

## Catalogue of the doctoral courses and seminars offered by the Department of Engineering (DI) Academic Year 2022/203

To register to the courses, please visit our webpage <https://www.unipa.it/dipartimenti/ingegneria/servizi-ai-dottorandi/offerta-formativa-2023/>

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](mailto:lidia.drago@unipa.it)).

**Proponent PhD programme: Advances in modeling, health-monitoring, infrastructures, geomatics, geotechnics, hazards, engineering structures, transportation (AimHighest)**

Code	Title of the Course	Course Coordinator/ Lecturer(s)	Coordinator's contact	Number of hours	Scheduled for (month/year)	Short description	Language
A_1	Corso breve su Elementi di Matlab per l'ingegneria	Dr. A. Di Matteo	alberto.dimatteo@unipa.it	16	Jan/Feb 2023 <i>remote mode</i>	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	
A_2	The transition from linear to circular economy. A new approach to manage resources and process in the civil engineering	Prof. G. Di Mino	gaetano.dimino@unipa.it	8	Jan 2023	The course is aimed at providing a training mainly based on the construction management which is a sector directly and strongly involved in the Ecological Transition, with particular reference to an innovative management of material and waste flows. The course offers a conceptual and technical instrumentation aimed at the transformation of the organizational and economic models of construction companies, as well as the adoption of suitable procedures, also in light of the new regulations introduced through the implementation of recent European directives on the subject.	ENGLISH
A_3	Building your reputation through research products: Planning, Drafting, Revising, Publishing and Disseminating your scientific papers	Prof. D. Lo Presti	davide.lopresti@unipa.it	8	From April to June 2023	The creative writing course introduces doctoral students to the issues involved in setting up a scientific article, organising it into paragraphs, presenting and discussing the results in relation to the open questions that technical scientific literature presents in connection with the research problem described and addressed.	ENGLISH
A_4	Big data analytics using Python	Dr. E. La Malfa Ribolla	emma.lamalfaribolla@unipa.it	8	June 2023	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 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.	
A_5	Applicazioni Geomatiche attraverso software di gestione open source	Dr. G. Dardanelli	gino.dardanelli@unipa.it	18-24	Feb 2023	Il corso si propone di fornire ai dottorandi del Dipartimento di Ingegneria degli strumenti operativi riguardanti il trattamento, l'analisi, la gestione di dati provenienti da stazioni totali, ricevitori GPS, livelli digitali.	ITALIANO

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						Le principali abilità acquisite nel corso saranno: capacità di applicare software geomatici per risolvere semplici problemi di poligonazione, livellazioni, dati GPS in statico ed NRTK, elaborazione dei risultati e loro interpretazione, determinazione degli elaborati finali.	
A_6	Il calcolo differenziale stocastico	Prof. M. Di Paola	mario.dipaola@unipa.it	8	Apr/May 2023	Obiettivo di questo corso è quello di fornire un'introduzione ai metodi del calcolo stocastico, con particolare riferimento al calcolo alla Ito. Partendo dalle definizioni e risultati fondamentali della teoria dei processi stocastici, con particolare riferimento alla classe dei processi di Markov, e quindi al processo di Wiener, il dottorando viene guidato alla formulazione di sistemi di equazioni differenziali stocastiche basandosi sul calcolo integrale alla Ito. Di particolare interesse è l'analisi delle soluzioni di sistemi di equazioni differenziali alla Ito ed ai legami con le equazioni alle derivate parziali. Particolare attenzione è data alle applicazioni alla Finanza, alla Biologia ed alla Ingegneria.	ITALIANO
A_7	Phase Field Models and Configurational Forces in Solid Mechanics	Prof. G. Giambanco	giuseppe.giambanco@unipa.it	8	Sept/Nov 2023	The phase field approach in the last decades has emerged as an efficient theoretical and computational tool to describe micro-structural changes and evolutions in solid materials. In particular it has been successfully applied to describe dynamic interfaces which separate two different materials or which appear due to mechanical phenomena such as strain localization and fracture. The approach will be presented in a thermodynamic consistent manner defining the free energy function which depends on an ordering parameter (the phase field variable) and the weak form of the general equilibrium state is derived in a variational form. Simple analytical applications will be developed for the case of fracture evolution in quasi-brittle materials and the numerical implementation in the framework of the finite element method will be introduced.	ENGLISH
A_8	Thermography	Prof. A. Maltese	antonino.maltese@unipa.it	22	November 2022	The course aims to provide PhD students of the Engineering Department with the theoretical and operational tools for the processing and analysis of thermographic data. The theoretical bases of thermography, the normative prescriptions, and the thermographic inspection methods will be exposed. Indoor thermographic inspection exercises will be carried out with a handheld camera and outdoor acquisitions with a drone equipped with a thermographic camera. The thermographic data will be processed with dedicated and open source software.	ENGLISH
A_9	Gis-based analysis	Dr. G. D'Orso	gabriele.dorso@unipa.it	12-16	Dec 2022/Jan 2023	The course aims to provide PhD students with knowledge about Geographic Information Systems (GIS), which are versatile tools used to conduct spatial analyses covering many areas of interest in the Civil Engineering sector. During the course, case studies will be presented, and students will use QGIS, one of the most widely used free and open-source GIS packages, for managing, collecting, mapping, or analyzing spatial data. This short course will allow participants to know how to conduct some spatial analyses with this software, highlighting its potential and limitations as a tool to support decisions in planning and design processes. The course will be covered by four lectures on: 1) Introduction to GIS fundamentals with QGIS. 2) Mapping Census data and analysis of territorial spatial phenomena. 3) GIS in transportation planning: building routable networks, traffic assignment, and route planning. 4) GIS-based accessibility analysis and risk assessment  L'obiettivo del corso è quello di presentare agli allievi uno strumento versatile ed utilizzabile per effettuare analisi spaziali	ENGLISH/ ITALIANO

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						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 software, evidenziandone le potenzialità e i limiti come mezzo di supporto alle decisioni nei processi progettuali e pianificatori. Gli argomenti delle lezioni includono: Introduzione ai Sistemi Informativi Geografici e al software QGIS; Analisi territoriali e demografiche con QGIS ; Costruzione di reti navigabili e operazioni di routing di reti ;Analisi di accessibilità e analisi di rischio.	
A_10	I modelli di microsimulazione del traffico in AIMSUN Next/Microscopic traffic simulation models in AIMSUN NEXT	Prof. M. L. Tumminello	marialuisa.tumminello01@unipa.it	12-16	Sept/Oct 2023	Il corso è orientato all'uso dei modelli di micro-simulazione del traffico e in particolare alla costruzione in Aimsun Next di un caso studio relativo a una rete e all'analisi dei risultati in termini di operatività e sicurezza. Gli argomenti includono: i modelli per la simulazione dei flussi di traffico (i modelli macroscopici, microscopici e mesoscopici); i modelli microscopici (car following, lane changing e gap-acceptance model); i parametri dei modelli microscopici per le prestazioni operative e di sicurezza; sviluppo di un caso studio inerente alla costruzione di un modello di rete in Aimsun Next costituito da intersezioni semaforizzate e a regolazione rotatoria; costruzione del modello in 3D (cenni); analisi di sensibilità e calibrazione dei parametri; simulazione e analisi dei risultati.	ITALIANO
A_11	Ottimizzazione topologico strutturale di componenti mediante tecnologie di manifattura additiva	Dr. E. Bologna	emanuela.bologna@unipa.it	12-16	June /July 2023	Il corso si propone di presentare le tecnologie di additive manufacturing ad oggi più diffuse per metalli e polimeri finalizzato alla ricerca di soluzioni ottimizzate. Verranno illustrati i sistemi di ultima generazione e le principali differenze, con un Focus sulle potenzialità nelle diverse applicazioni ingegneristiche. Inoltre, verrà messa in luce la potenzialità di utilizzare questa nuova tecnica di produzione ingegnerizzando le strutture grazie all'ottimizzazione topologica. In particolare grazie all'uso di nuovi algoritmi di generazione delle strutture a lattice utilizzate dal gruppo di ricerca per l'ottimizzazione dei componenti realizzati mediante manifattura additiva.	ITALIANO
A_12	Advanced tools for structural identification	Prof. C. Masnata	chiara.masnata@unipa.it	12-16	Jan 27 to Feb 24, 2023	The course will be covered by lectures on: fundamentals of experimental dynamics; Fourier analysis and modern testing techniques for structural systems; numerical examples and applications; vibration Control. A final workshop will concern an application on the identification of modal parameters.	ENGLISH
A_13	Nonconservative problems of dynamic stability	Prof. M. Zingales	massimiliano.zingales@unipa.it	12	May 2023	The course will be covered by five lectures on: fundamentals of system stability under conservative loads; stability of discrete and continuous systems under conservative and non-conservative loads; introduction to the effect of damping; stability analysis via Lyapunov direct method I; stability analysis via Lyapunov direct method II.	ENGLISH
A_14	Modern strategies of seismic vulnerability mitigation and seismic design of structures	Prof. L. Cavaleri	liborio.cavaleri@unipa.it	8	June to Sept 2023	The aim of this short course is to show as the design philosophy of structures, and consequently the standard codes, has modified changing structural response to seismic loads. The last century is covered showing the increasing of the attention to seismic actions and the improvement of the structures and their characteristics up to the modern strategies of seismic prevention based on isolation and dissipation energy. Attention is focused on masonry and reinforced concrete structures that include over the 90% of the structures in Italy trying to capture the lessons of the last earthquakes and the developments of scientific research.	ENGLISH
A_15	Modellazione agli elementi finiti di opere e	Prof. M. Rosone	marco.rosone@unipa.it	12-16	March/April 2023	L'obiettivo di questo corso è quello di introdurre i partecipanti all'utilizzo di Plaxis,	ITALIANO

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	sistemi geotecnici mediante Plaxis					un codice di calcolo agli elementi finiti che consente di eseguire analisi di deformazioni e analisi di stabilità nell'ambito di molteplici applicazioni ingegneristiche. Durante il corso verranno evidenziate le potenzialità della modellazione numerica agli elementi finiti, ponendo particolare attenzione alla calibrazione dei modelli costitutivi e alla individuazione delle strategie più idonee per modellare i problemi analizzati durante il corso.	

**PhD programme proponent: Chemical, environmental, biomedical, hydraulic and materials engineering**

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C_1	Preparation and characterization of (bio)polymer-based micro- and nanostructured systems	<b>Prof. R.Scaffaro</b> <b>Dr E.Fortunato Gulino</b>	roberto.scaffaro@unipa.it	18	Feb/Mar 2023	<p>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.</p> <p>The aim of the course is to provide a basic knowledge of the latest advances in the field of (bio)polymer-based micro- and nanostructured systems. Recently, the science and technology of (bio)polymer-based micro/nano-composites is emerging as one of the most impactful research areas, especially due to the increasing demand for advanced materials. Therefore, the main fabrication and characterization methods of composite materials will be introduced and discussed, together with the construction of a generic map of process-structure-property relationships, useful to design multifunctional materials for advanced applications, including water/air treatment, sensors, biomedicine, drug delivery, energy storage/conversion.</p>	ENGLISH
C_2	Nanoscience & nanomaterials: pushing the boundaries of technology	<b>Prof. C.Dispenza</b> <b>Dr. E.Muscolino</b>	clelia.dispenza@unipa.it	8	Feb 2023	<p>Il corso mira a fornire un'introduzione alle nanoscienze e alle nanotecnologie, spiegando perché i materiali di dimensioni nanometriche hanno proprietà sorprendentemente diverse dai loro analoghi macroscopici e come questi materiali, in virtù delle loro "speciali" proprietà, possano contribuire a trovare importanti applicazioni in svariati settori, da quello dei materiali strutturali ad elevate performance, a quello dell'elettronica e della sensoristica, così come in medicina per la prevenzione, diagnosi e cura delle malattie o per la rigenerazione dei tessuti.</p> <p>The course aims to provide an introduction to nanoscience and nanotechnology, explaining why nanoscale materials have properties that are strikingly different from their</p>	ENGLISH

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						macroscopic analogues and how these materials, by virtue of their 'special' properties, can contribute to finding important applications in a variety of fields, from high-performance structural materials to electronics and sensor technology, as well as in medicine for the prevention, diagnosis and treatment of diseases or for tissue regeneration.	
C_3	Critical issues and new perspectives in environmental remediation technologies	Prof. G.Viviani Prof. M.Torregrossa Prof. G.Mannina Prof. A.Cosenza Prof. S.F.Corsino Prof. D.Di Trapani	gaspare.viviani@unipa.it	10	July 2023	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.  The course presents the main critical issues that have emerged in recent years in the field of established technologies for environmental protection and the new proposals that can be implemented to ensure the achievement of eco-sustainable recovery objectives.	ENGLISH
C_4	Peculiar hydro-morphodynamic processes in rivers	Prof. ssa D.Termini	donatella.termini@unipa.it	8	July 2023	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 evolutivi influenzano fortemente l'habitat del sistema fluviale e le aree limitrofe.  The aim of the course is to provide the basic information to understand the main processes of evolution in natural rivers. The morphological evolution of rivers occurs as a result of "spontaneous adaptation" processes that occur due to natural (such as those induced by climate change) and/or anthropogenic actions. Different and complex forms can be generated in rivers depending on the kinematic characteristics of the flow and induced erosion/deposition phenomena. The different scenarios that occur during the evolutionary processes strongly influence the habitat of the river system and the surrounding areas	ENGLISH
C_5	Eulerian numerical methods for computational fluid dynamics	Prof. T.Tucciarelli Prof.ssa C. Aricò	tullio.tucciarelli@unipa.it	10	June 2023	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 un'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.  Partial differential equations provide the functional relationship between the state	ENGLISH

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						<p>variables of fluids in almost all real-world environments. Given initial and boundary conditions, a solution discretized in space and time can be found using Eulerian methods, where the state variables are calculated at a finite number of points fixed in time.</p> <p>The short course will offer an introduction to some traditional and advanced methods for their solution.</p> <p>Continuous Galerkin, discontinuous Petrov-Galerkin and mixed hybrid finite element methods will be presented and applied to unstructured 2D and 3D triangular grids. The required properties of the computational mesh will be discussed, along with the Delaunay definition and the extended Delaunay property.</p> <p>The MAST-RT0 methodology for solving the Navier-Stokes equations in 2D and 3D problems within complex domains will be presented; application to synthetic proofs and comparison with experimental results will be shown.</p>	
C_6.	Salinity Gradient Power: Fundamentals, main technologies and applications	<b>Ing. Alessandro Tamburini</b> <b>Prof. G.Micale</b> <b>Prof. A.Cipollina</b>	alessandro.tamburini@unipa.it	8	21 Feb 2023 22 Feb 2023 23 Feb 2023	<p>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 la relativa quantità effettivamente recuperabile.</p> <p>The aim of the course is to enable PhD students to have a first contact with this new form of renewable energy and related technologies. More specifically, the lectures will be divided into three main topics: (i) Fundamentals of Salinity Gradient Power, (ii) Main SGP technologies with focus on Reverse Electrodialysis, (iii) Applications and Perspectives. The course will help students learn the thermodynamics beyond SGP and the fundamentals of technologies that can exploit it, master the basics of relevant transport phenomena, and make simple calculations to estimate the theoretical energy available in a specific scenario and the amount that can actually be recovered.</p>	ENGLISH
C_7.	Neural Network for Machine Learning: Introduction to Artificial Neural Network, design and implementation in Matlab	<b>Prof. D.Pumo</b>	dario.pumo@unipa.it	8	July 2023	<p>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 e i vantaggi di questo approccio di modellazione.</p>	ENGLISH

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						Artificial neural network (ANN) is a branch of artificial intelligence that seeks to mimic the human brain's ability to rapidly process incoming information in a simplified manner and to learn from experience. Specifically, ANNs are biologically inspired computing systems that perform various tasks (e.g. signal processing, pattern recognition, regression, classification, clustering, prediction, etc.). ANNs are mature, flexible and powerful non-linear data-based models that have been successfully applied to solve complex tasks in science and engineering. The aim of the course is to provide the foundations for the design and implementation of ANNs (using MATLAB software), showing the potential and advantages of this modelling approach.	
C_8	Combined processing for the preparation of biopolymeric porous structures for biomedical applications	Dr F.Lo Presti	francesco.lopresti01@unipa.it	18	April 2023	<p>Il corso introduce ai biopolimeri porosi, che stanno ricevendo un crescente interesse in diversi campi tecnologicamente avanzati, compresi i dispositivi biomedicali. 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.</p> <p>This course introduces porous biopolymers, which are receiving increasing interest in several technologically advanced fields, including biomedical devices. In this context, interface tissue engineering (ITE) is a rapidly developing field that aims to produce devices designed to repair or regenerate diseased or damaged areas at the interface of different tissue types. This course will illustrate the development of tailor-made bio-inspired porous devices with mechanical properties similar to natural tissues by combining different processing approaches.</p>	ENGLISH
C_9	Theory and practice of electrochemical impedance spectroscopy	Prof. ssa M.Santamaria Dr. F.Di Franco Dr. A. Zaffora	monica.santamaria@unipa.it	10	17 July 2023 18 July 2023 19 July 2023	<p>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:</p> <ol style="list-style-type: none"> <li>1) Background (Variabili complesse, Equazioni differenziali, Statistica, Circuiti elettrici, Elettrochimica);</li> <li>2) Considerazioni Sperimentali (Strumentazione Elettrochimica, Disegno Sperimentale)</li> <li>3) Modelli di processo (analoghi di circuiti equivalenti, modelli cinetici, impedenza di diffusione, dispersione a tempo costante, funzioni di trasferimento generalizzate).</li> </ol> <p>Il corso prevede sia lezioni frontali che sessioni numeriche e pratiche.</p> <p>This course will introduce electrochemical impedance spectroscopy (EIS) and its application to the study of electrochemical and non-electrochemical processes. Details on the correct method of data acquisition and analysis will be discussed. The main contents are as follows:</p> <ol style="list-style-type: none"> <li>1) Background (Complex variables, Differential equations, Statistics, Electrical circuits, Electrochemistry);</li> <li>2) Experimental Considerations (Electrochemical Instrumentation, Experimental Design)</li> </ol>	ENGLISH

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						3) Process Models (Equivalent Circuit Analogues, Kinetic Models, Diffusion Impedance, Constant Time Dispersion, Generalised Transfer Functions). The course includes both lectures and numerical and practical sessions.	
C_10	Sensor and Biosensors	Prof. ssa R.Inguanta Dr. B.Patella	rosalinda.inguanta@unipa.it	8	Jun 2023	<p>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.</p> <p>The aim of this short course is to provide the basics for understanding the operating principles of the main types of sensors and to take a look at the development of research in this field. Case studies on sensors for food analysis, for the analysis of environmental pollutants (in water, soil) and for the identification of biomarkers useful for the early diagnosis of specific diseases, such as neurodegenerative and respiratory diseases, will also be presented and discussed. Six hours will be devoted to frontal teaching and two hours will be spent in laboratory practice on a special sensor.</p>	ENGLISH
C_11	Water depollution by Advanced Oxidation Technologies	Prof. V. Loddo	vittorio.loddo@unipa.it	10	July 2023	<p>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.</p> <p>This course presents water treatment using advanced oxidation processes (AOP) based on chemical and photochemical reactions. The most commonly used processes are described, and for each of them the main reaction mechanisms, principles, advantages, disadvantages, performance, by-product formation, coupling with other technologies and applications to water and wastewater depollution will be analysed, reporting the main results of studies published in the relevant literature.</p>	ENGLISH
C_12	Radiation science and safety	Prof. M. Jonsson (KTH – Sweden)	matsj@kth.se	10	27-29 June 2023	<p>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, per il monitoraggio ambientale, il trattamento dei materiali, la medicina nucleare e radiologia. Verranno inoltre discussi gli ambienti in cui la resistenza alle radiazioni ionizzanti è un criterio fondamentale di progettazione (es. industria nucleare, materiali per missioni spaziali). Il corso include elementi base di radiation safety.</p> <p>This course will provide a basic understanding of the interaction between ionising radiation and matter, provide an</p>	ENGLISH



Code	Title of the Course	Course Coordinator/ Lecturer(s)	Coordinator's contact	Number of hours	Scheduled for (month/year)	Short description	Language
						overview of the applications of radiation science in industrial processes, environmental monitoring, materials processing, nuclear medicine and radiology. Environments where resistance to ionising radiation is a design criterion (e.g. nuclear industry, materials for space missions) will also be discussed. The course includes also basic elements of radiation safety.	
C_13	Polymeric materials and resource efficiency	Prof. G. Lo Re (Chalmers – Sweden)	giadal@chalmers.se	10	6 April 2023 20 April 2023 4 May 2023 18 May 2023 8 June 2023	<p>Premessa e obiettivo: è in corso una discussione sullo sviluppo ecologicamente sostenibile, che influenza fondamentale tutte le attività della società odierna e futura. Una parte importante e fondamentale dello sviluppo sostenibile sembra essere l'impegno a fare un uso corretto 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.</p> <p>Background and objective: there is an ongoing discussion on ecologically sustainable development, which fundamentally influences all activities in society today and in the future. An important and fundamental part of sustainable development seems to be the commitment to make proper use of available resources, e.g. by combining product reuse, material recycling and energy recovery. Here, polymeric materials have an important role to play, e.g. in reducing the use of synthetic plastics and replacing them with bioplastics, increasing and improving the means of recycling plastics without losing the functional properties of the materials, and promoting the multiple re-use of plastic products. The limits of all these ambitions can be discussed from a scientific perspective.</p>	ENGLISH

### Proponent PhD programme: Energy

Code	Title of the Course	Course Coordinator/ Lecturer(s)	Coordinator's contact	Number of hours	Scheduled for (month/year)	Short description	Language
E_1	Inductive Power Transfer Systems for EV charging– Part 1	Dr. F. Pellitteri Dr. N. Campagna	filippo.pellitteri@unipa.it	6	Mar 2023	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	ENGLISH
E_2	Energy storage for grid support – Part 1	Prof. R. Miceli Dr. V. Castiglia	rosario.miceli@unipa.it	6	April 2023	The class will cover: - the state of the art on the energy storage technologies and power converters solutions for grid applications. - the services that the energy storage can provide for grid and residential applications - aspects related to the energy management of a grid-connected system	ENGLISH
E_3	Multilevel power converters: Part 1	Prof. A. O. Di Tommaso Dr. G.Schettino	antoninooscar.ditomma so@unipa.it	6	July 2023	Multilevel Power Inverters represent an innovative and promising technology in the power conversion field. They are gradually finding applications both in the field of	ENGLISH

						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;	
E_4	Positive Energy Districts: Towards a holistic approach to modeling and performance assessment - Part 1: Definitions, fundamentals and technologies of Positive Energy Districts	Dr. F. Guarino	francesco.guarino@unipa.it	6	Feb 023	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 Positive Energy Districts performance assessment will be investigated. This part of the class deals with definitions, fundamentals and technologies of PEDs.	ENGLISH
E_5	E-mobility: energy scenarios	Dr. M. Caruso Dr. C. Nevoloso	massimo.caruso16@unipa.it	8	June 2023	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.	ENGLISH
E_6	New challenges in HVDC systems	Prof. P. Romano Dr. A. Imburgia	pietro.romano@unipa.it	8	Nov 2023	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.	ENGLISH
E_7	Positive Energy Districts: Towards a holistic approach to modeling and performance assessment - Part 2: Energy modelling and sustainability assessment of Positive Energy Districts	Dr. F. Guarino	francesco.guarino@unipa.it	9	June 2024	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 Positive Energy Districts performance assessment will be investigated. This part of the class deals with energy modelling and sustainability assessment of PEDs.	ENGLISH
E_8	Electric Powertrain: Structure and Design	Dr. M. Caruso Dr. C. Nevoloso	massimo.caruso16@unipa.it	7	Feb 2025	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	ENGLISH
E_9	Energy storage for grid support – Part 2	Prof. R.Miceli Dr. V.Castiglia	rosario.miceli@unipa.it	6	Mar 2024	The class will be focused on simulation studies in Matlab/Simulink of the topics discussed in Part 1: - implementation of energy storage models, - implementation of power converters stage for grid interface	ENGLISH
E_10	Inductive Power Transfer Systems for EV charging– Part 2	Dr. F. Pellitteri Dr. N. Campagna	filippo.pellitteri@unipa.it	6	April 2024	The class will cover: - Dynamic wireless charging - Energy management and supervision strategies - Foreign Object Detection algorithms	ENGLISH
E_11	Multilevel power converters: Part 2	Prof. A. O. Di Tommaso Dr. G. Schettino	antoninooscar.ditommaso@unipa.it	6	July 2024	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	ENGLISH
E_12	Engineering challenges of Nuclear Fusion Reactor	Prof. P. A. Di Maio Dr. P.Chiovaro	pietroalessandro.dimaio@unipa.it	8	Jan 2025	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	ENGLISH

						components, blanket, divertor, magnets, vessel) and survey of the most critical engineering challenges in the their design and operation	
E_13	Energy transition and decarbonization	<b>Prof. ssa S.Longo</b>	sonia.longo@unipa.it	5	June 2025	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.	ENGLISH
E_14	Matlab and Arduino laboratory for solving electrical circuits	<b>Prof. G. Ala</b> <b>Prof. F. Viola</b> <b>Dr. G. Schettino</b>	fabio.viola@unipa.it	8	Nov 2024	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	ENGLISH
E_15	Sustainable energy systems based on the rational uses of energy sources and the integration of solar-concentrating technologies – Part I and II	<b>Dr. P. Catrini</b> <b>Dr. S. Guarino</b>	pietro.catrini@unipa.it	9	Sept-Oct 2023	The course will provide an overview of methods for the assessment of the rational use of energy and the 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.	ENGLISH
E_16	Data Acquisition Lab	<b>Prof. ssa V.Cosentino</b> <b>Dr. G. Artale</b>	valentina.cosentino@unipa.it	8	May 2024	The course will present advanced applications of Labview.	ENGLISH
E_17	Thermal Storage and building energy efficiency	<b>Prof. J. Kosny</b>	kosnyjan@gmail.com	12	May 2023	The course will give insight on thermal storage (technologies, applications, etc.) and on criteria for enhancing energy efficiency in buildings.	ENGLISH
E_18	Technologies for smart grids	<b>Prof. G. Zizzo</b> <b>Dr. G.Sciumè</b>	gaetano.zizzo@unipa.it	8	Feb 2025	The course will present various technologies for smart grids, among which: Vehicle-to-X, IoT applications to buildings and grids, BAC and TBM systems, energy blockchain.	ENGLISH

### Proponent PhD programme: Information and communication technologies

Code	Title of the Course	Course Coordinator/ Lecturer(s)	Coordinator's contact	Number of hours	Scheduled for (month/year)	Short description	Language
I_1.	Mathematical tools for signal representation and optimization: Beyond Fourier transforms	<b>Prof. F. Bagarello</b>	fabio.bagarello@unipa.it	16	18 April - 31 May	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	ENGLISH
I_2.	Mathematical tools for signal representation and optimization: Variational analysis and optimization	<b>Prof.ssa A. Nastasi</b>	antonella.nastasi@unipa.it	12	7 Feb 2023 14 Feb 2023 21 Feb 2023 28 Feb 2023	This course will cover the following aspects: 1. Introduction to calculus of variations. Integral functionals. 2. Energy functionals. Optimization problems. Eulero-Lagrange equations. 3. Direct methods of the calculus of variations. 4. Critical point theory. Compactness conditions and Mountain Pass Theorem. 5. Examples and open problem	ENGLISH
I_3	Biomedical signal analysis: heart rate variability assessment	<b>Prof. R. Pernice</b>	riccardo.pernice@unipa.it	10	17 Jan 2023 (08-11) 20 Jan 2023 (08-10) 30 Jan 2023 (15-17) 08 Feb 2023 (15-18)	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.	ENGLISH
I_4	Biomedical signal analysis: Reconstructing Complex System	<b>Prof. Y. Antonacci</b>	yuri.antonacci@unipa.it	10	18 Sept 2023 (10-13) 25 Sept 2023 (10-13)	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	ENGLISH

	Dynamics from Time Series Analysis				2 Oct 2023 (9-13)	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.	
I_5	Fundamentals of Big Data	<b>Prof.ssa S. Ester Rombo</b>	simonaester.rombo@unipa.it	10	June 2023	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 implementation: MapReduce, Apache Hadoop, Apache Spark	ENGLISH
I_6	Code optimization for resource-constrained devices	<b>Prof. P. Ferraro</b>	pierluca.ferraro@unipa.it	10	07 Nov 2022: 15-18 09 Nov 2022: 14-18 16 Nov 2022: 15-18 <b>Completed</b>	This 10-hour course will cover formal approaches for designing compilers of programming languages for systems with limited computational capabilities. Topics covered in the course will include formal techniques for the design of efficient lexers and parsers, and will discuss in depth the use of specialized tools to support the code optimization.	ENGLISH
I_7	Numerical simulations and applications: Finite element analysis	<b>Prof. A. Tognazzi</b>	andrea.tognazzi@unipa.it	20	5 June h 9:00-11:00 9 June h 9:00-12:00 12 June h 9:00-12:00 14 June h 9:00-12:00 16 June h 9:00-12:00 19 June h 9:00-12:00 23 June h 9:00-12:00	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.	ENGLISH
I_8	Numerical simulations and applications: Labview	<b>Prof.ssa V. Cosentino</b>	valentina.cosentino@unipa.it	15	12 Dec 2022, 14:30-18:30 13 Dec 2022, 14:30-18:30 14 Dec 2022, 14:30-18:00 15 Dec 2022, 14:30-18:00	The course introduces to LabVIEW programming. Covered topics are listed below. 1. Programming environment and basic functions: Front panel, block diagram, control palette, function palette, tool palette, status toolbar. Main commands; wirings; debug tools; basic functions, Express VIs, Standard VIs. 2. Main data structures: data types, arrays, clusters. 3. Main Execution Structures: While Loop, For Loop, Case structure. 4. Main functions for signal simulation, acquisition and processing: Waveforms and Express palettes, graphs, file I/O.	ENGLISH
I_9	Electronics for the Space: Mm-wave and THz technology	<b>Prof. A. Busacca</b> <b>Prof. S. Stivala</b>	alessandro.busacca@unipa.it	10	Feb 2024	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	ENGLISH
I_10	Emerging network technologies	<b>Prof. ssa I. Tinnirello,</b> <b>Prof. D. Croce</b> <b>Prof. S. Mangione</b>	ilenia.tinnirello@unipa.it	20	14-25 Nov 2022	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	ENGLISH

						methodologies for zero-touch beyond-5g networks and quantum information.	
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**Proponent PhD programme: Mechanical, manufacturing, management and aerospace Innovation**

Code	Title of the Course	Course Coordinator/ Lecturer	Coordinator's contact	Number of hours	Scheduled for (month/year)	Short description	Language
M_1	Computational Modelling of Composite and Heterogeneous Materials	<b>Prof. I. Benedetti</b> <b>Prof. A. Milazzo</b>	ivano.benedetti@unipa.it	8	May 2023	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 prospective applications will be discussed. Applications to low- and high-cycle fatigue, hydrogen embrittlement, multifunctional materials will be discussed.	ENGLISH
M_2	Probability	<b>Prof. A. Lombardo</b>	alberto.lombardo@unipa.it	9	Recorded lessons available upon request	Probability. Series/parallel systems. Bayes theorem. Discrete random variables: bernoullian, binomial, Poisson, ipergeometric. Continuous random variables: exponential, gamma, normal, lognormal, Weibull, multivariate normal	ENGLISH
M_3	Statistical Laboratory	<b>Prof. A. Lombardo</b>	alberto.lombardo@unipa.it	19	Recorded lessons available upon request	Statistical inference. Hypothesis tests. Parametric and non-parametric tests. Comparison between samples. Blocks. Statistical dependence: association, analysis of variance, randomized blocks, simple and multiple regression, stepwise regression, orthogonal design, general linear model, analysis of residuals, transformation	ENGLISH
M_4	Introduction to causal analysis	<b>Dr. S. Marcantonio</b>	salvatore.marcantonio@unipa.it	8	May/Jun 2023	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. Theoretical arguments will be shown along with exercises and software presentation.	ENGLISH
M_5	Crowdsourcing last mile delivery operations: New business models for the interconnected supply chain	<b>Prof. G. Aiello</b>	giuseppe.aiello03@unipa.it	8	Oct 2023	The advent of e-commerce is drastically changing the market scenario in logistic and freight transportation systems, and the segment of fast and cheap parcel delivery services has substantially increased in the last 20 years compared to Courier and Express deliveries. Two tier distribution systems have recently become popular with the proliferation of Single Day Delivery (SDD) for the business to consumer (B2C) e-commerce market. Such systems are based on lightweight electric vehicles (e.g. cargo-bikes, drones, etc.) and their design and management requires new approaches and methodologies. In addition, the advent crowdshipping is a game changer in the scenario of delivery services, and new business models are being developed for the interconnected supply chain.	ENGLISH
M_6	Retail 4.0 New technologies and methodologies for frontend and backend services	<b>Prof. G. Aiello</b>	giuseppe.aiello03@unipa.it	16	Mar 2023	With the spread of e-commerce, physical retail is nowadays undergoing a structural crisis, and the general opinion is that the survival of the retail industry in the next 10 years will be strictly related to its capability of introducing new models and technologies. The course offers a complete landscape of the new technologies and methodologies for improving the effectiveness of backend and frontend processes. In particular, the course addresses the topics of advanced	ENGLISH

						analytics for demand forecasting and inventory management based on Point of Sale (POS) data, as well as machine learning techniques for activity recognition and self-checkout systems. Practical examples from real cases will also be presented.	
<b>M_7</b>	Fundamentals of Life Cycle Engineering techniques	<b>Prof. G. Ingarao</b>	giuseppe.ingarao@unipa.it	8	May 2023	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 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.	ENGLISH
<b>M_8</b>	Additive Manufacturing	<b>Prof. T. Ingrassia</b> <b>Prof. G. Buffa</b>	tommaso.ingrassia@unipa.it	8	Sept 2023	Additive manufacturing (AM), also known as 3D printing, is an emerging technique for direct conversion of 3D computer aided designs into physical objects using a variety of approaches. AM technologies are flexible processes that allow for the creation of very complex and customizable 3D objects in just a few process steps. This course will give an overview of available processes, explain their underlying physical principles, present practical examples from actual industry projects, as well as discuss current research. In particular, the course topics will include: AM process fundamentals, material properties, design rules, cost and value analysis, industrial and consumer applications of AM. Emphasis will be placed on AM technologies for metals and other advanced materials as well as related process design principles in terms of the effects of the main process parameters on the final products quality.	ENGLISH
<b>M_9</b>	Non-Destructive Evaluation for Industry 4.0	<b>Prof. C. Mineo</b>	carmelo.mineo01@unipa.it	8	13-16 April 2023 2 h/day	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.	ENGLISH
<b>M_10</b>	Research Methods	<b>Prof. G. Battista Dagnino</b>	g.dagnino@lumsa.it	8	Jun 2023	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.	ENGLISH
<b>M_11</b>	Multi-sided platform business models	<b>Prof. P. Roma</b>	paolo.roma@unipa.it	8	Nov 2023	The PhD course will provide an overview of the logic of multi-sided platforms and their business models. 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	ENGLISH

						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_12	Open Innovation and Open Business Model	Prof.ssa E. Mazzola	erica.mazzola@unipa.it	8	July 2023	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.	ENGLISH
M_13	Sailing Tomorrow	Prof. A. Mancuso	antonio.mancuso@unipa.it	8	1 Feb 2023 3 Feb 2023	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 concerned. Will be show how the integration of CAD, FEM and CFD software allows designer to reach the final result in a faster way.	ENGLISH
M_14	Computer Modeling of Cardiovascular Problems	Prof. S. Pasta	salvatore.pasta@unipa.it	8	July 2023	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.	ENGLISH
M_15	Corporate Venture Capital: how corporate deals with innovative startups	Prof. G. Perrone	giovanni.perrone@unipa.it	8	July 2023	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 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	ENGLISH

						trajectories for further research contribution on this topic.	
<b>M_16</b>	Concept of measurement and related qualification in terms of uncertainty in engineering processes	<b>Prof. F. Scardulla</b>	francesco.scardulla@unipa.it	8	12 June 2023 23 June 2023	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.	ENGLISH
<b>M_17</b>	Innovation in measurements: from the concept of the device to the design of a business model	<b>Prof. F. Scardulla</b>	francesco.scardulla@unipa.it	8	17 April 2023 28 April 2023	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 startup 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, investments options, how to properly write a patent. The last lesson will be devoted to a practical pitch session.	ENGLISH
<b>M_18</b>	Sustainable Logistics and Transportation	<b>Prof.ssa S. Mancini</b>	simona.mancini@unipa.it	16	17 Jan 2023 20 Jan 2023	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.	ENGLISH
<b>M_19</b>	<b>Advanced Mathematical Modeling for complex decision problems</b>	<b>Prof.ssa S. Mancini</b>	simona.mancini@unipa.it	20	7 Feb 2023 10 Feb 2023	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 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.	ENGLISH



M_20	Multivariate Statistical Analysis	Prof. Giulia Marcon	giulia.marcon@unipa.it	14	7 feb 2023 09:00 - 13:00 8 feb 23 09:00 - 13:00 9 feb 23 09:00 - 13:00 10 feb 23 09:00 - 13:00	Multivariate statistical techniques are important tools in many application fields because they allow to describe and model the multivariate relationships among data. This course introduces the student to the most widespread un-supervised methods of multivariate analysis such as factor analysis, principal component analysis and cluster analysis. During the course both the theoretical and mathematical aspects as well as the application and interpretation of the results will be addressed.	ENGLISH
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