



International PhD Program on **Strategic Engineering** at Genoa University

Organized in Joint Cooperation among Università degli Studi di Genova, Italy, École des Mines d'Alès, France, Universidad de la Rioja, Spain, Obuda University, Hungary & Carol I National Defense University, Romania



International PhD Program on Strategic Engineering

Genoa University

During the PhD, the students have:

1. to carry out research activities, related to their PhD and summarized within their **R&D Thesis**. This is the main activity and in this, the students are supervised by a Supervisor Team.
2. The research activity is assessed at least as 120/180 PhD credits.
3. to perform **Education & Training Activities** devoted to reinforce the PhD Student Foundations and Skills on the subjects required for mastering Strategic Engineering. Education & Training Activities are assessed at least as 40/180 PhD credits.

1. R&D Thesis - at least 120/180 PhD credits

R&D on Projects

Each PhD Student needs to finalize activities to support R&D Initiatives, Developments, Experimentations and related Activities acquiring skills and expertise in Development in working on Innovative Projects.

International & External Activities for PhD Students

Each PhD Student has to spend at least 12 months by working on the PhD Project with the International Partner Institutions and/or Universities.

Scientific Production

Each PhD Student is expected to produce scientific papers on his PhD Project including International Conference Papers and International Journal Papers.

2. Education & Training Activities (E&T) - at least 40/180 PhD credits

PhD students in Strategic Engineering must acquire at least 40 PhD credits in E&T Activities over the duration of their PhD, generally along first two years of the PhD.

The E&T Plan for each PhD Student have to be approved by the Advisor Team, in accordance with the following rules:

1. Compulsory E&T Courses: attendance and success in the final examinations of 5 fundamental SE courses (Appendix A) for a total of 24 PhD credits and 48 hours in total
 - *Foundations of Modelling and Design of Complex Systems*, Prof. A.G. Bruzzone, 6 PhD Credits, 8h Lecture, 4hProject Work Assignment
 - *Foundations of Mathematical Modeling & Continuous/Discrete Simulation*, Prof. R.Cianci, 6 PhD Credits, 8h Lecture, 4hProject Work Assignment



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- *Foundations of Computational Intelligence*, Prof. F.Masulli, 6 PhD Credits, 8h Lecture, 4hProject Work Assignment
- *Fundamentals of Linear programming and network optimization*, Prof. A.F.Sciomachen, 3 PhD Credits, 4h Lecture, 2hProject Work Assignment
- *Foundations of Programming for Problem Solving in Python*, Prof. C.Cerrone & A.Cabri, 3 PhD Credits, 4h Lecture, 2hProject Work Assignment

2. Other E&T activities: these are proposed by the PhD students and must weigh at least 16 PhD credits.

The Advisor Team will approve the proposed activities and their credit weighting on a case-by-case basis. The different types of recommended activities are as follows:

- Optional E&T Courses (Appendix B);
- Conference attendances;
- Paper submissions;
- Attendance at Workshops and Webinars (for instance the ones proposed here: www.simulationteam.com/strategos/schedule) or Seminars delivered by outstanding Experts;
- Summer Schools;
- Support in teaching activities;
- Bearing Internships;
- Certificates, Exercises and other Activities.

Each PhD Student under supervision of the Advisor Team will extend his PhD Project and R&D Thesis on specific Applications to support Verification, Validation of his achievements and enhancement of his E&T Plan respect real challenges and problems.

Respect specific PhD Positions (e.g. Industrial PhD, Co-Sponsored PhD, Green Initiative PhD) the PhD Students will have to satisfy the specific requirement (e.g. an internship period of R&D jointly developed with Sponsor Company)



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APPENDIX A Compulsory Courses of the E&T Plan

These courses are based on a Lecture Package including the Fundamental Concepts, Exercises & Experiences and Evaluation usually based on an Oral Discussion of a Project Work assigned to **PhD Students**. Some of these Courses are delivered over 8 hours of Lectures that could be jointly delivered to PhD Students and STRATEGOS Master Students (8 hours), Assignment of Project Work (4 hours), Project Work Activities and Final Evaluation; the Lecture Package is specifically devoted to provide foundations and are clearly scheduled by the Professor at the beginning of the Course; after the Lectures, the PhD Students meet the Professor to receive a specific assignment/exercise to be finalized within a Project Work for the final evaluation; each PhD Student should research the sources, material and references necessary to finalize successfully the Project Work, then he have to present, demonstrated and discuss it, usually during an Oral Exam, with the Professor.

PhD students who have a MSc in Strategic Engineering (e.g. STRATEGOS) could propose to the Professor to just define, develop and present the Project Work during final Oral Exam.

The Compulsory Courses for the International PhD Program in Strategic Engineering are

A1 Foundations of Modelling and Design of Complex Systems

Prof.A.G.Bruzzone, 6 PhD Credits, 8h Lecture, 4h Project Work Assignment Lectures, Project Work Definition, Project Development, Final Discussion

Description: Foundation on Complex Systems. Transfer of knowledge about Simulation Paradigms and Modeling Methodologies effective for addressing Complex Systems. Transfer of capabilities to analyze real problems and case studies corresponding to Complex Systems. Acquisition of skills in Conceptual Modeling applied to Complex Problems. Acquisition of Skills in design of Simulation Architectures and Model Development applied to Complex Systems.

A2 Foundations of Mathematical Modeling & Continuous/Discrete Simulation

Prof. R.Cianci, 6 PhD Credits, 8h Lecture, 4hProject Work Assignment Lectures, Project Work Definition, Project Development, Final Discussion

Description: The course aims to provide a presentation of the most common partial differential equations (PDE) and their solution techniques through an analysis of various applications. The emphasis is devoted to second order PDE and the understanding of the specific techniques for elliptic, parabolic and hyperbolic cases.

A3 Foundations of Computational Intelligence

Prof. F.Masulli, 6 PhD Credits, 8h Lecture, 4hProject Work Assignment Lectures, Project Work Definition, Project Development, Final Discussion

Description: Neural networks; fuzzy logic systems; evolutionary computing; swarm intelligence; neuro-fuzzy and fuzzy neural systems; hybrid intelligent systems, machine learning; classification, regression learning, clustering



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A4 Fundamentals of Linear programming and network optimization

Prof. A.F.Sciomachen, 3 PhD Credits, 4h Lecture, 2h Project Work Assignment
Lectures, Project Work Definition, Project Development, Final Discussion

Description: PhD Students have to follow the Lessons on Linear Programming to master these techniques as well as to discuss a Project Work to be finalized and discussed

A5 Foundations of Programming for Problem Solving in Python

Prof. C.Cerrone & A.Cabri, 3 PhD Credits, 4h Lecture, 2h Project Work Assignment
Lectures, Project Work Definition, Project Development, Final Discussion

Description: PhD Students have to follow the lessons on the fundamental concepts of the Course as well as to discuss a Project Work to be finalized and discussed



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APPENDIX B Optional Courses

These Courses could be selected by the PhD Students and approved by Supervision Team among the following non exhaustive list:

B1 Courses ad Hoc for the International PhD Program in Strategic Engineering

These Courses are organized based on interest and are eligible for all PhD Students that are encourage to request it to the **PhD Council** and/or Advisor Team

- *Strategic Engineering: The Closed Loop M&S, Data Analytics & AI at Work*, Prof. A.G.Bruzzone. Description: The Course presents the main Principia of Strategic Engineering as well as examples and case studies related to this innovative discipline based on the closed loop among Data Analytics, AI, M&S and Big Data from multiple real and virtual Sources
- *Discrete Event Simulation Models for Strategic Decisions*, Prof. A.F.Sciomachen. Description: The Course presents how Discrete Event Simulation could be effectively used to support Strategic Decision Making
- *Strategic Planning for Logistics and Transportations*, Prof. E.M.Cepolina. Description: Models and Methodologies to address Strategic Planning in Logistics and Transportations
- *Matheuristics in Python*, Prof. C.Cerrone. Description: The Course presents advanced use of Python to implement models and heuristic algorithms to address complex problems
- *International Law for Conflicts and Cyber Security*, Prof. S.Dominelli. Description: The Course addresses the International Law as well as up to date advances in this sector with special attention to Crisis, Armed Conflicts and Cyber Security/Defense.
- *Geomatics & Strategic Decision Makers*, Prof. I.Ferrando. Description: The Course provides foundations of Geomatics with special attention to Strategic Decisions
- *Game Theory and Case Studies*: Prof.Lucia Pusillo. The Course provides foundations of Game Theories and Applied Examples

B2 Courses derived from STRATEGOS

Just **PhD Students** that don't have completed these following courses within **STRATEGOS MSc** could take these selections; therefore, these courses are based on a Lecture Package including the Fundamental Concepts, Exercises & Experiences and Evaluation usually based on an Oral Discussion of a Project Work assigned to **PhD Students**. Some of these Courses are delivered over 8 hours of Lectures that could be jointly delivered to **PhD Students** and **STRATEGOS Master Students** (8 hours), Assignment of Project Work (4 hours), Project Work Activities



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and Final Evaluation; the Lecture Package is specifically devoted to provide foundations and are clearly scheduled by the **Professor** at the beginning of the **Course**; after the Lectures, the **PhD Students** meet the **Professor** to receive a specific assignment/exercise to be finalized within a Project Work for the final evaluation; each **PhD Student** should research the sources, material and references necessary to finalize successfully the Project Work, then he have to present, demonstrated and discuss it, usually during an Oral Exam, with the **Professor**.

- *Foundations of Computer Games and Simulation*, Prof. de A. Gloria, F. De Rosa. The course covers the elements of programming for videogames. Students will learn the basics of both 2D and 3D programming along with the techniques used by the newest CAD tools for videogame design. After an introduction about the various types of simulation, a basic game engine for attaching the components of 2D games programming is presented. The basic of the 3D graphics and 3D videogame through the usage of a CAD graphics tool and an AAA game engine is also provided. One fifth of the credit is obtained through a final project.
- *Foundations of Strategies for Energy*, Prof. M. Rossi. The main aim of the course is to discuss both the practical and theoretical aspects of strategies for managing energy. More precisely the milestones for the course could be declined as follows: Strategies for controlling energy flows; Optimization and management strategies; Practical aspects applied to smart energy microgrid.
- *Foundations of Strategies for telecommunications*, Prof. M. Marchese. Enterprise strategic choices are heavily influenced by “changes” modifying the operating context. One of the most important is the “digitalization”: currently every business is a digital one. Some digital technologies, listed in the aim, will have a special impact on future industrial strategies, allowing the development of smart cities, manufacturing, factory and agriculture. The knowledge, use and application of these technologies will be essential to make decisions in strategic environments.
- *Foundations of Geograhpy, Commodities Trading, Geopolitics*, Dr. E.Palmesino. The course activation will be confirmed. Learning about geography, navigable waters, including rivers, lakes, canals, straits, territorial disputes, privileges, conflicts, the flow of major bulk commodities, sea routes, trade, origins and destinations; geopolitics of energy, particularly oil & gas

It could be possible to attend also to the Attendance at Workshops and Webinars organized within **STRATEGOS MSc** delivered by outstanding Experts (www.simulationteam.com/strategos/schedule)



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B3 Other Active PhD Courses in Genoa University

All **PhD Students** could propose to include in the E&T Plan, **PhD Courses** active in **Genoa University**; among others the following are mentioned due to their connection with **Strategic Engineering** Subjects and interest of the International PhD Program:

- *Modeling and Simulation*, Prof. A.G.Bruzzone. This course gives you an introduction to modeling methods and simulation tools for a wide range of systems.
- *Modelling & Simulation for Biomedical Systems*, Prof. A.G.Bruzzone. Techniques and Modelling Approaches for BioMedical System Analysis: moving from static models to dynamic simulation. Criteria for evaluating the different alternatives in term of layout design, process definition and management policies: performance analysis, quality of Service, economic evaluations. Models applied to real Case Study and validation of different methodological approaches with estimation of achievable improvements in the sector. Development and Analysis of Computer Models: statistical and dynamic verification and validation, experimental design in biomedical systems. The course includes lectures and exercises in classroom with cooperative and competitive team working involving sector experts; it includes also the use of simulation models in experimental case and the development of simulations related to biomedical systems. The course includes also the tours and visit in real Biomedical Facilities
- *HLA - High Level Architecture/Distributed Interactive Simulation Reference*, Prof. Prof. A. Bruzzone. This course is devoted to M&S Experts interested in technology transfer related to HLA/DIS standards. The course includes lecturing and exercises to be completed.
- *PDE - Partial Differential Equations, Analytical Approach and Applications*, Prof. R. Cianci. The course aims to provide a presentation of the most common partial differential equations (PDE) and their solution techniques through an analysis of various applications.
- *Numerical Methods for PDE*, Prof. P. Bagnerini. This course covers important classes of numerical methods for partial differential equations. The emphasis is on a solid understanding of the accuracy of these methods, with a view on the role they play in today's science and engineering problems.
- *Perturbation methods 1*, Nicoletta Tambroni and Giovanna Vittori. The course will be held on February 14-18, 2022. The minimum number of participants to activate the course is 7. The course is aimed at the description of the perturbation methods, mathematical approaches for



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calculating approximate solutions that are possible when in the problem under consideration appears a dimensionless parameter which is very small or very large. The course will illustrate the main perturbation techniques used for the solution of fluid dynamics problems. <http://dottorato.dicca.unige.it/eng/corsi.html>

- *Climate change and EU-ETS directive*, Prof. Michela Gallo. The course will start in case of 2 registrations at least and it be held during the II semester, between april-may 2020. The aim of the course is to give a general overview about climate change and Greenhouse gases emissions (GHG). The application of the Kyoto Protocol mechanisms the Paris Agreement and the EU Emission Trading System (2003/87/CE) will be discussed. Calculation and monitoring methodologies of the greenhouse gases for production plants under the CE directive application will be analysed. Moreover an annual communication of a GHG emissions according to EU-ETS Directive will be introduced as case study and the related carbon credits market. <http://dottorato.dicca.unige.it/eng/corsi.html>
- *Paper Writing*, Prof. M. Marchese. The course aims to provide some basic elements to: choose a research topic; manage and use sources; do a novel, serious, and useful research; describe and explain a research.

Other subjects could be proposed for instance on this link: <http://dottorato.dicca.unige.it/eng/corsi.html> or among courses delivered by outstanding External Teachers.

B4 External Courses in Partner Universities or in Prestigious Organizations

Each year the **PhD Students** could submit a proposal to their **Supervisors** for having recognized External Courses or Exercises from another University, Institution or qualified Organization. These External Courses and Exercises could be up to one per year and they should match with **Strategic Engineering** and the specific **PhD Project** of the **PhD Student**. These proposals should be submitted by providing a synthetic description (e.g. title, duration, organizer, schedule, subjects, evaluation criteria, web reference) to the **Supervisors**; in case of positive evaluation.