UNIVERSITA' DEGLI STUDI DI MILANO
PROGRAMME DESCRIPTION - ACADEMIC YEAR 2024/25
MASTER DEGREE
Physics (Classe LM-17)
Enrolled from academic year 2019/2020

HEADING

Degree classification - Denomination and code:	LM-17 Physics
Degree title:	Dottore Magistrale
Curricula currently available:	Specialist Curriculum / Multi-Sector Curriculum
Length of course:	2 years
Credits required for admission:	180
Total number of credits required to complete programme:	120
Years of course currently available:	1st , 2nd
Access procedures:	Open, subject to entry requirements
Course code:	F95

PERSONS/ROLES

Head of Study Programme

Prof.ssa Alessandra Guglielmetti

Tutors - Faculty

Tutor per l'orientamento (Academic guidance tutor)
F. Camera, S. Cialdi, G. Colò, L. Gariboldi, M. Giudici, A. Guglielmetti, G. Lodato, N. Manini, L.G. Molinari, S. Olivares, M. Paris, P. Piseri, M. Sorbi, G. Tiana, A. Vicini

Tutor per i piani di studio (Study plan tutor)
A. Guglielmetti

Tutor per la mobilità internazionale e l'Erasmus (Erasmus and International mobility)
N. Piovella

Tutor per stage e tirocini (Internship tutor)
A. Guglielmetti, N. Piovella

Tutor per laboratori e altre attività (Laboratory Classes)
R. Vecchi

Tutors - Students

ANDOLFATO BIANCA
ASINARI LUCA
CHEMOLI DARIO
COLOMBO TOMMASO
DE NARDI GIACOMO
FARINELLI FRANCESCO
GIUNTA CHIARA
PELLEGRINI GIOVANNI
PULLIA DARIO
SALIONI RAFFAELE

Degree Course website

https://fisica-lm.cdl.unimi.it

Admission

G. Maero, C. Barbieri, M. Genoni, S. Riboldi Email: commissione.ammissione@fisica.unimi.it

Dissertation and Final Exam

L. Bonizzoni (Presidente), C. Benedetti, F. Camera, S. Carrazza, V. Liberali, D. Maino

Enrolment

https://www.unimi.it/it/node/183

Laboratory Security

M. Potenza

Library

Via Celoria 18 - 20133 Milano http://www.sba.unimi.it/Biblioteche/bicf/13453.html

PLS Program Chair

M. Giliberti

Program Transfer

G. Maero, C. Barbieri, M. Genoni, S. Riboldi Email: commissione.ammissione@fisica.unimi.it

Reference Office

Via Celoria 16 - 20133 Milano Phone 02.50317401 https://informastudenti.unimi.it/saw/ess?AUTH=SAML

Schedule of Classes

S. Bottoni, M. Gherardi

Specific Learning Disabilities

L. Carminati

Student registrar

Phone 0250325032 https://www.unimi.it/it/studiare/servizi-gli-studenti/segreterie-informastudenti

CHARACTERISTICS OF DEGREE PROGRAMME

General and specific learning objectives

General and specific learning objectives

The Master's degree programme in Physics aims to enable students to either continue their academic studies or proficiently start working in research or professional contexts, having learnt the experimental, theoretical and mathematical bases of physics, and how to use the scientific method.
The Master's degree programme will enable students to deepen their knowledge of classical, relativity and quantum physics with regard to its phenomenological and theoretical aspects, as well as their mathematical formulas.
Having acquired adequate mathematical and computer skills, Master's graduates will be able to design and use mathematical models and calculus techniques to solve physics problems.
Students may also further their studies in the frame of postgraduate programmes. The coursework offers a wide range of subject options and pathways, to enable Master's graduates to find employment in basic and/or applied research, or in work environments requiring experimental-applicative competencies, familiarity with innovative methods, and the ability to use complex equipment.
More specifically, the programme is designed with the following objectives:
- Provide a solid knowledge base regarding the experimental-applicative domain, the theory and fundamentals of physics, microphysics, structure of matter, astrophysics/geophysics/space science;
- Prepare graduates who are flexible and have a strong aptitude for problem-solving;
- Prepare graduates who are able to describe natural phenomena in a strictly scientific manner, with a mathematical and statistical approach, as well as to work with a high degree of autonomy, taking on responsibilities for projects, even in a managerial and directive capacity;
- Provide tools for scientific communication and dissemination at a high level;
- Provide graduates with a solid knowledge of the contents and methodologies required for teaching.

Expected learning outcomes

Based on the Dublin descriptors, graduates of the Master's degree programme in Physics will develop the following competencies:

A) KNOWLEDGE AND UNDERSTANDING
Master's graduates in Physics will gain:
- Knowledge and understanding of the core disciplines of this degree class, with reference to the experimental-applicative and theoretical domains, microphysics and structure of matter, astrophysics/geophysics/space science;
- Knowledge and understanding of classical physics: mechanics, thermodynamics, electrodynamics, optics and wave propagation, fluid dynamics, analytical mechanics;
- Knowledge and understanding of modern physics: quantum mechanics, quantum theory of matter, nuclear physics, physics

of elementary particles, restricted relativity;
- An understanding of the cross-disciplinary aspects of studying physical phenomena and the ability to frame research problems in a wide-ranging historical and scientific context;
- Advanced mathematical knowledge: mathematical analysis, linear algebra and geometry, complex analysis, elements of functional analysis;
- In-depth knowledge of computer science: procedural programming and object-oriented programming, solving problems using numerical methods, computer networks;
- Knowledge of electronics and electronic instruments: analogue and digital electronics, equipment control, data acquisition systems.

B) APPLYING KNOWLEDGE AND UNDERSTANDING
Master's graduates in Physics will be able to:
- Use the scientific method to study physical phenomena and analyse experimental data;
- Design and/or develop mathematical models of reality;
- Carry out laboratory measurements using modern tools and process data using statistical methods and computer networks;
- Use physical signal sensors and detectors as well as measurement tools, including computer controlled tools;
- Use the specific instruments of one of the following fields: nuclear physics, spectroscopic measurements and vacuum techniques, thin films, electronics, optics, sensors for environmental measurement;
- Work in team: this ability will be acquired during the experimental teaching laboratories and the computational physics laboratory, as well as in research groups, also outside of the University, while working on the final thesis;
- Proficiently communicate in English in a scientific, teaching or dissemination context.

C) MAKING JUDGEMENTS
Master's graduates in Physics will be able to:
- Assess the implications of experimental data collected in the laboratory or made available by research agencies in critical applications (e.g. biomedical imaging, dosimetry, avionics, automotive sector);
- Reflect on the social and ethical responsibilities related to the application of knowledge;
- Autonomously assess the various aspects of teaching;
- Assess themselves in a scientific context and/or with a view to their entry into the job market.

D) COMMUNICATION SKILLS
Master's graduates in Physics will be able to:
- Communicate effectively both orally and in writing, to an expert or non-expert audience, with appropriate language and scientific rigour, adjusting the level of details and the communication focus according to each situation;
- Describe experimental and theoretical results using modern presentation techniques, including multimedia technologies;
- Proficiently and effectively use English in their specific field of expertise as well as to exchange basic information, particularly with regard to the scientific vocabulary and the technical terms of physics;
- Proficiently communicate in English in a scientific, teaching or dissemination context.

E) LEARNING SKILLS
Master's graduates in Physics will be able to:
- Effectively use textbooks and scientific publications written in English;
- Carry out complex bibliographic searches;
- Consult databases and electronic journals;
- Consult textbooks and specialised journals in specific research fields.

Professional profile and employment opportunities
Professional Profile and Career Opportunities

Professional Profile
Physicist

Career Opportunities
Graduates will typically work in industries and public and private institutions in facilities such as:

Research centers and laboratories
Hospitals and healthcare facilities that use techniques for diagnostics, therapy, and radiation protection
Astronomical observatories
Museums and other centers dedicated to scientific outreach
Banks and insurance companies
Facilities dedicated to the development of mathematical and statistical models of phenomena
Facilities dedicated to the use and development of complex systems and instruments
Institutions involved in the restoration of artistic assets and the preservation of environmental goods
Power plants (including nuclear power plants)
Facilities for data acquisition and processing

Graduates who have sufficient credits in specific groups of subjects may, as required by current legislation, participate in admission tests for training programs in secondary education.

Graduates interested in career opportunities that require further training will continue their studies in research doctorates or postgraduate schools.

Initial knowledge required

Admission requirements:
Bachelor's graduates in Physics (degree class L-30 and corresponding class pursuant to Ministerial Decree 509/99) can access the Master's degree programme in Physics.
Those who have a Bachelor's degree in another class can also access the programme, provided they have earned
- 24 CFU, i.e. university credits, in the scientific-disciplinary sectors (SSD) FIS/01-08, of which at least 12 in FIS/02 and at least 6 in total in FIS/03, FIS/04, FIS/05;
- 20 CFU in the scientific-disciplinary sectors (SSD) MAT/01-09
Those who have obtained an equivalent qualification abroad can also access the programme, provided that they prove to meet skills requirements.

Admission assessment

Applicants must prove in-depth knowledge of classical physics and mathematical analysis, and basic knowledge of geometry, computer science, analytical mechanics, quantum mechanics, the structure of matter, nuclear and subnuclear physics, as well as laboratory work skills (data acquisition and processing).
All candidates will be assessed through an interview on subjects covered by the core courses of the aforementioned degree programme in Physics.
The interviewing board will include faculty members appointed by the Academic Board. The interview may also take place before graduation. However, the candidate must obtain their degree by 31 December 2024.

For the 2024/2025 academic year, interviews are scheduled on the following dates:

28 June 2024, 9.00 am
13 September 2024, 9.00 am
25 October 2024, 10:45 am
10 January 2025, 10:45 am

The interviews will take place online using the Zoom platform by connecting to the following link: https://zoom.us/my/aula.consiglio

Candidates who fail the interview, whether graduates or upcoming graduates, may not enrol on the Master's degree programme for the current year.

Proficiency in English at a B1 level or higher under the Common European Framework of Reference for Languages (CEFR) is required for admission.
The B1-level requirement will be ascertained by the University Language Centre (SLAM) upon admission as follows:
- Language certificate at or above B1, obtained no more than three years earlier. For the list of language certificates recognized by the University please review: https://www.unimi.it/en/node/39267). The certificate must be uploaded when submitting the online application;
- English level achieved during a University of Milan degree programme and certified by the University Language Centre (SLAM) no more than four years before the date of admission application. In this case the process is automatic, the applicant does not have to attach any certificates to the application;
- Placement test administrated by the University Language Centre (SLAM) according to the calendar published on the website: https://www.unimi.it/en/node/39267
All those who fail to submit a valid certificate or do not meet the required proficiency level will be instructed during the admission procedure to take the placement test.
Applicants who do not take or pass the placement test will be required to obtain a language proficiency certificate recognized by the University (see: https://www.unimi.it/en/node/39322) and deliver it to the SLAM via the InformaStudenti service by the deadline fixed for the master’s programme (https://www.unimi.it/en/node/39267).
Applicants who do not meet the requirement by said deadline will not be admitted to the master's degree programme and may not sit any further tests.

Compulsory attendance

Attendance is compulsory and will be monitored in each class for laboratory courses.

Internship criteria

The Specialist Curriculum foresees a compulsory training and orientation internship which can also be correlated with the preparation of the thesis. The internship must be followed by a professor the degree program who will certify the quality of

the activity carried out. The internship lasts approximately 2 months and gives rise to 6 credits. Furthermore, it is possible to include additional internship periods in the study plan within the 12 University Training Credits (CFU) envisaged for free-choice activities. The guidelines for this second type of internship are given at the link https://fisica-lm.cdl.unimi.it/it/studiare/stage-e-tirocini

An essential condition for the approval of this type of training activity in the study plan is the presence of a teacher-tutor who guarantees the quality of the activity, quantifies its extent in terms of credits, and certifies the achievement through a written report of the pre-established learning objectives.

Degree programme final exams

Final exam

For their final exam, upcoming graduates will have to present and defend an original thesis written under the guidance of a supervisor.

This thesis must relate to theoretical or experimental research conducted independently at research groups, institutions or firms with the aim of solving a physics problem.

The thesis will document research design and implementation steps, and form part of the state of the art in the field.

This complex work will award a high number of credits (36 CFU).

Before starting thesis work, the student is required to submit an application (with a tentative thesis title) to the Degree Board for approval. The board will grant any applications that are consistent with the study programme, and assign each student their supervisor(s) and co-supervisor(s).

The official thesis assignment is a MANDATORY step to be taken before starting thesis work. Thesis supervisors and co-supervisors thereby take responsibility for and are required to check all formal aspects, including for insurance purposes. The thesis application must be submitted online at https://registrazione.fisica.unimi.it/richiesta-tesi/login.

Criteria for admission to the final exam

To be admitted to the final exam, the student must have earned 84 CFU. Moreover, there must be consistency between academic records and the last approved study plan.

Link for admission to the final exam

https://www.unimi.it/en/study/bachelor-and-master-study/graduation

Notes

In order to obtain their degree, students must be proficient in English at a B2 level, certified as follows:

- by summitting a B2 or higher level language certificate issued no more than three years prior to the date of application. You will find the list of language certificates recognized by the University at: https://www.unimi.it/en/node/39322). If not submitted during the application process, the certificate must be uploaded when enrolling, or subsequently at: http://studente.unimi.it/uploadCertificazioniLingue;
- B2 or higher level achieved earlier and validated during the application process;
- B2 or higher level achieved during the admission test;
- by taking a placement test administrated by the University Language Centre (SLAM) between October and January of year 1.

All those who do not achieve B2 or higher level will be required to attend a B2-level English course administrated by the University Language Centre (SLAM) during the second semester of year 1.

Those who do not attend the course or do not pass the end-of-course exam after six attempts must obtain the necessary certification privately before graduating.

EXPERIENCE OF STUDY ABROAD AS PART OF THE TRAINING PROGRAM

The University of Milan supports international mobility by providing its students with the opportunity to spend study and internship periods abroad. It is a unique chance to enrich your educational path in a new exciting environment.

The agreements entered into by the University with over 300 universities from the 27 EU member countries under the European Erasmus+ programme allow regularly enrolled students to carry out part of their studies at one of the partner universities or to undertake internships at companies, training and research centres and other organizations.

Similar international mobility opportunities are provided outside Europe, through agreements with a number of prestigious institutions.

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Study and internships abroad

The thesis work is often carried out in prestigious research centers like CERN or GSI, or important Universities worldwide, in the frame of international collaborations and research programs.

How to participate in Erasmus mobility programs

How to participate in Erasmus+ mobility programmes

The students of the University of Milan can participate in mobility programmes, through a public selection procedure.

Ad hoc commissions will evaluate:

• Academic career
• the candidate's proposed study programme abroad
• his/her foreign language proficiency
• the reasons behind his/her application

Call for applications and informative meetings

The public selection for Erasmus+ mobility for study generally begins around February each year with the publication of a call for applications specifying destinations and requirements. Regarding the Erasmus+ Mobility for Traineeship, the University of Milan usually publishes two calls a year enabling students to choose a destination defined by an inter-institutional agreement or to find a traineeship position on their own.

The University organizes informative meetings to illustrate mobility opportunities and rules for participation.

Erasmus+ scholarship

The European Union grants the winners of the Erasmus+ programme selection a scholarship to contribute to their mobility costs, which may be supplemented by the University funding for disadvantaged students.

Language courses

Students who pass the selections for mobility programmes can benefit from intensive foreign language courses offered each year by the University Language Centre (SLAM).

https://www.unimi.it/en/node/8/

Learn more at https://www.unimi.it/en/node/274/

For assistance, please contact:
International Mobility Office
Via Santa Sofia 9 (second floor)
Tel. 02 503 13501-12589-13495-13502

Contacts: InformaStudenti; mobility.out@unimi.it
Student Desk booking through InformaStudenti

1st COURSE YEAR Core/compulsory courses/activities common to all curricula

Learning activity		Ects	Sector
CLASSICAL ELECTRODYNAMICS		6	FIS/01
English proficiency B2 (3 ECTS)		3	ND
INFORMATICS ABILITY		3	NA
	Total compulsory credits	12	

2nd COURSE YEAR Core/compulsory courses/activities common to all curricula

Learning activity		Ects	Sector
FINAL EXAM		36	NA
	Total compulsory credits	36	

ACTIVE CURRICULA LIST

Specialist Curriculum Course years currently available: 1st , 2nd
Multi-Sector Curriculum Course years currently available: 1st , 2nd

Procedure for choosing a curriculum

When enrolling in the program students must choose between:

- Specialist Curriculum, oriented to gaining a deep knowledge in one field of Physics
- Multi-Sector Curriculum, oriented to teaching and Science dissemination

CURRICULUM: [F95-A] Specialist Curriculum

Qualifying Training Objectives

The Specialist curriculum program provides skills for theoretical and experimental research, as well as for entering post-graduate courses with advanced scientific contents. The provided skills match job requirements related to research in University and/or in Research Institutes, in Public Departments, in Industry. The teachings included in the specialist curriculum program are strongly connected with the research activities of teachers in the experimental and theoretical fields. In most laboratory courses the advanced equipment and/or technologies used by our research groups are made available to students. The contents of the theoretical and experimental Physics courses are related to the research topics of interest to the

teachers. Several courses are taught, within the framework of conventions, by established researchers of Public Research Agencies such as INFN and CNR.

COURSE YEAR UNDEFINED Core/compulsory courses/activities Curriculum-specific features Specialist Curriculum

Learning activity	Ects	Sector
MANDATORY TRAINING INTERNSHIP	6	NA
Total compulsory credits	6	

Further elective courses Curriculum-specific features Specialist Curriculum

Courses of type "CARATTERIZZANTI" (42 credits)

The student must complete 42 credits of this type by choosing a minimum of 6 credits in each of the groups below. The Classical Electrodynamics course (6 credits) belongs to the "Experimental Application" group and therefore covers the minimum request for this group.

"Experimental Application"		
ACCELERATOR PHYSICS 1	6	FIS/01
DATA STRUCTURES AND ALGORITHMS OF PHYSICS OF DATA	6	(3) FIS/07, (3) FIS/01
DOSIMETRY	6	FIS/07
ELECTRONICS 1	6	FIS/01
ELECTRONICS 2	6	FIS/01
ELECTRONICS LABORATORY *COURSE OFFERED EVERY OTHER YEAR: NOT AVAILABLE IN THE ACADEMIC YEAR 2024/25. ITS ACTIVATION IS SCHEDULED FOR THE ACADEMIC YEAR 2025/26*	6	FIS/01
ELEMENTS OF SUPERCONDUCTIVITY AND PHYSICS OF HIGH FIELD MAGNETS	6	FIS/01
ENVIRONMENTAL PHYSICS	6	FIS/07
HEALTH PHYSICS	6	FIS/07
IMAGING TECHNIQUES FOR BIOMEDICAL APPLICATIONS	6	(3) FIS/07, (3) FIS/01
MODELLING APPLICATIONS FOR ENVIRONMENTAL AND CULTURAL HERITAGE PHYSICS	6	FIS/07
OPTICAL ANALYSIS FOR CULTURAL HERITAGES	6	FIS/07
RADIOBIOLOGY	6	FIS/07
Theory and Fundamentals of Physics		
GRAVITY AND SUPERSTRINGS 1	6	FIS/02
MANY BODY THEORY 1	6	FIS/02
MANY BODY THEORY 2	6	FIS/02
MATHEMATICAL METHODS IN PHYSICS: DIFFERENTIAL EQUATIONS 1	6	FIS/02
MATHEMATICAL METHODS IN PHYSICS: GEOMETRY AND GROUP THEORY 1	6	FIS/02
MATHEMATICAL METHODS IN PHYSICS: GEOMETRY AND GROUP THEORY 2 *NOT AVAILABLE IN THE ACADEMIC YEAR 2024/25. ITS ACTIVATION IS SCHEDULED FOR THE ACADEMIC YEAR 2025/26*	6	FIS/02
QUANTUM FIELD THEORY 1	6	FIS/02
QUANTUM FIELD THEORY 2	6	FIS/02
STATISTICAL MECHANICS 1	6	FIS/02
STATISTICAL PHYSICS OF COMPLEX SYSTEMS	6	FIS/02
THEORY OF FUNDAMENTAL INTERACTIONS 1	6	FIS/02
THEORY OF QUANTUM OPEN SYSTEMS	6	FIS/02
Microphysics and Structure of Matter Field		
ACCELERATOR PHYSICS LABORATORY	6	FIS/04
ADVANCED STATISTICAL PHYSICS	6	FIS/03
APPLIED SUPERCONDUCTIVITY LABORATORY *COURSE OFFERED EVERY OTHER YEAR: NOT AVAILABLE IN THE ACADEMIC YEAR 2024/25. ITS ACTIVATION IS SCHEDULED FOR THE ACADEMIC YEAR 2025/26*	6	FIS/03
ASTROPARTICLE PHYSICS	6	FIS/04
COHERENCE AND CONTROL OF QUANTUM SYSTEM	6	FIS/03
ELECTRONIC STRUCTURE	6	FIS/03
ELECTROWEAK INTERACTIONS	6	FIS/04
INTERACTION AND DETECTION OF NUCLEAR RADIATION	6	FIS/04
LASER PHYSICS LABORATORY 1	6	FIS/03
MACHINE LEARNING	6	(3) FIS/04, (3) FIS/03
MAGNETIC PROPERTIES AND FINE ANALYSIS OF LOW DIMENSIONAL MATTER	6	FIS/03
NANOSCALE SOLID STATE PHYSICS	6	FIS/03
NUCLEAR ELECTRONICS	6	FIS/04
NUCLEAR PHYSICS	6	FIS/04
NUCLEAR SPECTROSCOPY LABORATORY	6	FIS/04
OPTICS 1	6	FIS/03
OPTICS LABORATORY AND APPLICATION	6	FIS/03
PARTICLE DETECTORS	6	FIS/04
PARTICLE PHYSICS	6	FIS/04
PHYSICS OF ELECTRONIC DEVICES	6	FIS/03
PHYSICS OF SOLIDS 1	6	FIS/03
PHYSICS PROTEIN 1	6	FIS/03
PLASMA PHYSICS AND CONTROLLED FUSION	6	FIS/03
PLASMA PHYSICS LABORATORY 1	6	FIS/03
PROBABILITY AND STATISTICS	6	(3) FIS/04, (3) FIS/03
QUANTUM INFORMATION THEORY	6	FIS/03
QUANTUM OPTICS	6	FIS/03
QUANTUM OPTICS LABORATORY	6	FIS/03
QUANTUM THEORY OF MATTER 2	6	FIS/03
RADIOACTIVITY	6	FIS/04
SEMICONDUCTOR PHYSICS	6	FIS/03
SURFACE PHYSICS 1	6	FIS/03

Astrophysics, Geophysics and Space Science Field		
ASTROPHYSICAL FLUID DYNAMICS	6	FIS/05
ATMOSPHERIC PHYSICS	6	FIS/06
COSMOLOGY 1	6	FIS/05
DYNAMICS OF GALAXIES	6	FIS/05
EXTRAGALACTIC ASTROPHYSICS	6	FIS/05
GENERAL ASTROPHYSICS 1	6	FIS/05
GENERAL ASTROPHYSICS 2	6	FIS/05
INTRODUCTION TO CONTINUUM PHYSICS	6	FIS/06
LABORATORY OF DATA MODELLING	6	(3) FIS/06, (3) FIS/05
NUCLEAR RELATIVISTIC ASTROPHYSICS 1	6	FIS/05
PHYSICS OF THE HYDROSPHERE AND THE CRYOSPHERE	6	GEO/12
RADIO ASTRONOMY 1	6	FIS/05
TECTONOPHYSICS	6	(3) FIS/06, (3) GEO/10
The student must also complete 18 credits by choosing from the following courses of type "AFFINI E INTEGRATIVI"		
ADVANCED GRAVITATIONAL PHYSICS	6	(3) FIS/05, (3) FIS/02
ALGEBRAIC TOPOLOGY	6	MAT/03
ATOMIC PHYSICS	6	FIS/03
BIOPHYSICS	6	(3) FIS/07, (3) FIS/03
COMPUTATIONAL PHYSICS LABORATORY	6	FIS/02
CONDENSED MATTER PHYSICS LABORATORY 2	6	FIS/03
COSMOLOGY 2	6	FIS/05
DATA ANALYTICS, FORWARD AND INVERSE MODELING: GEOPHYSICAL AND ENVIRONMENTAL FLUID DYNAMICS	6	GEO/12
DEEP LEARNING WITH APPLICATIONS	6	FIS/02
DIFFERENTIAL GEOMETRY	6	MAT/03
DIGITAL ELECTRONICS	6	ING-INF/01
DYNAMICAL SYSTEMS 1	6	MAT/07
EARTH PHYSICS LABORATORY	6	GEO/12
ENVIRONMENTAL PHYSICS LABORATORY	6	FIS/07
FOUNDATIONS IN ELECTRON MICROSCOPY (EM) AND ITS RELATED SPECTROSCOPIES	6	FIS/03
FOUNDATIONS OF ENERGY PRODUCTION	6	ING-IND/10
FOUNDATIONS OF PHYSICS	6	FIS/02
FOUNDATIONS OF QUANTUM MECHANICS	6	(3) FIS/03, (3) FIS/02
GEOMETRY 2	6	MAT/03
GRAVITY AND SUPERSTRINGS 2	6	FIS/02
HEALTH PHYSICS LABORATORY	6	FIS/07
HISTORY OF PHYSICS	6	FIS/08
INSTRUMENTATION APPLIED TO MEDICINE	6	FIS/07
INTRODUCTION TO ASTROPHYSICS	6	FIS/05
INTRODUCTION TO GENERAL RELATIVITY	6	FIS/02
INTRODUCTION TO HEALTH AND MEDICAL PHYSICS	6	FIS/07
LABORATORY OF SPACE INSTRUMENTATION (1)	6	FIS/05
LIQUID-STATE AND SOFT-MATTER PHYSICS	6	FIS/03
MATHEMATICAL ANALYSIS 4	6	MAT/05
METHODS OF DATA ANALYSIS	6	FIS/01
NANOPARTICLE PHYSICS	6	FIS/03
NONLINEAR OPTICS AND QUANTUM PHOTONICS	6	FIS/03
NUCLEAR MAGNETIC RESONANCE TECNIQUES: PHYSICS PRINCIPLES AND APPLICATIONS	6	FIS/07
NUMERICAL SIMULATION LABORATORY	6	(3) FIS/03, (3) FIS/02
NUMERICAL TECNIQUES FOR PHOTOREALISTIC IMAGE GENERATION	6	(3) FIS/06, (3) FIS/05
PARTICLE DETECTORS LABORATORY INSTRUMENTATION	6	FIS/01
PARTICLE PHYSICS LABORATORY 1	6	FIS/01
PERTURBATION THEORY OF HAMILTONIAN SYSTEMS	6	MAT/07
PHENOMENOLOGY OF THE STANDARD MODEL OF PARTICLE PHYSICS	6	FIS/04
PHYSICS LABORATORY OF CLIMATOLOGY AND ATMOSPHERIC PHYSICS *Course offered every other year: not available in the academic year 2024/25. Its activation is scheduled for the academic year 2025/26*	6	(3) FIS/07, (3) FIS/06
PHYSICS OF MEDICAL IMAGING	6	FIS/07
PREPARATION OF DIDACTICAL EXPERIENCES 1	6	FIS/08
PREPARATION OF DIDACTICAL EXPERIENCES 2	6	FIS/08
QUANTUM COMPUTING	6	FIS/03
QUANTUM WALKS	6	FIS/03
RADIATIVE PROCESSES IN ASTROPHYSICS	6	FIS/05
RADIO ASTRONOMY 2	6	FIS/05
SIMULATION OF CONDENSED MATTER AND BIOSYSTEMS	6	(2) BIO/10, (4) FIS/03
STOCHASTIC PROCESSES	6	(3) FIS/04, (3) FIS/03
THEORY OF FUNDAMENTAL INTERACTIONS 2	6	FIS/02
THIN FILM AND NANOSTRUCTURES CHARACTERIZATION	6	FIS/03
The student must also complete another 12 credits freely choosing from all the courses activated by the University, provided that they are culturally coherent with his/her educational path and cannot be superimposed, in content, to the fundamental and optional teachings already used in the Study Plan. All the teachings shown in this "Manifesto" that meet these criteria may be included in the selection.		

CURRICULUM: [F95-B] Multi-Sector Curriculum

Qualifying Training Objectives

The Multi-Sector curriculum program provides a broad spectrum of transversal knowledge covering the various areas of Physics. The provided skills match job requirements related to teaching and science dissemination. Graduates in this curriculum will have sufficient credits in appropriate groups of sectors to participate, as required by current legislation, in the public competitions for teaching in High Schools. From a didactic point of view, the multi-sector curriculum offers both

in-depth courses distributed evenly on the main areas of Physics, and courses in the anthropo-psycho-pedagogical area and in teaching methodologies and technologies. Specifically, 12 credits of type "caratterizzanti" are focused on teaching methodologies and technologies, while the "free choice" 18 credits cover the anthropo-psycho-pedagogical area so as to achieve the requirements for access to public competitions for teaching.

Further elective courses Curriculum-specific features Multi-Sector Curriculum

Courses of type "CARATTERIZZANTI" (48 credits)

The student must complete 48 credits of this type by choosing 12 credits in each of the groups below. The Classical Electrodynamics course belongs to the "Experimental Application" group and therefore covers 6 credits for this group.

Experimental Application		
ACCELERATOR PHYSICS 1	6	FIS/01
DOSIMETRY	6	FIS/07
ELECTRONICS 1	6	FIS/01
ELECTRONICS 2	6	FIS/01
ELECTRONICS LABORATORY *Course offered every other year: not available in the academic year 2024/25. Its activation is scheduled for the academic year 2025/26*	6	FIS/01
ELEMENTS OF SUPERCONDUCTIVITY AND PHYSICS OF HIGH FIELD MAGNETS	6	FIS/01
ENVIRONMENTAL PHYSICS	6	FIS/07
HEALTH PHYSICS	6	FIS/07
IMAGING TECHNIQUES FOR BIOMEDICAL APPLICATIONS	6	(3) FIS/07, (3) FIS/01
MODELLING APPLICATIONS FOR ENVIRONMENTAL AND CULTURAL HERITAGE PHYSICS	6	FIS/07
OPTICAL ANALYSIS FOR CULTURAL HERITAGES	6	FIS/07
RADIOBIOLOGY	6	FIS/07
Theory and Fundamentals of Physics		
HISTORY OF PHYSICS	6	FIS/08
PREPARATION OF DIDACTICAL EXPERIENCES 1	6	FIS/08
PREPARATION OF DIDACTICAL EXPERIENCES 2	6	FIS/08
Microphysics and Structure of Matter		
ACCELERATOR PHYSICS LABORATORY	6	FIS/04
ADVANCED STATISTICAL PHYSICS	6	FIS/03
APPLIED SUPERCONDUCTIVITY LABORATORY *Course offered every other year: not available in the academic year 2024/25. Its activation is scheduled for the academic year 2025/26*	6	FIS/03
ASTROPARTICLE PHYSICS	6	FIS/04
COHERENCE AND CONTROL OF QUANTUM SYSTEM	6	FIS/03
ELECTRONIC STRUCTURE	6	FIS/03
ELECTROWEAK INTERACTIONS	6	FIS/04
INTERACTION AND DETECTION OF NUCLEAR RADIATION	6	FIS/04
LASER PHYSICS LABORATORY 1	6	FIS/03
MAGNETIC PROPERTIES AND FINE ANALYSIS OF LOW DIMENSIONAL MATTER	6	FIS/03
NANOSCALE SOLID STATE PHYSICS	6	FIS/03
NUCLEAR ELECTRONICS	6	FIS/04
NUCLEAR PHYSICS	6	FIS/04
NUCLEAR SPECTROSCOPY LABORATORY	6	FIS/04
OPTICS 1	6	FIS/03
OPTICS LABORATORY AND APPLICATION	6	FIS/03
PARTICLE DETECTORS	6	FIS/04
PARTICLE PHYSICS	6	FIS/04
PHYSICS OF ELECTRONIC DEVICES	6	FIS/03
PHYSICS OF SOLIDS 1	6	FIS/03
PHYSICS PROTEIN 1	6	FIS/03
PLASMA PHYSICS AND CONTROLLED FUSION	6	FIS/03
PLASMA PHYSICS LABORATORY 1	6	FIS/03
QUANTUM INFORMATION THEORY	6	FIS/03
QUANTUM OPTICS	6	FIS/03
QUANTUM OPTICS LABORATORY	6	FIS/03
QUANTUM THEORY OF MATTER 2	6	FIS/03
RADIOACTIVITY	6	FIS/04
SEMICONDUCTOR PHYSICS	6	FIS/03
SURFACE PHYSICS 1	6	FIS/03
Astrophysics, Geophysics and Space Science		
ASTROPHYSICAL FLUID DYNAMICS	6	FIS/05
ATMOSPHERIC PHYSICS	6	FIS/06
COSMOLOGY 1	6	FIS/05
DYNAMICS OF GALAXIES	6	FIS/05
EXTRAGALACTIC ASTROPHYSICS	6	FIS/05
GENERAL ASTROPHYSICS 1	6	FIS/05
GENERAL ASTROPHYSICS 2	6	FIS/05
INTRODUCTION TO CONTINUUM PHYSICS	6	FIS/06
NUCLEAR RELATIVISTIC ASTROPHYSICS 1	6	FIS/05
PHYSICS OF THE HYDROSPHERE AND THE CRYOSPHERE	6	GEO/12
RADIO ASTRONOMY 1	6	FIS/05
TECTONOPHYSICS	6	(3) FIS/06, (3) GEO/10
The student must also complete 12 credits by choosing from the following courses of type "AFFINI E INTEGRATIVI".		
ADVANCED GRAVITATIONAL PHYSICS	6	(3) FIS/05, (3) FIS/02
ALGEBRAIC TOPOLOGY	6	MAT/03
ATOMIC PHYSICS	6	FIS/03
BIOPHYSICS	6	(3) FIS/07, (3) FIS/03

COMPUTATIONAL PHYSICS LABORATORY	6	FIS/02
CONDENSED MATTER PHYSICS LABORATORY 2	6	FIS/03
COSMOLOGY 2	6	FIS/05
DATA ANALYTICS, FORWARD AND INVERSE MODELING: GEOPHYSICAL AND ENVIRONMENTAL FLUID DYNAMICS	6	GEO/12
DATA STRUCTURES AND ALGORITHMS OF PHYSICS OF DATA	6	(3) FIS/07, (3) FIS/01
DEEP LEARNING WITH APPLICATIONS	6	FIS/02
DIFFERENTIAL GEOMETRY	6	MAT/03
DIGITAL ELECTRONICS	6	ING-INF/01
DYNAMICAL SYSTEMS 1	6	MAT/07
EARTH PHYSICS LABORATORY	6	GEO/12
ENVIRONMENTAL PHYSICS LABORATORY	6	FIS/07
FOUNDATIONS IN ELECTRON MICROSCOPY (EM) AND ITS RELATED SPECTROSCOPIES	6	FIS/03
FOUNDATIONS OF ENERGY PRODUCTION	6	ING-IND/10
FOUNDATIONS OF PHYSICS	6	FIS/02
FOUNDATIONS OF QUANTUM MECHANICS	6	(3) FIS/03, (3) FIS/02
GEOMETRY 2	6	MAT/03
GRAVITY AND SUPERSTRINGS 1	6	FIS/02
GRAVITY AND SUPERSTRINGS 2	6	FIS/02
HEALTH PHYSICS LABORATORY	6	FIS/07
INSTRUMENTATION APPLIED TO MEDICINE	6	FIS/07
INTRODUCTION TO ASTROPHYSICS	6	FIS/05
INTRODUCTION TO GENERAL RELATIVITY	6	FIS/02
INTRODUCTION TO HEALTH AND MEDICAL PHYSICS	6	FIS/07
LABORATORY OF DATA MODELLING	6	(3) FIS/06, (3) FIS/05
LABORATORY OF SPACE INSTRUMENTATION (1)	6	FIS/05
LIQUID-STATE AND SOFT-MATTER PHYSICS	6	FIS/03
MACHINE LEARNING	6	(3) FIS/04, (3) FIS/03
MANY BODY THEORY 1	6	FIS/02
MANY BODY THEORY 2	6	FIS/02
MATHEMATICAL ANALYSIS 4	6	MAT/05
MATHEMATICAL METHODS IN PHYSICS: DIFFERENTIAL EQUATIONS 1	6	FIS/02
MATHEMATICAL METHODS IN PHYSICS: GEOMETRY AND GROUP THEORY 1	6	FIS/02
MATHEMATICAL METHODS IN PHYSICS: GEOMETRY AND GROUP THEORY 2 *NOT AVAILABLE IN THE ACADEMIC YEAR 2024/25. ITS ACTIVATION IS SCHEDULED FOR THE ACADEMIC YEAR 2025/26*	6	FIS/02
METHODS OF DATA ANALYSIS	6	FIS/01
NANOPARTICLE PHYSICS	6	FIS/03
NONLINEAR OPTICS AND QUANTUM PHOTONICS	6	FIS/03
NUCLEAR MAGNETIC RESONANCE TECNIQUES: PHYSICS PRINCIPLES AND APPLICATIONS	6	FIS/07
NUMERICAL SIMULATION LABORATORY	6	(3) FIS/03, (3) FIS/02
NUMERICAL TECNIQUES FOR PHOTOREALISTIC IMAGE GENERATION	6	(3) FIS/06, (3) FIS/05
PARTICLE DETECTORS LABORATORY INSTRUMENTATION	6	FIS/01
PARTICLE PHYSICS LABORATORY 1	6	FIS/01
PERTURBATION THEORY OF HAMILTONIAN SYSTEMS	6	MAT/07
PHENOMENOLOGY OF THE STANDARD MODEL OF PARTICLE PHYSICS	6	FIS/04
PHYSICS LABORATORY OF CLIMATOLOGY AND ATMOSPHERIC PHYSICS *Course offered every other year: not available in the academic year 2024/25. Its activation is scheduled for the academic year 2025/26*	6	(3) FIS/07, (3) FIS/06
PHYSICS OF MEDICAL IMAGING	6	FIS/07
PROBABILITY AND STATISTICS	6	(3) FIS/04, (3) FIS/03
QUANTUM COMPUTING	6	FIS/03
QUANTUM FIELD THEORY 1	6	FIS/02
QUANTUM FIELD THEORY 2	6	FIS/02
QUANTUM WALKS	6	FIS/03
RADIATIVE PROCESSES IN ASTROPHYSICS	6	FIS/05
RADIO ASTRONOMY 2	6	FIS/05
SIMULATION OF CONDENSED MATTER AND BIOSYSTEMS	6	(2) BIO/10, (4) FIS/03
STATISTICAL MECHANICS 1	6	FIS/02
STATISTICAL PHYSICS OF COMPLEX SYSTEMS	6	FIS/02
STOCHASTIC PROCESSES	6	(3) FIS/04, (3) FIS/03
THEORY OF FUNDAMENTAL INTERACTIONS 1	6	FIS/02
THEORY OF FUNDAMENTAL INTERACTIONS 2	6	FIS/02
THEORY OF QUANTUM OPEN SYSTEMS	6	FIS/02
THIN FILM AND NANOSTRUCTURES CHARACTERIZATION	6	FIS/03
The student must also complete another 18 credits freely choosing from all the courses activated by the University, provided that they are culturally coherent with his/her educational path and cannot be superimposed, in content, to the fundamental and optional teachings already used in the Study Plan. The insertion of courses in the anthropo-psycho-pedagogical area is strongly recommended as required, based on current legislation, for access to public competitions for teaching.		