Dipartimento di
Tecnica e Gestione
dei sistemi industriali
Università di Padova

Doctoral Program in Mechatronics and Product Innovation Engineering

A.A 2025-2026

PhD Seminars provided by the PhD Office

The PhD Office, in collaboration with other University Offices and external experts, offers PhD students interdisciplinary training courses, seminars, and lessons related to the academic world, job market, and career development.

Seminars list and details: https://www.unipd.it/en/phd-interdisciplinary-teachings

preliminary authorization required

Python Programming for Data Science and Engineering

Seminar Area: Transversal Skills
Credits: 4 (20 hours)
Lecturer: Dr. Stefano Tortora, DEI, University of Padova
e-mail: stefano.tortora@unipd.it

Topics:
Python is an easy-to-learn and powerful high-level programming language that is becoming increasingly popular for scientific applications, including machine learning, statistics, data manipulation and transformation, as well as computer vision and robotics. The first objective of the course is to become familiar with Python syntax, development environments, and basic libraries. The second objective is to guide learners through basic inferential data analysis and to introduce the application of common machine learning algorithms. The course covers an introduction to the Python programming language, the main features that distinguish Python from other languages, Python syntax, modules and packages, numerical and scientific computing with NumPy and SciPy, labeled column-oriented data analysis with Pandas, MATLAB-style scientific visualization with Matplotlib, and the basics of machine learning in Python using scikit-learn.

Course requirements: Backgrounds in computing with some object-oriented programming language: C++, Java, MATLAB, etc.
Enrollment: add the course to the list of courses you plan to attend using the Course Enrollment Form (requires SSO authentication) and, if you are taking the course for credits, to the Study and Research Plan.

Evaluation: Homework assignments

preliminary authorization required

Data Visualization

Seminar Area: Transversal Skills
Credits: 4 (20 hours)
Lecturer: Dr. Matteo Ceccarello, DEI, University of Padova
e-mail: matteo.ceccarello@unipd.it

Topics:
Data visualization is a fundamental tool in a researcher's toolbox. Visualizing data allows us to uncover patterns and understand relationships within the data. Furthermore, visualization can be used to communicate the results of analyses more effectively.
This course covers topics related to human perception and color theory in order to inform design choices in data graphics. It also focuses on the use of the Grammar of Graphics to create visualizations in a modular way, overcoming the constraints imposed by the APIs of commonly used libraries. The course uses ggplot, an implementation of the Grammar of Graphics in the R programming language. However, the concepts and techniques presented are generally applicable to other environments as well, such as Python. For this reason, prior working knowledge of R is not required. The course addresses the principles of the Grammar of Graphics, key aspects of human perception and color theory, the ggplot implementation of the Grammar of Graphics, and practical case studies illustrating how to visualize data from different perspectives. It also discusses common pitfalls in scientific data visualization and explores more advanced and creative approaches beyond basic charts using the Grammar of Graphics.

Course requirements: basic programming notions

Evaluation: Homework assignments and final test.

preliminary authorization required

Statistics for Engineers

Seminar Area: Mathematical and Statistical Methods
Credits: 8 (40 hours)
Lecturers: Prof. Luigi Salmaso, Prof. Rosa Arboretti, Prof. Marta Disegna
e-mail: luigi.salmaso@unipd.it , rosa.arboretti@unipd.it , marta.disegna@unipd.it

Topics:
In this course will be offered an introduction to statistical methods most frequently used for experimentation in Engineering.
The course aims to develop knowledge of the fundamental statistical processes, techniques and ideas used in the collection, presentation, analysis and interpretation of data. develop the ability to understand, interpret, and communicate quantitative results and show how quantitative methods may be used to provide reliable information. develop an understanding of the scope and limitations of quantitative analysis.
The indicative content of the course is as follows: elements of univariate statistical methods, including descriptive statistics, probability and inferential statistics (point estimate, confidence interval and hypothesis tests). linear and non-linear regression models. multivariate data analysis. Design of experiment.
Lectures will cover both theoretical aspects and the analysis of practical problems. The applications will be conducted using MINITAB, licensed to University of Padova, and R/ Rstudio, open-source software.

Evaluation:
Attendance is required for at least 2/3 of the lecture hours. Final evaluation will be based on the discussion of a case study, preferably drawn from the individual PhD project of one of the group members.

preliminary authorization required

Heuristics for Mathematical Optimization

Seminar Area: Mathematical and Statistical Methods
Credits: 5 (20 hours)
Lecturer: Prof. Domenico Salvagnin
e-mail: dominiqs@gmail.com, domenico.salvagnin@unipd.it

Topics:
This course aims to make students familiar with the most common heuristic approaches for solving mathematical and combinatorial optimization problems. This includes general strategies such as local search, genetic algorithms, and heuristics based on mathematical models.
The course introduces mathematical optimization problems and discusses the differences between heuristic and exact optimization methods. It presents the general principles of heuristic design, including diversification, intensification, and randomization, and examines local search–based and genetic or population-based approaches. The subMIP paradigm is also covered. Finally, the course applies these methods to selected combinatorial optimization problems, including the traveling salesman problem, the quadratic assignment problem, facility location, and scheduling.

Course requirements: Moderate programming skills (on a language of choice), basics in linear/integer programming.
Enrollment: add the course to the list of courses you plan to attend using the Course Enrollment Form (requires SSO authentication) and, if you are taking the course for credits, to the Study and Research Plan.

Evaluation: Final programming project.

preliminary authorization required

Entrepreneurship and Startup

Seminar Area: Soft Skills
Credits: 4 credits (20 hours)

Lecturers: Prof. Moreno Muffatto, DII, University of Padova, Ing. Francesco Ferrati, DII, University of Padova
e-mail: moreno.muffatto@unipd.it, francesco.ferrati@unipd.it

Topics:
The course provides an introduction to entrepreneurship, with a focus on technology-based startups and their differences from small and medium-sized enterprises. It covers venture creation processes, early strategic decisions, and the role and characteristics of founding teams. The course follows the path from idea generation to market entry, addressing innovation, market analysis, product and service development, and intellectual property rights, including patents and the patenting process. It also introduces business models, revenue streams, startup financials, company valuation, and funding options, with attention to how investors evaluate new ventures and how to effectively present a business idea to them.

Evaluation:
Attendance is required for at least 70% of the lecture hours (i.e. 14 hours).
Final evaluation will be based on the discussion of a case study of a technology-based startup.

preliminary authorization required

Research and Entrepreneurship: from scientific papers and IP to startup creation

Seminar Area: Soft Skills
Credits: 3 credits (24 hours)
Lecturers: Prof. Fabrizio Dughiero, DII, University of Padova
e-mail: fabrizio.dughiero@unipd.it

Topics:
The course aims to develop PhD candidates' understanding of how an idea linked to a university-owned patent can be transformed into a business model for a technological startup. It covers intellectual property protection mechanisms and the rights of university employees, private employees, and freelancers, as well as the definitions of startups and spin-offs and the legal and regulatory frameworks governing their establishment and development. Funding sources for technological ventures are also introduced.
The course addresses methods for analyzing intellectual property and presents criteria for selecting patents suitable for business development. It examines the analysis of the underlying technology, idea, or business model associated with a patent and introduces design thinking techniques as a structured approach to early-stage business analysis.
Key topics include market and competition analysis, an introduction to the Business Model Canvas and its main components, and the principles underlying the development of a concise and effective business plan. The course also covers the preparation and structure of an investor pitch and discusses common strengths and weaknesses observed in early-stage technological business ideas.

Evaluation:
Attendance is required for at least 2/3 of the lecture hours. Final evaluation will be based on the discussion of a case study related to the individual or team project.

preliminary authorization required

Bibliographic resources and research tools for PHD students in Industrial Engineering

Seminar Area: Soft Skills
Credit: 1 credit (8 hours)
Lecturers: Librarians

Topics:
The course is organized into two modules. The first module is an online course to be completed before the face-to-face sessions and introduces the services offered by engineering libraries, including local and interlibrary loan, document delivery, bibliographic reference services, and book purchase proposals. It presents GalileoDiscovery as the University of Padova library search tool and provides an overview of major databases in engineering, economics, and management, as well as citation databases such as Scopus and Web of Science.
The second module is delivered face-to-face over two lessons and focuses on bibliometric indicators used to assess the quality of scientific publications. It addresses academic publishing and Open Access, with specific reference to the Padua Research Archive (PRA/IRIS) as the institutional repository for academic research, and discusses facilitations for authors and authors' rights. The module also covers Open Science and research data management, introducing Research Data Unipd as the institutional repository for research outputs, and concludes with bibliographic citations and citation styles, including an introduction to reference management using Zotero.

Evaluation:
Attendance is necessary. Online module is required for attending the face-to-face module. The participation will be confirmed through the execution of a final test.

preliminary authorization required

Academic English Courses for PhD students

Seminar Area: Soft Skills

Lectures: CLA
Credits: 12 (60 hours)
More details: https://cla.unipd.it/en/language-courses/english-for-phd/

Topics:
The purpose of this course is to review and develop English language competence in academic speaking and writing, with a focus on identifying and addressing individual challenges. It explores a range of formal academic speaking situations as well as informal academic contexts. Activities are designed to raise self-awareness of language skills and to provide strategies for continuous improvement.

Course requirements:
Each type of course requires a minimum entry level of English. It is not possible to attend a course without having first taken the entry test.

preliminary authorization required

From Researcher to Entrepreneur. How to turn research into business ideas

Seminar Area: Soft Skills
Lectures: Davide Tacconi
Credits: 3 (16 hours)
More details: STEM (PhD)

Topics:
This two-day intensive course is designed to guide PhD students at the University of Padua through a practical and interactive path that will help them transform their research and innovations into concrete business ideas. Through a combination of theory and practice, participants will learn how to generate business ideas, develop business models, build business plans, and finally present and defend their ideas in a competitive pitching session.
The course will be divided into two separate modules, each focused on a key aspect of the entrepreneurial process:
1. Generation and validation of ideas; business model of an innovative idea
2. Economic-financial planning of an innovative idea and its presentation

preliminary authorization required

How to write a scientific paper

Seminar Area: Soft skills
Credits: 2 (10 hours)
Lecturer: Prof.ssa Daria Battini
e-mail: daria.battini@unipd.it

Topics:
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.

Modality: In person seminar

Evaluation: Homework assignment

Collaborative Robotics: towards smart manufacturing

Seminar Area: Industrial Plant and Logistics
Credits: 2 (10 hours)
Lecturer: Prof. Maurizio Faccio
e-mail: maurizio.faccio@unipd.it

Topics:
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.

Modality: In-person seminar

Evaluation: Homework assignment

not available this year

Resilient and inclusive workplaces in the Industry 5.0 era: Advanced methods and smart tools in the manufacturing work environment

Seminar area: Industrial Plant and Logistics
Credits: 2 (10 hours)
Lecturer: Dr. Nicola Berti
e-mail: nicola.berti@unipd.it

Topics:
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.

Modality: In-person seminar

Evaluation:
The assignment will be related to the topics discussed during the seminar. PhD students will be asked to compute a risk assessment of some experimental working conditions, considering the adoption of the latest technology discussed in the seminar.

not available this year

Application of anyLogistix software for Optimizing Digital Supply Chains

Seminar area: Industrial Plant and Logistics
Credits: 2 (10 hours)
Lecturer: Dr. Niloofar Katiraee
e-mail: niloofar.katiraee@unipd.it

Topics:
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.

Evaluation:
PhD candidates must attend the entire seminar. During the session, participants will work on a case study using the anyLogistix software. They will optimize and simulate the supply network from the case. To earn credit, participants need to submit their results and analysis from the case study as an assignment.

not available this year

Discrete-Events and Agent-Based simulations with AnyLogic

Seminar area: Industrial Plant and Logistics
Credits: 2 (10 hours)
Lecturer: online seminar
e-mail: NA

Topics:
In 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.

Evaluation:
PhD candidates must attend the entire seminar, that will be followed by an online assignment

not available this year

System Dynamics Simulations with AnyLogic

Seminar area: Industrial Plant and Logistics
Credits: 2 (10 hours)
Lecturer: online seminar
e-mail: NA

Topics:
In 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

Evaluation:
PhD candidates must attend the entire seminar, that will be followed by an online assignment

not available this year

Building and solving mathematical models for manufacturing and logistics systems

Seminar area: Industrial Plant and Logistics
Credits: 2 (10 hours)
Lecturer: Prof.ssa Serena Finco
e-mail: serena.finco@unipd.it

Topics:
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.

Modality: In-person seminar

Evaluation:
PhD candidates must attend the entire seminar. During the session, participants will work on a mathematical model and will learn how to implement it in Python. To earn credit, participants need to submit their model and the analysis of the results.

Date: February 18th (room: TBD)

Numerical methods for Magnetic Field Computation and Design of electromagnetic Actuators in mechatronics

Seminar area: Mechatronics
Credits: 2 (10 hours)
Lecturer: Prof. Giuseppe Chitarin
e-mail: giuseppe.chitarin@unipd.it

Topics:
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 the magnetic vector potential and reduced scalar potential formulations. The course introduces the Finite Element Method (FEM) for addressing electromagnetic problems and includes hands-on lab sessions where students use FEM software to design and simulate actuators.
Students will develop a solid understanding of magnetic fields, forces, and electromagnetic actuators. They will learn to solve magnetic field equations, apply numerical techniques, and use FEM software to design and optimize actuators in mechatronic systems. The course aims to provide both theoretical knowledge and practical skills essential for electromagnetic design.

Modality: 10 hours in-person (Traditional frontal lessons, Numerical simulation lab) PhD candidates must attend at least 80% of the seminar hours.

Evaluation:
The examination will involve a numerical FEM simulation on a specific course topic, with a requirement to analyze and discuss the results.

not available this year

Data-driven Science for Dynamical Systems

Seminar area: Mechatronics
Credits: 2 (10 hours)
Lecturer: Dr. Jason Bettega
e-mail: jason.bettega@unipd.it

Topics:
The seminar covers 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, with a focus on their applications in frequency analysis and nonlinear system modeling. It addresses common data-driven methods widely used across engineering fields to extract valuable information from raw measurement data. These techniques apply to system identification, control, and analysis of dynamical systems in both the time and frequency domains. As a result, participants will gain a comprehensive overview of these data-driven approaches, enhancing their ability to work effectively with raw measurement data.

Modality: 10 hours blended (Traditional frontal lessons, Numerical simulation lab) PhD candidates must attend at least 50% of the seminar hours.

Evaluation:
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.

not available this year

Immersive Technologies and Experiences for Smart Industry

Seminar area: Mechatronics
Credits: 1 (5 hours)
Lecturer: Prof. Michele Geronazzo
e-mail: michele.geronazzo@unipd.it

Topics:
This course unit covers immersive VR/AR technologies, 3D computer vision, multimodal sensing, and AI, focusing 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, demonstrating how these technologies can enhance industrial processes.
The learning objectives aim to equip students with the skills to design immersive cyber-physical systems that seamlessly integrate visual and auditory feedback. Students will develop a deep understanding of perception engineering, human factors, and user-centric design, enabling them to optimize human-machine interactions and improve overall user experience in industrial applications.

Modality: 10 hours blended (Hybrid interactive lectures, guided discussions, case-study analyses complemented by targeted readings)
PhD candidates must attend at least 100% of the seminar hours.

Evaluation:
The examination will consist of completing a homework assignment.

not available this year

Design and Optimization of EMI Filters for Electronic Systems

Seminar area: Mechatronics
Credits: 2 (10 hours)
Lecturer: Prof. Alessandro Sona
e-mail: alessandro.sona@unipd.it

Topics:
This course covers filtering strategies for power supply systems, with a focus 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 damping phenomena. The course also addresses practical aspects of filter design and installation, as well as optimal positioning and connection techniques to enhance electromagnetic compatibility and overall system performance. Participants will gain a solid understanding of EMI filters, including their key components, design principles, and installation techniques, and will explore strategies for optimizing filtering performance and ensuring effective use in practical applications.

Modality: 10 hours in-person (Traditional frontal lessons, classroom discussions on practical case studies)
PhD candidates must attend at least 80% of the seminar hours

Evaluation:
The examination will consist of completing a homework assignment.

Autonomous Mobile Robotics: Aerial and Ground Controlled Systems

Seminar area: Mechatronics
Credits: 2 (10 hours)
Lecturer: Prof.ssa Giulia Michieletto
e-mail: giulia.michieletto@unipd.it

Topics:
This seminar explores the modeling and control of both aerial and ground mobile robots. It begins with robot modeling, focusing on maneuverability properties and how these are affected by actuation characteristics. A significant part of the seminar is dedicated to the control of individual robots, emphasizing path-following tasks. Finally, the seminar introduces multi-robot systems, providing insights into coordination and control strategies for collaborative tasks.
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 and gain an understanding of multi-robot systems, exploring how robots can collaborate on complex tasks across diverse application domains.

Modality: 10 hours in-person (Traditional frontal lessons)
PhD candidates must attend at least 80% of the seminar hours.

Evaluation:
The examination consists of a discussion on a state-of-the-art research work related to autonomous mobile robotics within the candidate's area of interest.

Introduction to Physics-Informed Machine Learning

Seminar area: Mechatronics
Credits: 2 (10 hours)
Lecturer: Prof.ssa Monica Reggiani
e-mail: monica.reggiani@unipd.it

Topics:
The course unit begins with an exploration of AI and machine learning in science and engineering, emphasizing their intersection and diverse applications. It then covers strategies for curating training data, focusing on selecting and preparing datasets that incorporate physical principles to improve model performance. Next, students delve into Physics-Informed Neural Networks (PINNs), learning how these networks embed physical laws to solve differential equations and model dynamic systems. The course also guides students in choosing what to model, offering methods for selecting suitable physical models and integrating them with machine learning techniques. Finally, the course concludes with a flipped classroom format, where students present how key concepts and methodologies apply to their own research topics.
By the end of the course, students will understand how to embed physical laws into machine learning models, curate and preprocess datasets reflecting physical phenomena, design and implement PINNs, and select and integrate appropriate physical models with machine learning techniques to solve real-world problems.

Modality: 10 hours in-person (Traditional frontal lessons, case studies, flipped classroom sessions)
PhD candidates must attend at least 80% of the seminar hours

Evaluation:
The examination will consist of completing a homework assignment.

Basics of CAD modeling and technical drawing: how to read and understand Technical Product Documentation

Seminar area: Mechanics of Materials
Credits: 3 (15 hours)
Lecturer: Prof. Roberto Meneghello, Dr. Mattia Maltauro
e-mail: roberto.meneghello@unipd.it, mattia.maltauro@unipd.it

Topics

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

Modality: Traditional lectures + laboratory experience

Evaluation:
To be defined

Thermo-fluid dynamics in 3D printed channels

Seminar area: Mechanics of Materials
Credits: 2 (10 hours)
Lecturer: Prof. Simone Mancin, Dott. Dario Guarda
e-mail: simone.mancin@unipd.it, dario.guarda@unipd.it

Topics
This course focuses on the thermal and fluid-dynamics aspects of flow within 3D-printed channels and heat exchangers. Such systems are fundamental for the thermal management of electronic components, where the removal of high heat fluxes is required. The course provides the essential background to understand, control, and size the most important parameters governing these systems, enabling their optimization for specific application needs. The optimization process is carried out using ANSYS Fluent, which allows the simulation and analysis of geometries of greatest relevance to the selected case studies.

Modality: 4 hours of traditional classroom teaching covering the theoretical background, plus 4 hours in the computer laboratory (VM), during which exercises in ANSYS Fluent are carried out to apply the theory presented.

Evaluation: It is required to carry out a Fluent exercise similar to those performed during the course.

Material selection in a Critical Raw Materials perspective

Seminar area: Mechanics of Materials
Credits: 1 (5 hours)
Lecturer: Prof. Paolo Ferro
e-mail: paolo.ferro@unipd.it

Topics
1. Critical Row Materials
2. Material selection approach
3. Material selection in a CRM perspective

Modality: Traditional lecture

Evaluation: To be defined

not available this year

Efficiency and Renewable Energy in Building Climatization for a Sustainable Future

Seminar area: Mechanics of Materials
Credits: 1 (5 hours)
Lecturer: Prof. Marco Noro
e-mail: marco.noro@unipd.it

Topics

- The global context: UN Climate Change, Intergovernmental Panel on Climate Change
- The European context: Green Deal, Fit for 55
- REPowerEU and the energy context with focus on renewable energes and energy efficiency
- Most effective energy efficiency solutions for the future zero emission buildings for generation, conversion, and end-use of energy:
    - Mechanical ventilation systems
    - Heat pumps
    - Solar systems (thermal and electric)
    - Co/Trigeneration
    - Thermal storage systems
- Hydrogen and energy vectors for future efficient buildings
- European and Italian strategies for hydrogen: generation, transport, distribution and storage
- Actual and future use of hydrogen: mobility, energy, industry
- Fuel cells for buildings: technologies, characteristics, efficiency, costs, applications

Modality: Traditional lecture

Evaluation: To be defined

How to control functionality in product life-cycle using geometrical specifications

Seminar area: Mechanics of Materials
Credits: 2 (10 hours)
Lecturer: Prof. Gianmaria Concheri, Dr. Mattia Maltauro
e-mail: gianmaria.concheri@unipd.it, mattia.maltauro@unipd.it

Topics

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

Modality: Traditional lecture

Evaluation: To be defined

not available this year

Measurement methods in thermo-fluid dynamics

Seminar area: Mechanics of Materials
Credits: 2 (10 hours)
Lecturer: Prof.ssa Giulia Righetti, Dott. Giacomo Favero
e-mail: giulia.righetti@unipd.it, giacomo.favero@unipd.it

Topics

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.

Modality: Traditional lecture + laboratory experience

Evaluation: The examination consists in the preparation of a technical report concerning the measurements collected during the laboratory activity

Reverse Engineering: from physical world to virtual modeling and rapid prototyping

Seminar area: Mechanics of Materials
Credits: 2 (10 hours)
Lecturer: Prof. Roberto Meneghello
e-mail: roberto.meneghello@unipd.it

Topics

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 systems 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

Modality: Traditional lecture + laboratory experience

Evaluation: to be defined

not available this year