English denomination	**Numerical methods for Magnetic Field Computation and Design of electromagnetic Actuators in mechatronics**
SS	GSD 09/IIET-01 SSD IIET-01/A Elettrotecnica
Teacher in charge (if defined)	prof. Giuseppe Chitarin Department of Management and Engineering, University of Padova
Teaching Hours	10
Number of ECTS credits allocated	2
Course period	06/2025
Course delivery method	☒ In presence ☐ Remotely ☐ Blended
Language of instruction	english
Mandatory attendance	☒ Yes (80% minimum of presence) ☐ No
Course unit contents	This course covers the principles of magnetic fields, forces, and electromagnetic actuators in mechatronics. It explores magnetic field equations, material properties, and numerical methods for solving these equations, including magnetic vector potential and reduced scalar potential. The course introduces the Finite Element Method (FEM) for solving electromagnetic problems and includes hands-on lab sessions where students use FEM software to design and simulate actuators.
Learning goals	Students will gain a solid understanding of magnetic fields, forces, and electromagnetic actuators. They will learn to solve magnetic field equations, apply numerical methods, and use FEM software to design and optimize actuators in mechatronic systems. The course aims to equip students with both theoretical knowledge and practical skills for electromagnetic design.
Teaching methods	Traditional frontal lessons, Numerical simulation lab
Course on transversal, interdisciplinary, transdisciplinary skills	☐ Yes ☒ No
Available for PhD students from other courses	☒ Yes ☐ No
Prerequisites (not mandatory)	

Examination methods (in applicable)	The examination will involve a numerical FEM simulation on a specific course topic, with a requirement to analyze and discuss the results.
Suggested readings	
Additional information	

Course unit English denomination	**Immersive Technologies and Experiences for Smart Industry**
SS	GSD 09/IINF-05 SSD IINF-05/A Sistemi di elaborazione delle informazioni
Teacher in charge (if defined)	prof. Michele Geronazzo Department of Management and Engineering, University of Padova
Teaching Hours	5
Number of ECTS credits allocated	1
Course period	06/2025
Course delivery method	☒ In presence ☐ Remotely ☐ Blended
Language of instruction	english
Mandatory attendance	☒ Yes (100% minimum of presence) ☐ No
Course unit contents	The course unit covers immersive VR/AR technologies, 3D computer vision, multimodal sensing, and AI, with a focus on their applications in smart industrial environments. It explores human-centered design principles and practical use cases such as teleoperation, maintenance, assembly guidance, and training, highlighting how these technologies can enhance industrial processes.
Learning goals	The learning goals aim to equip students with the skills to design immersive cyber-physical systems that seamlessly integrate visual and auditory feedback. Students will also develop a deep understanding of perception engineering, human factors, and user-centric design, enabling them to optimize human-machine interactions and improve the overall user experience in industrial applications.
Teaching methods	Hybrid interactive lectures, guided discussions, case-study analyses complemented by targeted readings
Course on transversal, interdisciplinary, transdisciplinary skills	☐ Yes ☒ No
Available for PhD students from other courses	☒ Yes ☐ No
Prerequisites	Homework assignments

(not mandatory)	
Examination methods (in applicable)	TBD
Suggested readings	
Additional information	

Course unit English denomination	**Design and Optimization of EMI Filters for Electronic Systems**
SS	GSD 09/IMIS-01 SSD IMIS-01/B Misure elettriche ed elettroniche
Teacher in charge (if defined)	prof. Alessandro Sona Department of Management and Engineering, University of Padova
Teaching Hours	10
Number of ECTS credits allocated	2
Course period	06/2025
Course delivery method	☒ In presence ☐ Remotely ☐ Blended
Language of instruction	english
Mandatory attendance	☒ Yes (80% minimum of presence) ☐ No
Course unit contents	This course covers filtering strategies for power supply systems, focusing on the design and implementation of EMI filters. It explores key components such as inductors, capacitors, common-mode chokes, and ferrite beads, detailing their roles in noise suppression. Various filter types, including three-terminal, four-terminal, and feedthrough filters, are examined, along with insertion loss analysis and the damping phenomenon. The course also addresses practical aspects of filter design, installation methods, and optimal positioning and connection techniques to enhance electromagnetic compatibility and overall system performance.
Learning goals	Participants will gain a deep understanding of EMI filters, including their key components, design principles, and installation techniques. They will also explore strategies for optimizing filtering performance and ensuring effective utilization in practical applications.
Teaching methods	Traditional frontal lessons, classroom discussions on practical case studies
Course on transversal, interdisciplinary, transdisciplinary skills	☐ Yes ☒ No
Available for PhD students from other courses	☒ Yes ☐ No
Prerequisites	

(not mandatory)	
Examination methods (in applicable)	Homework assignments
Suggested readings	
Additional information	

Course unit English denomination	**Autonomous Mobile Robotics: Aerial and Ground Controlled Systems**
SS	GSD 09/IINF-04 SSD IINF-04/A Automatica
Teacher in charge (if defined)	prof. Giulia Michieletto Department of Management and Engineering, University of Padova
Teaching Hours	10
Number of ECTS credits allocated	2
Course period	11/2025
Course delivery method	☐ In presence ☐ Remotely ☒ Blended
Language of instruction	english
Mandatory attendance	☒ Yes (80% minimum of presence) ☐ No
Course unit contents	This seminar explores the modeling and control of both aerial and ground mobile robots. The focus begins with modeling, particularly examining the maneuverability properties of robots and how these are influenced by their actuation features. A key component of the seminar is dedicated to the control of individual robots, with an emphasis on path-following tasks. Lastly, the seminar introduces multi-robot systems, offering insights into the coordination and control techniques necessary for collaborative tasks.
Learning goals	By the end of the seminar, students will understand the differences in dynamics and maneuverability between aerial and ground robots. They will learn to design effective control solutions for path-following tasks and explore the potential of multi-robot systems, gaining insights into how robots can collaborate on complex tasks across various application fields.
Teaching methods	Traditional frontal lessons
Course on transversal, interdisciplinary, transdisciplinary skills	☐ Yes ☒ No
Available for PhD students from other courses	☒ Yes ☐ No
Prerequisites (not mandatory)	

Examination methods (in applicable)	The examination method involves a discussion of a state-of-the-art work related to autonomous mobile robotics in the student's area of interest.
Suggested readings	
Additional information	

Course unit English denomination	**Introduction to Physics-Informed Machine Learning**
SS	GSD 09/IINF-05 SSD IINF-05/A Sistemi di elaborazione delle informazioni
Teacher in charge (if defined)	prof. Monica Reggiani Department of Management and Engineering, University of Padova
Teaching Hours	10
Number of ECTS credits allocated	2
Course period	02/2026
Course delivery method	☒ In presence ☐ Remotely ☐ Blended
Language of instruction	english
Mandatory attendance	☒ Yes (80% minimum of presence) ☐ No
Course unit contents	The course unit begins with an exploration of AI and ML in science and engineering, highlighting their intersection and various applications. It then moves on to curating training data, focusing on strategies for selecting and preparing datasets that incorporate physical principles to enhance model performance. Next, students will dive into Physics-Informed Neural Networks (PINNs), learning how these networks embed physical laws to solve differential equations and model dynamic systems. The course also covers the process of choosing what to model, offering guidance on selecting appropriate physical models and integrating them with machine learning techniques. Finally, the course wraps up with a flipped classroom format, where students present how the key concepts and methodologies apply to their own research topics.
Learning goals	By the end of the course, students will understand how to embed physical laws into machine learning models, curate and preprocess datasets that reflect physical phenomena, design and implement Physics-Informed Neural Networks (PINNs), and select and integrate appropriate physical models with machine learning techniques to solve real-world problems.
Teaching methods	Traditional frontal lessons, case studies, flipped classroom sessions
Course on transversal, interdisciplinary, transdisciplinary skills	☒ Yes ☐ No

Available for PhD students from other courses	☒ Yes ☐ No
Prerequisites (not mandatory)	
Examination methods (in applicable)	Homework assignments
Suggested readings	
Additional information	

Course unit English denomination	**Material selection in a Critical Raw Materials perspective**
SS	IIND-03/C
Teacher in charge (if defined)	Paolo Ferro
Teaching Hours	5
Number of ECTS credits allocated	1
Course period	Spring 2026
Course delivery method	☒ In presence ☐ Remotely ☐ Blended
Language of instruction	English
Mandatory attendance	☒ Yes (100% minimum of presence) ☐ No
Course unit contents	1. Critical Row Materials 2. Material selection approach 3. Material selection in a CRM perspective
Learning goals	Integrating the consideration of Critical Raw Materials into material selection whit a view to promote sustainability, reducing supply risks, and supporting responsible innovation in engineering and design.
Teaching methods	Traditional frontal lectures
Course on transversal, interdisciplinary, transdisciplinary skills	☒ Yes ☐ No
Available for PhD students from other courses	☒ Yes ☐ No
Prerequisites (not mandatory)	
Examination methods (if applicable)	Homework assignments

Suggested readings	
Additional information	
Course unit English denomination	**Efficiency and Renewable Energy in Building Climatization for a Sustainable Future**
SS	IIND-07/A
Teacher in charge (if defined)	Marco Noro
Teaching Hours	5
Number of ECTS credits allocated	1
Course period	Spring 2026
Course delivery method	☒ In presence ☐ Remotely ☐ Blended
Language of instruction	English
Mandatory attendance	☒ Yes (100% minimum of presence) ☐ No
Course unit contents	The course will introduce the most effective energy efficiency solutions for the future nearly zero energy buildings, covering generation, conversion, and end-use of energy, with emphasis on meeting regional and global energy needs in a sustainable manner. Heat pumps technologies, solar systems (thermal and electric), modern cogeneration technologies, mechanical ventilation systems and efficient thermal storage systems will be presented. A particular focus will be dedicated to hydrogen and fuel cells as possible technologies for the completely future decarbonization of energy systems in buildings climatization.
Learning goals	Participants will focus on the reduction of the energy needs of buildings and the use of different energy efficiency and renewable energy technologies for annual climatization, to meet the EU goal of climate neutrality by 2050.
Teaching methods	Traditional frontal lectures

Course on transversal, interdisciplinary, transdisciplinary skills	☒ Yes ☐ No
Available for PhD students from other courses	☒ Yes ☐ No
Prerequisites (not mandatory)	
Examination methods (if applicable)	Homework assignments
Suggested readings	
Additional information	

Course unit English denomination	**Thermo-fluid dynamics in 3D printed channels**
SS	IIND-07/A
Teacher in charge (if defined)	Simone Mancin
Teaching Hours	10
Number of ECTS credits allocated	2
Course period	Spring 2026
Course delivery method	☒ In presence ☐ Remotely ☐ Blended
Language of instruction	English
Mandatory attendance	☒ Yes (100% minimum of presence) ☐ No
Course unit contents	Thermo-fluid dynamics of printed channels and systems: controlling most important parameter in the design of efficient 3D printed heat exchangers.
Learning goals	Understanding the relevant variables and main constrains in the design for additive manufacturing of innovative heat exchangers.
Teaching methods	Traditional frontal lectures
Course on transversal, interdisciplinary, transdisciplinary skills	☒ Yes ☐ No
Available for PhD students from other courses	☒ Yes ☐ No
Prerequisites (not mandatory)	
Examination methods (if applicable)	Homework assignments
Suggested readings	

Additional information	
Course unit English denomination	**How to control functionality in product life-cycle using geometrical specifications**
SS	IIND-03/B
Teacher in charge (if defined)	Gianmaria Concheri - Mattia Maltauro
Teaching Hours	10
Number of ECTS credits allocated	2
Course period	Summer 2026
Course delivery method	☒ In presence ☐ Remotely ☐ Blended
Language of instruction	English
Mandatory attendance	☒ Yes (80% minimum of presence) ☐ No
Course unit contents	1. General introduction to Geometrical Product Specification 2. Integrated ISO GPS/ASME GD&T methodology fundamentals 3. How to Write (H2W) methodology 4. H2W advanced topics: a. Datum System b. Dependency/independency principles and envelope requirement c. Linear sizes according to ISO 14405-1 d. Dimensions other than linear sizes (ISO 14405-2) and geometrical tolerances according to ISO 1101 e. The Boundary Condition concept. MMC and LMC modifiers (with applications) 5. How to Compute (H2C) methodology: Position tolerances assignment 6. H2C advanced topics: a. Tolerance stack-up analysis: worst case and statistical approaches b. Linear geometric tolerance stack-up analysis 7. Application Examples
Learning goals	For designers, technologists and metrologists: to achieve the fundamentals of ISO Geometric Product Specification methodology

Teaching methods	Traditional frontal lectures
Course on transversal, interdisciplinary, transdisciplinary skills	☒ Yes ☐ No
Available for PhD students from other courses	☒ Yes ☐ No
Prerequisites (not mandatory)	
Examination methods (if applicable)	Homework assignments
Suggested readings	
Additional information	

Course unit English denomination	**Measurement methods in thermo-fluid dynamics**
SS	IIND-07/A
Teacher in charge (if defined)	Giulia Righetti
Teaching Hours	10
Number of ECTS credits allocated	2
Course period	Summer 2026
Course delivery method	☒ In presence ☐ Remotely ☐ Blended
Language of instruction	English
Mandatory attendance	☒ Yes (100% minimum of presence) ☐ No
Course unit contents	1. Theory (4 h) a. Measurements in thermo-fluid dynamics b. Measurement's uncertainty and how to calculate it c. Temperature measurements d. Flow rate measurements e. Pressure measurements f. Energy and power measurements 2. Laboratory (4 h) a. Thermocouples theory, application and calibration.
Learning goals	A comprehensive introduction to theory and practice of measurements methods.
Teaching methods	Traditional frontal lectures + laboratory experience
Course on transversal, interdisciplinary, transdisciplinary skills	☒ Yes ☐ No
Available for PhD students from other courses	☒ Yes ☐ No
Prerequisites (not mandatory)	

Examination methods
(if applicable)

Suggested readings

Additional information

Course unit English denomination	**Reverse Engineering: from physical world to virtual modeling and rapid prototyping**
SS	IIND-03/B
Teacher in charge (if defined)	Roberto Meneghello
Teaching Hours	10
Number of ECTS credits allocated	2
Course period	Summer 2026
Course delivery method	☒ In presence ☐ Remotely ☐ Blended
Language of instruction	English
Mandatory attendance	☒ Yes (80% minimum of presence) ☐ No
Course unit contents	1. General introduction to Reverse Engineering 2. Digitization technologies: 3D scanning in industry, medicine, art 3. Tech. laboratory: how to use 3D scanner technologies 4. Virtual prototyping: classification of CAD system and representation schemes 5. CAD laboratory: how to model from point clouds to mesh, mesh to curve/surface, mesh/surface to solid 6. Application examples of rapid prototyping
Learning goals	Students will understand the RE process from the equipment selection to the data processing and basic CAD modeling
Teaching methods	Traditional frontal lectures + laboratory experience
Course on transversal, interdisciplinary, transdisciplinary skills	☒ Yes ☐ No
Available for PhD students from other courses	☒ Yes ☐ No
Prerequisites (not mandatory)	

Examination methods (if applicable)	Homework assignments
Suggested readings	
Additional information	