Educational Programme

41st Cycle

Academic Years 2025/2026

General information for the PhD course

The National PhD in Science and Technology for Advanced Therapies (STAT) aims to train professionals with interdisciplinary skills, capable of integrating basic research, technological development, and clinical application. The program aims to provide a multidisciplinary training path that combines scientific, technological, methodological, and regulatory aspects.

The Scuola Universitaria Superiore IUSS di Pavia, Fondazione Telethon, University of Pavia, and Fondazione CNAO collaborate to create a stimulating environment to address the challenges of advanced therapies, with particular attention to gene and cell therapies, advanced physical therapies including Hadron therapy and biotechnologies applied in the biomedical field.

The course prepares researchers and professionals able to operate in highly interdisciplinary contexts, developing a common language between experts from different areas, including medicine, biology, engineering, physics, economics, and law. The proposed research projects will address complex issues, focusing on biomolecular sciences, gene therapies, hadron therapy, and physical therapies, involving candidates from the biomedical, technological, and socio-economic-legal sectors.

In addition to specialist training, the program addresses cross-cutting aspects related to innovation in medicine, including technological risks, ethical and legal implications, and possible paths for the transfer of technologies from the laboratory to the market.

The present initiative and the design of a unique inter-university, multi-disciplinary doctoral course considers all of these aspects.

The PhD program is structured in **three distinct curricula**:

- **Curriculum 1:** Hadron therapy and advanced biophysical therapies.
- **Curriculum 2:** Gene and cell therapies.
- **Curriculum 3:** Biomolecular and Biotechnological sciences.

PhD students will benefit from the opportunity to access cutting-edge laboratories in partner institutions and companies involved in the project; internships and industrial collaborations, facilitating entry into the world of work; cross-cutting modules on regulation, ethics, and technology transfer, to address the scientific and social challenges of emerging therapies.

The PhD degree course aims to equip candidates with in-depth knowledge and technical expertise in their chosen specialty, and high-level, cross-disciplinary and robust education in disciplines that are common to all 3 curricula.

The objective is to give all candidates the opportunity to choose among the expertise available in the Italian universities and research centers involved in the project and to work in inter-disciplinary teams on 'hot topics' related to advanced therapies. Students will be able to design their education programmes in terms of the courses and topics studied, to learn how to solve problems from different angles, and how to engage in effective discussion with experts in other domains.

During the PhD-STAT multi-disciplinary events, candidates will work in inter-disciplinary teams on key aspects of the complex problems related to human health. They will be asked to propose effective solutions that take into consideration not only the purely technical aspects of their respective disciplines but also the socio-economical-ethical implication related to the application of advanced technologies in biomedicine.

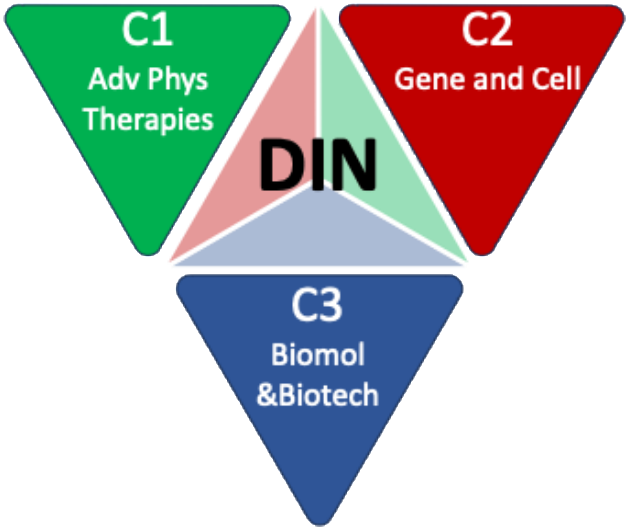

Figure 1 – The 3 curricula offered by the PhD course in Science and Technologies in Advanced Therapies

Programme structure

The PhD program is structured in **three distinct curricula**:

- **Curriculum 1:** Hadron therapy and advanced biophysical therapies.
- **Curriculum 2:** Gene and cell therapies.
- **Curriculum 3:** Biomolecular and Biotechnological sciences.

PhD students will benefit from the opportunity to access cutting-edge laboratories in partner institutions and companies involved in the project; internships and industrial collaborations, facilitating entry into the world of work; cross-cutting modules on regulation, ethics, and technology transfer, to address the scientific and social challenges of emerging therapies.

It is expected that the PhD-STAT community will 30+ PhD candidates enrolled in the supporting universities, along with their academic supervisors and the even more numerous individuals involved in delivering the lectures and training. We expect the community to meet together for around 2 weeks annually to discuss and work together on topics of common interest.

Candidates will be assigned to scholarship in one of the areas within the three curricula. Candidates will be enrolled in the universities/laboratories offering the relevant specializations and will follow an education roadmap that include activities at three levels:

- the multi-disciplinary PhD level;

- the multi-disciplinary level of the student's particular curriculum;
- a more focused level related to the particular disciplinary area.

The students' work will focus mainly on the focal discipline, although we expect some 50% of the training and around 20% of the time will be devoted to study in other disciplines.

To guarantee a multi-disciplinary and inter-university education experience, students will participate in three types of educational events (including seminars, courses, workshops):

- multi-disciplinary (MD) events, which will include all the PhD STAT candidates;
- Curriculum (CU) events, which will include all PhD candidates following that particular curriculum;
- focused (mostly single-discipline) (FD) events, to be agreed with supervisors and which will mostly be held at the universities where students are enrolled.

Table 1 summarizes the minimum hours devoted to MD, CU and FD events. Table 2 present an example of the structure of MD workshops.

Apart from the final year multi-disciplinary workshop, all educational events will take place during the first 18 months of the PhD course, leaving the final 18 months for the doctoral research project.

Event		Organizer	Minimum Number of hours
(MD) Multi-disciplinary events	MD-Workshop 1 (year 1)	PhD board	60 hours
	MD-Workshop 2 (year 3)		
(CU) Curriculum events	CU-Seasonal School (year 1)	Curriculum board	60 hours
	CU-Workshop (year 2)		
(FD) Focused and mostly single-disciplinary events	Thematic courses	Supervisors	40 hours
Total			Minimum 160 hours over 3 years

Table 1. PhD-STAT education events at the three levels: multi-disciplinary, curriculum, and focused and mostly single-disciplinary and minimum number of hours

Multi-Disciplinary Events (MD)

Cross-cutting modules will be offered on risks, regulation, ethical impacts of advanced technologies in medicine, and technology transfer pathways

These courses will be delivered during the second year of the PhD course. In addition to these modules, a couple (one per year) of general multidisciplinary events will be organized to gather together all PhD students (of all the 3 curricula) in workshops including talks from experts in the field of advanced therapies.

Curriculum events (CU)

The CU-events will include content and formats related to the relevant curriculum and will provide a broad overview of the curriculum research topics. The CU-events will be organized in two sessions:

- year-1 CU Seasonal School (CU-SS) will be held in the first year of the PhD and will provide an opportunity for the PhD candidates to attend topical lectures on some of the themes related to their work;
- at the end of each year, the PhD students of each curriculum will have the opportunity to present their activity in front of experts in the field and to share their respective experiences with their peers.

Focused and disciplinary events (FD)

These refer mostly to single-theme and single-disciplinary courses.

FD-events will be defined by the PhD students with their supervisors.

Supporting inclusion and diversity

Inclusion and diversity are fundamental values required for education and scientific excellence. Scholars with diverse talents, backgrounds and perspectives will contribute insights and innovative approaches to tackle difficult scientific problems and societal challenges. Everyone involved in this PhD Program will promote and support inclusion and diversity, and foster an environment where the brightest, most creative minds from every segment of society and every part of the globe can achieve their full academic and professional potential.

PhD program language

All PhD candidates are expected to have a good knowledge of the English language. Note that all MU and CU events and most FD events will be conducted in English. The PhD thesis can be in Italian or English.

CU1. Hadron Therapy and Advanced Biophysical Therapies.

Education aims and method

The education plan for this curriculum exploits the diverse and multidisciplinary expertise of the research theme supervisors. The aim is to train the PhD candidates to deal with the complexity of advanced technologies applied to Biomedicine with a particular focus (but not limited to) Hadron therapy that represents a challenging, multidisciplinary field holding promises for future personalized medical approaches. .

Approach

Given the complexity of the topic, candidates are expected to develop, during their PhD, the ability to engage with experts from other disciplinary fields to address the complex challenges related to the development of innovative technologies for biomedicine.

Teaching methods

The modules will include two-hour lectures focusing on different areas of hadron therapy and technological approaches to medicine; they will provide general background information targeted at non-experts and also will explore certain questions, specific to the curriculum areas, in great depth. The curriculum lectures will be mostly face to face. The training module will foster interaction and collaboration among all participants, from lecturers to students, for building a common core of advanced knowledge.

CU teaching modules

- Radiotherapy (20 hours)
- Radiobiology (30 hours)
- Medical Physics (30 hours)
- Bioengineering (30 hours)
- Biomedical Sensors (30 hours)
- Introduction to Accelerator Physics (30 hours)
- Radiation Protection (20 hours)
- Risk (30 hours)

FD teaching courses

The specific training activities will be tailored to each candidate based on their backgrounds. The courses will be chosen from among the range of courses being offered by all the universities contributing to the curriculum and will include both general and specialized and methodological courses.

Candidates will have the option to customize their training with other specialist seminar activities of the curriculum offered by the experts coming from all Universities and Research Centers participating to the Programme.

CU2. Gene and cell therapies

Education aims and method

The overarching goal of this education plan is to train highly specialized researchers in the design, development, and clinical application of innovative therapies based on genetic technologies.

Approach

PhD candidates are expected to cultivate robust methodological skills, encompassing both quantitative and qualitative approaches, to tackle the scientific and clinical challenges of the future. Emphasis will be placed on the advancement of innovative therapies grounded in genetic technologies, necessitating a profound comprehension of genetics, molecular biology, and precision medicine. Proficiency in utilizing cutting-edge genetic manipulation techniques, such as CRISPR-Cas9, TALENs, and ZFNs, is deemed essential. Furthermore, a thorough understanding of the interplay between gene therapies and the immune system, alongside the ethical considerations and regulatory frameworks governing these therapies, will be crucial

Teaching methods

Teaching methods will include traditional and interactive lectures combined with individual and team activities, including laboratory-oriented activities and group data analysis.

CU teaching modules

Bioinformatics Resources (25 hours)
◦
From the discovery of Tumor-Targeting Ligands to the development of Drugs (16 hours)
◦
Biomolecular methodologies, biomolecular, cellular and pharmacological methods (100 hours)

FD teaching courses

The specific training activities will be tailored to each candidate based on their backgrounds. The courses will be chosen from among the range of courses being offered by all the universities contributing to the curriculum and will include both general and specialized and methodological courses.
Candidates will have the option to customize their training with other specialist seminar activities of the curriculum offered by the experts coming from all Universities and Research Centers participating to the Programme

CU3. Biomolecular and Biotechnological Sciences

Education aims and method

The training in this curriculum is aimed at integrating fundamental disciplines such as structural biology, bioinorganic and pharmaceutical chemistry, biocatalysis, molecular microbiology, neuropharmacology, and molecular hematology in CU teaching modules

Approach

PhD candidates are expected to develop a strong foundation in experimental laboratory research. The emphasis will be on basic sciences such as protein structure and engineering, and on research with industrial interest including work on enzymes and transgenic plants, and research with medical interest related to genes that cause disease, and on drugs with an emphasis on oncological themes and those linked to neurodegeneration.

Teaching methods

Teaching methods will include traditional and interactive lectures combined with individual and team activities, including laboratory-oriented activities and group data analysis.

CU teaching modules

Bioinformatics Resources (25 hours)
From the discovery of Tumor-Targeting Ligands to the development of Drugs (16 hours)
Biomolecular methodologies, biomolecular, cellular and pharmacological methods (100 hours)

FD teaching courses

The specific training activities will be tailored to each candidate based on their backgrounds. The courses will be chosen from among the range of courses being offered by all the universities contributing to the curriculum and will include both general and specialized and methodological courses.

Candidates will have the option to customize their training with other specialist seminar activities of the curriculum offered by the experts coming from all Universities and Research Centers participating to the Programme.