UNIVERSITÀ
degli STUDI
di CATANIA

DIDACTIC REGULATIONS of the MASTER OF SCIENCE in

Physics (LM17)

For Students Registered in the Academic Year
2020-21

Approved by the Academic Senate in the session of June 30th, 2020

1. GENERAL DETAILS

1.1 Department concerned: Physics and Astronomy

1.2 Class: LM17 Physics

1.3 Address: *Via S. Sofia 64, 95123 Catania*

1.4 Particular organizational rules

- International course divided into six curricula.
The MSc Degree Course is coordinated by the President, who is also the QA manager; the MGQA consists of the President, a professor of the degree course, a student representative and a representative from the Teaching Secretary office of the Department of Physics and Astronomy "Ettore Majorana". Contact teachers are provided for each Curriculum. All actions are carried out in liaison with the Department's Board.

The Management Group for Quality Assurance (MGQA) is made up of:
- Prof. Francesca Zuccarello (President of the MSc Degree in Physics).
- Prof. Francesco Ruffino (Associate Prof., SSD FIS/01)
- Dr. Sara De Francisci (Teaching Secretary Office)
- Dott. Daniele Rizzo (Student Rep)

1.5 Key professional roles:
The activities that LM-17 graduates will be able to carry out include in particular:

Functions in a work context:
The graduate in Physics will be able to perform the following functions:
- Researcher at research Institutions and Universities
- Researcher in industries in the R&D sector
- In charge of the activities of laboratories with coordination and management duties where complex instrumentation and machinery are present.
- Design and management of technologies in areas related to physical disciplines, in the sectors of industry, environment, health, cultural heritage and public administration, ensuring the promotion and development of scientific and technological innovation.
- In charge of the management and quality control of processes and products
- Manager with duties dealing with large amounts of data
- Consultant and promoter in spin-off activities
- Lecturer and promoter of scientific culture, after having acquired further specializations.

Skills associated with the role:
Graduates in Physics have the following skills:
- ability to conduct fundamental applied research activities independently and in groups
- ability to tackle problems even in complex situations where a quantitative approach is required
- ability in the use of complex instrumentation in laboratories in the various fields of physics
- ability to collaborate with colleagues, also in an interdisciplinary and international context and with roles of responsibility
- skills in the design of new technologies in the environment, cultural heritage, medicine, instrumentation for astrophysics, nanotechnologies
- skills in the development and use of data analysis, statistical analysis and simulation software
- ability to present their work to specialist and non-specialist interlocutors.

Professional outlets:
Graduates in Physics will be able to find employment, at an executive level, in:
- fundamental and applied research activities, in public and private research bodies such as INFN, INAF, CNR, CERN, INGV, ENEA, ESO, ASI, ESA, etc.
- the industrial sector in the design of innovative technologies in companies that invest in R&D on the properties of new materials, nanotechnologies, optics, fine mechanics, electronic devices, sensors, instrumentation for energy and environmental applications, etc.
- regional agencies for the environment, for the prevention and control of environmental risks
- National heritage for the BBCCAA, for analysis in the field of cultural heritage
- Civil Protection for seismic risk analysis
- radioprotection of human beings and the environment, control and management of equipment that emit ionizing radiation in health care companies, analysis laboratories and medical offices
-data analysis and modelling of complex systems and stochastic phenomena in banks, financial, insurance and consulting companies
- applications of mathematical and computer knowledge in computer design studies
Graduates can also envisage teaching in schools as a professional outlet, once the teaching qualification process has been completed and the examinations required by law are passed.
The Master's Degree in Physics is also the only qualification that allows access to the selection process for admission to the Specialization in Medical Physics for the achievement of the title of Specialist in Medical Physics included within the health profession.
The graduate in Physics will also soon be able to operate as a freelancer, enrolled in the recently created professional register of Chemists and Physicists (UNI 11683: 2017 standard) as a Master Physicist (MP). The MP carries out professional activities that require the mastery of scientific method, specific technical-scientific skills and the ability to model complex phenomena through the use of advanced and innovative methodologies.

The course prepares for the professions of

- Physicists (ISTAT 2.1.1.1.1 code)
- Astronomers and astrophysicists (ISTAT 2.1.1.1.2 code)

1.6 Access to the course: unrestricted

1.7 Course language: English

1.8 Course duration: two years

2. ADMISSION REQUIREMENTS

2.1 Curricular requirements

The Master's degree program in Physics is a course with an unrestricted number.

To be admitted to the Master's degree program in Physics it is necessary to:

i) be in possession of a three-year university degree or diploma, or any other qualification obtained abroad, recognized as valid by the Degree Program Board

ii) possess the following specific curricular requirements:

- 27 ECTS of Mathematics SSD (Disciplinary Scientific Sector – Academic Fields and Disciplines)

- 60 ECTS of Physics SSD (Disciplinary Scientific Sector – Academic Fields and Disciplines)

- be able to use the English language fluently, in written and oral form, with reference also to specific disciplinary language (at least a B2 level).

iii) pass the test of satisfactory preparation (see point 2.2).

A conditional offer is made to students who, at the time of submitting their registration application in the first year, do not have all the requisites required. In order to complete registration, credits (not part of the CdSM study plan) must be acquired by the end of the first exam session of the A.Y. 2020/2021.

As far as the passage or transfer of students already registered in previous Academic Years in other degree courses of the University of Catania or of another University is concerned, please refer to the "General Prospectus of Studies" and the relative announcements that will be published on the website of University (www.unict.it).

In the case of foreign students, or in possession of a degree with a curricular path that cannot be defined in terms of ECTS, the degree program committee establishes the equivalence between courses in terms of ECTS and educational content.

2.2 Admission tests and methods of testing the adequacy of preparation

Adequate preparation is considered satisfactory if the candidate has obtained a Bachelor's Degree in Physics with a final grade of not less than 100 and has a B2 level certification (or self-declaration) of knowledge of the English language, or has passed the exam of an English language university course for which the achievement of this level is certified, subject to the provisions of the University Teaching Regulations on the assessment of the non-obsolescence of the cognitive contents of credits awarded within the last 6 years.

In the other cases there will be an admission test, which aims to verify the adequacy of the preparation and consists of an interview with an evaluation commission, annually appointed by the CCdS (Committee of the Course of Studies), which will ascertain the knowledge and skills required for enrolment. The interview will take place on the date, location and time published on the University website (www.unict.it) and will focus on basic topics regarding: fundamental knowledge of phenomenology and models of classical and modern physics; laboratory skills, in particular dedicated to the knowledge of basic instrumentation, to the measurement and processing of data also through IT tools.

During the interview, the knowledge of the English language will also be tested for candidates who do not have the relevant certification. The interview can also be carried out remotely on-line at the candidate’s request to the person in charge of the procedure.

Following the interview, the candidate can be evaluated by the commission as ADMITTED or NOT ADMITTED. Admitted candidates will be able to proceed with registration according to the procedures for registration and enrolment in study courses that will be published on www.unict.it.
svolto anche per via telematica su richiesta del candidato al responsabile del procedimento.
For how to access to the Nuclear Phenomena and their Applications (NucPhys) curriculum, reference is made to the Consortium Agreement ((http://www.emm-nucphys.eu/).

2.3 Criteria for the recognition of credits obtained in other study courses

Students from other universities or other university degree programs may apply for recognition of previously earned credits. The Board of the CdS (Course of Studies) will verify the congruency of these credits with the course study plan and will decide on the eventual validation, total or partial, of them. The criterion used ensures the validation of the largest possible number of credits acquired by the student, as suggested by the University Teaching Regulations.

In the event that the student comes from a study course belonging to the same class, the share of credits which relate to the same disciplinary scientific sector and awarded to the student cannot be less than 50% of those already accrued.

For anything not included herein, please refer to the University Teaching Regulations, as amended by D.R. n. 251 of 25/01/2018, and the University guidelines for the recognition of university educational credits, approved by the Academic Senate on 21.02.2011.

2.4 Criteria for recognizing professional knowledge and skills

The Committee of the Master's Degree Course in Physics can recognize any knowledge and professional skills certified in accordance with current legislation on the subject as university training credits (ECTS). The recognition of these credits is approved by the Committee of the Master's Degree Course in Physics, based on the verification of the congruency of the activities carried out with the objectives of the Master's Degree course. Activities already recognized for the purpose of assigning ECTSs in the context of degree courses cannot be recognized again as educational credits in the context of the Master's Degree course.

2.5 Criteria for recognizing knowledge and skills gained in post-level training activities secondary school realized with the help of the University

The Committee of the Master's Degree Course in Physics will be able to recognize any knowledge and professional skills acquired in post-secondary level training activities carried out with the University's support, if congruent with the educational objectives of the degree course, attributing university training credits to these activities on the basis of the evaluation of adequate certification qualifications that certify their possession.

2.6 Maximum number of recognizable credits

Credits recognizable for knowledge and skills mentioned in the previous tables 2.4 and 2.5 cannot be in more than 12 ECTS (note MIUR 1063 of 29.04.2011).

3. ORGANIZATION OF TEACHING

3.1 Attendance

Attendance at the courses is usually compulsory. In the case of working students, student athletes and students in difficult situations, as required by Art. 27 of the University Teaching Regulations and the Regulations for the recognition of the status of student workers, student athletes, students in difficulty and students with disabilities (DR n.1598 of 2/5/2018), partial or total exemptions from attendance will be granted, by means of a specific decision of the Committee of the Master's Degree Course in Physics, upon presentation of an official request recognized as such by the Committee and if the conditions exist, agreed on with the teachers holding the courses concerned, to activate the necessary forms of supplementary teaching support, suitable for guaranteeing the adequate preparation of the student. Furthermore, to meet the needs of working students, the Committee of the Master's Degree Program, in accordance with Article 26 of the University Teaching Regulations at the request of the student concerned, can authorize a part-time course that can be divided into 4 years instead of 2, with unchanged contents.

The student who has not acquired the attendance of the courses foreseen by their educational path, in the previous course year, is regularly registered in the following year, although the obligation to attend the courses which they have not obtained the certificate of attendance for remains.

At the end of the 2 years, the student is registered as not having done all his/her exams within the prescribed deadline (fuori corso-FC) with the obligation to obtain the certificate of attendance for the relevant courses.

3.2 Methods of ascertaining attendance

The methods of conducting the courses and the relative verification of attendance are delegated to the organizational autonomy of the teachers holding the courses. Each teacher holding a teaching course, at least 15 days before the start of the 1st session of the exams of the course itself, will send to the Student Services Office the list of those who, having not attended the course, are not entitled to obtain the certification.

3.3 Type of teaching methods used

Lessons will be given in English.

The courses can include several modules, each of which refers to a different type of activity, which corresponds to a different fraction of the total time commitment to be allocated to the activities run by the teacher, according to the scheme below:

Lectures (F)	1 ECTS = 7 hours of lectures in the lecture room
Laboratory or practical activities (L)	1 ECTS = 15 hours of work (exercises in lecture room or laboratory) run by a teacher
Activities for the final exam (PF)	1 ECTS = 25 hours of self-study

Any variations to the equivalence between 1 ECTS of lectures and the number of hours of lessons may be established in the event that the University regulates such correspondence for the lessons provided in distance learning mode.

Credits are usually acquired by passing the relative exams.

3.4 Verification of the Preparation Procedure

The exams, whatever the type chosen by the teacher, are in any case concluded in oral form(O) with an oral test held between the student and the Examining Commission, aimed at ascertaining the degree of learning and understanding of the topics contained in the course program. Written (W) or practical (P) tests may be provided to help assess the student. The results of these tests are in no case preclusive to carrying out the exam in its oral form.

The exam mark is expressed on a total of thirty and may considering any tests taken during the course and the results achieved in any written or practical tests. However, the exam is the ultimate test and as such must be completed by the student. To pass the exam, a minimum grade of 18/30 must be achieved. The commission can award honours to the student who obtains the highest marks. The exam is registered, electronically, by the Examining Commission, which records the contents of the test and the grade attributed.

By passing the exam, the student is credited with the number of credits corresponding to the relevant course, according to what is shown in the Teaching Plan of the Master's Degree Course valid at the time of their initial registration in the Master's Degree course. In the event that the student decides to interrupt the exam before its conclusion, the annotation "withdrawn" is shown. If the examination ends with a negative result, the annotation "not approved" is recorded.

If the exam is divided into several tests, the Examining Commission takes minutes at the end of the exam. Internships and training courses are not evaluated with a grade and the relative credits are acquired after a positive evaluation of the report on the work done by the student and endorsed by the tutor.

3.5 Rules for submitting individual study plans

As a rule, immediately after registering in the first year, according to a calendar published on the Master' s Course website, each student must indicate the chosen curriculum and submit the study plan with the indication of the courses chosen from among the options proposed in the curriculum, in accordance with the Teaching Regulations. Elective courses must also be indicated in the study plan, these can be chosen from among all the courses offered at the University of Catania.

The replacement of one or more disciplines with respect to the teaching plan envisaged for the curriculum, in accordance with the constraints of the law, is considered as a proposal for a personalized study plan. The study plan (SP) approval procedure specifies that: a) The SPs presented by students are kept in a reserved area of the CdS (Course of Studies) web page, available to the teachers on the Master's Degree Committee and made available for a period of one week; b) The Curriculum Coordinator (s) evaluate(s) the SP, based on the comparison with the educational offer for the Curriculum in question and with the requirements on the ECTS for each subject area, taking into account any opinions provided by the other professors of the Master's Degree Committee; c) In the case of a positive evaluation, the SP is officially approved; d) In the case of customized SPs, as long as they conform with the ECTS requirements for each disciplinary area, if the Curriculum Coordinator, having assessed the congruence and validity of the training course, provides a favourable opinion, the SP is officially approved; e) In the event of a negative decision of the Curriculum Coordinator, the request for a personalized study plan, together with the cultural reasons that inspire it, is submitted for examination to the Committee of the Master of Science in Physics for possible approval; f) The list of approved Study Plans is published on the CdS (Course of Studies) website (anonymously, referring to the student's registration number).

3.6 Criteria for periodic verification of the non-obsolescence of cognitive contents

Not provided

3.7 Criteria for verifying credits awarded after a six-year period or longer

Credits awarded within the last six years are considered fully valid if there have been no substantial changes to the contents of the courses to which they refer. Only if this is not the case, the Committee of the Master's Degree Course will have to express itself on the congruity between the acquired knowledge and the new educational objectives of the course to which the credits refer.

3.8 Recognition criteria for studies completed abroad

Please refer to art. 29 of the University Teaching Regulations: https://www.unict.it/it/ateneo/regolamento-didattico-di-ateneo

4. OTHER TRAINING ACTIVITIES

4.1 Activities chosen by the student

12 ECTS The student can choose from among courses or other types of training activities provided or organized by the University, as long as they are congruent with their training plan and adequately motivated.

The validation of the choice of educational activities will be decided by the Committee of the Master's Degree Course. These credits are understood to be acquired after passing an exam or other form of testing approved by the CCdS (Committee of the Course of Studies).

4.2 Further training activities (Article 10, paragraph 5, letters c, d of the DM 270/2004)

a) Further linguistic knowledge

not provided

b) Computing and Networking Skills

not provided

c) Training and internships for the curricula:

- ASTROPHYSICS
- PHYSICS APPLIED TO CULTURAL HERITAGE, ENVIRONMENT AND MEDICINE
- CONDENSED MATTER PHYSICS
- NUCLEAR AND PARTICLE PHYSICS
- THEORETICAL PHYSICS

Support activities and internships are envisaged, for a total of **2 ECTS**, generally aimed at preparing the final thesis (internship dissertation), but not necessarily for this purpose, at laboratories and research institutions, public bodies and industries, also in the framework of national and international agreements, intended as highly qualifying activities for the preparation of the Master's degree in Physics.

Alternatively, students can acquire the aforementioned 2 ECTSs with a computing /networking skills upgrading activity (E-infrastructures for Physics) or any seminars on the preparation of research projects (as indicated by the Advisory Board).

In the case of internship carried out abroad of the 2 credits acquired, this will be explicitly mentioned in the *diploma supplement*.

For the curriculum

- NUCLEAR PHENOMENA AND THEIR APPLICATIONS

activated as part of the ERASMUS program, **12 ECTS** are attributed to the internship activities, in accordance with the Consortium Agreement.

d) Other useful knowledge for entering the labour market

not provided

4.3 Study periods abroad

The educational activities followed abroad for which no ECTS equivalent is recognized are, however, mentioned in the final certification describing the student's university studies.

4.4 Final test

(Framework A5-SUA)

The final exam of the Master's Degree in Physics consists in the discussion in front of an examining board appointed for the purpose of the final exam, of a thesis (dissertation) normally prepared under the guidance of a professor of this University chosen as Supervisor. The board is normally made up of professors belonging to the Department of Physics and Astronomy, but teachers from other Departments or even other Universities can also be part of it in the case the dissertation is carried out in collaboration with teachers or structures of other Departments or Universities and / or on interdisciplinary subjects.

The test consists of a written report on an original theoretical or experimental study of specific interest in the fields of Physics and its applications. The work can also be carried out outside the Department of Physics and Astronomy in companies, structures and laboratories both public and private, in Italy and abroad. The supervisor can choose to be assisted by one or more co-supervisors who may belong to other universities, including foreign ones, or to both public and private research institutions. The procedures for carrying out the exam and the final graduation grade, a mark on 110, are governed by specific regulations for the graduation exam available online on the degree course website.

For the ERASMUS curriculum, the dissertation will be prepared under the guidance of one or more professors of one or more partner universities and the final graduation exam will be taken in front of an examination board that will also have external members of the partner universities and may take place in one of the consortium offices, as required by the *Consortium Agreement*.

Upon passing the final exam, the student is awarded 40 ECTSs divided into an integrated course of 30 ECTSs for research activities for the preparation of the dissertation work and 10 ECTSs for the preparation of the final paper. The student who carries out, wholly or partially, the dissertation research work abroad will be awarded 5 ECTS for each month of stay up to a maximum of 6 months. The possible options among which the student can choose are:

10 ECTS dissertation writing and final exam + 30 ECTS dissertation research at DFA
10 ECTS for dissertation writing and final exam + 5 ECTS for foreign dissertation research + 25 ECTS for DFA dissertation research
10 ECTS for dissertation writing and final exam + 10 ECTS for foreign dissertation research + 20 ECTS for DFA dissertation research
10 ECTS for dissertation writing and final exam + 15 ECTS foreign dissertation research + 15 ECTS dissertation research DFA
10 ECTS dissertation writing and final exam + 20 ECTS foreign dissertation research + 10 ECTS dissertation research DFA
10 ECTS dissertation writing and final exam + 25 ECTS foreign dissertation research + 5 ECTS dissertation research DFA
10 ECTS of dissertation writing and final exam + 30 ECTS for foreign dissertation research

5. SCHEDULED TEACHING

LIST OF COURSES

Didactic Plan for students registered in A.Y. 2020/2021

n.	SSD	Title	CFU	n. of hours		propaedeutics	Educational objectives
				lecture	other activit.		
1	FIS/07	Accelerator Physics and Applications	6	42	0	-	*
2	FIS/02	Advanced Mathematical Methods for Physics	6	42	0	-	*
3	FIS/07	Advanced Nuclear Techniques Applied to Medicine	6	42	0	-	*
4	FIS/02	Advanced Quantum Mechanics	6	35	15	-	*
5	FIS/02	Advanced Statistical Mechanics	6	35	15	-	*
6	FIS/07	Archaeometry	6	42	0	-	*
7	FIS/01	Astroparticle Physics	6	42	0	-	*
8	FIS/05	Astrophysics	6	42	0	-	*
9	FIS/01	Astrophysics Laboratory I	6	28	30	-	*
10	FIS/01	Astrophysics Laboratory II	6	28	30	9	*
11	FIS/02	Atomic and Plasma Physics (**)	6	42	0		*
12	FIS/07	Basic Experimental and Applied Laboratory (**)	6	21	45		*
13	FIS/04	Basic Nuclear Physics (**)	6	42	0	-	*
14	FIS/07	Biophysics	6	42	0	-	*
15	FIS/04	Common Advanced Course (**)	6	42	0	-	*
16	FIS/03	Computational Quantum Dynamics	6	28	30	-	*
17	INF/01	Computer Lab	6	21	45	-	*
18	INF/01	Computer Science for Physics	6	35	15	-	*
19	FIS/02	Computing and Numerical Methods (**)	6	35	15	-	*
20	FIS/05	Cosmic Ray Physics	6	42	0		
21	FIS/01	Data Analysis Techniques for Nuclear and Particle Physics	6	28	30	-	*
22	FIS/01	Electronics and Applications	6	42	0	-	*
23	FIS/04	Elementary Particle Physics - I	6	42	0	-	*
24	FIS/04	Elementary Particle Physics - II	6	35	15	-	*
25	FIS/01	Environmental Radioactivity	6	42	0	-	*
26	FIS/07	Environmental Physics	6	42	0	-	*
27	FIS/01	Environmental Physics Laboratory	6	28	30	-	*
28	FIS/01	Experimental Methods for Nuclear Physics	6	42	0	-	*
29	FIS/01	Experimental Methods for Particle Physics	6	21	45	-	*
30	FIS/05	Extragalactic Astronomy and Cosmology	6	42	0	-	*
31	FIS/05	General Relativity	6	42	0	-	*

32	FIS/04	Hadronic Physics with Electroweak Probes	6	42	0		
33	FIS/01	Heavy Ions Physics	6	42	0	-	*
34	FIS/05	High Energy Astrophysics	6	42	0	-	*
35	FIS/04	High Energy Nuclear Physics	6	42	0	-	*
36	FIS/07	Image Analysis and Fundamentals of Dosimetry	6	42	0	-	*

37	FIS/06	Magnetohydrodynamics and Plasma Physics	6	42	0	-	*
38	FIS/03	Many-Body Theory	6	42	0	-	*
39	FIS/01	Materials and Nanostructures Laboratory	6	21	45	-	*
40	FIS/07	Medical Physics	6	42	0	-	*
41	FIS/04	Nuclear and Subnuclear Physics	6	42	0	-	*
42	FIS/01	Nuclear and Subnuclear Physics Laboratory	6	21	45	-	*
43	FIS/04	Nuclear Astrophysics	6	42	0	-	*
44	FIS/02	Nuclear Reaction Theory	6	35	15	-	*
45	FIS/04	Nuclear Structure	6	28	30	-	*
46	FIS/03	Photonics	6	42	0	-	*
47	FIS/02	Physics of Complex Systems	6	35	15	-	*
48	FIS/01	Physics of Materials	6	42	0	-	*
49	FIS/01	Physics of Nanostructures	6	42	0	-	*
50	FIS/03	Plasma Spectroscopy	6	42	0	-	*
51	FIS/02	Quantum Field Theory - I	6	28	30	-	*
52	FIS/02	Quantum Field Theory - II	6	28	30	51	*
53	FIS/03	Quantum Information	6	35	15	-	*
54	FIS/02	Quantum Mechanics (**)	6	35	15		
55	FIS/02	Quantum Optics	6	42	0	-	*
56	FIS/02	Quantum Phases of Matter	6	42	0	-	*
57	FIS/05	Radioastronomy	6	42	0	-	*
58	FIS/03	Semiconductor Physics and Technology	6	42	0	-	*
59	GEO/10	Seismology	6	42	0	-	*
60	FIS/05	Solar Physics	6	42	0	-	*
61	FIS/03	Solid-State Physics	6	42	0	-	*
62	FIS/05	Space Physics	6	42	0	-	*
63	FIS/03	Spectroscopy	6	42	0	-	*
64	FIS/02	Standard Model Theory	6	35	15	-	*
65	FIS/03	Superconductivity	6	42	0	-	*
66	FIS/02	Theory of Strong Interactions	6	35	15	-	*

(*) See the Master's Degree website ***https://www.dfa.unict.it/corsi/LM-17*** or ***http://syllabus.unict.it***

(**) *Teaching provided at a University Partner of the Nucphys Consortium*

6. OFFICIAL STUDY PLAN
for students registered
in A.Y. 2020/2021

6.1 CURRICULUM *(ASTROPHYSICS)*

n.	SSD	TITLE	ECTS	didactic form	exams	attendance
1st year - 1st semester						
4	*FIS/02*	*Advanced Quantum Mechanics*	*6*	*F*	*E*	*Y*
5 *37*	*FIS/02* *FIS/06*	*Advanced Statistical Mechanics /* *Magnetohydrodynamics and Plasma Physics*	*6*	*F*	*E*	*Y*
8	*FIS/05*	*Astrophysics*	*6*	*F*	*E*	*Y*
50	*FIS/03*	*Plasma Spectroscopy*	*6*	*F*	*E*	*Y*
9	*FIS/01*	*Astrophysics Laboratory I*	*6*	*F*	*E*	*Y*
1st year – 2nd semester						
57 *34*	*FIS/05*	*Radioastronomy /* *High Energy Astrophysics*	*6*	*F*	*E*	*Y*
60 *31*	*FIS/05*	*Solar Physics /* *General Relativity*	*6*	*F*	*E*	*Y*
43	*FIS/04*	*Nuclear Astrophysics*	*6*	*F*	*E*	*Y*
-	-	*Elective course*	*6*	*F*	*E*	*Y*
2nd year – 1st semester						
30 *20*	*FIS/05*	*Extragalactic Astronomy and Cosmology /* *Cosmic Ray Physics*	*6*	*F*	*E*	*Y*
62	*FIS/05*	*Space Physics*	*6*	*F*	*E*	*Y*
10 *7*	*FIS/01*	*Astrophysics Laboratory II /* *Astroparticle Physics*	*6*	*F*	*E*	*Y*
-	-	*Elective course*	*6*	*F*	*E*	*Y*
2nd year – 2nd semester						
-	-	*Thesis Internship/* *E-infrastructures for Physics*	*2*	-	-	-
-	-	*Master Thesis Research (DFA) – Thesis and Final Exam/* *Master Thesis Research (Abroad 1 month) + Master Thesis Research DFA + Thesis and Final Exam/* *Master Thesis Research (Abroad 2 months) + Master Thesis Research DFA + Thesis and Final Exam/* *Master Thesis Research (Abroad 3 months) + Master Thesis Research DFA + Thesis and Final Exam/* *Master Thesis Research (Abroad 4 months) + Master Thesis Research DFA + Thesis and Final Exam/* *Master Thesis Research (Abroad 5 months) + Master Thesis Research DFA + Thesis and Final Exam/* *Master Thesis Research (Abroad) – Thesis and Final Exam*	*40*	*PF*	*E*	*N*

6.2 CURRICULUM

(PHYSICS APPLIED TO CULTURAL HERITAGE, ENVIRONMENT AND MEDICINE)

n.	SSD	TITLE	ECTS	didactic form	exams	attendance
1st year - 1st semester						
4	*FIS/02*	*Advanced Quantum Mechanics*	*6*	*F*	*E*	*Y*
61	*FIS/03*	*Solid-State Physics*	*6*	*F*	*E*	*Y*
41	*FIS/04*	*Nuclear and Subnuclear Physics*	*6*	*F*	*E*	*Y*
26 *14*	*FIS/07*	*Environmental Physics /* *Biophysics*	*6*	*F*	*E*	*Y*
22	*FIS/01*	*Electronics and Applications (in option with Environmental Physics Laboratory delivered in the second semester)*	*6*	*F*	*E*	*Y*
1st year – 2nd semester						
27	*FIS/01*	*Environmental Physics Laboratory (in option Electronics and Applications delivered in the first semester)*	*6*	*F*	*E*	*Y*
25 *40*	*FIS/01* *FIS/07*	*Environmental Radioactivity* *Medical Physics*	*6*	*F*	*E*	*Y*
1 *3*	*FIS/07*	*Accelerator Physics and Applications /* *Advanced Nuclear Techniques Applied to Medicine*	*6*	*F*	*E*	*Y*
59 *6*	*GEO/10* *FIS/07*	*Seismology /* *Archaeometry*	*6*	*F*	*E*	*Y*
-	-	*Elective Course*	*6*	*F*	*E*	*Y*
2nd year - 1st semester						
63	*FIS/03*	*Spectroscopy*	*6*	*F*	*E*	*Y*
42	*FIS/01*	*Nuclear and Subnuclear Physics Laboratory*	*6*	*F*	*E*	*Y*
18 *17* *36*	*INF/01* *FIS/07*	*Computer Science for Physics /* *Computer Lab /* *Image Analysis and Fundamentals of Dosimetry*	*6*	*F*	*E*	*Y*
-	-	*Elective Course*	*6*	*F*	*E*	*Y*
2nd year – 2nd semester						
-	-	*Thesis Internship/* *E-infrastructures for Physics*	*2*	-	-	-
-	-	*Master Thesis Research (DFA) – Thesis and Final Exam/* *Master Thesis Research (Abroad 1 month) + Master Thesis Research DFA + Thesis and Final Exam/* *Master Thesis Research (Abroad 2 months) + Master Thesis Research DFA + Thesis and Final Exam/* *Master Thesis Research (Abroad 3 months) + Master Thesis Research DFA + Thesis and Final Exam/* *Master Thesis Research (Abroad 4 months) + Master Thesis Research DFA + Thesis and Final Exam/* *Master Thesis Research (Abroad 5 months) + Master Thesis Research DFA + Thesis and Final Exam/* *Master Thesis Research (Abroad) – Thesis and Final Exam*	*40*	*PF*	*E*	*N*

6.3 CURRICULUM *(CONDENSED MATTER PHYSICS)*

n.	SSD	TITLE	ECTS	didactic form	exams	attendance
1st year - 1st semester						
4	*FIS/02*	*Advanced Quantum Mechanics*	*6*	*F*	*E*	*Y*
61	*FIS/03*	*Solid-State Physics*	*6*	*F*	*E*	*Y*
5	*FIS/02*	*Advanced Statistical Mechanics*	*6*	*F*	*E*	*Y*
48	*FIS/01*	*Physics of Materials*	*6*	*F*	*E*	*Y*
1st year – 2nd semester						
39	*FIS/01*	*Materials and Nanostructures Laboratory*	*6*	*F*	*E*	*Y*
46	*FIS/03*	*Photonics*	*6*	*F*	*E*	*Y*
55 *56*	*FIS/02*	*Quantum Optics /* *Quantum Phases of Matter*	*6*	*F*	*E*	*Y*
58 *65*	*FIS/03*	*Semiconductor Physics and Technology /* *Superconductivity*	*6*	*F*	*E*	*Y*
-	-	*Elective Course*	*6*	*F*	*E*	*Y*
2nd year - 1st semester						
49	*FIS/01*	*Physics of Nanostructures*	*6*	*F*	*E*	*Y*
63 *53*	*FIS/03*	*Spectroscopy /* *Quantum Information*	*6*	*F*	*E*	*Y*
16 *38*	*FIS/03*	*Computational Quantum Dynamics/* *Many-Body Theory*	*6*	*F*	*E*	*Y*
2nd year – 2nd semester						
-	-	*Elective Course*	*6*	*F*	*E*	*Y*
-	-	*Thesis Internship/* *E-infrastructures for Physics*	*2*	-	-	-
-	-	*Master Thesis Research (DFA) – Thesis and Final Exam/* *Master Thesis Research (Abroad 1 month) + Master Thesis Research DFA + Thesis and Final Exam/* *Master Thesis Research (Abroad 2 months) + Master Thesis Research DFA + Thesis and Final Exam/* *Master Thesis Research (Abroad 3 months) + Master Thesis Research DFA + Thesis and Final Exam/* *Master Thesis Research (Abroad 4 months) + Master Thesis Research DFA + Thesis and Final Exam/* *Master Thesis Research (Abroad 5 months) + Master Thesis Research DFA + Thesis and Final Exam/* *Master Thesis Research (Abroad) – Thesis and Final Exam*	*40*	*PF*	*E*	*N*

6.4 CURRICULUM *(NUCLEAR AND PARTICLE PHYSICS)*

n.	SSD	TITLE	ECTS	didactic form	exams	attendance
1st year - 1st semester						
4	*FIS/02*	*Advanced Quantum Mechanics*	*6*	*F*	*E*	*Y*
61	*FIS/03*	*Solid-State Physics*	*6*	*F*	*E*	*Y*
41	*FIS/04*	*Nuclear and Subnuclear Physics*	*6*	*F*	*E*	*Y*
42	*FIS/01*	*Nuclear and Subnuclear Physics Laboratory*	*6*	*F*	*E*	*Y*
1st year – 2nd semester						
51 *44*	*FIS/02*	*Quantum Field Theory – I /* *Nuclear Reaction Theory*	*6*	*F*	*E*	*Y*
66	*FIS/02*	*Theory of Strong Interactions*	*6*	*F*	*E*	*Y*
23 *43*	*FIS/04*	*Elementary Particle Physics – I /* *Nuclear Astrophysics*	*6*	*F*	*E*	*Y*
29 *28* *21*	*FIS/01*	*Experimental Methods for Particle Physics /* *Experimental Methods for Nuclear Physics /* *Data Analysis Techniques for Nuclear and Particle Physics*	*6*	*F*	*E*	*Y*
-	-	*Elective Course*	*6*	*F*	*E*	*Y*
2nd year - 1st semester						
7 *33*	*FIS/04*	*Astroparticle Physics /* *Heavy Ions Physics*	*6*	*F*	*E*	*Y*
32 *35*	*FIS/04*	*Hadronic Physics with Electroweak Probes /* *High Energy Nuclear Physics*	*6*	*F*	*E*	*Y*
24 *45*	*FIS/04*	*Elementary Particle Physics – II /* *Nuclear Structure*	*6*	*F*	*E*	*Y*
-	-	*Elective Course*	*6*	*F*	*E*	*Y*
2nd year – 2nd semester						
-	-	*Thesis Internship/* *E-infrastructures for Physics*	*2*	-	-	-
-	-	*Master Thesis Research (DFA) – Thesis and Final Exam/* *Master Thesis Research (Abroad 1 month) + Master Thesis Research DFA + Thesis and Final Exam/* *Master Thesis Research (Abroad 2 months) + Master Thesis Research DFA + Thesis and Final Exam/* *Master Thesis Research (Abroad 3 months) + Master Thesis Research DFA + Thesis and Final Exam/* *Master Thesis Research (Abroad 4 months) + Master Thesis Research DFA + Thesis and Final Exam/* *Master Thesis Research (Abroad 5 months) + Master Thesis Research DFA + Thesis and Final Exam/* *Master Thesis Research (Abroad) – Thesis and Final Exam*	*40*	*PF*	*E*	*N*

6.5 CURRICULUM *(THEORETICAL PHYSICS)*

n.	SSD	TITLE	ECTS	didactic form	exams	attendance
1st year - 1st semester						
4	*FIS/02*	*Advanced Quantum Mechanics*	*6*	*F*	*E*	*Y*
61	*FIS/03*	*Solid-State Physics*	*6*	*F*	*E*	*Y*
5	*FIS/02*	*Advanced Statistical Mechanics*	*6*	*F*	*E*	*Y*
51	*FIS/02*	*Quantum Field Theory - I*	*6*	*F*	*E*	*Y*
1st year – 2nd semester						
31	*FIS/05*	*General Relativity*	*6*	*F*	*E*	*Y*
52	*FIS/02*	*Quantum Field Theory - II*	*6*	*F*	*E*	*Y*
47 *66* *2*	*FIS/02*	*Physics of Complex Systems /* *Theory of Strong Interactions* *Advanced Mathematical Methods for Physics*	*6*	*F*	*E*	*Y*
44 *56* *65*	*FIS/02*	*Nuclear Reaction Theory /* *Quantum Phases of Matter/* *Superconductivity*	*6*	*F*	*E*	*Y*
-	-	*Elective Course*	*6*	*F*	*E*	*Y*
2nd year - 1st semester						
64	*FIS/02*	*Standard Model Theory*	*6*	*F*	*E*	*Y*
38 *53* *41* *24*	*FIS/03* *FIS/04*	*Many-Body Theory /* *Quantum Information /* *Nuclear and Subnuclear Physics/* *Elementary Particle Physics II*	*6*	*F*	*E*	*Y*
7 *33*	*FIS/01*	*Astroparticle Physics /* *Heavy Ions Physics*	*6*	*F*	*E*	*Y*
2nd year – 2nd semester						
	-	*Elective Course*	*6*	*F*	*E*	*Y*
-	-	*Thesis Internship/* *E-infrastructures for Physics*	*2*	-	-	-
-	-	*Master Thesis and Final ExamMaster Thesis Research (DFA) – Thesis and Final Exam/* *Master Thesis Research (Abroad 1 month) + Master Thesis Research DFA + Thesis and Final Exam/* *Master Thesis Research (Abroad 2 months) + Master Thesis Research DFA + Thesis and Final Exam/* *Master Thesis Research (Abroad 3 months) + Master Thesis Research DFA + Thesis and Final Exam/* *Master Thesis Research (Abroad 4 months) + Master Thesis Research DFA + Thesis and Final Exam/* *Master Thesis Research (Abroad 5 months) + Master Thesis Research DFA + Thesis and Final Exam/* *Master Thesis Research (Abroad) – Thesis and Final Exam*	*40*	*PF*	*E*	*N*

6.6 CURRICULUM *(NUCLEAR PHENOMENA AND THEIR APPLICATIONS)*						
n.	SSD	TITLE	ECTS	didactic form	exams	attendance
1st year - 1st semester						
54	*FIS/02*	*Quantum Mechanics (*)*	*6*	*F*	*E*	*Y*
19	*FIS/02*	*Computing and Numerical Methods (*)*	*6*	*F*	*E*	*Y*
13	*FIS/04*	*Basic Nuclear Physics (*)*	*6*	*F*	*E*	*Y*
12	*FIS/07*	*Basic Experimental and Applied Laboratory (*)*	*6*	*F*	*E*	*Y*
11	*FIS/02*	*Atomic and Plasma Physics (*)*	*6*	*F*	*E*	*Y*
1st year – 2nd semester						
44	*FIS/02*	*Nuclear Reaction Theory*	*6*	*F*	*E*	*Y*
1 *21*	*FIS/07* *FIS/01*	*Accelerator Physics and Applications /* *Data Analysis Techniques for Nuclear and Particle Physics*	*6*	*F*	*E*	*Y*
43	*FIS/04*	*Nuclear Astrophysics*	*6*	*F*	*E*	*Y*
6 *40*	*FIS/07*	*Archaeometry /* *Medical Physics*	*6*	*F*	*E*	*Y*
3 *25*	*FIS/07* *FIS/01*	*Advanced Nuclear Techniques Applied to Medicine/* *Environmental Radioactivity*	*6*	*F*	*E*	*Y*
2nd year - 1st semester						
15	*FIS/04*	*Common Advanced Course (*)*	*6*	*F*	*E*	*Y*
	-	*Elective Course*	*6*	*F*	*E*	*Y*
2nd year – 2nd semester						
-	-	*Research Internship*	*12*	-	-	-
-	-	*Master Thesis and Final Exam*	*30*	*PF*	*E*	*N*

(**) *Teaching provided at a University Partner of the Nucphys Consortium*

N.B. For each curriculum the courses in the same optional group are listed within a single box.