Catalogue of the doctoral courses and seminars offered by the Department of Engineering (DI)
Academic Year 2023/2024
(Approved by the Engineering Department Council on January 24th, 2024)

PhD students of the Department of engineering can freely register to attend a course. Please, read carefully the guidelines before registering.
Students of other Unipa PhD programmes are also welcome but need to be admitted upon request by writing an email to the DI Doctoral Courses and Seminars secretary (Ms Lidia Drago email: lidia.drago@unipa.it)

Proponent PhD programme: Information and communication technologies							
Code	**Program Involved**	**Title of the Course**	**N° hours**	**Lecturer(s)**	**Brief Synopsis**	**Tentative period**	**Language**
I.1	ICT	Mathematical tools for signal representation and optimization: Beyond Fourier transforms	**15**	**Prof. Fabio Bagarello** *(University of Palermo)* *Contact email: fabio.bagarello@unipa.it*	This course on advanced mathematical tools for signal representation will cover the following aspects: - Hilbert spaces: the space of signals - Frame - Coherent states - Gabor transform - Wavelet transforms	April	EN
I.2	ICT	Variational analysis and optimization	**12**	**Prof. Antonella Nastasi** *(University of Palermo)*	This course will cover the following aspects: • Introduction to calculus of variations. Integral functionals. • Energy functionals.	July	

				Contact email: antonella.nastasi@unipa.it	• Optimization problems. Eulero-Lagrange equations. • Direct methods of the calculus of variations. • Critical point theory. Compactness conditions and Mountain Pass Theorem. Examples and open problems.		EN
I.3	ICT	Biomedical signal analysis: heart rate variability assessment	**10**	**Prof. Riccardo Pernice** *(University of Palermo)* *Contact email: riccardo.pernice@unipa.it*	This course aims to introduce the most widely employed heart rate variability indexes in time, frequency and information-theoretic domain and show how they can be exploited for assessing the cardiac autonomic function. The course includes both lectures and practical sessions using MATLAB software.	November	EN
I.4	ICT	Biomedical signal analysis: Reconstructing Complex System Dynamics from Time Series Analysis	**10**	**Prof. Yuri Antonacci** *(University of Palermo)* *Contact email: yuri.antonacci@unipa.it*	The aim of this course is to provide an overview of different advanced time series methods that are at the basis of the approaches currently available to study the dynamics of very different complex systems. Different methodologies will be reviewed, ranging from model-free to model-based data-driven, to artificial neural networks inspired models, describing the basic concepts and the advantages and limitations of different methods when applied to the study of physiological and non-physiological complex systems. The effectiveness of the approaches presented will be demonstrated with applications on: (i) physiological systems; (ii) electronic chaotic oscillators; (iii) climate dynamics. The course includes both lectures and practical sessions using MATLAB software.	September/October	EN
I.5	ICT/ CEBHyME	Fundamentals of Big Data	**6**	**Prof. Simona Rombo** *(University of Palermo)* *Contact email: simonaester.rombo@unipa.it*	This course will present problems, technologies and solutions for big data and data warehousing design. It will cover the following topics. Introduction to Big Data and Data Mining, Problems and solutions on data cleaning. Technologies and practical	July	EN

					implementation: MapReduce, Apache, Hadoop, Apache Spark		
I.6	ICT	Numerical simulations and applications: Finite element analysis	**20**	**Prof. Andrea Tognazzi** *(University of Palermo)* *Contact email: andrea.tognazzi@unipa.it*	This course is an introduction to the finite element method as applicable to a range of problems in physics and engineering sciences. The emphasis is on coding up the formulations in a modern, open-source environment that can be expanded to different applications, with a special attention to the problem of signal propagation.	June	EN
I.7	ICT	Numerical simulations and applications: Labview	**15**	**Prof. Valentina Cosentino** *(University of Palermo)* *Contact email: valentina.cosentino@unipa.it*	The course introduces to LabVIEW programming.	July	EN
I.8	ICT	Electronics for the Space: Mm-wave and THz technology	**10**	**Prof. Alessandro Busacca** **Prof. Salvatore Stivala** *(University of Palermo)* *Contact email: alessandro.busacca@unipa.it*	This course aims to introduce students to the problems of generating, guiding and detecting electromagnetic radiation in the millimeter wave (mm-waves) and at Terahertz (THz) frequency bands. Recent techniques about signal-processing functionalities in the THz range will be also addressed. In particular, the course will cover: -Fields of application of mm-waves and THz-waves -Generation techniques -Receiver types THz time-domain spectroscopy and waveguides for broadband THz signal processing	September	EN
I.9	ICT	Emerging network technologies	**20**	**Prof. Ilenia Tinnirello** **Prof. Daniele Croce** **Prof. Stefano Mangione** *(University of Palermo)* *Contact email: ilenia.tinnirello@unipa.it*	This course will present some emerging trends in network technologies, and in particular open architectures for beyond-5G cellular systems and solutions for massive IoT applications. It will also present some frontier topics, such as methodologies for zero-touch beyond-5g networks and quantum information.	September	EN

I.10	ICT	Deep learning applications for the analysis of biomedical data	**12**	**Prof. Salvatore Contino** *(University of Palermo)* *Contact email: salvatore.contino01@unipa.it*	The proposed PhD course will deal with the use of technologies based on Deep Learning (DL) and Machine Learning (ML) on biomedical data. Specifically, it will deal with Machine Learning and Deep Learning algorithms used at the state of the art, with particular interest in the different types of chemicals, biological and medical data. The course will be structured in 12 hours, divided as follows: 1) Lecture 1 (3h). Perspective on Machine Learning and Deep Learning. Classification, Clustering and Semantic Segmentation. 2) Lecture 2 (3h). Biomedical data (structured and unstructured data). Pre-processing algorithms for data optimisation. 3) Lecture 3 (3h). DL and ML applications in chemistry and biology (Classification and Clustering). 4) Lecture 4 (3h). DL and ML applications for image analysis (Classification and Semantic Segmentation).	September/October	IT or EN (upon request)
I.11	ICT	Privacy-Preserving Techniques for Data Analysis	**12**	**Prof. Vincenzo Agate** *(University of Palermo)* *Contact email: vincenzo.agate@unipa.it*	This course will present techniques for designing privacy-preserving systems and applications, and discuss the possibilities and limitations of their use. Topics covered in the course include secure multi-party computation techniques and related cryptographic algorithms, and in-depth discussion of specialized tools and libraries for building secure systems for analyzing user data in a privacy preserving manner.	February	IT or EN upon request
I.12	ICT	Machine Learning Techniques based on FPGA	**12**	**Prof. Gianluigi Chiarello** *(University of Palermo)* *Contact email: gianluigi.chiarello@unipa.it*	The course aims to provide the state of the art on the implementation of Machine Learning (ML) and Deep Learning (DL) techniques in FPGA-type devices. This course aims to illustrate how ML techniques can be implemented in FPGA devices from a dual point of view. First, the course will focus on the technological aspect: the software and hardware tools available on the market will be presented and development methodologies will be illustrated, discussing practical	April	EN

					cases. Secondly, the course will show the state of the art of ML applications on FPGAs through the analysis of concrete cases and examples of applications (of varying complexity).		
I.13	ICT	Introduction to embedded system design based on SoC	**21**	**Prof. Gianluigi Chiarello** *(University of Palermo)* *Contact email: gianluigi.chiarello@unipa.it*	The course aims to introduce the design of embedded systems using Xilinx SoC and the tool Vivado. After a general description of the Xilinx SoC architecture, the functionalities offered by the Vivavdo will be analysed. The following lessons will deal with the main design and integration techniques of the main functions necessary for the design of embedded systems. There will be practical exercises on development boards based on Xilinx Zynq®-7000 All Programmable SoC.	February/March	EN
I.14	ICT	Microwave Sensors for Health Applications	**6**	**Prof. Antonio Lombardo** *(University College London, UK)* *Contact email: a.lombardo@ucl.ac.uk*	Recent advances and future challenges in the design of microwave sensors for health applications will be discussed. The adoption of microwave sensors in medicine has been recently assessed as a convenient approach to non-invasive sensing, diagnostics, and therapy, mainly due to the relatively innocuous nature of microwave radiation and its penetration ability through biological media. Nevertheless, technological advancements are still required to fully exploit the promising advantages of microwaves by properly facing their complex interactions which are accurately modeled in terms of its electromagnetic properties when considering the design of microwave sensors.	March/April	EN
I.15	ICT	Ultra-Low-Power CMOS Design and	**12**	**Dr. Roberto La Rosa**	This course will present strategies and techniques for designing Ultra-Low-Power CMOS for energy	September	

		Application techniques for energy autonomous devices		*(ST Microelectronics)* *Contact email: roberto.larosa@st.com*	autonomous devices. The operating and limitations of their use will be discussed. Topics covered in the course include energy harvesting techniques for developing battery-less sensors based on CMOS processes.		EN
I.16	ICT	Navigation and Control of Unmanned Aerial Vehicles (UAVs): a comprehensive approach.	**30**	**Prof. Kimon Valavanis** *(University of Denver, US)* *Contact email: kimon.valavanis@du.edu*	The course objective is twofold: i.) Provide a comprehensive study of unmanned fixed-wing and rotorcraft navigation and control techniques, including a review of kinematics, dynamics and equations of motion, sensors, identification, controller design and implementation, as well as advances in unmanned aviation technology. When focusing on multi-rotor UAVs, a detailed modeling approach based on Lagrange formulation is followed, which also accounts for rotor dynamics, gyroscopic effects, all types of drag, disturbances, and abrupt changes of mass. A comprehensive presentation of linear, linearized, nonlinear and soft-computing based controller designs are discussed, the focus being on helicopter, rotorcraft, and fixed-wing navigation and control designs. A comparison of advantages and limitations of implemented techniques follows, subsequently introducing a generalized 'one-fits-all' flight control system (FCS) in which the specific controller design approach is a plug-in-plug-out module. Implementation details and how to guarantee task execution given strict timing requirements is detailed. Case studies include simulation and experimental results for several prototype UAVs. ii.) Present a detailed methodology for designing and navigating/controlling a new type of fixed-wing aircraft with enhanced aerodynamic performance based on the concept of Circulation Control, which allows for lift enhancement, reduced takeoff and landing distance, delayed stall and	April	EN

					increased effective payload. CC based aircraft design is followed by controller design that also includes identification of stability and control derivatives. Simulation results, experimental/wind-tunnel and flight tests validate and verify the proposed methodology. Consequently, a general framework for controller design of a class of nonlinear systems with unstructured, time-varying uncertainties (aerodynamic uncertainties) is proposed, supported by obtained results. Prerequisites: Knowledge of feedback control systems is required. Knowledge of fundamentals of robotics is desirable, but not necessary. All required background information will be presented in class.		
I.17	ICT	Advanced material investigations by Electron Microscopy: theoretical and experimental hints	**8**	**Prof. Simona Boninelli** *(IMM – CNR, Catania)* *Contact email: simona.boninelli@ct.infn.it*	Electron Microscopy has emerged has a crucial characterization technique in material science, providing highly resolved evidence of chemical, optical and morphological structure of matter from micron to atomic scale. In this course I will give an overview of physical fundamentals and electro-optical alignment lying at the basis of both Scanning Electron Microscope (SEM) and (Scanning)-Transmission Electron Microscope (S-TEM), equipped with spectroscopic tools such as Energy Dispersive X-ray Spectroscopy and Electron Energy Loss Spectroscopy. Analogies and differences between these two techniques will be emphasized. The morphology and chemical mapping of nanomaterials (nanowires, metal-oxides and metallic nanoalloys, nanobelts) and thin films (Si, Ge, SiC) will be presented pointing at their specific practical applications, spanning from microelectronics to power devices. Moreover, we will remote connect with the the Beyond nano Electron Microscopy Lab located at IMM-CNR in Catania, to follow live a S-TEM	February	EN

					session to investigate the crystallographic atomic arrangement at the nanoscale and beyond. The tentative program is: 1st lesson: EM to overcome the resolution limit of light 2nd lesson: Conventional S-TEM techniques for defects characterization 3rd lesson: Spectroscopic analyses form chemical mapping 4th lesson: Remote controlled STEM analysis		
I.18	ICT	Computer-Aided Design of electronic circuits and systems	**12**	**Prof. Daniele Sciré** *(University of Palermo)* *Contact email: daniele.scire@unipa.it*	il corso propone di fornire le competenze di base sulla progettazione e analisi di circuiti e sistemi elettronici tramite l'ausilio di software gratuiti di simulazione basati su SPICE (es. Microcap, LTSpice). Nel corso verranno trattati gli algoritmi e i metodi numerici usati dai software di simulazione circuitale sia nel dominio del tempo che della frequenza, i modelli dei dispositivi a stato solido più comunemente usati e l'applicazione di metodi statistici e di ottimizzazione alla progettazione di circuiti elettronici. Le lezioni frontali saranno integrate da esercitazioni sull'applicazione dei concetti visti a lezione sul software di simulazione. Al termine del corso gli allievi dottorandi avranno acquisito le conoscenze operative per utilizzare adeguatamente ed in modo accurato più comuni software di simulazione SPICE.	March	EN
I.19	ICT	Machine learning techniques for cyber threat detection in distributed systems	**12**	**Prof. Federico Concone** *(University of Palermo)*	This 12-hour course will focus on the use of machine learning to detect attacks in relevant cybersecurity domains.	March	

				Contact email: federico.concone@unipa.it	Topics covered in the course will include intelligent data analysis techniques for discovering critical events raced by the spread of false information, as well as the detection of malicious activities performed by humans in the internal perimeters of data centers.		IT or EN (upon request)
I.20	ICT	Robot Consciousness	**12**	**Prof. Antonio Chella** *(University of Palermo)* *Contact email: antonio.chella@unipa.it*	Robot consciousness focuses on attempts to apply AI, robotics, and computer science methods to various ways of understanding consciousness and examining consciousness's possible role in robot systems. The course will present the current state of research and discuss both the theoretical foundations and the experimental results of the emerging field of robot consciousness. The student will be able to apply the methodologies studied in different contexts and learn analysis and synthesis processes related to robot consciousness, including advanced methods.	March	EN

Proponent PhD programme: Mechanical, manufacturing, management and aerospace Innovation (M3AI)							
M.1	M3AI	Computational Modelling of Composite and Heterogeneous Materials	8	Prof. Ivano Benedetti Prof. Alberto Milazzo (University of Palermo) Contact email: ivano.benedetti@unipa.it	The course will introduce some recent developments on computational modelling of composite and polycrystalline materials, with a focus on the analysis of damage and fracture problems. Some specific concepts and techniques, such as the Generalised Unified Formulation for multilayered composites modelling and Cohesive Zone Modelling for the analysis of damage and fracture initiation in heterogeneous materials, will be introduced and recent and prosepctive applications will be discussed. Applications to low- and high-cycle fatigue, hydrogen embrittlement, multifunctional materials will be discussed.	May	EN
M.2	M3AI	Introduction to causal analysis	8	Dott. Salvatore Marcantonio (University of Palermo) Contact email: salvatore.marcantonio@unipa.it	The Course aims at introducing causal analysis through graphical models according to Judea Pearl's methodology. It will cover: preliminaries, statistical and causal models, graphical models and their applications, the Effects of interventions, counterfactuals and their Applications. Teoretical M.3arguments will be M3AI shown along withM.4 excerces and software presentation.	May/June	IT
M.3	M3AI	Fundamentals of Life Cycle Engineering techniques	8	Prof. Giuseppe Ingarao (University of Palermo) Contact email: giuseppe.ingarao@unipa.it	The course aims at providing skills concerning products environmental impact analysis. The whole product life cycle as well as the inventory techniques for each phase life will be analyzed. The concept of material embodied energy, as well as the idea of dominant phase of a product/component life cycle will be analyzed. Life Cycle engineering (LCE) techniques will be presented as means to identify environmentally friendly solution while designing products/components. Comparatives industrial case	May	EN

					studies will be thoroughly analyzed. Also, the Circular Economy paradigm will be analyzed; specifically, several Circular Economy strategies concerning the case of aluminum alloys Reuse/Recycle will be presented.		
M.4	M3AI	Non-Destructive Evaluation for Industry 4.0	8	Prof. Carmelo Mineo (University of Palermo) Contact email: carmelo.mineo01@unipa.it	This course will discuss the evolution of Non-Destructive Evaluation (NDE) for the assessment of industrial production in the landscape of Industry 4.0. As it has happened in the history of industrial development, NDE will be critical for the success of the fourth industrial revolution, by providing the database needed for feedback in a networked production environment. This course will present a review of the recent scientific literature and of several current-day challenges (informatization, digitalization, standardization, networking, etc.) that are being tackled to adapt NDE to the requirements of the rising industrial revolution.	May	EN
M.5	M3AI	Research Methods	8	Prof. Giovanni Battista Dagnino (Lumsa University, Palermo) Contact email: g.dagnino@lumsa.it	The PhD course in research methods is aimed to buttress students in achieving an insightful appreciation of the essence and unfolding mechanisms underlying the research process and engender the fundamental preconditions to develop the skills required to conduct inquiry and write scholarly research publishable in top-level academic journals. The targeted knowledge to achieve is concerned with the ability to execute separate parts of 'normal science' projects within professional standards including the basic guidelines for understanding theory construction and development, literature review and qualitative design.	June	EN
M.6	M3AI	Multi-sided platform business models	8	Prof. Paolo Roma	The PhD course will provide an overview of the logic of multi-sided platforms and their business models.	November	EN

				(University of Palermo) Contact email: paolo.roma@unipa.it	In a world where more and more businesses have been re-organized as multi-sided (platform) markets, the main purpose of the course is to offer PhD students a broad understanding of how multi-sided platforms can generate a competitive advantage and enhance marketability of new products and technologies. By exploring several important types of economy/business models enabled by Internet and organised as multi-sided platforms, such as sharing economy, app market, crowdfunding, the course will offer a set of guidelines on how to take advantage of multi-sided platforms in different fields of application to support innovation.		
M.7	M3AI	Open Innovation and Open Business Model	8	Prof.ssa Erica Mazzola (University of Palermo) Contact email: erica.mazzola@unipa.it	The PhD course will discuss the current research investigating phenomena related to the open and collaborative innovation. The aim of the PhD course is to advance the class understanding of how corporations innovate combining diverse forms ranging from corporate innovation (e.g. Corporate Venture Capital), incubators, accelerators, start-up competitions, entrepreneurship, new product development, and related fields. The course will expose PhD students to a hybrid set of methods to understand the wide array of approaches to do research in the field of Innovation Management.		EN
M.8	M3AI	Sailing Tomorrow	8	Prof. Antonio Mancuso (University of Palermo) Contact email: antonio.mancuso@unipa.it	The PhD course will provide an overview of the design methodology in the field of sailing yacht particularly concerning high speed boats. The new opportunities provided by the use of lifting surfaces (the so-called foils) changes the design paradigm dramatically. An intensive use of advanced software aimed to improve both aero/hydro dynamics and structural performances become mandatory. During the course will be faced problems as far as shape, structures and rigging of a regatta sailing yacht are	February	EN

					concerned. Will be show how the integration of CAD, FEM and CFD software allows designer to reach the final result in a faster way.		
M.9	M3AI	Computer Modeling of Cardiovascular Problems	8	Prof. Salvatore Pasta (University of Palermo) Contact email: salvatore.pasta@unipa.it	Computational modeling can revolution the way we diagnose and treat cardiovascular diseases. While medical drugs can reduce the risk of heart diseases, biomedical devices play a key role in managing cardiovascular problems. Just as in other industries, the efficacy of biomedical device and treatments can be greatly improved by using computer aided engineering (CAE). However, when compared with other industries, the biomedical engineering has been lagging in its adoption of CAE, in part due to the challenges in modeling the complexity human system and in the absence of published standards. In this course, the numerical challenges in the development of computer models for simulating the heart mechanics under normal and pathological conditions will be addressed. The role of patient-specific segmentation from medical images, the adaptation of constitutive models for simulating the electro-fluid-mechanical interaction of the myocardium and the selection of boundary conditions will be presented. Simulations of structural heart valve diseases and aneurysm physiopathology will be shown. The need for verification and validation of computer models according to the recent ASME VV40 will be presented.	July	IT or EN upon request
M.10	M3AI	Corporate Venture Capital: how corporate deals with innovative startups	8	Prof. Giovanni Perrone (University of Palermo) Contact email: giovanni.perrone@unipa.it	The PhD course will concern the topic of how corporates engage with technology startups for new knowledge acquisition in an Open Innovation perspective. The course will discuss traditional framework of CVC by evidencing the approach corporates use in their investments by underlying strategies and operational modes. Furthermore, the	July	EN

					course will review the principal drawbacks of traditional CVC equity investments, and will discuss new form of corporate engagement with technology startups such as incubators and accelerators. The course will provide real cases of what discussed and will also provide trajectories for further research contribution on this topic.		
M.11	M3AI	Concept of measurement and related qualification in terms of uncertainty in engineering processes	8	Prof. Francesco Scardulla (University of Palermo) Contact email: francesco.scardulla@unipa.it	No measurement provides an exact number and thus, several measurements performed in identical conditions provide different results. Hence the importance of the correct quantification of uncertainty in the technological, scientific and commercial fields, which calculation is regulated by international agreements and procedures. In this course, you will learn what information you need to calculate uncertainty, how to identify contributors to uncertainty, and how to evaluate your calculations to prevent overestimating or underestimating uncertainty. This course is highly recommended for all students who have never faced the concept of measurement uncertainty.	March - June	IT or EN upon request
M.12	M3AI	Innovation in measurements: from the concept of the device to the design of a business model	8	Prof. Francesco Scardulla (University of Palermo) Contact email: francesco.scardulla@unipa.it	During a PhD course or after its conclusion, it is possible to come up with an idea/technology that is believed to be innovative or revolutionary. Unfortunately, the only idea is not enough to bring it to the market through the launch of a startup. People don't know the steps and they are often intimidated by the whole process, letting the ideas die without any chance. In this course you will learn how to evaluate your business idea and protect it from potential competitors and what are all the first steps to take to found a start-up and let investors believing in it. The main topics that will be covered are: how to write an executive summary and a business model, how to build a pitch and how to present it,	March - June	IT or EN upon request

					investments options, how to properly write a patent. The last lession will be devoted to a practical pitch session.		
M.13	M3AI	Sustainable Logistics and Transportation	12	Prof. Simona Mancini (University of Palermo) Contact email: simona.mancini@unipa.it	The course will present the main issues arising in green and sustainable logistics and will analyze viable solutions to this issue, which include both the exploitation of more sustainable resources (such as electric vehicles) and a smarter usage of available resources. We will discuss the main advantages and disadvantages of exploiting electric vehicles, the issues to manage when dealing with such vehicles (en-route recharging planning, recharging slots reservation, recharging stations location) both in freight delivery and in public transport. The impact of different incentives, such as the introduction of toll zones or restricted areas for fuel-engine vehicles, will be discussed in details. Furthermore, open challenges and latest advances in City Logistics (multi-echelon distribution systems for long-haul transportation, collaboration among carriers, closed loop supply chains) will be discussed. Hints about reverse logistics will be provided. The course will integrate lectures with discussion of recent journal papers reporting latest advances in the literature.	January	EN
M.14	M3AI	Advanced Mathematical Modeling for complex decision problems	12	Prof. Simona Mancini (University of Palermo) Contact email: simona.mancini@unipa.it	The aim of the course is to give the students advanced modeling skills that can allow them to be able to provide mathematical formulations for decision problems they can face in their research field. The first part of the course will provide the needed knowledge to transform a textual description of a decision problem into a mathematical formulation. The second part will address specific problems such as production and scheduling problems, packing problems and vehicle routing	February	EN

					problems. Given a single problem, different formulations will be provided and analyzed. Techniques to provide smarter formulation (i.e. formulations that can solve quicker the problems to the optimality) will be presented. Hints about formulations strengthening techniques and exact solving methods will be provided.		
M.15	M3AI	New trends in future metrology: measurements of non-physical quantities (measuring the unmeasurable)	8	Prof. Leonardo D'Acquisto (University of Palermo) Contact email: leonardo.dacquisto@unipa.it	The measurement of quantities according to perception is of great interest for the optimal characterization of the interaction of persons with their living and working environment. It formally conflicts with the definition of physical quantity (PQ): " A physical quantity is a physical property of a material or system that can be quantified by measurement". Despite that, there is growing interest to a new approach to the development of a theory of measurements for non-physical quantities (NPQs). For these measurements it is not possible to ensure traceability because of their exclusive nature as substantiated by the subject. NPQs exist in the immaterial world in the sense they exist only in the mind of people either as a reflection of properties of real material world or as a personal understanding of the subject. Measurements of PQs and NPQs have clearly different fields of application. So, NPQ) have different fields of application. Measurements of NPQ are: a way to perceive the material world through its reflection in human minds and a way to perceive the immaterial world of each person through its understanding (or lack of understanding) by other people.	February	IT or EN upon request
M.16	M3AI	Sensors 4.0 - smart sensors and	8	Prof. Leonardo D'Acquisto (University of Palermo)	Industrial Internet of Things (IIoT) or its related denomination Industry 4.0 are two widespread used terms to indicate the actual revolution in the industrial approach involving automation and	June-July	IT or EN

		measurement approach for Industry 4.0		Contact email: leonardo.dacquisto@unipa.it	control. On the ground of data generated at all levels of the production processes, disruptive improvements are made possible in terms of process quality, efficiency, productivity and flexibility. Smart sensors are the basic step providing added value to the measurement information which enables new process functionality in terms of self monitoring and self-configuration to condition monitoring of complex processes. Today's smart sensors, in this sense, are the fourth measurement revolution moving from the basic mechanical and thermal sensors like dynamometer spring scale and liquid expansion thermometer.		upon request
Proponent PhD programme: Engineering of Structures and Infrastructures							
S.1	ESI	Sicurezza strutturale di elementi in c.a. e c.a.p soggetti a degrado	**8**	**Prof. Giuseppe Campione** *(University of Palermo)* *Contact email: giuseppe.campione@unipa.it*	Scopo del corso è quello di fornire gli strumenti di calcolo di verifica allo stato limite di esercizio ed ultimo di strutture in cemento armato ordinario e precompresso soggette a fenomeni di degrado indotti da carbonatazione e dall'attacco cloridrico (corrosione generale e localizzata). Sulla base di evidenze e studi sperimentali si propongono legami costitutivi di natura fenomenologica da impiegare nelle verifiche di sicurezza in cemento armato ordinario e precompresso, fornendo anche degli esempi di calcolo di strutture esistenti.	December 2023	IT or EN upon request
S.2	ESI	GIS based analysis	**8**	**Dr. Gabriele D'Orso** *(University of Palermo)* *Contact email: gabriele.dorso@unipa.it*	L'obiettivo del corso è quello di presentare agli allievi uno strumento versatile ed utilizzabile per effettuare analisi spaziali inerenti ai diversi campi dell'ingegneria civile. Per le analisi si utilizzerà un software GIS open-source, QGIS. Attraverso la presentazione di casi studio, verranno fornite ai partecipanti del corso breve delle conoscenze su tale	January 2024	IT or EN upon request

					software, evidenziandone le potenzialità e i limiti come mezzo di supporto alle decisioni nei processi progettuali e pianificatori.		
S.3	ESI	Virtual Experiments: Why?	**8**	**Prof. Antonella Pirrotta** *(University of Palermo)* *Contact email: antonina.pirrotta@unipa.it*	Modeling and simulation are becoming increasingly important enablers for the analysis and design of complex systems. The connection between mathematics and reality is just experimental tests. The latter makes the difference between mathematical method and scientific method, that is experimental tests for validation is an important step of the scientific method.	March 2024	IT or EN upon request
S.4	CEBHyME/ ESI	Corso breve su Elementi di Matlab per l'ingegneria	**12**	**Prof. Alberto di Matteo** *(University of Palermo)* *Contact email: alberto.dimatteo@unipa.it*	Il corso si pone l'obiettivo di introdurre gli elementi basilari della programmazione in linguaggio MATLAB e le sue applicazioni in problemi tipici dell'Ingegneria Civile. La trattazione dei vari argomenti avviene in maniera graduale anche attraverso esempi applicativi. Si parte dalle nozioni elementari sui fondamenti dell'ambiente e del linguaggio MATLAB per pervenire all'uso in applicazioni non banali	April 2024	IT or EN upon request
S.5	ESI	Metodi di valutazione delle prestazioni operative e di sicurezza delle infrastrutture stradali nell'attuale contesto e nella transitione al futuro	**8**	**Prof. Anna Granà** *(University of Palermo)* *Contact email: anna.grana@unipa.it*	Il corso si propone di fornire gli strumenti conoscitivi, interpretativi e applicativi per svolgere valutazioni di efficienza operativa e di sicurezza delle infrastrutture stradali. In questa prospettiva, i modelli di micro-simulazione del traffico consentono di prevedere e di esaminare gli impatti indotti da soluzioni progettuali nuove o da soluzioni alternative all'assetto viario esistente, e di concettualizzare scenari what-if in presenza di tecnologie di guida cooperativa. Sulla base di recenti studi e ricerche, il corso presenta non solo approcci tradizionali, ma anche metodi avanzati per l'analisi di sicurezza e di efficienza operativa delle infrastrutture stradali urbane ed extraurbane, fornendo anche esempi utili e di supporto	May 2024	IT or EN upon request

					decisionale nella transizione verso sistemi viari efficienti e sicuri a servizio della mobilità.		
S.6	ESI	Progetto e simulazione di un modello di rete in Aimsun Next [Designing and simulating a road network model in Aimsun Next]	**8**	**Dr. Maria Luisa Tumminello** *(University of Palermo)* *Contact email: marialuisa.tumminello01@unipa.it*	Il corso, composto da 2 lezioni di 4 ore, verrà svolto in modo interattivo con i partecipanti, al fine di renderlo particolarmente efficace e fruibile per i nuovi utenti, oltre che significativamente produttivo per utenti con conoscenze base precedentemente acquisite.	June 2024	IT or EN upon request
S.7	ESI	Nonconservative problems of dynamic stability	**8**	**Prof. Massimiliano Zingales** *(University of Palermo)* *Contact email: massimiliano.zingales@unipa.it*	Nonconservative problems of dynamic stability	July 2024	IT or EN upon request
S.8	ESI	Vulnerabilità sismica e tecniche di intervento	**8**	**Prof. Piero Colajanni** *(University of Palermo)* *Contact email: piero.colajanni@unipa.it*	Scopo del corso è quello di fornire gli strumenti per la verifica della vulnerabilità sismica, il progetto di interventi di adeguamento/miglioramento, e il progetto di nuove strutture attraverso l'analisi statica non lineare di edifici a struttura intelaiata in c.a e di ponti in c.a. e c.a.p. Partendo dalle formulazioni dei metodi pr4esenti in normativa, verranno analizzate l'efficacia di metodi avanzati per la valutazione della risposta di strutture irregolari, in pianta e in elevazione. I risultati forniti dalle diverse tecniche di analisi statica non lineare verranno confrontati con risultati di analisi dinamiche non lineari al passo.	September 2024	IT or EN upon request
S.9	ESI	Elementi di modellazione FEM per la meccanica strutturale mediante ADINA, ABAQUS e FEAP. 28 ore primo anno	**16**	**Prof. Francesco Parrinello** *(University of Palermo)* *Contact email: francesco.parrinello@unipa.it*	ADINA, ABAQUS e FEAP sono codici di calcolo multi fisico ad elementi finiti che operano in campo lineare e non-lineare per la risoluzione di numerose applicazioni nell'ambito dell'ingegneria civile, meccanica, idraulica e dei materiali.	October 2024	IT or EN upon request
S.10	ESI	Modern strategies of seismic vulnerability	**8**	**Prof. Liborio Cavaleri**	Modern strategies of seismic vulnerability mitigation and seismic design of structures	November 2024	IT or EN

		mitigation and seismic design of structures		*(University of Palermo)* *Contact email: liborio.cavaleri@unipa.it*			upon request
S.11	ESI/ CEBHyME	Big data analytics using Python	**12**	**Prof. Emma la Malfa Ribolla** *(University of Palermo)* *Contact email: emma.lamalfaribolla@unipa.it*	Il corso introduce all'organizzazione, elaborazione e gestione di ampi volumi di dati. Sarà possibile apprendere i principi di base del linguaggio di Programmazione Python, uno dei linguaggi più diffusi per l'analisi dei dati. Saranno altresì approfondite le ultime tecnologie per la Big Data Analytics con Python, linguaggio multiparadigma ricco di librerie e facilmente integrabile nei sistemi reali. Gli argomenti includono: i tipi di dato in Python e le operazioni e i metodi di conversione, gli algoritmi e i diagrammi di flusso, le istruzioni per il controllo del flusso, input dati, gestione delle errori, cicli while e for, funzioni, variabili globali e locali, i moduli della Standard Library.	December 2024	IT or EN upon request
S.12	ESI	Il ruolo di indagini mirate per la corretta definizione del modello geotecnico di sottosuolo e per la interpretazione e soluzione di problemi di ingegneria geotecnica	**8**	**Prof. Maurizio Ziccarelli** *(University of Palermo)* *Contact email: maurizio.ziccarelli@unipa.it*	Il ruolo di indagini mirate per la corretta definizione del modello geotecnico di sottosuolo e per la interpretazione e soluzione di problemi di ingegneria geotecnica	January 2025	IT or EN upon request
S.13	ESI	Modellazione agli elementi finiti di opere e sistemi geotecnici mediante Plaxis	**12**	**Dr. Marco Rosone** *(University of Palermo)* *Contact email: marco.rosone@unipa.it*	Modellazione agli elementi finiti di opere e sistemi geotecnici mediante Plaxis	February 2025	IT or EN upon request
S.14	ESI/CEBHyME	Building your reputation through research products: Planning, Drafting, Revising, Publishing and	**8**	**Prof. Davide Lo Presti** *(University of Palermo)*	Il corso di scrittura creativa introduce i dottorandi/e alle questioni connesse all'impostazione di un articolo scientifico, alla sua organizzazione in paragrafi, alla presentazione e alla discussione dei risultati in relazione alle domande aperte che	March 2025	IT or EN upon request

		Disseminating your scientific papers		*Contact email: davide.lopresti@unipa.it*	letteratura tecnico scientifica presenta in relazione al problema di ricerca descritto e affrontato		
S.15	ESI	Theory of linear viscoelasticity applied to concrete bridges	**8**	**Prof. Fabio Granata** *(University of Palermo)* *Contact email: michelefabio.granata@unipa.it*	Il corso fornirà i principi fondamentali della teoria della viscoelasticità lineare nel calcestruzzo e gli effetti sulle strutture a schema variato come i ponti in calcestruzzo armato e precompresso. In particolare si approfondiranno i modelli di viscosità raccomandati in letteratura, l'influenza sul comportamento strutturale dei ponti, le cadute di precompressione e le fasi costruttive.	April 2025	IT or EN upon request
S.16	ESI	Biomedical signal anlalysis	**8**	**Dr. Emanuela Bologna** *(University of Palermo)* *Contact email: emanuela.bologna@unipa.it*	Gli argomenti del corso includono: - analisi del segnale biomedico per la valutazione della vulnerabilità della frequenza cardiaca; - ricostruzione dinamiche all'analisi delle serie temporali; elaborazione e analisi di immagini biomediche.	May 2025	IT or EN upon request
S.17	ESI	Innovative materials for shear and flexural strenghtening of masonry structural members	**8**	**Prof. Lidia La Mendola** *(University of Palermo)* *Contact email: lidia.lamendola@unipa.it*	Il breve corso si propone di fornire agli studenti una sintesi delle ricerche più attuali sul rinforzo di elementi strutturali in muratura, quali: - maschi murari, fasce di piano, volte, ecc. Il rinforzo costituito da materiali innovativi, leggeri e rimovibili, funziona generalmente a flessione e taglio o, nel caso delle volte, per assorbire gli sforzi di trazione che si generano nelle sezioni in cui si formano le cerniere. Affinchè il rinforzo possa funzionare è di fondamentale importanza la trasmissione degi sforzi all'interfaccia muratura-rinforzo. Questo problema è stato oggetto di studi condotti con altre università italiane e straniere nell'ambito di progetti di ricerca e tesi di dottorato di ricerca. Sarà presentata una indagine sperimentale condotta da UniPa oltre che nell'ambito di un Round-robin Test e un modello analitico-numerico proposto.	June 2025	IT or EN upon request

S.18	ESI	Uso di CFRM nel rinforzo strututrale delle muratrure	**8**	**Dr. Jennifer D'Anna** *(University of Palermo)* *Contact email: jennifer.danna@unipa.it*	Uso di CFRM nel rinforzo strututrale delle muratrure	September 2025	IT or EN upon request
S.19	ESI	Nonlinear Porous media mechanics as a basis for a wide class of multiphysics problems	**8**	**Prof. Guido Borino** *(University of Palermo)* *Contact email: guido.borino@unipa.it*	The proposed course, starting from the basis of finite displacements continuum mixture theory, will show the fundamental relations in terms of generalized kinematics and statics, together with generalized constitutive relations. Conservation laws and thermodynamics principles will be also developed in the appropriate form for the considered problems. Finally, a few simple applications will be proposed.	November 2025	IT or EN upon request
Proponent PhD programme: Chemical, Environmental, Biomedical, Hydraulic and Materials Engineering (CEBHyME)							
C.1	CEBHyME	Preparation and characterization of (bio)polymer-based micro- and nanostructured systems	**18**	**Prof. Roberto Scaffaro** **Dr. Emmanuel Fortunato Gulino** *(University of Palermo)* *Contact email:* *roberto.scaffaro@unipa.it* *emmanuelfortunato.gulino@unipa.it*	L'obiettivo del corso è fornire una conoscenza di base sugli ultimi progressi nel campo dei sistemi micro e nanostrutturati basati su (bio)polimeri. Recentemente, la scienza e la tecnologia dei micro/nano-compositi a base di (bio)polimeri sta emergendo come uno degli ambiti di ricerca di maggior impatto, soprattutto a causa della crescente domanda di materiali avanzati. Verranno quindi introdotti e discussi i principali metodi di fabbricazione e caratterizzazione dei materiali compositi, insieme alla costruzione di una mappa generica delle relazioni processo-struttura-proprietà, utile per progettare materiali multifunzionali per applicazioni avanzate, tra cui trattamento acqua/aria, sensori , biomedicina, somministrazione di farmaci, accumulo/conversione di energia.	February 2024	EN

C.2	CEBHyME	Nanoscience & nanomaterials: pushing the boundaries of technology	**8**	**Prof. Clelia Dispenza** **Dr. Emanuela Muscolino** *(University of Palermo)* *Contact email: clelia.dispenza@unipa.it*	Il corso mira a fornire un'introduzione alle nanoscienze e alle nanotecnologie, spiegando perché i materiali ridotti alla nanoscala possono improvvisamente mostrare proprietà molto diverse rispetto a ciò che mostrano su una macroscala, comprendendo alcuni sviluppi attuali e sfide non affrontate. La partecipazione a questo corso frantuma il termine monolitico "nanotecnologia" nella miriade di sfaccettature che è in realtà.	February – March 2024	EN
C.3	CEBHyME	Critical issues and new perspectives in environmental remediation technologies	**10**	**Prof. Gaspare Viviani** **Prof. Michele Torregrossa** **Prof. Giorgio Mannina** **Prof. Alida Cosenza** **Prof. Santo Fabio Corsino** **Prof. Daniele Di Trapani** *(University of Palermo)* *Contact email:* *gaspare.viviani@unipa.it* *santofabio.corsino@unipa.it*	Il corso presenta le principali criticità emerse negli ultimi anni nell'ambito delle tecnologie consolidate per la tutela ambientale e le nuove proposte che possono essere attuate per garantire il raggiungimento di obiettivi di recupero ecosostenibile.	July 2024	EN
C.4	CEBHyME	Peculiar hydro-morphodynamic processes in rivers	**8**	**Prof. Donatella Termini** *(University of Palermo)* *Contact email:* *donatella.termini@unipa.it*	Lo scopo del corso è quello di fornire le informazioni di base per comprendere i principali processi di evoluzione nei fiumi naturali. L'evoluzione morfologica del fiume avviene a seguito di processi di "adattamento spontaneo" che si verificano a causa di azioni naturali (come quelle indotte dai cambiamenti climatici) e/o di origine antropica. Nei fiumi si possono generare forme diverse e complesse a seconda delle caratteristiche cinematiche del flusso e dei fenomeni di erosione/deposizione indotti. I diversi scenari che si presentano durante i processi	July 2024	EN

					evolutivi influenzano fortemente l'habitat del sistema fluviale e le aree limitrofe.		
C.5	CEBHyME	Eulerian numerical methods for computational fluid dynamics	**8**	**Prof. Tullio Tucciarelli** *(University of Palermo)* *Contact email: tullio.tucciarelli@unipa.it*	Le equazioni differenziali parziali forniscono la relazione funzionale tra le variabili di stato dei fluidi in quasi tutti gli ambienti reali. Date le condizioni iniziali e al contorno, una soluzione discretizzata nello spazio e nel tempo può essere trovata con i metodi euleriani, dove le variabili di stato sono calcolate in un numero finito di punti fissati nel tempo. Il corso breve offrirà C.8un'introduzione ad alcuni metodi tradizionali e avanzati per la loro soluzione. I metodi di Galerkin continuo, Petrov-Galerkin discontinuo e di elementi finiti ibridi misti saranno presentati e applicati a griglie triangolari 2D e 3D non strutturate. Verranno discusse le proprietà richieste della mesh computazionale, insieme alla definizione di Delaunay e alla proprietà estesa di Delaunay. Verrà presentata la metodologia MAST-RT0 per la soluzione delle equazioni di Navier-Stokes in problemi 2D e 3D all'interno di domini complessi; verrà mostrata l'applicazione a prove di sintesi e il confronto con i risultati sperimentali.	July 2024	EN
C.6	CEBHyME	Salinity Gradient Power: Fundamentals, main technologies and applications	**8**	**Prof. Alessandro Tamburini** **Prof. Giorgio Micale** **Prof. Andrea Cipollina** *(University of Palermo)* *Contact email: alessandro.tamburini@unipa.it*	L'obiettivo del corso è quello di consentire ai dottorandi di avere un primo contatto con questa nuova forma di energia rinnovabile e le relative tecnologie. Più precisamente, le lezioni saranno suddivise in tre argomenti principali: (i) Fondamenti di Salinity Gradient Power, (ii) principali tecnologie SGP con focus sull'elettrodialisi inversa, (iii) applicazioni e prospettive. Il corso aiuterà gli studenti ad apprendere la termodinamica oltre l'SGP e i fondamenti delle tecnologie in grado di sfruttarlo, a padroneggiare le basi dei fenomeni di trasporto rilevanti e a fare semplici calcoli per stimare l'energia teorica disponibile in uno scenario specifico e le relative importo effettivamente recuperabile.	July 2024	EN

C.7	CEBHyME	Neural Network for Machine Learning: Introduction to Artificial Neural Network, design and implementation in Matlab	**8**	**Prof. Dario Pumo** *(University of Palermo)* *Contact email: dario.pumo@unipa.it*	La rete neurale artificiale (ANN) è una branca dell'intelligenza artificiale che cerca di imitare la capacità del cervello umano di elaborare rapidamente le informazioni in entrata in modo semplificato e di imparare dall'esperienza. In particolare, le ANN sono sistemi di calcolo di ispirazione biologica, che svolgono vari compiti (ad es. elaborazione del segnale, riconoscimento di modelli, regressione, classificazione, raggruppamento, previsione, ecc.). Le ANN sono modelli basati sui dati non lineari maturi, flessibili e potenti che sono stati applicati con successo per risolvere compiti complessi nel campo della scienza e dell'ingegneria. Lo scopo del corso è fornire le basi per la progettazione e l'implementazione di ANN (utilizzando il software MATLAB), mostrando le potenzialità ei vantaggi di questo approccio di modellazione.	7-11 July 2025	EN
C.8	CEBHyME	Combined processing for the preparation of biopolymeric porous structures for biomedical applications	**18**	**Dr. Elisa Capuana** *(University of Palermo)* *Contact email: elisa.capuana@unipa.it*	Il corso introduce ai biopolimeri porosi, che stanno ricevendo un crescente interesse in diversi campi tecnologicamente avanzati, compresi i dispositivi biomedici. In questo contesto, l'ingegneria dei tessuti dell'interfaccia (ITE) è un campo in rapido sviluppo che mira alla produzione di dispositivi progettati per riparare o rigenerare zone malate o danneggiate all'interfaccia di diversi tipi di tessuto. Il corso illustrerà lo sviluppo dei dispositivi porosi bio-ispirati su misura con proprietà meccaniche simili ai tessuti naturali combinando diversi approcci di elaborazione.	February 2024	EN
C.9	CEBHyME	Theory and practice of electrochemical impedance spectroscopy	**10**	**Prof. Monica Santamaria** **Prof. Francesco Di Franco** **Dr. Andrea Zaffora** *(University of Palermo)* *Contact email: monica.santamaria@unipa.it*	Il corso introdurrà la spettroscopia di impedenza elettrochimica (EIS) e la sua applicazione allo studio dei processi elettrochimici e non. Verranno discussi i dettagli relativi al metodo corretto di acquisizione e analisi dei dati. Di seguito i contenuti principali: 1) Background (Variabili complesse, Equazioni differenziali, Statistica, Circuiti elettrici, Elettrochimica); 2) Considerazioni sperimentali (Strumentazione Elettrochimica, Disegno Sperimentale); 3) Modelli di processo (analoghi di	July 2024	EN

					circuiti equivalenti, modelli cinetici, impedenza di diffusione, dispersione a tempo costante, funzioni di trasferimento generalizzate). Il corso prevede sia lezioni frontali che sessioni numeriche e pratiche.		
C.10	CEBHyME	Sensor and Biosensors	**8**	**Prof. Rosalinda Inguanta** **Dr. Bernardo Patella** *(University of Palermo)* *Contact email: rosalinda.inguanta@unipa.it*	Lo scopo di questo breve corso è fornire le nozioni di base per comprendere i principi di funzionamento delle principali tipologie di sensori e dare uno sguardo allo sviluppo della ricerca in questo settore. Verranno inoltre presentati e discussi casi di studio su sensori per l'analisi degli alimenti, per l'analisi degli inquinanti ambientali (nelle acque, nei suoli) e per l'identificazione di biomarcatori utili alla diagnosi precoce di malattie specifiche, come ad esempio malattie neurodegenerative e respiratorie. Sei ore saranno dedicate alla didattica frontale e due ore saranno di attività pratica in laboratorio su apposito sensore.	June 2024	EN
C.11	CEBHyME	Water depollution by Advanced Oxidation Technologies	**10**	**Prof. Vittorio Loddo** *(University of Palermo)* *Contact email: vittorio.loddo@unipa.it*	Il corso presenta i trattamenti delle acque mediante processi di ossidazione avanzati (AOP) basati su reazioni chimiche e fotochimiche. Vengono descritti i processi più utilizzati e per ciascuno di essi verranno analizzati i principali meccanismi di reazione, principi, vantaggi, svantaggi, prestazioni, formazione di sottoprodotti, accoppiamento con altre tecnologie e applicazioni al disinquinamento delle acque e delle acque reflue riportandone i principali risultati di studi pubblicati nella letteratura di riferimento.	July 2024	EN
C.12	CEBHyME	Radiation science and safety	**10**	**Prof. Mats Jonsson** *(KTH – Sweden)* *Contact email: matsj@kth.se*	Le radiazioni ionizzanti sono diventate uno strumento versatile in medicina e in vari settori della tecnologia. Le radiazioni vengono utilizzate come mezzo per monitorare i processi in tempo reale e per applicazioni di imaging avanzate sia nell'industria che in numerose applicazioni mediche. Inoltre, le radiazioni ionizzanti vengono utilizzate anche per indurre processi nei materiali e per curare il cancro e	July 2024	

					altre malattie. L'impatto della ionizzazione su tutti i tipi di materiali è anche il motivo per cui l'esposizione alle radiazioni ionizzanti è un pericolo per la salute. Questo corso fornirà una comprensione di base sull'interazione tra radiazioni ionizzanti e materia, fornirà una panoramica delle applicazioni della scienza delle radiazioni nei processi industriali, monitoraggio ambientale, trattamento dei materiali, medicina nucleare e radiologia. Verranno inoltre discussi gli ambienti in cui la resistenza alle radiazioni ionizzanti è un criterio di progettazione (es. industria nucleare, materiali per missioni spaziali). Poiché tutte le applicazioni che utilizzano radiazioni ionizzanti richiedono conoscenze sulla sicurezza dalle radiazioni, il corso include anche le basi della sicurezza dalle radiazioni.		EN
C.13	CEBHyME	Polymeric materials and resource efficiency	**10**	**Prof. Giada Lo Re** *(Chalmers University of Technology – Sweden)* *Contact email: giadal@chalmers.se*	Premessa e obiettivo: è in corso una forte discussione sullo sviluppo ecologicamente sostenibile, che influenza fondamentalmente tutte le attività della società odierna e che si prevede continuerà nel prossimo futuro. Una parte importante e fondamentale dello sviluppo sostenibile sembra essere l'impegno a fare un uso corretto e deliberato delle risorse disponibili, ad esempio combinando il riutilizzo dei prodotti, il riciclo dei materiali e il recupero dell'energia. In questo ambito, i materiali polimerici hanno un ruolo importante da svolgere, ad esempio per quanto riguarda la riduzione dell'uso di plastiche sintetiche e la loro sostituzione con bioplastiche, l'aumento e il miglioramento dei mezzi per il riciclaggio delle plastiche senza perdere le proprietà funzionali dei materiali e la promozione del riutilizzo multiplo dei prodotti in plastica. I limiti di tutte queste ambizioni possono essere discussi da una prospettiva scientifica.	Apr-Jun 2024	EN

C.14	CEBHyME	Organ-on-Chip: a potential alternative to traditional animal testing	**8**	**Prof. Francesco Lo Presti** *(University of Palermo)* *Contact email: francesco.lopresti@unipa.it*	Otto candidati farmaci su nove che entrano nella fase di sperimentazione clinica falliscono, principalmente a causa della scarsa sicurezza ed efficacia. Questo è dovuto al basso valore predittivo dei modelli animali utilizzati nello sviluppo dei farmaci. Sebbene esistano metodi tradizionali di analisi *in vitro*, questi non offrono la complessità necessaria per imitare i processi fisiologici olistici che si verificano nel corpo umano, in particolare le interazioni organo-organo. Pertanto, sono necessari metodi predittivi più avanzati per studiare l'efficacia dei farmaci nella fase preclinica. I recenti sviluppi nei modelli dinamici *Organ-on-Chip* (OoC) sono molto promettenti. Un OoC si basa sullo sviluppo di una coltura di uno o più sistemi cellulari in una piccola camera o bioreattore irrorato con un flusso laminare di terreni di coltura, in grado di fornire livelli adeguati di nutrienti e di stress di taglio. Questo corso breve offre una panoramica dei sistemi disponibili e viene discusso il difficile percorso verso un sistema pienamente convalidato.	5- 6 February 2024	EN
C.15	CEBHyME	Green hydrogen production, storage and end uses across the energy system	**9**	**Prof. Rosalinda Inguanta** **Dr. Roberto Luigi Oliveri** *(University of Palermo)* *Contact email: rosalinda.inguanta@unipa.it*	Scopo del corso è di fornire le informazioni di base sui metodi di produzione di idrogeno, con particolare attenzione all'idrogeno verde, e sui principali metodi di storage. Saranno inoltre discussi alcuni casi studio di microgrid e isole energetiche con accoppiamenti fonti rinnovabili-idrogeno. Il corso sarà suddiviso in tre sessioni: due (6 ore) di didattica frontale e una (3 ore) di attività pratica in laboratorio.	June 2024	EN
C.16	CEBHyME	Microalgal biotechnology: from reactor design to industrial applications	**6**	**Dr. Serena Lima** *(University of Palermo)* *Contact email: serena.lima@unipa.it*	Le microalghe sono microorganismi fotosintetici di grande interesse processistico. Esse sono in grado di crescere rapidamente fissando la CO2 e di produrre un'ampia gamma di composti ad alto valore aggiunto che sono ampiamente sfruttati nell'industria cosmetica, nutraceutica e alimentare. Inoltre, la biomassa microalgale presenta alti contenuti di oli che possono essere sfruttati come combustibile. L'obiettivo del Corso è di fornire una visione approfondita delle possibili applicazioni della	March 2024	EN

					biomassa microalgale affrontandone la diversità, le potenzialità di sfruttamento e le modalità di coltivazione. Inoltre, ci si soffermerà sul reactor design e su specifici esempi di processi che interessano le microalghe.		
C.17	CEBHyME	Project Planning	**8**	**Prof. Gianluca Li Puma** *(University of Palermo)* *Contact email: gianluca.lipuma@unipa.it*	This short module gives the basic elements on how to design a project including: Project network diagram; Critical path analysis; Project flexibility using floats and slacks; Resource loading histogram; Project uncertainty; Minimum cost of Expediting; and Overall project optimisation.	26/02-08/03 2024	EN
C.18	CEBHyME	Preparation and submission of a manuscript to a high impact journal	**6**	**Prof. Gianluca Li Puma** *(University of Palermo)* *Contact email: gianluca.lipuma@unipa.it*	This short module gives key skills on the preparation of high-quality manuscripts for publication in high-impact, international peer-review journals, including: How to structure and write an impactful research article, the Title, an effective and succinct Abstract, how to structure the Introduction, the Material and Methods, the Results and Discussion, the Conclusions and the References sections. It also comprises the article submission procedure, the peer-review process and post publication tips to increase the visibility and impact of the published article.	26/02-08/03 2024	EN
C.19	CEBHyME	Advanced Reaction Engineering	**14**	**Prof. Gianluca Li Puma** *(University of Palermo)* *Contact email: gianluca.lipuma@unipa.it*	The emphasis of this module is on computer aided design and modeling of chemical reactors. The module includes: Review of Mole Balances, Rate Laws and Stoichiometry. The Chemical Reaction Engineering Algorithm for reactor design. Isothermal and non-isothermal reactions. Multiple reactions in PFR, PBR and CSTR. Non-ideal reactor design and computer aided reactor design and modeling.	13/05-31/05 2024	EN
Proponent PhD programme: Energy							
E.1	Energy	Technologies for smart grids	8	**Prof. Gaetano Zizzo** **Dr. Giuseppe Sciumè**	The course will present various technologies for smart grids, among which: Vehicle-to-X, IoT applications to buildings and grids, BAC and TBM	02/2024	EN

				(University of Palermo) *Contact email: gaetano.zizzo@unipa.it*	systems, energy blockchain, Renewable Energy Communities.		
E.2	Energy	Inductive Power Transfer Systems for EV charging– Part 1	6	**Dr. Filippo Pellitteri** **Dr. Nicola Campagna** *(University of Palermo)* *Contact email: filippo.pellitteri@unipa.it*	The class will cover: - State of the art on the wireless charging - Resonant Inductive Power Transfer Systems - Coils design and simulation through Matlab/Simulink - Compensation topologies - Bifurcation phenomenon	03/2025	EN
E.3	Energy	Multilevel power converters: Part 1	6	**Prof. Antonino Oscar Di Tommaso** **Dr. Giuseppe Schettino** *(University of Palermo)* *Contact email: antoninooscar.ditommaso@unipa.it*	Multilevel Power Inverters represent an innovative and promising technology in the power conversion field. They are gradually finding applications both in the field of energy transmission and distribution, and in the field of electric drives, thanks to their improved performance, if compared with traditional inverter. The course covers the following topics: - state of the art of multilevel power converters; - applications fields; - topology structures; - mathematical model and implementation;	07/2024	EN
E.4	Energy	E-mobility: energy scenarios	8	**Dr. Massimo Caruso** **Dr. Claudio Nevoloso** *(University of Palermo)* *Contact email: massimo.caruso16@unipa.it*	The class introduces the e-mobility concept and deals with the electric automotive market development, the evolution of EV charging systems and the concept of vehicle-to-grid.	06/2024	EN
E.5	Energy	Sustainable energy systems based on the	9	**Dr. Pietro Catrini**	The course will provide an overview of methods for the assessment of the rational use of energy and the	09-10/2026	EN

		rational uses of energy sources and the integration of solar-concentrating technologies – Part I and II		**Dr. Stefania Guarino** *(University of Palermo)* *Contact email: pietro.catrini@unipa.it*	promotion of energy-saving measures in real systems. Moreover, the course will focus on fundamentals, modeling, optimization, and innovative applications of solar concentrators for renewable energy generation.		
E.6	Energy	Energy modelling and sustainability assessment of Positive Energy Districts	9	**Dr. Francesco Guarino** *(University of Palermo)* *Contact email: francesco.guarino@unipa.it*	The class will be based on the concept of Positive Energy Districts with a specific focus on the available definitions and the their scientific implications, technical feasibility as well as a description of the most effective technologies to be used in different geographical contexts. Fundamentals of positive energydistricts energy modeling will follow with general considerations as well as applications to specific tools packages. Lastly, the sustainability perspective (including environmental, economics and social) of Positive Energy Districts performance assessment will be investigated. This part of the class deals with energy modelling and sustainability assessment of PEDs.	06/2024	EN
E.7	Energy	Building energy Efficiency	10	**Prof. Jan Kosny** *(University of Massachusetts Lowell)* *Contact email: jan_kosny@uml.edu*	The course will deliver basics of buildings energy efficiency, thermal design of buildings envelope, buildings thermal mass and thermal storage, thermal insulation and integration of buildings with the power grid.	09/2026	EN
E.8	Energy	Energy storage for grid support	6	**Prof. Rosario Miceli** *(University of Palermo)* *Contact email: rosario.miceli@unipa.it*	The class will be focused on simulation studies in Matlab/Simulink framework of the following topics: implementation of simulation models of energy storage and implementation of simulation models of power converters stage for grid interface.	03/2024	EN
E.9	Energy	Inductive Power Transfer Systems for EV charging– Part 2	6	**Dr. Filippo Pellitteri** **Dr. Nicola Campagna**	The class will cover:- Dynamic wireless charging - Energy management and supervision strategies - Foreign Object Detection algorithms	06/2024	EN

				(University of Palermo) *Contact email: filippo.pellitteri@unipa.it*			
E.10	Energy	Data Acquisition Lab	8	**Prof. Valentina Cosentino** **Dr. Giovanni Artale** *(University of Palermo)* *Contact email: valentina.cosentino@unipa.it*	The course will present advanced applications of Labview.	05/2024	EN
E.11	Energy	Multilevel power converters: Part 2	6	**Prof. Antonino Oscar Di Tommaso** **Dr. Giuseppe Schettino** *(University of Palermo)* *Contact email: antoninooscar.ditommaso@unipa.it*	The part 2 of the course on multilevel power inverters will cover: - modulation techniques; - innovative modulation algorithms; - impact of multilevel power converters in electrical drive applications	07/2025	EN
E.12	Energy	Definitions, fundamentals and technologies of Positive Energy Districts	6	**Dr. Francesco Guarino** *(University of Palermo)* *Contact email: francesco.guarino@unipa.it*	The class will be based on the concept of Positive Energy Districts with a specific focus on the available definitions and the their scientific implications, technical feasibility as well as a description of the most effective technologies to be used in different geographical contexts. Fundamentals of positive energy districts energy modeling will follow with general considerations as well as applications to specific tools packages. Lastly, the sustainability perspective (including environmental, economics and social) of PositiveEnergy Districts performance assessment will be investigated. This part of the class deals with definitions, fundamentals and technologies of PEDs.	03/2024	EN

E.13	Energy	Steady-state analysis and cosimulation of multi carrier energy networks	8	**Dr. Rossano Musca** *(University of Palermo)* *Contact email: rossano.musca@unipa.it*	The course will focus on algorithms and tools for performing steady-state analysis and cosimulation of multi carrier energy networks and hubs. Part of the course will be based on the development of suitable models in Neplan and Simulink.	11-12/2025	EN
E.14	Energy	New challenges in HVDC systems	8	**Prof. Pietro Romano** **Dr. Antonino Imburgia** **Dr Giuseppe Rizzo** *(University of Palermo)* *Contact email: pietro.romano@unipa.it*	The aim of the course is to present the salient characteristics that future high-voltage DC connections will have to possess in relation to the use of new materials for the construction of cables and accessories and the use of new technologies for monitoring the operating state. The most modern technologies for detecting the main causes of cable ageing, such as partial discharge and space charge, will be presented.	09/2024	EN
E.15	Energy	Matlab and Arduino laboratory for solving electrical circuits	8	**Prof. Guido Ala** **Prof. Fabio Viola** **Dr. Giuseppe Schettino** *(University of Palermo)* *Contact email: fabio.viola@unipa.it*	The course is based on the use of advanced systems such as Matlab and Arduino for the solution of electrical problems. The objectives are multiple: 1) learn how to use a virtual lab like simscape / simulink 2) The course uses the Matlab grader platform to define innovative methods of self-assessment and management of tasks in the classroom 3) The arduino laboratory aims to start the first basic knowledge on the programming of microcontrollers for diagnostics on systems and machines	12/2024	EN
E.16	Energy	Engineering challenges of Nuclear Fusion Reactor	8	**Prof. Pietro Alessandro Di Maio** **Dr. Pierluigi Chiovaro** *(University of Palermo)* *Contact email: pietroalessandro.dimaio@unipa.it*	Fundamentals of nuclear fusion reactors based on closed magnetic confinement systems for the conversion of nuclear fusion energy into electric energy to be delivered to the grid Overview of the main reactors components and systems (plasma facing components, blanket, divertor, magnets, vessel) and survey of the most critical engineering challenges in the their design and operation	01/2025	EN

E.17	Energy	Energy transition and decarbonization	5	**Prof.ssa Sonia Longo** *(University of Palermo)* *Contact email: sonia.longo@unipa.it*	Research activities and policy goals and actions on energy transition and decarbonization. Background and fundamentals on the energy transition, the definition of decarbonization and circular strategies, tools for measuring effective reduction of GHGs emissions with a specific policy/action.	06/2025	EN
E.18	Energy	Electric Powertrain: Structure and Design	7	**Dr. Massimo Caruso** **Dr. Claudio Nevoloso** *(University of Palermo)* *Contact email: massimo.caruso16@unipa.it*	The course covers the following topics:a) Introduction to electric powertrain b) Electric motors in the automotive field c) power electronic converters for automotive d) storage systems for automotive e) The design phase	02/2025	EN
E.19	Energy	Optimization of energy systems	8	**Dr. Francesco Montana** *(University of Palermo)* *Contact email: francesco.montana@unipa.it*	The course will provide an overview of optimization algorithms with a specific focus on energy applications. The first part of the course will be focused on a brief theoretical background on main concepts – convex and non-convex problems, duality, linearity, simplex algorithm, genetic algorithms, simulation-based optimization, single and multi-objective optimization, optimal planning. The second part of the course will be based on many examples and exercises performed on the following platforms: MS Excel, MATLAB, MOBO. The exercises will concern the following topics: renewable energies, building energy demand, microgrids and distributed energy resources.	01/2026	EN
E.20	Energy	Energy Performance Certification of Buildings	6	**Prof. Giuseppina Ciulla** *(University of Palermo)* *Contact email: giuseppina.ciulla@unipa.it*	The course aims to provide, with reference to the legislation in force in Italy, all the tools necessary for the analysis of energy performance of buildings. Tools, procedures, methodologies and practical examples will be described.	02/2026	EN