PhD School - Politecnico di Milano

Regulations of the PhD Programme in:

Environmental and Infrastructure Engineering

Cycle XLI

1. General Information

PhD School	**Politecnico di Milano**
PhD Programme	**Environmental and Infrastructure Engineering**
Course start:	**12 September 2025**
Location of the PhD Programme	**Milano Leonardo**
Promoter Department	**Department of Civil and Environmental Engineering (DICA)**
Scientific Disciplinary Sectors	ICAR/01 Hydraulics ICAR/02 Hydraulic and maritime constructions and Hydrology ICAR/03 Sanitary Environmental Engineering ICAR/04 Highways, railways and airports ICAR/06 Topography and Cartography GEO/05 Applied Geology
PhD School Website	http://www.dottorato.polimi.it/en/
PhD Programme Website	https://www.dottorato.polimi.it/en/phd-programmes/engineering/environmental-and-infrastructure-engineering
Areas	**01 Water Science and Engineering** - SSD ICAR/02 (Hydraulic and maritime constructions and Hydrology) **02 Transport Infrastructures and Geosciences** - SSD ICAR/04 (Roads, railroads and airports) - SSD GEO/05 (Applied Geology) **03 Environmental and Hydraulic Engineering and Geomatics** - SSD ICAR/03 (Sanitary Environmental Engineering) - SSD ICAR/01 (Hydraulics) - SSD ICAR/06 (Topography and Cartography)

2. General presentation

The PhD in Environmental and Infrastructure Engineering is designed to train young scientist and future professionals to address the scientific and technological challenges associated with environment and infrastructures. The program is characterized by a strong inter- and multi-sectorial structure and is organized according to the following three key thematic profiles: (i) Water Science and Engineering; (ii) Transport Infrastructures and Geosciences; (iii) Environmental and Hydraulic Engineering and Geomatics.
Educational and research activities are designed to integrate (i) process identification, (ii) rigorous theoretical treatment and modelling according to increasing levels of complexity, (iii) design of ensuing applications and (iv) implications to engineering problems and scenarios. Training and research activities place PhD candidates within international networks (see also Section 8).

Area 01 - Water Science and Engineering

The main research activities of “Area 01” are centred on the field of water resources spanning from hydrology to coastal engineering. A short description of the main research branches is given in the following.

1. *Hydrology and water resources* addresses in-depth understanding of the physical processes of the hydrological cycle, which determine flood as well as drought phenomena and pollution migration. Measurement and modelling of variables active in water and energy budgets (radiation, evapotranspiration, snow mantle dynamics, hydrological losses) are carried out. In situ data as well as satellite data of the earth's surface are used to understand the processes and their representative scales. Continuous distributed water balance models are developed for simulating and monitoring

flood as well as drought processes.

2. *Hydrogeological hazard and mitigation strategies* focuses on the analysis of hydrological extremes, frequency of floods, droughts and precipitation. Probabilistic and physically based models are used together with field observation to study and reproduce rainfall fields, floods and droughts. Early warning operative systems are developed for shallow land sliding, snow avalanching and flood risk.
3. *Hydraulic networks engineering* addresses the evaluation of design variables for urban sewage and aqueducts. In particular, aqueduct efficiency, water quality and quantity in drainage networks and effects of local and diffused structures for flood and pollution controls are investigated.
4. *Coastal engineering* addresses the hydrodynamics of wave motion, marine currents, littoral dynamics and wave-structure interactions.

Area 02 - Transport Infrastructures and Geosciences

The main research topics considered as fundamental for the development of research activities concerning transport infrastructures could be summed up in four main topics, reciprocally connected to the topics related to other PhD research profiles.

1. *Transport networks*. Complex transport network modelling (both homogeneous and non-homogeneous modal networks), also considering the functional interactions with regional, national and international territory.
2. *Sustainable development*. Analysis of the complex phenomenology characterizing the dynamics of development and its relations with the infrastructure system. Interaction between tunnels and underground hydraulic systems.
3. *Technological innovation*. Analysis of methods, criteria and indicators for the performance characterization of infrastructure construction and maintenance techniques.
4. *Risk management*. Analysis and development of improvement measures concerning both the construction and management of road infrastructures, aimed at reducing risk for both workers and users. Geological risk deriving from the construction of transportation infrastructures.
5. *Applied geology*. a) analysis of the hydrogeological risk linked to the underground excavation in rocks (e.g., water inflow, piezometric drawdown); b) landslide hazard (assessment of the influence of key hydrogeological parameters, such as permeability and heterogeneity coefficient, on slope instability); c) water resources identification and management, pollution problems, also in coastal aquifers.
6. *Methods. M*odelling and decision process analysis, at a strategic, tactical and operative level, characterizing road infrastructure design, construction and management (including Project Management, Pavement Management Systems, Bridge Management Systems).

Area 03 – Environmental and Hydraulic Engineering and Geomatics

Research in **Environmental Engineering** covers the following topics:

1. Water supply technology and treatment, wastewater treatment and reuse, liquid waste treatment, recovery of energy and products from wastewater, liquid waste and sludges, advanced biological and physical-chemical water and wastewater treatment; sludge management and disposal; anaerobic biotechnologies.
2. Management and planning of environmental resources: source apportionment of pollutant loads and assessment of their effects on the receiving water bodies/environmental components; water quality modelling, scenario analysis and knowledge-based decision support systems of management alternatives.
3. Solid wastes and sludge minimization and management (composting the organic fraction of solid wastes, waste-to-energy plants, sanitary landfill, leachate treatment, hazardous waste solidification). Bioenergy from agricultural wastes and by-products.
4. Air quality assessment and control (statistical models of air quality data, source apportionment techniques, sampling and monitoring of fine and ultrafine atmospheric particles, emissions modelling for impact assessment), gaseous emissions treatment technologies (measurement/analysis of conventional and trace pollutant emissions at lab and field scale plants, evaluation of process techniques for pollutants removal).

5. Contaminated soil, sediment and groundwater: characterization, risk assessment, in-situ and on-site remediation technologies.

Research topics of **Hydraulic Engineering** include: fluid mechanics; fluid-structure interactions; hydraulic measurements; river hydraulics; hydraulic risk quantification and management; flow and transport processes in porous systems; hydraulic networks. Experimental, modeling and methodological aspects are considered. Key research areas include:

1. *Fluid mechanics*. Emphasis is devoted to the analysis of physical processes observed at various scales and their depiction in the context of appropriate interpretive models. Research and educational activities comprise analysis of advanced methodologies of computational and experimental fluid dynamics (e.g., image analysis techniques for hydraulic processes on multiple observational scales) and modeling of processes of fluid-structure interactions for environmental, civil and industrial engineering applications.
2. *River hydraulics and sediment mechanics*. The key research topics are associated with optimization of approaches and technologies for land protection. Research and educational activities include modeling of free surface flows, local and general scour processes, hyper-concentrated flows, flooding and hydraulic risk quantification and management.
3. *Flow and transport processes in porous systems*. Key research topics include: characterization of hydraulic properties from pore-scale to aquifer systems; well testing; inverse modeling / history matching / data assimilation; flow and multicomponent reactive transport process in heterogeneous media under uncertainty; multiphase flows, including oil and gas reservoir engineering; scaling of hydrogeological quantities; mixing processes in coastal aquifers; geothermal fluxes at the reservoir and basin scales. A major focus is the study of theoretical and operational bases for the assessment of hydro-geo-chemical processes governing the distribution and residence time of solutes and fluids in the subsurface. Critical applications include quantification of environmental risk associated with polluted aquifer systems and the improvement of enhanced oil recovery approaches.

Geomatics includes all disciplines dealing with positioning, global and local reference system establishment, surface surveying and reconstruction from a global scale down to the scale of the individual architectural manufact, representing data by graphical or virtual tools, archiving and cross-referencing spatial information in terms of geographic information systems. Summarizing, we can identify the following education and research topics:

1. *Physical geodesy and satellite geodesy*, including estimation and representation of the gravity field at all scales and its geophysical interpretation.
2. *Positioning, deformation estimation and navigation*, with the use of both classical and satellite techniques, such as GPS.
3. *Surface surveying with optical or other sensors*, such as SAR, LIDAR, etc., at different scales from regional down to the manufact scale.
4. *Digital photogrammetry and image analysis*, including the development of photogrammetric software for the geometrical reconstruction of surfaces and feature extraction.
5. *Remote sensing*, namely the problem of identifying, by suitable spectral analysis, specific geographic information.
6. *Geographic information systems*, with application of the most modern technology for internet GIS and mobile GIS.
7. *Cultural heritage reconstruction and archiving*, with the solution of complex problems of combination of different data into a unique data base, providing three-dimensional virtual models that preserve full geometrical and metrical information.

The PhD Programme is run by a Coordinator (see Attachment A1) and a Faculty Board (see Attachment A2). The Coordinator chairs the Faculty Board, coordinates the preparation of the annual Educational Programme and organises the general educational activities of the PhD course. The Faculty Board is responsible for the Educational programme and for teaching and administrative activities related to the PhD course.

3. Objectives

The PhD Programme is structured according to the three areas illustrated in Section 2. The PhD degree is awarded upon completion of at least three years of advanced study and research. Within these years, a minimum of 25 credits must be acquired through *PhD level courses* (see Section 6). These courses provide the knowledge required as a basis for the general framework illustrated in the PhD Programme and provide the common knowledge background to PhD candidates. Research training is provided through mentoring by the Faculty members. PhD courses will leverage on the long-standing experience and know-how in laboratory activities of the academic board members (see Section 7) as well as of PoliMI-DICA international networks. Contacts with bodies other than Universities have been established through participation to specialized seminars and refresher courses provided by experts from industry, together with short training internships for PhD candidates at highly qualified companies.

One of the distinctive skills developed during the PhD experience is the ability to transfer knowledge effectively, adapting it to different contexts, audiences, and communication occasions. This skill enables PhD graduates to work effectively in teams and disseminate their research results both within their specific community and to broader, more diverse audiences.

The PhD program aims to help candidates communicate technical information, both orally and in writing, tailored to academic or non-academic recipients. This goal is supported by courses offered by the PhD School, including Technical Communication classes. Additionally, candidates participate in activities promoting experiential learning ('learning by doing'), the typical learning method of the PhD journey.

Main elements of the programme include: (*a*) an improved preparation of candidates at the fundamental level, as required by the PhD School, with the introduction of new opportunities for candidate evaluation through written exercises and/or oral examinations, and (*b*) development of close ties with stakeholders to foster the emergence of outstanding professional skills attractive to industry.

The key activity of the entire PhD Programme is the development of the thesis/dissertation. This phase should reflect the leading and unconditioned role of research and is fully in line with the requirements and needs of authorities, public bodies and private companies. A research experience at International Research Centres and/or Universities is considered to be highly relevant for PhD candidates to complete their education and to exchange research experience and expertise.

4. Professional opportunities and job market

PhD students will be skilled in an interdisciplinary and multi-sectoral environment and will gain excellent communication, management and research skills. They will acquire a set of skills and a knowledge base that are transferable to a range of real-world ecosystem services-related problems. A PhD in Environmental and Infrastructure Engineering provides highly qualified personnel to cover key positions and roles in research centres, top level management in Public Bodies and Authorities involved in environmental policies, as well as senior consultants for engineering companies within European and international markets.

5. Enrolment

5.1 Admission requirements

Italian and International citizens can apply. They are requested to have graduated in accordance with the pre-existing laws D.M. 3.11.1999 n. 509, or to have a Master of Science degree in accordance with D.M. 3.11.1999 n. 509, or a Master of Science in accordance with D.M. 22.10.2004 n. 270, or similar academic title obtained abroad, equivalent for duration and content to the Italian title, with an overall duration of university

studies of at least five years. The certified knowledge of the English language is a requirement for admission. Please refer to the PhD School website for details.

The admission to the programs will be established according to the evaluation of the candidates' curricula, motivation letters, and an illustrative report about the development of a possible PhD research, which candidates will send contextually with their application to the admission announcement.

5.2 Admission deadlines and number of vacancies

The number of positions is indicated in the Call for admission to the 41th PhD cycle Programmes available at **https://www.dottorato.polimi.it/en/prospective-phd-candidates/calls-and-regulations**
Scholarships are available on both general and specific topics, as described in the call.

6. Contents

6.1 Requirements for the PhD title achievement

The achievement of the PhD title in Environmental and Infrastructure Engineering requires a study and research activity of at least three years equivalent of full-time study, research and development of PhD thesis.

PhD candidates in Environmental and Infrastructure Engineering must earn a minimum of 25 credits from courses (see paragraph 6.3), and continuously conduct studies and research. The Faculty Board may assign extra course credits to be achieved in case it is necessary to complete preparation in specific topics relevant to research projects.

At the beginning of the PhD activities, the Faculty Board assigns a tutor and a Supervisor to each PhD candidate to supervise and assist him/her in the overall training programme. The tutor shall be a professor belonging to the Faculty Board. The tutors assist the candidates in the choice of courses to be included in the study plan, which is submitted for approval to the Coordinator of the PhD Programme (see also section 6.4). The doctoral activity is carried out under the guidance of a Supervisor, responsible for candidate's research activity, study plan and thesis development. The Supervisor can belong to an institution other than Politecnico di Milano and can be supported by one or more co-supervisors.

Each candidate must experiment three modes of technical-scientific communication:

1. Oral presentation to experts in the field and topic, aimed at developing the ability to communicate advanced content within a limited timeframe, highlighting key aspects of the research/project and justifying methodological choices, to an audience with high evaluation skills. This experience, aimed at sharing projects among colleagues, is achieved by participating in at least one conference or workshop where research results are presented.

2. Oral presentation to stakeholders with expertise in the field but not in the specific topic, transferring contents with appropriate details in unlimited timeframes. This skill, aimed at the ability to transfer research/project content to non-expert collaborators, is gained through specific training experiences with specific goals and typical timelines of academic and corporate settings.

3. Written communication for a community of experts. This skill is aimed at the ability to organize the document content, shorter than a book or thesis but still broad in scope, with an appropriate level of technical-scientific detail. This mode, typical of internal reports or technical notes, is experienced by creating written documents addressed to a relevant scientific community such as scientific or technical articles.

Each candidate is required to participate as a speaker in at least one international conference or workshop, complete at least one training activity, and publish at least one scientific or technical contribution aimed at an expert community. Any exceptions must be justified and authorized by the Faculty Board.

6.2 Research development

The main aim of all Politecnico di Milano PhD programmes is the development in the candidates of a research-oriented mind-set, with expertise and skills in a specific research topic. To this end, candidates develop a problem-solving capability in complex contexts, including the capacity of performing deep problem analysis, identifying original solutions, and evaluating their applicability in practical contexts. These skills provide the PhD candidates with major opportunities of development in their research both in the academic field, and in public and private organisations.
PhD candidates are requested to develop an original research contribution. The PhD thesis must thus contribute to increase the knowledge in the candidate's research field. Besides, it has to be coherent with the research topics developed in the Department where the PhD Programme is carried out.

The original research results are collected in the PhD thesis, where the candidate's contribution is put in perspective with respect to the research state of the art in the specific research field. The PhD research is developed under the guidance of a supervisor, who supports the candidate in the setting-out and in the everyday activities related to the thesis development. The supervisor is not necessarily a member of the Faculty Board and may also belong to an institution different from Politecnico di Milano. The supervisor can be supported by one or more co-supervisors.

Further activities intended to develop the candidate's personal skills and research expertise are encouraged during the PhD path. Candidates must acquire the capability to present and discuss their work in their research community. Consequently, both the participation to international conferences and the publication of the research results in peer-reviewed journals are encouraged.

The PhD programme favours the candidates' research interactions with other groups in their research field, preferably abroad. Research visits of at least three months are strongly encouraged, as through them the candidates may acquire further skills to develop their research work and thesis.
The duration of the programme is normally three years.

6.3 Objectives and general framework of the teaching activities

The PhD Programmes and the PhD School activate teaching forms of different kind and credit value, including courses, seminars, project workshops, laboratories. Teaching activities both cover the basic research issues (problems, theories, methods), which represent the founding element of the PhD Programme and clearly identify its cultural position and deepen in a specialist way some research issues connected with the problems developed in the theses. Lessons are usually held in English, except when indicated otherwise.

The PhD School also provides training in soft and transferable skills, aimed at equipping candidates with competencies that are essential for diverse career paths and for meeting the evolving demands of the global job market. The list of such courses for the 2025–2026 academic year is available in Table B. Each PhD candidate must earn at least 10 of the required 25 credits through these courses.

The didactic structure is reported in the tables below, which summarize the candidate's path (as regards coursework activities). At the same time, the programme foresees that the candidates are devoted to research activity in a continuous way, following the lead of their supervisors, and of the Faculty Board. Evaluation procedures for each course are described in the “Manifesto”.

First and Second year

Courses	**ETCS (min-max)**
PhD School Courses (see Table B)	10 - 15
Courses characterising the PhD Programme (see Table A)	10 - 20
Other PhD courses, specialist courses, long-training seminars.	0 - 10

Third year

The third year is dedicated entirely to research and the development of the doctoral thesis.

PhD Course List

A) Courses characterising the PhD Programme. The PhD Programme in Environmental and Infrastructure Engineering offers a set of characterizing courses listed in **Table A**. Completion of at least 10 ECTS from this list is required for admission to the final examination. All courses are taught in English. Other courses may be activated during the year. In this case the candidates will be promptly informed and will be allowed to insert these new courses in their study plan.

B) PhD School Courses. Each year, the PhD School organizes a range of interdisciplinary and general courses. A minimum of 10 ECTS must be acquired from these offerings. The full list is available online. Selected courses are listed in **Table B**.

C) Other PhD courses, specialistic courses, log-training seminars. Up to 10 ECTS may be earned through courses offered by other PhD programmes at Politecnico di Milano or by external institutions. In the latter case, prior approval from the supervisor and the PhD Coordinator is required. The attendance of Specialist Courses, Workshops, Schools, Seminars cycles is strongly encouraged and (if these seminars, workshops are certified and evaluated) may permit to acquire credits according to the modalities established by the Faculty Board and previous approval of the study plan submitted by the candidate. These courses and workshops can also be included in the study plan, even if they are not evaluated (and therefore not qualified as credits), as optional "additional teaching".

Table A: PHD COURSES CHARACTERISING THE PHD PROGRAMME

SSD	Course name	Professor	A.Y./Semester	ETCS
ICAR/06	Monte Carlo-Markov chains statistical methods	G. VENUTI; M. REGUZZONI	Alternate years	5
ICAR/02	Modelling Extremes and Dependence in Multivariate Problems	C. DE MICHELE; G. SALVADORI; F. DURANTE	Alternate years	5
ICAR/06	Statistical and numerical methods	R. BARZAGHI; G. VENUTI	Alternate years	5
ICAR/01	Fluid mechanics	G.V. MESSA	Alternate years	5
ICAR/01	Groundwater- Modeling under uncertainty	A. GUADAGNINI; M. RIVA	Alternate years	5
ICAR/01 ICAR/07	Granular Matter: from packing to flow	D. BERZI; C. DI PRISCO	Alternate years	5
ICAR/01	Particle-laden flows: theory and engineering applications	G.V. MESSA; M. MALAVASI	Alternate years	5
ICAR/03	Machine Learning methods for engineering applications: support-tools for monitoring, modelling, and experimental design	B. CANTONI, F. TROVO'	Alternate years	5
ICAR/02	Sustainable Water and Food Security	M.C. RULLI	Alternate years	5
ICAR/02	Mountain hydrology and climate change	D. BOCCHIOLA	Alternate years	5
ICAR/02	Sea Waves and Hydropower	A. BIANCHI; G. PASSONI	Annually	5
ICAR/02	Remote Sensing and its Applications in Cryospheric Sciences	C. DE MICHELE; A.N. ARSLAN	Alternate years	5

ICAR/03	Advanced techniques for (bio)chemical reactor modelling	A. TUROLLA	Alternate years	5
ICAR/03	Statistics applied to Environmental Engineering	A. AZZELLINO	Annually	5
ICAR/04	Road material performances characterization	E. TORALDO	Alternate years	5
ICAR/06	Satellite Positioning	C. DE GAETANI	Alternate years	5
ICAR/06	Advanced Geographycal Information Systems	D. CARRION	Alternate years	5
ICAR/06	Photogrammetry and Image Analysis	L. PINTO; V. CASELLA	Alternate years	5
ICAR/06	Satellite geodesy	F. MIGLIACCIO	Alternate years	5
ICAR/06	DTM generation	R. BARZAGHI	Alternate years	5

Note: for courses with “Alternate years”, please refer to the “Manifesto” of each Academic Year

Table B SUGGESTED CROSS –SECTORAL COURSES

Professor	Course Name	ECTS
ALIVERTI ANDREA	ETHICS IN RESEARCH	5
ARMONDI SIMONETTA	STRENGTHENING CRITICAL SPATIAL THINKING	5
ARNABOLDI MICHELA	ADVANCED INTERACTION SKILLS FOR ACADEMIC PROFESSIONALS	5
BISCARI PAOLO	INDUSTRIAL SKILLS	5
BISCARI PAOLO	ENGLISH FOR ACADEMIC COMMUNICATION	5
BISCARI PAOLO	SCIENTIFIC COMMUNICATION IN ENGLISH	5
BISCARI PAOLO	RESEARCH SKILLS	5
BOBADILLA RODRIGUEZ H F	SCIENTIFIC MODELS: CONCEPTUAL FOUNDATIONS AND PHILOSOPHICAL ISSUES	5
BOERI ELISA	RECORDING WORK 4 BUILDING MEMORY: METHODS, PRACTICES, TOOLS, SKILLS TO MANAGE THE KNOWLEDGE	5
BROVELLI MARIA ANTONIA	THE COPERNICUS GREEN REVOLUTION FOR SUSTAINABLE DEVELOPMENT	5
BRUNETTO DOMENICO SAVIO	INNOVATIVE TEACHING SKILLS	5
CANINA MARIA RITA	CREATIVE DESIGN THINKING	5
CARDILLI LORENZO	EUROPEAN CULTURE	5
COLOMBO GABRIELE	RESEARCH COMMUNICATION. ISSUE MAPPING: EXPLORING PUBLIC DEBATES SURROUNDING ACADEMIC TOPICS	5
CONCI CLAUDIO	COMMUNICATION STRATEGIES THAT SCORE IN WORLDWIDE ACADEMIA	5
DI BLAS NICOLETTA	PROFESSIONAL COMMUNICATION	5
FUGGETTA ALFONSO	PROJECT MANAGEMENT BASICS	5
HESSELBEIN CHRISTOPHER L	TECHNOLOGY AND SOCIETY	5

IAROSSI MARIA POMPEIANA	POWER OF IMAGES AND VISUAL COMMUNICATION FOR RESEARCH DISSEMINATION	5
LAVAGNA MONICA	SUSTAINABILITY METRICS, LIFE CYCLE ASSESSMENT AND ENVIRONMENTAL FOOTPRINT	5
MANCINI MAURO	PROJECT MANAGEMENT (IN ACTION)	5
MASARATI PIERANGELO	ETHICAL ASPECTS OF RESEARCH ON DUAL USE TECHNOLOGIES	5
OPPIO ALESSANDRA	HOW TO SUPPORT COMPLEX DECISIONS: APPROACHES AND TOOLS	5
OSSI PAOLO MARIA	SULLA RESPONSABILITÀ DELLA TECNICA	5
PAGANONI ANNA MARIA	LA COMUNICAZIONE NELLA SCIENZA	5
PARMEGGIANI FABIO	SCIENCE, TECHNOLOGY, SOCIETY AND WIKIPEDIA	5
PIZZOCARO SILVIA LUISA	PRACTICING RESEARCH COLLABORATION	5
ROCCHI DANIELE	ETHICS OF ARTIFICIAL INTELLIGENCE	5
SANCASSANI SUSANNA	TEACHING METHODOLOGIES, STRATEGIES AND STYLES	5
SHENDRIKOVA DIANA	SCIENCE DIPLOMACY FOR RESEARCHERS. FILLING THE GAP BETWEEN SCIENCE AND POLICY WITHIN THE GLOBAL CHALLENGES	5
VOLONTE PAOLO GAETANO	INTRODUCTION TO ACADEMIC RESEARCH	5
VOLONTE PAOLO GAETANO	TECHNOLOGY AND INEQUALITY	5

6.4 PhD Agreement

During the first year of the doctoral program, the PhD candidates must sign a PhD Agreement with their Supervisor and tutor, according to the "Doctoral Agreement Manual" attached to the University PhD Regulations.

6.5 Presentation of the study plan

PhD candidates must submit a study plan, which may be revised periodically (approximately every three months), in order to adequate it to possible changes in the course list, or to needs motivated by the development of their PhD career. The study plans must be approved by the PhD programme Coordinator, according to the modalities established by the Faculty Board of the PhD Programme itself.

6.6 Yearly evaluations

Candidates present their work to the Faculty Board at least once a year. The candidates must pass an annual evaluation in order to be admitted to the following PhD year. The third-year evaluation establishes the candidate's admission to the final PhD defence.
As a result of each annual evaluation, the candidates passing the exam receive an evaluation (A/B/C/D) and may proceed with the enrolment at the following year. Candidates who do not pass the exam are qualified either as “Repeating candidate” (Er) or “not able to carry on with the PhD” (Ei). In the former case (Er), the candidates are allowed to repeat the PhD year at most once. The PhD scholarships – if any – are suspended during the repetition year. In the latter case (Ei) the candidates are excluded from the PhD programme and lose their scholarships – if any.
After the final year, candidates who have achieved sufficient results, but need more time to conclude their research work and write their theses, may obtain the admission to a further year.

6.7 PhD thesis preparation and final exam

The main objective of the PhD career is the development of an original research contribute. The PhD thesis is expected to contribute to the advance of the knowledge in the candidate's research field.
The PhD study and research work are carried out, full time, during the three years of the PhD course. Stages or study periods in National or International companies or external Institutions may complete the candidate's preparation. The resulting theses need to be coherent with the research issues developed in the Department where the PhD programme is developed. The candidate must present an original thesis, discuss its contribution to the state of the art in the research field.

The PhD research is developed following the lead of a supervisor, who supports the candidate in the setting out and in the everyday activities regarding the thesis development. At the conclusion of the PhD studies, the Faculty Board evaluates the candidates. Candidates who receive a positive evaluation submit their theses to two external reviewers for refereeing. If the evaluation provided by the reviewers is positive (or after the revisions required by the external reviewers), the candidates defend their thesis in a final exam, in front of a Committee composed of three members (at least two of which must be external experts).

Candidates will be asked to demonstrate knowledge of the Italian language, equal to at least A1 level of the Common European Framework of Reference for the knowledge of languages. This requirement will be needed in order to register for the final exam. Italian native speakers and all those who can demonstrate knowledge of the Italian language to the required level will be exempt.

7. Laboratories, PhD Secretariat Services

Laboratory Gaudenzio Fantoli

Established in 1939, it hosts activities related to Hydraulic Engineering and Water Science Engineering. It comprises areas devoted to research and educational activities. Two main floors, each covering an area of about 800 m^2, are currently devoted to laboratory activities. The Lab staff comprises 4 people. Major hydraulic facilities include:

- *Free surface flume*: a 30 m 1.0 m 0.6 m flume with adjustable floor and glass sides, a fixed floor flume with glass sides. It is provided with the tools to convert the structure into a wave flume (piston wavemaker, artificial beach, wave gauges).
- *Hydraulic channel:* a 6 m × 0.5 m × 0.5 m free surface flume designed for studying fluid-structure interaction by means of direct measurement of forces, stress distributions, displacements and velocity distributions. Image analysis techniques are employed for kinematic measurements.
- *Test plant for flow resistances*: a water flow loop, provided with flowmeter and pressure transmitters, dedicated to measure the loss coefficient and other characteristics of regulation devices (including, *e.g.* valves, resistors, connectors). The plant is also equipped with high pressure pumps.
- *Transparent pressurized duct*: specifically built for sediment transport and scour experiments with image processing measurements. The duct length is 5.8 m with a cross section 40 cm wide and 16 cm deep. In the central part of the duct is a recess section with a length of 2 m and depth of 0.5 m. The hydraulic head in the duct is imposed by a Bazin weir located in the downstream tank; the upstream tank is provided with a streamlined inlet to avoid wakes in the flow.
- *Dam-break flume*: used to investigate the dam-break wave (unsteady flow) of a hyperconcentrated mixture of water and cohesionless granular matter. It consists of a 6 m long, square section (0.5 x 0.5 m) flume of adjustable slope. Failure of the dam is simulated by means of a pneumatic rising sluice-gate (opening time t = 0.3 s). One of the side walls of the flume is made of glass in order to record of wave propagation by means of a digital camera.
- *Rotating drum*: this device is used to investigate the behavior of a steady dry granular flow over a loose bed. It consists of a cylinder (inner diameter D = 1 m and axial length W = 250 mm) half-filled with granular material, which is mounted on a pair of friction rollers and rotates around its axis at a constant angular velocity. One of the endplates of the cylinder is made of 10 mm thick glass to allow optical measurement of the flow fields through a progressive CCD scan camera.

Other site facilities include: a series of calibrated basins with a total capacity of 50 m^3, a computer centre, an electronics workshop for construction and repair of instrumentation; a mechanical workshop for the construction of experimental facilities, laboratory instrumentation for measuring most hydraulic parameters (including an automated system to detect and measure river-bed shapes), and field instrumentation to measure hydrodynamic processes. The Lab has been certified within the SQA (Quality Assurance Protocol of the Politecnico) within the context of hydraulic parameter measurements, determination of characteristic curves of hydraulic machinery and field and laboratory scale flow rate determination. The laboratory is a SIT certified Calibration Centre for measurement of liquid flow rates (range: 3-80 l/s). Finally, a total free area of 600 m^2 is available for set-up of hydraulic models. The area is served by an overhead traveling crane of 1500 kg_p and by a piping system allowing a maximum flow rate of about 600 l/s.

Laboratory of Environmental Engineering (LIA)

It hosts activities related to Environmental Technologies. It currently covers 580 m^2 and is divided into two sections: the analytical section with different working areas (wet chemistry, sample preparation, analytical instrumentation, and biology) and the pilot-plant section. The Laboratory staff comprises 3 permanent staff (2 graduates) and one temporary position (graduate). The main activities of Laboratory are: (a) sampling and determination of pollutants in different environmental matrices (water, air, soil, sludge, solid waste); (b) evaluation of remedial technologies with laboratory pilot plants; (c) planning and management of demonstrative wastewater treatment pilot plant; (d) tests of biodegradation and treatability of wastewaters by means of titration/respirometric sensors an BMP (biomethane potential); (e) tests for the characterization of sludge and digestates with CST (capillary suction time), filtration apparatus and a zetameter. Analytical instrumentation includes: electrometry, nephelometry, molecular absorption spectrophotometry, atomic absorption spectrometry, liquid chromatography (ionic and HPLC), gas-chromatography, X-ray spectrometry, polarography, voltammetry, TOC analyser, ion-coupled plasma mass Spectrometry (ICP-MS). The Laboratory is also equipped with instrumentation for sampling of liquid, solid and gaseous pollutants.
The pilot plant section is equipped with: aerobic and anaerobic instrumented bioreactors for activated sludge and fixed biomass processes, membrane bioreactors, batch reactors for contaminated soil remediation, reactors for chemical oxidation and water disinfection, biosensors for the study of microbial activity. Experimental activity through pilot-plants is frequently carried out at public institutions and private firms.

Research Laboratory on Transportation Infrastructures (InfraLab)

The Research Laboratory on Transportation Infrastructures (InfraLab) is nowadays a European leading laboratory for both university education and experimental scientific research. Regarding education activities, InfraLab, recently renewed, is equipped by a teaching room, offering to the candidates the possibility of performing several standard tests on construction materials. From the experimental research point of view, the activities of InfraLab are mainly focused on the study of new materials, methods and technologies for construction and maintenance of transportation infrastructures, at different scales, including both laboratory tests, and real scale assessments by on-site test tracks, thanks to an experimental area of 50.000 m^2 located in Carpiano (Mi). Quality controls of materials and pavements during construction and in-service infrastructures' monitoring are two other key activities of the Laboratory. InfraLab is equipped by a set of machines and apparatus for materials' characterization according to European and US standards, also including specific and performance-related tests. In this view, the Laboratory also designs and develops in-house test equipment, up to the prototype level, both independently and in collaboration with companies. Moreover, InfraLab is able to assist authorities and enterprises during the development, design, construction and maintenance of transportation infrastructures.

Laboratory of Geomatics

The recent development of the subject has fostered activities in new fields of advanced research such as spatial geodesy, navigation, photogrammetry, remote sensing, numerical cartography, Geographic Information Systems (GIS), as well as a return to the field of geophysics. These studies are conducted by the Department with the support of structures such as:
- the International Service for the Geoid, which can be considered as an IT laboratory for the gravity field
- the laboratory of Geomatics, which is partly instrumental and partly IT.

The main instruments, software and activities conducted in the laboratory are illustrated in the following.

Surveying and monitoring: GPS instruments (geodetic and low-cost receivers); Total stations and levelling instruments; UAV; measurements to monitor ground, buildings and structures; photogrammetric surveying of architectural manufacts; thematic mapping; infrastructure land registry.
Data management and interpretation: Gravimetric data interpretation; geoid determination; spatial mission analysis; GPS permanent network analysis; Statistical methods in surveying and monitoring; integration of images and maps; management of GIS data bases; evaluation of uncertainty and reliability.

Additional details are available at:
https://www.dica.polimi.it/research/research-laboratories/?lang=en
https://www.dica.polimi.it/research/interdepartmental-laboratories/?lang=en

PhD Secretariat Services

Elena Raguzzoni, Laura Mattiolo
Department of Civil and Environmental Engineering
Phone: +39 0223996504
e-mail: elena.raguzzoni@polimi.it; phd-dica@polimi.it

8. Internationalisation and intersectoriality

Carrying out study and research activities at external laboratories is strongly recommended. Politecnico di Milano supports joint PhD paths with International Institutions, as well as Joint and Double PhD programmes. Further information is available on the PhD School website and on the PhD programme website. Some agreements and collaborations with international institutions are currently active for the PhD programme in Environmental and Infrastructure Engineering, as summarized below.

- Pontificia Universidad Católica De Chile (Chile) (PhD Double Degree Agreement)
- University of Lausanne (Switzerland) (PhD Double Degree Agreement)
- The University of Arizona (USA) (Research collaboration)
- Imperial College London (UK) (Research collaboration)
- ETH Zurich (Switzerland) (Research collaboration)
- TU Delft (The Netherlands) (Research collaboration)
- Universitat Politecnica de Catalunya – Barcelonatech (Spain) (Research collaboration).

Interaction with and exposure to non-academic sectors provides significant benefits to doctoral candidates as well as to research and innovation intensive employment sectors. Direct exposure to the challenges and opportunities in non-academic sectors of the economy and society at large is fostered by networking, connectivity, inter-sectorial mobility and wide access to knowledge. In particular, the PhD programme in Environmental and Infrastructure Engineering collaborates with the following Research Agencies and/or Industrial partners:

- A2A Life Company (Research collaboration and scholarship funding)
- Acque Bresciane (Research collaboration and scholarship funding)
- Agenzia Spaziale Italiana (Italian Space Agency) (Research collaboration and scholarship funding)
- Appflue s.r.l. (Research collaboration and scholarship funding)
- Arianet s.r.l. (Research collaboration and scholarship funding)
- Autorità di bacino distrettuale del fiume Po (Research collaboration and scholarship funding)
- Banca d'Italia (Research collaboration and scholarship funding)
- Bracco Imaging S.p.A. (Research collaboration and scholarship funding)
- EBWorld (Research collaboration and scholarship funding)
- ENEL Foundation (Research collaboration and scholarship funding)
- ENI (Research collaboration)
- ERSAF – Ente Regionale Servizi all'Agricoltura e alle Foreste (Research collaboration and scholarship funding)

- European Space Agency (Research collaboration and scholarship funding)
- Geolog Technologies srl (Research collaboration and scholarship funding)
- Gruppo CAP (Research collaboration and scholarship funding)
- Lario Reti Holding (Research collaboration and scholarship funding)
- Metropolitana Milanese S.p.A. (Research collaboration)
- Pibiviesse s.r.l. (Research collaboration and scholarship funding)
- Piksel s.r.l. (Research collaboration and scholarship funding)
- Rea Dalmine S.p.A. (Research collaboration and scholarship funding)
- Regione Lombardia (Research collaboration and scholarship funding)
- RSE S.p.A. – Ricerche sul Sistema Energetico (Research collaboration and scholarship funding)
- Tecne SpA (Research collaboration and scholarship funding)
- Water Alliance, Acque di Lombardia (Research collaboration and scholarship funding)

Attachment A1 – PhD Programme Coordinator

Prof. Monica Riva - Short CV (2 pages)

Address

Dipartimento di Ingegneria Civile e Ambientale (DICA)
Politecnico di Milano
Piazza L. Da Vinci, 32 - 20133 Milano (Italy)

Communication

Tel. +39-02-2399-6214
www.mipore.polimi.it
e-mail: monica.riva@polimi.it

Born. December 13th, 1970, Lecco (Italy)

Education. Graduated in Civil Engineering (hydraulics), Polimi (1996). Doctoral Degree in Hydraulic Engineering, Polimi (2000).

ACADEMIC CAREER

2016-present Full Professor, Dept. of Civil and Environmental Engineering, Politecnico di Milano.

2013-oggi Adjunct Professor, Dept. of Hydrology and Water Resources, University of Arizona, Tucson, USA.

2011-2015 Associate Professor, Dept. of Civil and Environmental Engineering, Politecnico di Milano.

2002-2010 Researcher, Dept. of Environmental, Hydraulic, Infrastructures and Surveying Engineering, Politecnico di Milano.

1999-2002 Assistant Researcher, Dept. of Environmental, Hydraulic, Infrastructures and Surveying Engineering, Politecnico di Milano.

INTERNATIONAL AWARDS AND HONOR

2024 Elected Member of the European Academy of Sciences and Arts (Class IV - Natural Sciences).

2021 Outstanding Editor Award, *Hydrology and Earth System Sciences (HESS)*, EGU. *Citation: for particularly outstanding activities to maintain and further develop the high international standards and reputation of the journal*.

2020 Mercator Fellow, DFG, German Research Foundation, Germania.

INSTITUTIONAL ROLES

2020-present Rector's Delegate for International Networks, Politecnico di Milano, https://www.polimi.it/il-politecnico/network-internazionali.

2023-present Head of the PhD programme in Environmental and Infrastructure Engineering, Politecnico di Milano https://www.dica.polimi.it/phd/iai.

2019 - 2022 Deputy Director of the PhD programme in Environmental and Infrastructure Engineering, Politecnico di Milano.

INTERNATIONAL APPOINTMENTS AND MANAGERIAL ACTIVITIES

2024 - present President of the Advisory Assembly of the ENHANCE University Alliance - European Universities of Technology Alliance, https://enhanceuniversity.eu.

2023 - present Elected Member of the Management Board (*Secretary General*) of the international TIME network (Top International Managers in Engineering), https://timeassociation.org.

2020 - 2023 Vice-President of the General Assembly of the ENHANCE University Alliance.

2019 - present Elected Member of the Council (Board of Directors) of the *International Society for Porous Media* (InterPore), https://www.interpore.org.

2018 - present Editor of the Journal: *Encyclopedia of Geosciences*, European Geosciences Union (EGU), https://encyclopedia-of-geosciences.net.

2016 - 2020 Coordinator of the Subdivision on Subsurface Hydrology and Groundwater, EGU.

2014 - 2023 General Secretary of the Italian Chapter of InterPore.

2013, 2014 Professeur Invité all'Università di Strasburgo, Francia.

2011, 2012 Visiting Professor, Dept. of Hydrology and Water Resources, The University of Arizona, Tucson, Arizona, USA.

2010 - present Associate Editor of the Journal *Water Resources Research* (WRR), American Geophysical Union (AGU), https://agupubs.onlinelibrary.wiley.com.

2010 - 2022 Organizer and Scientific Committee Member for annual sessions on Subsurface Hydrology at the EGU General Assembly.

2008 Visiting Scientist at the CNRS/INSU, Poitiers (France). Program: HTHS, Hydrodynamic and Transfers in Hydrogeological Systems, EC2CO/MACH-1: Modeling of Heterogeneous Carbonate Aquifers.

2004 - 2009 Editor of the Journal *Reviews of Geophysics*, AGU, https://agupubs.onlinelibrary.wiley.com.

1999, 2006 Visiting Scientist at Dept. of Hydrology and Water Resources, The University of Arizona, Tucson, Arizona, USA.

RESEARCH ACTIVITY. The research activity has primarily focused (around 200 publications, including 124 in international journals and 4 book chapters listed in the Journal Citation Report) on subsurface flow and transport dynamics. The main topics addressed include stochastic inverse calibration processes, probabilistic delineation of wellhead protection zones, hydrological scaling, uncertainty quantification, multiphase flow, and groundwater management. Current main research activities include: (i) Management of groundwater resources under multiple stress factors and sources of uncertainty related to both subsurface characteristics and atmospheric agents; and (ii) Impact of groundwater availability in terms of quantity and quality on ecosystems. She is a leading scientist of the MIPORE research group of Polimi @ DICA (www.mipore.polimi.it).

RESEARCH PROJECTS. She has been PI of EU projects (e.g., Horizon2020. Project Title: "Trapping and Removal of X-ray Contrast Medium agents from water resource and stream Sediments- New Concepts in Trapping, Recycling and Management (REMEDI)". Project funded under the H2020-MSCA-ITN-2020 call; Horizon2020. Project Title: "Removal and Mitigation of Pollution from the Use of Pesticides: Prevention, Recycling and Resource Management (RECYCLE)". Progetto finanziato nella call H2020-MSCA-RISE-2019; Horizon2020. Project Title: "Furthering the Knowledge Base For Reducing the Environmental Footprint of Shale Gas Development" (FracRisk); FP7. Project Title: "Towards improved groundwater vulnerability assessment" (IMVUL), Marie Curie Initial Training Network; FP5. Project Title: "Stochastic Analysis of Well-Head Protection and Risk Assessment" (W-SAHaRA). She has coordinated the Water JPI project WE-NEED (2016-2019) "WatEr NEEDs, Availability, Quality and Sustainability", within the ERA-NET Cofund Water Works 2014. She has delivered 14 keynotes/invited talks.

TEACHING ACTIVITY. Fluid Mechanics and Groundwater. Supervisor/Co-supervisor of 20 PhD Thesis

INVITED PRESENTATION. 16 Invited presentations/Keynotes at international conferences and workshops, as well as lectures/seminars at universities and research centers in Europe, North America, and China.

MEMBERSHIPS. American Geophysical Union; European Geophysical Union; Interpore-International Society for Porous Media; National Groundwater Association; Board of Engineers (Italy).

LIST OF PUBLICATIONS: https://www.mipore.polimi.it/dt_team/monica-riva/

Attachment A2 – PhD Faculty Board

Name	Affiliation	Scientific Disciplinary Sector
Antonelli Manuela	Politecnico di Milano – DICA	ICAR/03 Sanitary Environmental Engineering
Azzellino Arianna	Politecnico di Milano – DICA	ICAR/03 Sanitary Environmental Engineering
Barzaghi Riccardo	Politecnico di Milano – DICA	ICAR/06 Topography and Cartography
Becciu Gianfranco	Politecnico di Milano – DICA	ICAR/02 Hydraulic and maritime constructions and Hydrology
Bocchiola Daniele	Politecnico di Milano – DICA	ICAR/02 Hydraulic and maritime constructions and Hydrology
Canziani Roberto (Deputy Coordinator)	Politecnico di Milano - DICA	ICAR/03 Sanitary Environmental Engineering
Corbari Chiara	Politecnico di Milano - DICA	ICAR/02 Hydraulic and maritime constructions and Hydrology
Crispino Maurizio	Politecnico di Milano - DICA	ICAR/04 Highways, railways and airports
De Michele Carlo	Politecnico di Milano - DICA	ICAR/02 Hydraulic and maritime constructions and Hydrology
De Gaetani Carlo Iapige	Politecnico di Milano - DICA	ICAR/06 Topography and Cartography
Grosso Mario	Politecnico di Milano - DICA	ICAR/03 Sanitary Environmental Engineering
Guadagnini Alberto	Politecnico di Milano - DICA	ICAR/01 Hydraulics
Lonati Giovanni	Politecnico di Milano - DICA	ICAR/03 Sanitary Environmental Engineering
Longoni Laura	Politecnico di Milano - DICA	GEO/05 Applied Geology
Malavasi Stefano	Politecnico di Milano - DICA	ICAR/01 Hydraulics
Mancini Marco	Politecnico di Milano - DICA	ICAR/02 Hydraulic and maritime constructions and Hydrology
Migliaccio Federica	Politecnico di Milano - DICA	ICAR/06 Topography and Cartography
Messa Gianandrea V	Politecnico di Milano - DICA	ICAR/01 Hydraulics
Papini Monica	Politecnico di Milano - DICA	GEO/05 Applied Geology
Radice Alessio	Politecnico di Milano - DICA	ICAR/01 Hydraulics
Ravazzani Giovanni	Politecnico di Milano - DICA	ICAR/02 Hydraulic and maritime constructions and Hydrology
Riva Monica (Coordinator)	Politecnico di Milano - DICA	ICAR/01 Hydraulics
Toraldo Emanuele	Politecnico di Milano - DICA	ICAR/04 Highways, railways and airports
Venuti Giovanna	Politecnico di Milano - DICA	ICAR/06 Topography and Cartography

Attachment A3 – PhD Advisory Board

Name	Affiliation
Sanchez-Vila Xavier	Politechnical University of Catalonia, Barcelona (SP)
Ackerer Philippe	CNRS, Strasbourg (F)
Sansalone John J.	University of Florida(USA)
Burlando Paolo	ETH Zurigo (CH)
Luca Dei Cas	ARPA Lombardia
Valentina Bisinella	Technical University of Denmark (DK)
Losa Massimo	Università di Pisa
Nico Snew	University of Stuttgart (DE)