Dottorato di ricerca in Ingegneria Meccanica e Industriale

Training Activities Program 2024/2025

The list may be subject to changes. Please refer to the website https://drimi.unibs.it/courses-activities for the updated list, registrations, and scheduling

Course	Hours	Year Of study	Syllabus	Curricula	Teacher
Development of data acquisition systems in Labview	9	All	*The aim of the course is to make students autonomous in the development of measurement systems and other basic monitoring systems. In particular the course it's designed for who will need to handle mechanical measurements in labview. The practical approach chosen for this coursework is needed to ensure that the student will reach complete autonomy in the practical realization of measurement systems for industry or research.. Short introduction to Labview programming. PC-based instrumentation issues. Practical application and design choices Practice. The course will be held in English if requested, in Italian if all the students are Italian.*	All	Prof. Matteo Lancini
Circular economy and sustainability:	9	All	*Circular Economy has increasingly gained attention from academia, companies and policy-makers as a promising approach to jointly promote environmental sustainability and*	All	

Designing and assessing circular business models			*competitiveness. Circular Economy differs from the linear economy, i.e. the traditional way in which goods are produced, sold and disposed of, since it decouples economic growth from resource extraction and environmental losses.* *Manufacturing companies can pursue several strategies to enable a transition towards a sustainable Circular Economy, such as introduction of new and "environment-friendly" materials, product durability and life-extension, pay-per-use business models, refurbishment, remanufacturing, recycling and so forth.* *The course will address the following topics:* *What is the Circular Economy and why it is important for manufacturing companies* *How to implement Circular Economy in practices - Product redesign, production processes, Servitization, Supply chain reconfiguration, and the enabling role of digital technologies.* *How to implement circular business models in practice: business model canvas and group work.* *How to assess and measure "circularity": indicators, methods, and Life Cycle Assessment (LCA).*		Prof. Nicola Saccani
Complementi di specificazione geometrica dei prodotti	6	All	*Nel primo intervento del corso verranno sinteticamente richiamati i contenuti delle principali norme ISO GPS sulla specificazione geometrica dei prodotti (tolleranze geometriche, riferimenti, ...), nel secondo intervento del corso verranno commentati indicazioni a disegno di casi reali come esempi applicativi del sistema ISO GPS.*	All	Prof. Gabriele Baronio
Resource and Energy Economics	18	All	*The course describes and illustrates the main energy sources, such as oil, gas, coal, solar, wind, hydroelectric and nuclear. The course is also updated with respect to energy market developments with new sources and technologies. The study is mainly based on an in-depth examination of economic aspects. The core of the course is devoted to explaining some of the economic methodologies that are adopted in the energy market, such as input-output matrices, cost-benefit analysis (CBA), computational economic equilibrium (CGE) models,*	All	To be defined

			integrated-assessment models (IAM), agent-based models (ABM), and real options theory (ROT). The course also illustrates some results and projects developed by the lecturer's research groups.		
Fuel cells for power production: from basic theory to system applications	9	All	*Fuel cells are emerging and innovative solutions for power generation. Thanks to their high efficiency and their modularity, these electrochemical devices can be adopted in several fields: small applications such as portable devices, medium size with electric and thermal power production for transportation or residential applications, electric generation in innovative large power plants. Although the commercial success of this technology, researchers are facing different open issues related to physical and mechanical aspects.* *Starting from the description of the different types of fuel cells, the course covers:* *• Definition of the basic principles and the main operating parameters* *• Fuel cell system modelling and applications: plant layout, energy balance, efficiency and some practical examples*	All	Prof. Gioele di Marcoberardino
Postprocessing of mechanical measurement data	12	All	*The course will prepare PhD students for the development of measurement systems, focusing on data analysis applied to mechanical measurements taken in non-standard environments, where postprocessing is critical.* *The main subjects will be:* *-practical approach to experimental data collection* *-synchronizing different measurement systems via hardware (trigger, gps, ntp)* *-synchronizing different measurement systems via software (crosscorrelation, optimization)* *-main spectral analysis tools and their application (FFT, PSD, FRF, spectrograms)* *-periodic signals analysis (TFA, TSA)* *-sensor fusion techniques (with and without handling incongruencies)*	All	Prof. Matteo Lancini

			-machine learning on mechanical quantities: feature engineering of time-dependent mechanical quantities (normalization, spectral features) *The course will be held in English if requested, in Italian if all students are Italian"*		
PID Control: Review of methods and new approaches	9	All	*At the core of process control we find an indispensable tool: The Proportional- Integrative Derivative, PID, controller. Although many changes and innovations have been introduced since its early development during the 1930s and '40s, the basic idea behind the PID controller still applies successfully in practice. it seems that PID control is here to stay as the preferred control algorithm, at least at the bottom layer. In general, the tuning of the controller must be done taking into account different objectives, such as output performance, robustness, input usage and noise sensitivity, etc. With this context in mind, the basic aim of the proposed short course is to give a review of current approaches as well as some newinsights into the tuning problem by considering unifying approaches to take care of the most relevant conflicting objectives, namely the robustness/performance and servo/regulator trade-offs; recent proposals for handling higher order process dynamics; and resilience considerations with respect to implementation changes, among other topics.*	All	To be defined
Il rischio di fornitura nelle moderne supply chain	3	All	*1). Definizione e modellazione del richio d'impresa* *2). Definizione e modellazione del rischio di fornitura* *3). Quantificazione del rischio di fornitura* *4). Gli effetti delle interruzioni di fornitura* *5). la mitigazione del rischio di fornitura* *6). dati del contesto Italiano*	All	To be defined
Solution of hard physical problems with MATLAB	18	All	*The goal of this course is to give a modern introduction to mathematical methods applied to solve hard physical problems that arise in engineering applications— flow in porous media, transport phenomena in confined environments, subsurface flows, singularities in fluid mechanics, non-equilibrium thermodynamics— .*	All	To be defined

			Some of the approaches presented will be: dominant balance, dimensional analysis, scaling analysis, singularities, similarity solution of pde... *The course is complemented with a series of toolboxes/easy to use packages for routine numerical and symbolic computations MATLAB applied to specific problems.*		
Transizione Energetica, inquinamento atmosferico e cambiamento climatico	9	All	*Modelli per la valutazione di politiche energetiche su qualità dell'aria e emissioni di gas serra. Modelli descrittivi di qualità dell'aria prognostici e data driven. Modelli decisonali multiobiettivo per politiche energetiche. Modelli di impatto sulla salute.*	All	To be defined
Materials Characterization: microscopy and surface analysis	12	All	*The Course will provide technical knowledge about characterization of materials using various microscopy and surface analysis techniques.* *The main experimental techniques that will be described are:* *- scanning/transmission electron microscopy (SEM, STEM, TEM): working principles, main differences, samples preparation (mechanical, FIB);* *- micro- and nanomechanical characterization: working principles, advantages, applications for coatings.* *Case studies and practical examples of applications for different materials will be described. The aim is to provide tools to understand which experimental technique is adequate according to the material and the property of interest, which are the advantages but also which issues or limitations you should be aware of.* *Finally, we will visit the Metallurgy laboratories.*	All	To be defined
Nanoscience and Nanotechnology	18	All	*The goal of this course is to provide an introduction to nanoscience and nanotechnology, including the basics of preparation of nanomaterials and their characterization, together with the use of some of the required instrumentations. This course is suitable for graduate students with various physics, chemistry and engineering backgrounds.* *Introduction to nanoscience and nanotechnology (1h)*	All	Prof. Dario Zappa

			(Lecture: E. Comini) *Basic introduction on nanotechnology, the advantages and disadvantaged comparted to traditional material science and some possible application fields.* *Preparation of nanoscaled materials: nanoparticles, nanowires and nanotubes (2h)* *(Lecture: E. Comini)* *A collection of deposition techniques that could be used for the fabrication of different topologies of nanostructures, including nanoparticles, nanowires, nanotubes and heterostructures: evaporation-condensation techniques; chemical and physical vapor deposition; thermal evaporation; pulsed layer deposition; atomic layer deposition; hydrothermal; electrospinning; sputtering; electrochemical anodization and more.* *Preparation of nanoscaled materials: nanoparticles, nanowires and nanotubes (4h)* *(Practice: D. Zappa) SENSOR Lab via valotti 9 II floor.* *Practical fabrication of some metal oxide nanostructures using some of the techniques introduced. Student will manage experiments using the facilities at SENSOR Laboratory.* *Surface and structural characterization (6h)* *(Lecture: E. Comini)* *Introduction to some of the most common characterization techniques used for the investigation of materials at nanoscale: X-Ray diffraction (XRD), Raman; atomic force microscopy (AFM), UV-VIS spectroscopy.* *Surface and structural characterization (5h)* *(Practice: D. Zappa) SENSOR Lab via valotti 9 II floor.* *Practical characterization of some nanostructured materials fabricated by the students in this course by using some of the*		Prof.ssa Elisabetta Comini

			advanced characterization techniques available at SENSOR Laboratory (X-Ray)		
Industrial Energy Conservation and Management	48	All	*Introduces graduate students to the general principles of energy management and energy conservation planning, conducting energy audit, monitoring and evaluating and following up energy saving measured/projects, case studies.*	All	To be defined