Educational Program

Guidelines to build up the learning plan

Generalities

The Educational Program indicates, year by year, the activities, both collective and individual, available for the realisation of the training process of the students of the PhD Course in Mathematics, Physics and Applications for Engineering at the University of Campania "Luigi Vanvitelli".

The Learning Plan is the document that details the training pathway of each student.

For each individual PhD cycle, the Educational Program and the Learning Plan are approved by the Board of Professors (henceforth referred to as the Board). The Board is also responsible for the training process of each student; in the implementation of these competences, for each student the Board is assisted by the Supervisor and at least one co-Supervisor, and by possible preliminary discussions.

The acquisition of the degree is based on the system of training credits (CFU). Credits are acquired by completing the activities set out in the Learning Plan. The credits that can be acquired are determined for each activity on the basis of the overall commitment required of the student in terms of study and learning. In order to be admitted to the final examination, the student must have acquired 60 CFUs per year, for a total of 180 CFUs.

The training process consists of:

- - Educational activities;
- - Scientific activities;
- - Subsidiary activities.

Educational activities

Teaching activities are divided into:

- Alignment teaching, of specific interest to first-year students. It is aimed at standardising the students' skills and knowledge. When necessary, it is prescribed and customised for each student, taking into account the training curriculum accrued before entering the Doctoral Course.
- Collective basic teaching, typically intended for all the students of the Course, organised in part within the Doctoral School in Mathematics, Physics and Applications for Engineering or by the University. It includes: interdisciplinary, multidisciplinary and transdisciplinary training; language training; computer training; research management and the exploitation and dissemination of results, intellectual property and open access to data and research products and the fundamental principles of ethics and integrity.
  See Table 2 for a list of mandatory basic courses.
- Advanced teaching, typically intended for specific groups of students of the course. Advanced teaching is typically delivered by means of higher education courses taught by internal or, exceptionally, external highly qualified lecturers. PhD students must choose at least 3 courses, for no less than 60 hours of teaching, from those proposed in the Educational Program, as detailed below. A further list of courses organised in partnership between our Doctorate and the Physics Doctorates of the University of Bari "A. Moro", the University of Salento, Lecce, and the University of Naples "Federico II" will be added to the list of proposed courses. It is envisaged that 1 of the courses to be chosen in the Educational Program may be replaced by one or more course modules within the framework of the partnership. Similarly, 1 of the courses to be chosen in the Educational Program may be replaced by one or more modules of courses provided by other Doctoral Courses or within national or international Schools of Higher Education or international Schools of Higher

Education, and the recognition of the relative CFUs takes place once and the attestation of attendance of the lessons is provided together with the certification of the final exam passing.
For the purposes of acquiring further CFUs, PhD students may also attend lectures provided by other PhD courses, subject to the approval of the Supervisors and the Coordinator. In this case the number of CFU corresponds to the number established in the Educational Program of the corresponding PhD course and the recognition of the relative CFUs takes place attendance of the classes is provided together with the certification of the final exam passing. The Training activities carried out within the framework of national or international Schools of Higher Education may be recognised, subject to the approval of the Supervisors and the Co-ordinator. Any teaching activities not included among those listed above will be assessed on a case-by-case basis by the Board of Professors.
Please refer to Table 3 for the list of advanced teaching activities.

Scientific Activities

Scientific activities are divided into

- experimental, theoretical or numerical activities aimed at achieving scientific objectives;
- preparation of scientific papers to be presented at national or international conferences, or to be published in national or international journals;
- participation to scientific conferences, congresses, symposia and seminars;
- preparation and production of documents (reports, procedures, etc.) of scientific importance;
- participation in the work of national or international research groups;
- participation in technology transfer activities;
- thesis writing;
- any other activity to be defined by the Board.

Recognition of credits for an activity requires, where applicable, a certificate of participation issued by the body that organised the activity.

Subsidiary activities

Other activities include

- Subsidiary or supplementary teaching activities within the limits specified in the Regulation of the PhD Course;
- proposing and organising scientific projects;
- third mission activities: relations with schools or local authorities; organisation of or participation in science dissemination events (e.g. Researchers' Night, Futuro Remoto);
- contribution to the organisation of scientific or higher education events;
- any other activity useful, in the opinion of the Board, to the training of students.

Admission to the following year or to the final examination

The Board, at the end of each year, in the final phase, for each of the students

- recognises the credits acquired for the activity carried out during the year on the basis of a descriptive report of the carried-out activity, a public presentation, if any, and the opinion of the supervisors
- authorises admission to the final examination or passage to the following year if the requirements are met, and possibly defines the activities to be carried out to recover credits not acquired.

Temporal Distribution of Activities in the Training Process

As a rule, the activities of each student's training process respond to the time distribution summarised in Table 1. Specific needs may suggest, for individual students, different arrangements, e.g. students who have

won grants funded by an institution or a company may agree with the latter on a customised training plan in line with their scientific interests and consistent with the training objectives of the PhD Course.

***Table 1**. Time distribution of CFU's to be acquired in the doctoral program*

	First Year	**Second Year**	**Third Year**	**CFU**
Educational activity	20-40	4-20	0-10	**28-48**
Scientific activity	20-40	35-52	35-60	**120-152**
Subsidiary activity	0-15	0-15	0-15	**0-24**
Total	**60**	**60**	**60**	**180**

Course Evaluation System

The evaluation system of the training pathway, within the more general evaluation system of the PhD Course, requires for the following specific activities:

- evaluation of the Course by the students (organisation, articulation, training programme, facilities, tutoring, availability of funds, etc.);
- evaluation of the Course by the lecturers (organisation, prerequisites, facilities);

The organisation and management of the Evaluation System are the responsibility of the Board, which, among other things, defines its practical implementation (operational tools, timing, responsibilities, etc.).

List of the courses a.a. 2022/2023

Table 2: *Basic courses and seminars (compulsory)*

Activity	Description
English course	The English language course is subdivided into 3 modules (intermediate, advanced, academic-scientific) to which students gain access subject to an entrance test. The first module is organised at University level, while the two more advanced ones at Doctoral School level. In addition, free language courses are available to doctoral students on the Rosetta Stone platform, with a choice of 24 languages.
Patent as an inventive research activity (Prof. A. Capece)	The course focuses on patenting principles, practices and strategies in national and international research management and exploitation processes. The lectures aim to transfer a theoretical background on which to graft tools for practical use such as the forms and procedural steps to structure patent applications; search techniques in patent databases and classification codes; patentability requirements for an invention. In order to enable doctoral students to acquire the necessary skills to exploit the results of their research and related intellectual property, new contexts and areas of application of industrial research, smart business models, integrated projects and innovative solutions will be identified. Workshop activities will be launched for the pairing-exchange between doctoral students belonging to different scientific disciplines aimed at structuring new proposals for the valorisation of intellectual property to simulate the creation of start-ups and spin-offs.
Introduction to modern computing infrastructures (Prof. M. Iacono)	The course aims to provide doctoral students with the basic knowledge of modern computing infrastructures, presenting the main small- and large-scale computing infrastructures, in order to enable them to use them appropriately for the requirements of using and developing specialised computer applications for research problems. After an introduction to the characteristics of modern computing nodes and computer networks, the course presents the main topics related to the architecture, organisation and software support offered by today's large-scale computing systems, with particular reference to massively distributed architectures and cloud applications. The course also includes an introduction to the performance evaluation of these systems and the related modelling.
Valorization and dissemination of results, intellectual property and open access to research data and products Course on Data Management (Prof. M. Iacono+Seminars by Prof. M. Mastroianni).	A course in data management is planned as part of the teaching activities organised at the level of the School of Engineering and Basic Sciences. The aim of the course is to present the fundamental concepts and theories in data management in order to promote their application to research activities and professional practice. Fundamental concepts on data management in research and professional practice are presented: database management systems, database architectures, the role of data in decision-making processes, data life cycle, data protection regulations, drafting a data management plan.
Management of research and knowledge of European and international research systems	Courses, compulsory for PhD students, are organised at the Athenaeum level, held by experts from the European Research Promotion Agency (APRE) by the Athenaeum: 1) Open access & science 1 module; 2) Dissemination, Communication & Exploitation: how to maximise results, 1 module; 3) Possible post-PhD training paths 1 module.
Valorization and dissemination of results, intellectual property and open access to research data and products	There are three modules of 4 hours each, common to all PhDs, on Spin Off and Research Start-ups; introductory concepts and prerequisites for starting a company; the business model and regulations; the innovation ecosystem supporting start-ups.

Activity	Description
Principi fondamentali di etica, uguaglianza di genere e integrità	The University, in cooperation with the Agency for the Promotion of European Research (APRE), organises information paths on the Horizon Europe calls. There are modules on Ethics in Horizon and Gender in Horizon Europe. PhD students will be stimulated to reflect on the (gender) orientation of research and the role in European funding programmes. Two modules are common to all PhDs.

Table 3. *Advanced courses*

Name	Professor	SSD	ECTS	Hours	Year	Notes
Algebraic and geometric methods in combinatorics and coding theory	O. Polverino/F. Zullo	MAT/03	4	20	1	
Spline models for regression analysis	R. Campagna	MAT/08	4	20	1	
Theory of nuclear forces	L. Coraggio	FIS/02	4	20	1	
Physics for Space Application	M. De Cesare	FIS/07	4	20	1	
Research in mathematics Education	U. Dello Iacono	MAT/04	4	20	1	
Stability analysis of open-channel flows with Newtonian and non-Newtonian fluids	M. Iervolino	ICAR/01	4	20	1	
Biophotonics for clinics and environment	M. Lepore/I. Delfino	FIS/07	4	20	1	
An Introduction to Linear Dynamics	E. D'Aniello	MAT/05	4	20	1	
Biophysical mechanisms and therapeutic implications of human exposure to ionizing radiation	L. Manti	FIS/07	4	20	1	
Petri Nets and their applications in science and engineering	S. Marrone	INF/01	4	20	2	
New Concepts and Materials for Applications in Electronics, Photovoltaics and Energy Storage	G. Landi	FIS/01 ING-INF/01	4	20	1	
Computational solid and structure mechanics: Finite elements and Boundary elements	V. Minutolo	ICAR/08	4	20	1	
Principle of non-Newtonian Fluid Mechanics	C. Carotenuto/M. Minale	ING-IND/24	4	20	1	
Numerical Applications for Physics and Engineering	B. Morrone	ING-IND/10	4	20	1	L'iscrizione al corso non è consentita ai dottorandi laureati in Matematica
Navier-Stokes equations: an introduction to the well(ill)-posed initial boundary value problem.	P. Maremonti	MAT/07	4	20	1	

Digital Signal Processing	S. Marrone/L. Verde	INF/01	4	20	1	
Financial mathematics and behavioural finance	V. Ventre	SECS-S/06	4	20	1	
Stochastic Processes and Analysis of Correlations	E. Lippiello/A. Sarracino	FIS/02	4	16	1	
Astrophysics with ultra-high-energy neutrinos and Neutrino Telescope	P. Migliozzi	FIS/04	2	8	1	
An introduction to Reaction-Diffusion Equations	B. Pellacci	MAT/05	4	20	1	
Isotope Physics and Methodologies	F. Marzaioli	FIS/07	4	20	1	
Optics and Photonics for advanced multimodal metrology	P. Ferraro	FIS/03	4	20	1	
Pyro-electrohrdrodynamics and advanced technologies for soft-matter manipulation	S. Coppola/S.Grilli	FIS/07	4	20	1	
Statistical Methods in Experimental Sciences	F. Terrasi	FIS/07	4	20	1	
Introduction to Set Theory	P. D'Aquino	MAT/01	4	20	1	The PhD student may choose only one of these two courses
Model theoretic analysis of algebraic structures	P. D'Aquino	MAT/01	4	20	1	

For the course contents, refer to the Educational Program.
For the list of the courses within the partnership with Physics Doctorates of the University of Bari "A. Moro", the University of Salento, Lecce, and the University of Naples "Federico II", refer to the PhD webpage, link to Supra Courses.