



PhD in INGEGNERIA ELETTRICA / ELECTRICAL ENGINEERING - 39th cycle

Number of scholarship offered	1
Department	DIPARTIMENTO DI ENERGIA

Description of the PhD Programme
<p>The PhD Programme in Electrical Engineering is based on both courses and research in any field of the Electrical Engineering: from electric power systems to electrical machines, drives and automation, from basic electromagnetics to electric measurements and signal processing. Research is carried out according to the guidance provided by the research groups at both the Dipartimento di Energia (DENG) and the Dipartimento di Elettronica, Informazione e Bioingegneria (DEIB), where the PhD student will be hosted. Courses are delivered at either the Bovisa-Lambruschini or the Leonardo Politecnico Campuses.</p> <p>The Programme includes advanced training and research in the following fields:</p> <p>A) Circuits and Electromagnetics: This field is meant to provide basic knowledge of methods in electrical engineering for power applications. Students are specifically trained to develop critical ability and innovative approaches. The training method encourages the development of discussion and debating skills in a team environment. The main research and training subjects are: nonlinear networks and periodic time-variant networks; analysis methods for three-phase and multiphase systems; switching circuits; electromagnetic field equations and numerical analysis; electromagnetic compatibility</p> <p>B) Power Systems: A PhD in the field of Power Systems deals with the following subjects: electrical energy production (e.g., frequency and voltage control, protections, renewable energy sources, Dispersed Generation, Microgrids); electrical energy transmission (e.g., power system analysis, real and reactive power optimization, security and stability, integration of renewables); electricity markets (e.g., models, ancillary services, regulations); power quality and Smart Grids (e.g., harmonic distortion, active filters, UPS, interruptions and voltage dips, DC distribution), electric transportations.</p> <p>C) Electric machines and drives: This research field is strictly related to the rising demand for improved machine and converter performance, in terms of low price, efficiency, robustness, dynamic response and drive control. This need leads to device optimization and improved design</p>



and testing criteria. Moreover, a system approach is required for accurate integration of technical and economic aspects. The main subjects in this field are: new materials; novel magnetic structures; methodologies of model development for design and operating analysis; optimization procedures; finite elements code, simulation programs and environments for device study; control system definition.

D) Measurements: This research field concentrates on the fundamentals of metrology, particularly with respect to characterization of modern measurement systems based on complex digital signal processing structures. Some of the main subjects of study are: measurement methodology as it relates to power systems, including medium and high voltage systems and components, as well as both digital and analog signal processing. Methodologies and measurement systems associated with industrial automation and, in particular, microelectronic sensor applications, distributed structures and advanced methods and algorithms for maintenance-oriented diagnosis of complex systems are investigated in detail.



PhD in INGEGNERIA ELETTRICA / ELECTRICAL ENGINEERING - 39th cycle

OPEN SUBJECT Research Field: CONVERTERS, ELECTRICAL MACHINES AND DRIVES

Monthly net income of PhDscholarship (max 36 months)
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€ 1400.0

In case of a change of the welfare rates during the three-year period, the amount could be modified.

Context of the research activity	
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Motivation and objectives of the research in this field	<p>Sizing and operation modelling of static devices (transformers and electronic converters) and electromechanical components (standard and special rotating electrical machines), aimed to improve performances and energy efficiency. Design, development, control and testing of electrical drives and of machines with novel, patented configuration (*), for the energy production from renewable sources (wind, hydro). Coordinated employ and control of static and rotating components for the optimized production, control and exploitation of electric energy. Microgrids and synthetic inertia: analysis and control.</p> <p>(*) https://www.polimi.it/index.php?id=6247&sel_brevetto=3821</p>
Methods and techniques that will be developed and used to carry out the research	<p>Development of algorithms for design and operation modelling of electromagnetic, electromechanical and electronics components. Definition of control techniques and schemes to optimize the performances of electrical drives. Experimental activities for parameter identification and validation tests.</p>
Educational objectives	<p>Refinement of skills in design and optimization of components and drives. Assistance in development of models of complex electromechanical and electronic systems. Training in actively contributing to the project</p>



	team, both in academic researches and in activities with industrial partners.
Job opportunities	R&D Companies, University career.
Composition of the research group	1 Full Professors 3 Associated Professors 0 Assistant Professors 2 PhD Students
Name of the research directors	Antonino Di Gerlando

Contacts	
<p>antonino.digerlando@polimi.it phone: 02 23993722 https://www4.ceda.polimi.it/manifesti/manifesti/controller/ricerche/RicercaPerDocentiPublic.do?EVN_ELENCO_DIDATTICA=evento&lang=IT&k_doc=879&n_docente=di%20ger&tab_ricerca=2&jaf_currentWFID=main https://www.energia.polimi.it/en/energy-department/research/research-groups/converters-electrical-machines-and-drives/ https://www.energia.polimi.it/en/energy-department/laboratories/research-laboratories/converters-electrical-machines-nd-drivers/#c1818</p>	

Additional support - Financial aid per PhD student per year (gross amount)	
Housing - Foreign Students	--
Housing - Out-of-town residents (more than 80Km out of Milano)	--

Scholarship Increase for a period abroad	
Amount monthly	700.0 €
By number of months	6

Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information
<p>Educational activities: Financial aid per PhD student is available for purchase of study books and material, funding for participation in courses, summer schools, workshops and conferences, instrumentations and computer, etc. This amount is equal to 10% of the annual gross amount, for 3 years.</p> <p>Teaching assistantship: Availability of funding in recognition of supporting teaching activities by the PhD student. There are various forms of financial aid for activities of support to the teaching practice. The PhD</p>



student is encouraged to take part in these activities, within the limits allowed by the regulations.

Computer availability: individual use.

Desk availability: individual use.

Awards:

Awards will be recognized to the PhD candidate up to Euro 1700 (gross amount) per year, in case of exceptional achievements in the research project, subject to the evaluation of the research director.



PhD in INGEGNERIA ELETTRICA / ELECTRICAL ENGINEERING - 39th cycle

OPEN SUBJECT Research Field: ELECTRIC POWER CONVERSIONS AND SYSTEMS

Monthly net income of PhDscholarship (max 36 months)

€ 1400.0

In case of a change of the welfare rates during the three-year period, the amount could be modified.

Context of the research activity

Motivation and objectives of the research in this field

The research field is divided into two main categories: the first is related to automotive applications while the second one is related to renewable energies and their integration in power systems.

For the first point, the innovation in automotive are driven by developing of electric propulsion and storage systems. In this scenario the research is mainly focused in: i) studying, designing and modelling innovative power converters for traction drives and onboard electric actuators; ii) studying and modelling of storage systems optimizing their use for transportation.

For the second point, nowadays, converter-interfaced power sources (which include also electrical energy storage devices) are spreading throughout the power grids (at high, medium, and low voltage levels). Moreover, electrical drives are increasingly gaining importance, also because they foster energy efficiency.

In this context, some of the major objectives of the research activity are: (i) the modelling of static electrical energy conversion devices; (ii) the modelling of electromechanical devices (e.g., rotating machines, switches); (iii) the design of innovative control strategies to optimally exploit renewable sources, storage capabilities, and to improve load behaviour and dynamic responses; (iv) the design of optimal management strategies of the various resources making up micro-grids or portion of a power systems.

Methods and techniques that will be

The methods that will be used to perform the research



<p>developed and used to carry out the research</p>	<p>activity are based on traditional tools from mathematics, physics, circuit theory, and control theory, along with more advanced techniques such as model predictive control, stochastic programming, Monte Carlo theory, neural networks. Development of algorithms for design and operation modelling of electromagnetic, electromechanical and electronics components. Definition of control techniques and schemes to optimize the performances of electrical drives. Experimental activities for parameter identification and validation tests. Prototype design, realization and test. Microcontroller and FPGA programming for power electronics. Design and implementation of optimization algorithm for the coordinated (optimal) management of converter-interfaced power sources (including energy storage devices) with respect to different objective functions (e.g., ancillary services provision, economic benefits).</p>
<p>Educational objectives</p>	<p>Refinement of skills in design and optimization of components and drives. Assistance in development of models of complex electromechanical and electronic systems. Training in actively contributing to the project team, both in academic research and in activities with industrial partners.</p>
<p>Job opportunities</p>	<p>R&D Italian Firms, University career.</p>
<p>Composition of the research group</p>	<p>1 Full Professors 4 Associated Professors 3 Assistant Professors 8 PhD Students</p>
<p>Name of the research directors</p>	<p>Francesco Castelli Dezza, Luigi Piegari</p>

Contacts
<p>francesco.castellidezza@polimi.it phone: 02 23998455</p> <p>luigi.piegari@polimi.it phone: 02 23994125</p>

Additional support - Financial aid per PhD student per year (gross amount)



Housing - Foreign Students	1st year	2nd year	3rd year
	1500.0 € per student	1500.0 € per student	1500.0 € per student
	max number of financial aid available: 1, given in order of merit ..		
Housing - Out-of-town residents (more than 80Km out of Milano)	1st year	2nd year	3rd year
	1000.0 € per student	1000.0 € per student	1000.0 € per student
	max number of financial aid available: 1, given in order of merit ..		

Scholarship Increase for a period abroad	
Amount monthly	700.0 €
By number of months	6

Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information

Educational activities:
Financial aid per PhD student is available for purchase of study books and material, funding for participation in courses, summer schools, workshops and conferences, instrumentations and computer, etc.. This amount is equal to 10% of the annual gross amount, for 3 years.

Teaching assistantship:
Availability of funding in recognition of supporting teaching activities by the PhD student. There are various forms of financial aid for activities of support to the teaching practice. The PhD student is encouraged to take part in these activities, within the limits allowed by the regulations.

Computer availability: individual use.
Desk availability: individual use.



PhD in INGEGNERIA ELETTRICA / ELECTRICAL ENGINEERING - 39th cycle

OPEN SUBJECT Research Field: ELECTRIC POWER SYSTEMS

Monthly net income of PhDscholarship (max 36 months)

€ 1400.0

In case of a change of the welfare rates during the three-year period, the amount could be modified.

Context of the research activity

<p>Motivation and objectives of the research in this field</p>	<p>Worldwide, in this area, the research is focusing on the sustainability of generation, operation of electric systems in the presence of electricity markets and final uses of electricity. Therefore, one of the two main pillars of the research carried out at the Department of Energy in the field of power systems includes generation from RES, Dispersed Generation, Smart Grids with storage and power quality issues. In this regard, particular attention can be paid to regulatory issues and electricity markets in their relationship to the power system analysis and control, security and optimization. A second pillar deals with final uses of electricity, such as electric systems for transportation (railway, urban and subway applications), lighting systems, electro-thermal and electro-magnetic applications.</p>
<p>Methods and techniques that will be developed and used to carry out the research</p>	<p>System modelling through modern methods based on probabilistic procedures (Montecarlo-based), fuzzy logic, neural networks, genetic algorithms, chaos theory, game theory and other theory system analysis, together with traditional mathematical tools and programming, big data analysis, order reduction techniques. For some topics, lab activities (i.e., experimental approaches) for model validation and characterization are included.</p>
<p>Educational objectives</p>	<p>Prepare researchers with high scientific qualification, autonomous research ability in the Power System area: this includes specific skills in modelling of both technical</p>



	and economic issues, simulations, critical analysis and validation of results.
Job opportunities	The main opportunities are offered, typically, by R&D departments of both small and large innovative companies and manufacturers, research centres, Transmission and Distribution Operators, Regulating authorities, Generation Companies. Finally, the academia is also an option.
Composition of the research group	5 Full Professors 5 Associated Professors 4 Assistant Professors 15 PhD Students
Name of the research directors	Roberto Faranda

Contacts	
Email: Roberto.faranda@polimi.it Tel +39 02 2399 3793	
Research group: https://www.energia.polimi.it/en/energy-department/research/research-groups/electric-power-systems-group/#c1812 https://www.energia.polimi.it/en/energy-department/laboratories/research-laboratories/electric-power-system-epslab/#c2480 https://www.energia.polimi.it/en/energy-department/laboratories/research-laboratories/photovoltaicpower-quality-and-lighting-system/#c1820	

Additional support - Financial aid per PhD student per year (gross amount)	
Housing - Foreign Students	--
Housing - Out-of-town residents (more than 80Km out of Milano)	--

Scholarship Increase for a period abroad	
Amount monthly	700.0 €
By number of months	6

Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information
<p>Educational activities:</p> <p>Financial aid per PhD student is available for purchase of study books and material, funding for participation in courses, summer schools, workshops and conferences, instrumentations and computer, etc. This amount is equal to 10% of the annual gross amount, for 3 years.</p>



Teaching assistantship:

Availability of funding in recognition of supporting teaching activities by the PhD student. There are various forms of financial aid for activities of support to the teaching practice. The PhD student is encouraged to take part in these activities, within the limits allowed by the regulations.

Computer availability: individual use.

Desk availability: individual use.



PhD in INGEGNERIA ELETTRICA / ELECTRICAL ENGINEERING - 39th cycle

OPEN SUBJECT Research Field: ELECTRICAL AND ELECTRONIC MEASUREMENTS

Monthly net income of PhDscholarship (max 36 months)

€ 1400.0

In case of a change of the welfare rates during the three-year period, the amount could be modified.

Context of the research activity

Motivation and objectives of the research in this field

The research activity will be focused on, but not necessarily restricted to, the measurement of physical quantities in complex processes, with a special attention to the topic of distributed measurement systems. Smart sensors and innovative measurement architectures are considered, capable of providing reliable results by exploiting embedded measurement systems. Typical application will include sensors, transducers, optical instrumentation, measurement algorithms and architectures for monitoring and diagnostic of electrical power systems/components, smart grids and experiments in high energy physics and magnetic confined nuclear fusion.

A more recent topic in the research activity is represented by the reliability assessment. In particular, the research will be focused on system reliability (PV systems are an application) and useful life evaluation of electric and electronic components and the development of virtual sensors to improve reliability.

<http://www.deib.polimi.it/eng/research-lines/details/131>

<http://www.deib.polimi.it/eng/research-lines/details/102>

Methods and techniques that will be developed and used to carry out the research

Analog and Digital processing methods for measurement and uncertainty estimation for systems monitoring using wide distributed measurement systems and smart metering. Development of multiprocessors and dedicated data acquisition and distributed monitoring instruments. Development of smart sensors for electrical and non-electrical quantities. Study and development of optical



	instruments, based on novel measurement methods, for scientific and industrial applications.
Educational objectives	This research theme has the aim of forming a highly qualified engineer in the field of Instrumentation and Measurement, with specific skills on metrology, uncertainty estimation, signal processing, instrumentation, system diagnosis and electrical/non-electrical quantity measurements.
Job opportunities	The natural position for a PhD achieving this curriculum is any R&D position in the R&D department of instrument manufacturers, electric utilities, supervision of in-field measurements and monitoring, calibration labs and research centers both in and outside academia.
Composition of the research group	5 Full Professors 4 Associated Professors 1 Assistant Professors 5 PhD Students
Name of the research directors	Alessandro Ferrero

Contacts	
alessandro.ferrero@polimi.it Tel +39 02 23993751 https://www.deib.polimi.it/eng/people/dettagli/60662	

Additional support - Financial aid per PhD student per year (gross amount)			
	1st year	2nd year	3rd year
Housing - Foreign Students	1500.0 € per student	1500.0 € per student	1500.0 € per student
max number of financial aid available: 3, given in order of merit ..			
Housing - Out-of-town residents (more than 80Km out of Milano)	--		

Scholarship Increase for a period abroad	
Amount monthly	700.0 €
By number of months	6

Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information
Educational activities: Financial aid per PhD student is available for purchase of study books and material, funding for



Financial aid per PhD student is available for purchase of study books and material, funding for participation in courses, summer schools, workshops and conferences, instrumentations and computer, etc. This amount is equal to 10% of the annual gross amount, for 3 years.

Teaching assistantship: Availability of funding in recognition of supporting teaching activities by the PhD student. There are various forms of financial aid for activities of support to the teaching practice. The PhD student is encouraged to take part in these activities, within the limits allowed by the regulations.

Computer availability: individual use.

Desk availability: individual use.



PhD in INGEGNERIA ELETTRICA / ELECTRICAL ENGINEERING - 39th cycle

OPEN SUBJECT Research Field: ELECTRICAL ENGINEERING AND MEASUREMENTS

Monthly net income of PhDscholarship (max 36 months)
€ 1400.0
In case of a change of the welfare rates during the three-year period, the amount could be modified.

Context of the research activity	
Motivation and objectives of the research in this field	<p>The research activity in the EE area is mainly focused on the design and simulation of electrical circuits and systems, including novel approaches for analysis, design and testing of the main EM applications and devices, model based diagnosis of electrical power systems and components, optimal signal processing, wide area monitoring systems, non invasive diagnostics systems. Involved research areas include EM theory, Optimization Theory, Machine Learning and Computational intelligence techniques, Antenna Design, Wireless Sensor Networks, Electromagnetic Compatibility (EMC), advanced electromagnetic field simulation, distributed systems and device modeling, multi-physics modeling and simulation of renewable energy production systems, electrical storage systems and electrical vehicles, also in view of novel micro-grids supplying heat and electricity, to ensure secure and efficient operation also in the presence of high penetration of renewable generation. These research activities, even though pursued at the fundamental level are directly inspired and tested on real world, state of the art applications.</p>
Methods and techniques that will be developed and used to carry out the research	<p>Methods and techniques include: circuit theory, computational electromagnetics, biomimetic approaches, evolutionary algorithms and numerical techniques for the analysis of electromagnetic field for electromechanical systems, device simulation and parameters extraction, modeling of nonlinear phenomena in renewable energy systems by means of mixed approaches, digital and</p>



	optimal signal processing for non invasive diagnosis, estimation and prediction.
Educational objectives	The aim is to form a highly qualified engineer in a highly motivated and qualified research group, gaining experience, knowledge and skills in cutting edge technologies of the power generation and energy conversion field, and microgrid design and optimization with possible involvement in international and EU projects as well as in the cooperation with leading industries and R&D institutions.
Job opportunities	This research activity will qualify the candidate for future academic and research positions, as well as for a highly qualified professional career in industries or organizations operating in the energy and electrical fields, such as Aerospace, Automotive, Energy and Environment, Railways.
Composition of the research group	2 Full Professors 5 Associated Professors 2 Assistant Professors 5 PhD Students
Name of the research directors	Sonia Leva, Riccardo Zich, Gabriele D'Antona

Contacts
<p>Email: sonia.leva@polimi.it Phone: +39-022399-3709 Web-page: www.solartech.polimi.it</p> <p>Email: riccardo.zich@polimi.it Phone: +39 02 2399 4405 Web-page: https://www.energia.polimi.it/en/energy-department/research/research-groups/electrical-engineering/#c1806</p> <p>Email: gabriele.dantona@polimi.it Phone: +39 02 2399 3706 Web-page: https://www.energia.polimi.it/en/energy-department/research/research-groups/electrical-and-electronic-measuremnts/#c1808</p>

Additional support - Financial aid per PhD student per year (gross amount)



Housing - Foreign Students	--
Housing - Out-of-town residents (more than 80Km out of Milano)	--

Scholarship Increase for a period abroad	
Amount monthly	700.0 €
By number of months	6

Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information

Educational activities:

Financial aid per PhD student is available for purchase of study books and material, funding for participation in courses, summer schools, workshops and conferences, instrumentations and computer, etc. This amount is equal to 10% of the annual gross amount, for 3 years.

Teaching assistantship: Availability of funding in recognition of supporting teaching activities by the PhD student. There are various forms of financial aid for activities of support to the teaching practice. The PhD student is encouraged to take part in these activities, within the limits allowed by the regulations.

Computer availability: individual use.

Desk availability: individual use.



PhD in INGEGNERIA ELETTRICA / ELECTRICAL ENGINEERING - 39th cycle

**OPEN SUBJECT Research Field: ELECTROMAGNETIC COMPATIBILITY (EMC) AND
CIRCUIT THEORY (CT)**

Monthly net income of PhDscholarship (max 36 months)

€ 1400.0

In case of a change of the welfare rates during the three-year period, the amount could be modified.

Context of the research activity

**Motivation and objectives of the research
in this field**

Electromagnetic Compatibility (EMC)

Research activity in the field of EMC covers the following main lines: a) modeling of interference effects in complex wiring structures (i.e., field-to-wire coupling and crosstalk, conducted immunity and emissions), b) statistical techniques for EMC estimation, c) new and/or simplified experimental procedures and setups for EMC testing, d) EMC-oriented design strategies (e.g., optimized design of EMI-filters, PCB lands, IC package, and interconnects), e) EMC aspects in power electronics. The research lines are mainly related to the Aerospace, Automotive, Shipbuilding, Energy, and Railway industry sectors.

Advanced Circuit Theory (CT)

Research activity is mainly focused on the design and simulation of electrical circuits and systems. The activities are: -- advanced circuit simulation methods, -- RF circuit macro-modeling for synchronization of electrical systems, -- advanced electro-magnetic field simulation and device modeling, -- multi-physics modeling and simulation of renewable energy production systems, electrical storage systems and electrical vehicles. These research activities, even though pursued at the fundamental level, are directly inspired and tested on real world, state-of-the-art applications.



Methods and techniques that will be developed and used to carry out the research	Methods and techniques include: circuit theory and simulation, multiconductor transmission line theory, statistical techniques for EMC, measurement theory and techniques for EMC, electromagnetic modeling, modeling and simulation (at system, unit, device and component level) by means of mixed approaches, nonlinear techniques, reduced-order techniques, model-parameters extraction from measurements, etc..
Educational objectives	The aim is to form highly qualified PhD candidates in: a) Electromagnetic Compatibility, with the ability to face complex EMC/EM problems in real-life electronic and electrical systems and applications, b) numerical simulation and analysis of electrical systems and circuits.
Job opportunities	Successful fulfilment of the research programs associated with these Scholarships will provide PhD candidates with the qualifications required to seek employment in diversified industry and university sectors in the EE field, such as Aerospace, Transportation (Automotive, Aeronautics, and Railway), Energy, Environment, etc.
Composition of the research group	5 Full Professors 6 Associated Professors 4 Assistant Professors 4 PhD Students
Name of the research directors	Sergio Pignari, Angelo Brambilla

Contacts
<p>Email: sergio.pignari@polimi.it Phone: +39 02 2399 3726 Web-page: http://www.deib.polimi.it/ita/personale/dettagli/68176</p> <p>Email: angelo.brambilla@polimi.it Phone: +39 02 2399 3681 Web-page: http://www.deib.polimi.it/eng/people/details/61206</p>

Additional support - Financial aid per PhD student per year (gross amount)			
	1st year	2nd year	3rd year
Housing - Foreign Students	1500.0 € per student	1500.0 € per student	1500.0 € per student



	max number of financial aid available: 3, given in order of merit (only for students without scholarship)..
Housing - Out-of-town residents (more than 80Km out of Milano)	--

Scholarship Increase for a period abroad	
Amount monthly	700.0 €
By number of months	6

Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information
<p>Educational activities: Financial aid per PhD student is available for purchase of study books and material, funding for participation in courses, summer schools, workshops and conferences, instrumentations and computer, etc.. This amount is equal to 10% of the annual gross amount, for 3 years.</p> <p>Teaching assistantship: Availability of funding in recognition of supporting teaching activities by the PhD student. There are various forms of financial aid for activities of support to the teaching practice. The PhD student is encouraged to take part in these activities, within the limits allowed by the regulations.</p> <p><i>Computer availability:</i> individual use. <i>Desk availability:</i> individual use.</p>