UNIVERSITA' DEGLI STUDI DI MILANO
PROGRAMME DESCRIPTION - ACADEMIC YEAR 2022/23
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

Degree Course Coordinator
Prof. Nicola Manini

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, P.M. Pizzochero, M. Sorbi, G. Tiana, A. Vicini

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

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
Davide ABRIOLA
Clara IAQUINTA
Andrea SALA
Raffaele SALIONI

Degree Course website
https://fisica-lm.cdl.unimi.it

Admission
G. Bertin, M. Di Vece, M. Fanti, G. Maero Email: commissione.ammissione@fisica.unimi.it

Dissertation and Final Exam
I. Veronese (Presidente), C. Benedetti, S. Carrazza, F. Crespi, V. Liberali, D. Maino,

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

Laboratory Security
M. Potenza

PLS Program Chair
M. Giliberti

Program Transfer
G. Bertin, M. Di Vece, M. Fanti, G. Maero Email: commissione.ammissione@fisica.unimi.it

Reference Office
Via Celoria 16 - 20133 Milano Phone 02.50317401 Email: cl.fisica@unimi.it

Schedule of Classes
M. Gherardi, A. Guglielmetti, M. Zaro, F. Cordani

Specific Learning Disabilities
L. Carminati

Statistical Dats
G. Colò, A. Guglielmetti, F. Ragusa

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

CHARACTERISTICS OF DEGREE PROGRAMME

General and specific learning objectives

The aim given to the Master's course in Physics is to enable the graduate student to either continue with further studies or to take part in research or professional activity with the necessary competence, having learnt the use of scientific methods and experimental basis, theoretical and mathematical, on which physics is based.
The Master's degree course will enable the student to deepen acquired knowledge in classic physics, relativity and quantum physics as regards to phenomenological aspects, theoretical aspects and their mathematical formulas.
Having acquired adequate mathematical and computer instruments, the student will be able to carry out tests in formulations in the use of mathematical models and in the use of calculus techniques for problem solving in physics.
The Master's Degree course is open to further development and in-depth study in post-graduate courses. It foresees different majors which permit the graduate student to enter basic research and/or applied research and in work-related areas which require experimental-applicative competences, the knowledge of innovative methods, the use of complex equipment.

Expected learning outcomes

Master's graduates will be able to work with wide autonomy, even assuming responsibility for projects and groups, and to use the specific knowledge acquired for modeling complex systems in most fields of applied sciences.

Professional profile and employment opportunities

Graduates will typically work in industry and in public or private institutions, in structures such as:
- research centers and laboratories
- hospitals and health facilities that use techniques for diagnostics, therapy and radiation protection
- astronomical observatories
- museums and other centers dedicated to scientific dissemination
- banks and insurance companies
- divisions dedicated to the development of mathematical-statistical models of phenomena
- divisions dedicated to the use and development of systems and instruments
- structures active in the restoration of artistic heritage and in the protection of environmental assets
- power plants (including for example nuclear power plants)
- structures for data acquisition and processing

Job opportunities include, by way of example:
- analysis and scientific classification of measurable phenomena of interest;
- prototype designer and developer;
- expert in the use and development of instruments;
- expert in measurements of natural phenomena (e.g. radioactivity, electromagnetic fields, etc.);
- risk assessment in the field of radiation protection and scientific support to decision making
- data scientist;
- developer of mathematical-statistical forecasting models in a wide range of fields (mechanics, finance, medicine, ...);
- work group coordinator;
- research and development;

- dissemination of scientific culture;
- technical-scientific training of staff and/or external users;
- designing innovative teaching projects;
- editor of scientific texts (articles, books, essays, etc.)

Professional skills
Physics graduates will have the skillset required for the above professions. These skills rest on a sound scientific background and open-mindedness, and include:
- classical and modern physics skills and acumen;
- the ability to use the scientific method;
- the ability to lead, coordinate, and inspire R&D teams;
- advanced mathematics, statistics and computer skills;
- the ability to process and interpret statistical data on the basis of physical theories or models;
- the ability to use complex equipment and computer interface for optimizing measurement automation;
- the ability to communicate science effectively, also in English

Initial knowledge required

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 2022.

For the 2022/2023 academic year, interviews are scheduled on the following dates:
30 June 2022, 9.00 am, board room of the Department of Physics
16 September 2022, 9.00 am, board room of the Department of Physics
28 October 2022, 9.00 am, board room of the Department of Physics
13 January 2023, 9.00 am, board room of the Department of Physics.

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.
English language proficiency is assessed by the University Language Centre (SLAM) during the admission process based on:
- a language certificate obtained no more than 3 years earlier, at B1 or higher (the list of language certificates recognized by the University is available at https://www.unimi.it/en/study/language-proficiency/placement-tests-and-english-courses/english-entry-tests). The certificate must be uploaded when submitting the online application;
- the English level achieved during a Bachelor's degree programme through SLAM. The test must have been passed within the last four years. Language proficiency certificates will be checked by our offices, without the candidate having to attach any documents;
- placement test delivered by SLAM, which will take place as described here: https://www.unimi.it/en/study/language-proficiency/placement-tests-and-english-courses/english-entry-tests

All those who fail to submit a valid certificate or do not meet language proficiency requirements will be asked to sit a language test when applying for admission.
Candidates who do not sit or pass the placement test will have until 31 December 2022 to obtain and submit a recognized certificate to SLAM.
Students who do not meet the requirement by 31 December will not be admitted to the Master's degree programme and may not sit further tests.

Compulsory attendance

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

Internship criteria

The specialist curriculum includes an internship, possibly in connection with thesis work. Interns will be supervised by a programme instructor who will certify the quality of training activities

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

Campus

Academic offices for the Bachelor's degree programme in Physics: Department of Physics, Via Celoria 16
Course venue: courses are held in the classrooms of the Physics Department, via Celoria 16, or in the teaching facilities, Via Celoria 20

Laboratories

The degree programme mainly uses the laboratories at the Physics Department

Notes

a) 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 Bachelor's degree programme through SLAM courses and tests. The test must have been passed within the last four years. It will be assessed administratively, without the applicant having to attach any certificates;
- Placement Test delivered by the University Language Centre (SLAM), which will take place according to the schedule posted to 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 invited to take the test through the admission procedure.
Candidates who do not sit or pass the placement test will have until 31 December 2022 to obtain and submit a recognized certificate to SLAM.
Students who do not meet the requirement by 31 December will not be admitted to the Master's degree programme and may not sit further tests.

b) In order to obtain their degree, students must be proficient in English at a B2 level. This proficiency level may be certified as follows:
- Through a language certificate at a B2 level or higher, as submitted during the admission procedure;
- Through the entrance test (B2 level or higher);
- Through a Placement Test, which is delivered by the University Language Centre (SLAM) during year I only, from October to January (B2 or higher).
All students who do not have a B2 level or higher will be required to attend a B2-level English course, which will be delivered by the University Language Centre (SLAM), in the second semester of year I only.
Those who do not attend the course or do not pass the end-of-course test within six attempts must obtain a paid language certificate by graduation.

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.

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
APPLIED SUPERCONDUCTIVITY	6	FIS/01
DATA STRUCTURES AND ALGORITHMS OF PHYSICS OF DATA	6	FIS/07, FIS/01
DOSIMETRY	6	FIS/07
ELECTRONICS 1	6	FIS/01
ELECTRONICS 2	6	FIS/01
ELECTRONICS LABORATORY	6	FIS/01
ENVIRONMENTAL PHYSICS	6	FIS/07
HEALTH PHYSICS	6	FIS/07
IMAGING TECHNIQUES FOR BIOMEDICAL APPLICATIONS	6	FIS/07, 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	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
STATISTICAL QUANTUM FIELD THEORY 1	6	FIS/02
THEORY OF FUNDAMENTAL INTERACTIONS 1	6	FIS/02
Microphysics and Structure of Matter Field		
ACCELERATOR PHYSICS LABORATORY	6	FIS/04
ADVANCED STATISTICAL PHYSICS	6	FIS/03
APPLIED SUPERCONDUCTIVITY LABORATORY	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	FIS/04, 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	FIS/04, 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		
ASTRONOMY 1	6	FIS/05
ASTRONOMY 2	6	FIS/05
ATMOSPHERIC PHYSICS	6	FIS/06
COSMIC PHYSICS 1	6	FIS/05
COSMOLOGY	6	FIS/05
EARTH PHYSICS	6	GEO/12
EXTRAGALACTIC ASTROPHYSICS	6	FIS/05
INTRODUCTION TO CONTINUUM PHYSICS	6	FIS/06
LABORATORY OF DATA MODELLING	6	FIS/06, FIS/05
NUCLEAR RELATIVISTIC ASTROPHYSICS 1	6	FIS/05
RADIO ASTRONOMY 1	6	FIS/05
TECTONOPHYSICS	6	FIS/06, GEO/10
THEORETICAL ASTROPHYSICS 1	6	FIS/05
The student must also complete 18 credits by choosing from the following courses of type "AFFINI E INTEGRATIVI"		
ALGEBRAIC TOPOLOGY	6	MAT/03
ATOMIC PHYSICS	6	FIS/03
BIOPHYSICS	6	FIS/07, FIS/03
CLASSICAL MECHANICS 2	6	MAT/07
COMPUTATIONAL BIOPHYSICS	6	BIO/10, INF/01, FIS/03
COMPUTATIONAL PHYSICS LABORATORY	6	FIS/02
CONDENSED MATTER PHYSICS LABORATORY 2	6	FIS/03
COSMIC PHYSICS 2	6	FIS/05
COSMOLOGY 2	6	FIS/05
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	FIS/03, FIS/02
GEOMETRY 2	6	MAT/03
GEOPHYSICAL AND ENVIRONMENTAL MODELING	6	GEO/12
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
NUCLEAR RELATIVISTIC ASTROPHYSICS 2	6	FIS/05
NUCLEAR WEAPONS, DISARMAMENT AND NUCLEAR PROLIFERATION	6	CHIM/03, FIS/04
NUMERICAL SIMULATION LABORATORY	6	FIS/03, FIS/02
NUMERICAL TECNIQUES FOR PHOTOREALISTIC IMAGE GENERATION	6	FIS/06, 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
PHYSICAL APPLICATIONS OF GROUP THEORY	6	FIS/02
PHYSICS LABORATORY OF CLIMATOLOGY AND ATMOSPHERIC PHYSICS	6	FIS/07, 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 INFORMATION THEORY	6	FIS/03
QUANTUM WALKS	6	FIS/03
RADIO ASTRONOMY 2	6	FIS/05
STATISTICAL QUANTUM FIELD THEORY 2	6	FIS/02
STOCHASTIC PROCESSES	6	FIS/04, FIS/03
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 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.		
The student must also complete another 6 credits related to training and orientation internships possibly in the context of the thesis work. In this case the tutor teacher for the activity may be the thesis supervisor.		

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
APPLIED SUPERCONDUCTIVITY	6	FIS/01
DOSIMETRY	6	FIS/07
ELECTRONICS 1	6	FIS/01
ELECTRONICS 2	6	FIS/01
ELECTRONICS LABORATORY	6	FIS/01
ENVIRONMENTAL PHYSICS	6	FIS/07
HEALTH PHYSICS	6	FIS/07
IMAGING TECHNIQUES FOR BIOMEDICAL APPLICATIONS	6	FIS/07, 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	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 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		
ASTRONOMY 1	6	FIS/05
ASTRONOMY 2	6	FIS/05
ATMOSPHERIC PHYSICS	6	FIS/06
COSMIC PHYSICS 1	6	FIS/05
COSMOLOGY	6	FIS/05
EARTH PHYSICS	6	GEO/12
EXTRAGALACTIC ASTROPHYSICS	6	FIS/05
INTRODUCTION TO CONTINUUM PHYSICS	6	FIS/06
NUCLEAR RELATIVISTIC ASTROPHYSICS 1	6	FIS/05
RADIO ASTRONOMY 1	6	FIS/05
TECTONOPHYSICS	6	FIS/06, GEO/10
THEORETICAL ASTROPHYSICS 1	6	FIS/05
The student must also complete 12 credits by choosing from the following courses of type "AFFINI E INTEGRATIVI".		
ALGEBRAIC TOPOLOGY	6	MAT/03

ATOMIC PHYSICS	6	FIS/03
BIOPHYSICS	6	FIS/07, FIS/03
CLASSICAL MECHANICS 2	6	MAT/07
COMPUTATIONAL BIOPHYSICS	6	BIO/10, INF/01, FIS/03
COMPUTATIONAL PHYSICS LABORATORY	6	FIS/02
CONDENSED MATTER PHYSICS LABORATORY 2	6	FIS/03
COSMIC PHYSICS 2	6	FIS/05
COSMOLOGY 2	6	FIS/05
DATA STRUCTURES AND ALGORITHMS OF PHYSICS OF DATA	6	FIS/07, 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	FIS/03, FIS/02
GEOMETRY 2	6	MAT/03
GEOPHYSICAL AND ENVIRONMENTAL MODELING	6	GEO/12
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	FIS/06, FIS/05
LABORATORY OF SPACE INSTRUMENTATION (1)	6	FIS/05
LIQUID-STATE AND SOFT-MATTER PHYSICS	6	FIS/03
MACHINE LEARNING	6	FIS/04, 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	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
NUCLEAR RELATIVISTIC ASTROPHYSICS 2	6	FIS/05
NUCLEAR WEAPONS, DISARMAMENT AND NUCLEAR PROLIFERATION	6	CHIM/03, FIS/04
NUMERICAL SIMULATION LABORATORY	6	FIS/03, FIS/02
NUMERICAL TECNIQUES FOR PHOTOREALISTIC IMAGE GENERATION	6	FIS/06, 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
PHYSICAL APPLICATIONS OF GROUP THEORY	6	FIS/02
PHYSICS LABORATORY OF CLIMATOLOGY AND ATMOSPHERIC PHYSICS	6	FIS/07, FIS/06
PHYSICS OF MEDICAL IMAGING	6	FIS/07
PROBABILITY AND STATISTICS	6	FIS/04, FIS/03
QUANTUM COMPUTING	6	FIS/03
QUANTUM FIELD THEORY 1	6	FIS/02
QUANTUM FIELD THEORY 2	6	FIS/02
QUANTUM INFORMATION THEORY	6	FIS/03
QUANTUM WALKS	6	FIS/03
RADIO ASTRONOMY 2	6	FIS/05
STATISTICAL MECHANICS 1	6	FIS/02
STATISTICAL PHYSICS OF COMPLEX SYSTEMS	6	FIS/02
STATISTICAL QUANTUM FIELD THEORY 1	6	FIS/02
STATISTICAL QUANTUM FIELD THEORY 2	6	FIS/02
STOCHASTIC PROCESSES	6	FIS/04, 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.