DIPARTIMENTO DI INGEGNERIA

UNIVERSITÀ DI PALERMO – CICLO XLI (41°)

SYLLABUS DEI CORSI

PHD IN ENERGY

Code	Program Involved	Title of the Course	N° hours	CFU	*Lecturer(s)*	Brief Synopsis	Tentative period	Language
E1	Energy	**Technologies for smart grids**	8	1	*Giuseppe Sciumè* *(University of Palermo)* *contact email:* *giuseppe.sciume01@unipa.it*	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, Renewable Energy Communities.	01/2026 - 01/2027	EN
E2	Energy	**Inductive Power Transfer Systems for EV charging**	6	1	*Filippo Pellitteri* *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 - Dynamic wireless charging - Energy management and supervision strategies - Foreign Object Detection algorithms	03/2026 - 03/2027	EN
E3	Energy	**Multilevel power converters: Part 1**	6	1	*Antonino Oscar Di Tommaso* *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;	07/2026 - 07/2027	EN

E4	Energy	**Multilevel power converters: Part 2**	6	1	*Antonino Oscar Di Tommaso* *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	07/2026	EN
E5	Energy	**E-mobility: energy scenarios**	8	1	*Massimo Caruso* *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.	06/2026 – 06/2027	EN
E6	Energy	**Advancing Sustainable Energy Systems through Efficient Resource Use and Monitoring of Their Operation**	6	1	*Pietro Catrini* *(University of Palermo)* *contact email:* *pietro.catrini@unipa.it*	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	09/2026 – 09/2027	EN
E7	Energy	**Solar energy systems and data analytics: technologies, data-driven modeling, forecasting, and predictive diagnostics**	6	1	*Stefania Guarino* *(University of Palermo)* *contact email:* *stefania.guarino@unipa.it*	This course explores the intersection of solar energy technologies and advanced data analytics, highlighting how data-driven approaches can optimize performance, forecasting, and maintenance of solar systems. The session begins with a broad perspective on renewables in the energy transition, focusing on solar energy's unique characteristics—from irradiance variability to performance metrics—and key technologies like photovoltaics (PV), concentrated solar power (CSP), and solar thermal systems. The discussion then shifts to cutting-edge applications, blending experimental research with computational modeling. Case studies include solar thermal asphalt systems (experimental heat harvesting), bifacial PV in agrivoltaics (Python-based yield simulations), and time-series forecasting (using tools like Prophet) paired with anomaly detection for technical and weather-related disruptions. For CSP dish-Stirling systems, the course covers experimental validation, hybrid analytical-neural modeling, and techno-economic optimization, emphasizing sustainability trade-offs. Throughout, the focus remains on transforming raw data into useful information for predictive maintenance, energy yield optimization, or system design.	10/2026 – 03/2027	EN

E8	Energy	**Energy modelling and sustainability assessment of Positive Energy Districts**	9	1	*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 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.	06/2026	EN
E9	Energy	**Passive building envelope systems for climate change resilience**	5	1	*Giorgia Peri (University of Palermo) contact email: giorgia.peri@unipa.it*	The course aims to address the following aspects: • Energy efficiency and thermal comfort; • Climate Change and extreme metereological events; • Retrofit of buildings with regard to energy effciency and thermal comfort in the light of climate change and extreme metereological events taking place; Contribution made by the use of green roofs and cool roofs to climate change resilience.	12/2026 – 12/2027	EN
E10	Energy	**Innovative Applications of Heat Pumps in Renewable Energy Systems**	6	1	*Maurizio La Villetta (University of Palermo) contact email: maurizio.lavilletta@unipa.it*	The course will provide an overview of the main procedures for designing air conditioning systems based on air-to-water heat pumps. The course will start on defining the current diffusion of heat pumps considering the regulatory framework in Europe and Italy. The course will analyse the classification of heat pumps based on operating principles, thermodynamic cycles and performance indicators for innovative Renewable Energy Systems. Also, the potential benefits of Demand Response using heat pumps and thermal energy storage in buildings will be analysed by considering the thermal comfort of the occupants using a dynamic simulation model.	11/2026 - 11/2027	EN

E11	Energy	**Computational FluidDynamics of Conjugate Heat Transfer Problems**	12	2	*Andrea Quartararo* *(University of Palermo)* *contact email:* *andrea.quartararo@unipa.it*	The class will cover: • General description of conjugate heat transfer problems. • Simulation workflow for conjugate heat transfer problems with finite-volume numerical codes. Practical application on high heat flux heat sink components.	02/2026 – 02/2027	EN
E12	Energy	**Data Acquisition Lab**	8	1	*Giovanni Artale* *(University of Palermo)* *contact email:* *giovanni.artale@unipa.it*	The course will present advanced applications of Labview.	05/2026 – 05/2027	EN
E13	Energy	**Definitions, fundamentals and technologies of Positive Energy Districts**	6	1	*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 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.	03/2026 – 03/2027	EN
E14	Energy	**Advanced dynamics of electric power systems**	8	1	*Rossano Musca* *(University of Palermo)* *contact email:* *rossano.musca@unipa.it*	The course focuses on advanced algorithms and software tools for dynamic simulations of electric systems. The course includes the development of simulation models in Neplan and Simscape Electrical of Matlab/Simulink.	10/2026 – 12/2026	EN
E15	Energy	**New challenges in HVDC systems**	8	1	*Pietro Romano* *(University of Palermo)* *Antonino Imburgia* *(University of Palermo)* *Giuseppe Rizzo* *(EOSS srl)* *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.	09/2026 – 09/2027	EN

E16	Energy	**Matlab and Arduino laboratory for solving electrical circuits**	8	1	*Fabio Viola* *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	12/2026 – 12/2027	EN
E17	Energy	**Engineering challenges of Nuclear Fusion Reactor**	12	2	*Pietro Alessandro Di Maio* *Gaetano Bongiovì* *(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 their design and operation	01/2026 – 01/2027	EN
E18	Energy	**Energy transition and decarbonization**	5	1	*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.	06/2026 – 06/2027	EN
E19	Energy	**Electric Powertrain: Structure and Design**	7	1	*Massimo Caruso* *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	02/2026 – 02/2027	EN
E20	Energy	**Optimization of energy systems**	12	2	*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	11/2026 – 01/2027	EN

						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.		
E21	Energy	**Energy Performance Certification of Buildings**	6	1	*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 – 02/2027	EN
E22	Energy	**Specialized software for network analysis in static and short-circuit conditions**	12	2	*Antony Vasile* *(University of Brescia)* *Contact email:* *antony.vasile@unibs.it*	Specialized software plays a crucial role in modern electrical engineering. This course will provide insight about design, analysis, and optimization of electrical networks in static conditions, with power flow simulations of complex systems and a dedicated module on safety and coordination of protections devices.	12/2026 – 12/2027	EN
E23	Energy	**Methods and tools for the assessment of indoor environmental quality**	10	2	*Marina Bonomolo* *(University of Palermo)* *Contact email:* *marina.bonomolo@unipa.it*	The class will be focused on the study of assessment of indoor environmental quality and, in particular, on methods and technologies for optimize efficient and smart systems design and for the post-occupancy evaluation. Furthermore, the course will introduce innovative methods (such as digital twin and predictive methods).	04/2026 – 04/2027	EN
E24	Energy	**Energy and environmental resilience to climate change in the built environment**	8	1	*Laura Cirrincione* *(University of Palermo)* *Contact email:* *laura.cirrincione@unipa.it*	The course will cover the following aspects: - Global, European, and national policies and regulatory frameworks regarding the concepts of sustainability and resilience in the built environment - Similarities and distinctions between the concepts of energy and environmental sustainability and resilience in the built environment - Up to date smart solutions and technologies to improve energy and environmental resilience to climate change in the built environment (indoor and outdoor) - Assessment of buildings resilience to climate change using ad hoc selected indicators - Simulative applications for the evaluation of alternative mitigation scenarios to optimize decision processes.	02/2026 – 02/2027	EN

E25	Energy	**Fundamentals of the Monte Carlo Method for engineering**	12	2	*Pierluigi Chiovaro* *(University of Palermo)* *Contact email:* *pierluigi.chiovaro@unipa.it*	The class will cover: • Elements of probability theory and statistics. • Monte Carlo integration. • Sampling from probability density functions and cumulative functions; transformations of probability density functions. • Neutron transport integral equation and random walk. Monte Carlo methods applied to the problem of thermal conduction.	01/2026 – 01/2027	EN
E26	Energy	**Thermal-hydraulic System Codes for Nuclear Power Plants**	12	2	*Eugenio Vallone* *(University of Palermo)* *Contact email:* *eugenio.vallone@unipa.it*	The course will cover the following topics: • the balance of plant of a nuclear power plant; • system codes and their role in the design and safety assessment of a nuclear power plant; • basic theory of thermal-hydraulic system codes; fundamentals of nuclear power plant modelling.	04/2026 – 04/2027	
E27	Energy	**Design and performance analysis of low-enthalpy geothermal systems**	6	1	*Alessandro Buscemi* *(University of Palermo)* *Contact email:* *alessandro.buscemi@unipa.it*	This 6-hour intensive course guides doctoral students through the key steps of designing a low-enthalpy geothermal system. Starting by tracing the undisturbed soil temperature profile, in situ and laboratory methods for determining the thermal conductivity and diffusivity of soils are then explained. The course goes on to present basic sizing criteria for vertical borehole heat exchangers using numerical models in TRNSYS, and concludes with parameters for evaluating seasonal energy performance, illustrated through a case study.	01/2026 – 06/2026	