MASTER in PHYSICS

For each curriculum there are:

1. MANDATORY COURSES

2. **5** ELECTIVE COURSES THAT MUST BE CHOSEN IN APPROPRIATE LISTS

3. **2** ELECTIVE COURSES WITH NO CONSTRAINTS

THE CURRICULUM AND THE ELECTIVE COURSES HAVE TO BE CHOSEN IN THE FOLLOWING PERIODs:

1) October 15 – December 15

2) February 1 – February 20

ONLY ONCE IN EACH ACADEMIC YEAR!!!!

THE CURRICULA CAN BE FOUND AT:

https://www.phys.uniroma1.it/fisica/sites/default/files/allegati/
Piani_formativi_magistrali_LM17.pdf

Curriculum in THEORETICAL PHYSICS

For students interested in

1) Physics of fundamental interactions (theory)
2) General relativity and theoretical astrophysics
3) Statistical mechanics and the physics of complex systems
4) Mathematical physics

People interested in condensed matter theory should consider the curriculum in condensed matter, while the biosystem curriculum is more appropriate for those that would like to study (theoretically) problems at the boundary of physics, biology and chemistry

Theoretical physics of the fundamental interactions

One analyzes the structure of matter at the subnuclear level. The aim is that of giving predictions that can be compared with experiments at accelerators like CERN, in neutrino experiments... A new subfield is "Astroparticle physics"

Theoretical Astrophysics

Here one studies the structure and evolution of stars and black holes, gravitational waves (theory) in close connection with the experimental groups, cosmology ...

Complex systems and statistical mechanics

addressed to students interested in the study of

- disordered systems, spin glasses, structural glasses, the statistical behavior of systems with intrinsic disorder

- statistical mechanics (both at the classical and quantum level) of nonequilibrium systems.

- interdisciplinary activity on dynamic large-scale phenomena that occur in fields "beyond" physics (from biology to economics and social sciences) but that can be understood using statistical mechanics methods.

Corso di laurea in Fisica (LM-17) - Curriculum Teorico Generale

N.	Insegnamenti	CFU	anno	sem.	SSD	eng	ambito
1	Relativistic Quantum Mechanics	6	1	1	FIS/02	Y	caratt.
2	Condensed Matter Physics	6	1	1	FIS/03	Y	caratt.
3	Physics Laboratory I (insegnamento propedeutico a Physics Laboratory II)	6	1	1	FIS/01	Y	caratt.
4	Physics Laboratory II	9	1	2	FIS/01	Y	caratt.
5	Mathematical Physics	6	1	2	MAT/07	Y	aff.-int.
6	English language	4	1	2		Y	AAF
7	gruppo A	6	1/2	1/2			caratt.
8	gruppo A	6	1/2	1/2			caratt.
9	gruppo B	6	1/2	1/2			aff.-int.
10	Corso a scelta	6	1	2			
11	gruppo A	6	1/2	1/2			caratt.
12	gruppo B	6	1/2	1/2			aff.-int.
13	Corso a scelta	6	2	1			
14	Internship	3	2	1		Y	AAF
15	Thesis Project	38	2	2		Y	AAF

Gruppo A (caratt.)

		CFU	anno	sem.	SSD	eng	
1	Electroweak interactions	6	1	1	FIS/02	Y	
2	Statistical Mechanics and Critical Phenomena	6	1	1	FIS/02	Y	
3	Relatività generale [fis]	6	1	1	FIS/02	N	
4	Quantum electrodynamics	6	1	2	FIS/02	Y	
5	Computational Statistical Mechanics	6	1	2	FIS/02	Y	
6	Meccanica Statistica del Non Equilibrio	6	1	2	FIS/02	N	
7	Nonlinear Waves and Solitons	6	1	2	FIS/02	Y	
8	Statistical Mechanics of Disordered Systems	6	2	1	FIS/02	Y	
9	Quantum Field Theory	6	2	1	FIS/02	Y	

Gruppo B (aff.-int.)

		CFU	anno	sem.	SSD	eng	
1	Computing Methods for Physics	6	1	1	INF/01	Y	
2	Statistical Mechanics and Critical Phenomena	6	1	1	FIS/02	Y	
3	Relatività generale [fis]	6	1	1	FIS/02	N	
4	Electroweak interactions	6	1	1	FIS/02	Y	
5	Nonlinear and Quantum Optics	6	1	1	FIS/03	Y	
6	Theoretical Biophysics	6	1	2	FIS/02	Y	
7	Quantum electrodynamics	6	1	2	FIS/02	Y	
8	Meccanica Statistica del Non Equilibrio	6	1	2	FIS/02	N	
9	Onde gravitazionali, stelle e buchi neri	6	1	2	FIS/02	N	
10	Neural Networks	6	1	2	FIS/02	Y	
11	Simmetrie ed interazioni fondamentali	6	1	2	FIS/02	N	
12	Nuclear Physics	6	1	2	FIS/04	Y	
13	Solid State Physics	6	1	2	FIS/03	Y	
14	Many-body Physics	6	1	2	FIS/03	Y	
15	Superconductivity and Superfluidity	6	2	1	FIS/03	Y	
16	Physics of Complex Systems	6	2	1	FIS/03	Y	
17	Introduction to Particle Physics	6	2	1	FIS/01	Y	
18	Quantum information and Computation	6	2	1	FIS/01	Y	
19	Weak interactions in the standard model and beyond	6	2	1	FIS/02	Y	
20	Introduzione alla teoria dei processi stocastici ed applicazioni alla fisica	6	2	1	FIS/02	N	
21	Statistical Mechanics of Disordered Systems	6	2	1	FIS/02	Y	
22	Introduzione alla gravita' quantistica	6	2	1	FIS/02	Y	

CFU = number of credits
Anno = year (first or second year)
Sem. = semester in which the course is taught
Eng = in English (Y) or in Italian (N)

SSD:
 FIS: Physics course
 CHIM: Chemistry course
 BIO: Biology course
 INF: Computer science course
 MAT: Mathematics course

FIVE MANDATORY COURSES (same for all curricula)

3 COURSES FROM GROUP A
2 COURSES FROM GROUP B

2 ELECTIVE COURSES (CORSO A SCELTA LIBERA)

Among the 7 courses, the student must choose 1 course which is NON-FIS, i.e. labelled INF, MAT, CHIM, BIO

MANDATORY COURSES: PHYSICS LABORATORY

THERE IS A FIRST SEMESTER COURSE (THEORY) AND A SECOND SEMESTER COURSE (LAB ACTIVITY) : TWO DIFFERENT EXAMS.

THE EXAM OF PHYSICS LAB I SHOULD BE PASSED BEFORE THAT OF PHYSICS LAB II

There are different labs that depend on the chosen curriculum

Different labs

A) Particle and Astroparticle: Prof.CAVOTO
B) Condensed Matter: Prof. MARIANI
C) Biosystems: Prof. BORDI

THEORY CURRICULUM:

1) students interested in high-energy physics or general relativity should take LAB A)

2) all other students will choose the LAB coherently with the chosen curriculum

MANDATORY COURSES:
RELATIVISTIC QUANTUM MECHANICS

TWO DIFFERENT COURSES:

a) GENERAL COURSE (4 hrs/week, it ends in January)
Prof. Massimo Testa.

b) COMPRESSED COURSE (8 hrs/week, it ends before November 15th)
Prof. Roberto Bonciani

This course is mandatory for the Particle and Astroparticle Physics curriculum

The students who intend to take Electroweak Interactions must take this course.

"Free choice" courses: one at the first year, one at the second

The first year: it is possible to schedule a course which is given at the second year (i.e. to anticipate a second year course)

However: it is not possible to schedule in the second year a first year course (i.e. to postpone a first year course) because it may no longer be active (professor retiring or moving to another university etc.)

How many courses should be scheduled every year?

The curriculum must be balanced

FIRST year: 5 mandatory courses + English = 37 CFU
4-6 more courses = 24-36 CFU

SECOND year: 1-3 courses = 6-18 CFU
thesis + internship = 41 CFU

unbalanced curricula will not be approved

SECOND YEAR

Thesis: students are advised to decide the subject and the advisor of the thesis at the beginning of the first semester

NOTE: the thesis should be consistent with the chosen curriculum and with the elective courses that one is taking.

INTERNSHIP(3 CFU): how it works in practice

1) After two months of working on the thesis, the thesis advisor should give the student a signed form, which certifies the work that has been done.

2) The student should register in INFOSTUD (same procedure as that for an exam) **in the due time.**

3) The day of the exam the student should go to the professor in charge of internships:
Particle and Astroparticle: Prof. Bagnaia
Condensed Matter: Prof. Mariani
Biosystems: Prof. Bordi
General Theory: Prof. Bonciani

To be registered: the student must show the form signed by the advisor and the standard form to register the exams to the professor in charge.
Finally, the student will bring the form signed by the advisor to the secretary Marco Dante

N.	Insegnamenti	CFU	anno	sem.	SSD	eng	ambito
	Corso di laurea in Fisica (LM-17) - Curriculum Teorico Generale						
1	Relativistic Quantum Mechanics	6	1	1	FIS/02	Y	caratt.
2	Condensed Matter Physics	6	1	1	FIS/03	Y	caratt.
3	Physics Laboratory I (insegnamento propedeutico a Physics Laboratory II)	6	1	1	FIS/01	Y	caratt.
4	Physics Laboratory II	9	1	2	FIS/01	Y	caratt.
5	Mathematical Physics	6	1	2	MAT/07	Y	aff.-int.
6	English language	4	1	2		Y	AAF
7	gruppo A	6	1 / 2	1 / 2			caratt.
8	gruppo A	6	1 / 2	1 / 2			caratt.
9	gruppo B	6	1 / 2	1 / 2			aff.-int.
10	Corso a scelta	6	1	2			
11	gruppo A	6	1 / 2	1 / 2			caratt.
12	gruppo B	6	1 / 2	1 / 2			aff.-int.
13	Corso a scelta	6	2	1			
14	Internship	3	2	1		Y	AAF

Mandatory courses:

FIRST semester: Relativistic quantum mechanics, Condensed Matter, Physics Laboratory I

SECOND semester: Mathematical Physics, Physics Laboratory II

Gruppo A (caratt.)

1	Electroweak interactions	6	1	1	FIS/02	Y	
2	Statistical Mechanics and Critical Phenomena	6	1	1	FIS/02	Y	
3	Relatività generale [fis]	6	1	1	FIS/02	N	
4	Quantum electrodynamics	6	1	2	FIS/02	Y	
5	Computational Statistical Mechanics	6	1	2	FIS/02	Y	
6	Meccanica Statistica del Non Equilibrio	6	1	2	FIS/02	N	
7	Nonlinear Waves and Solitons	6	1	2	FIS/02	Y	
8	Statistical Mechanics of Disordered Systems	6	2	1	FIS/02	Y	
9	Quantum Field Theory	6	2	1	FIS/02	Y	

GROUP A: you have to choose 3 COURSES in this list

WARNING: each course has to be chosen in the right year and in the right semester

Gruppo B (aff.-int.)

1	Computing Methods for Physics	6	1	1	INF/01	Y	
2	Statistical Mechanics and Critical Phenomena	6	1	1	FIS/02	Y	
3	Relatività generale [fis]	6	1	1	FIS/02	N	
4	Electroweak interactions	6	1	1	FIS/02	Y	
5	Nonlinear and Quantum Optics	6	1	1	FIS/03	Y	
6	Theoretical Biophysics	6	1	2	FIS/02	Y	
7	Quantum electrodynamics	6	1	2	FIS/02	Y	
8	Meccanica Statistica del Non Equilibrio	6	1	2	FIS/02	N	
9	Onde gravitazionali, stelle e buchi neri	6	1	2	FIS/02	N	
10	Neural Networks	6	1	2	FIS/02	Y	
11	Simmetrie ed interazioni fondamentali	6	1	2	FIS/02	N	
12	Nuclear Physics	6	1	2	FIS/04	Y	
13	Solid State Physics	6	1	2	FIS/03	Y	
14	Many-body Physics	6	1	2	FIS/03	Y	
15	Superconductivity and Superfluidity	6	2	1	FIS/03	Y	
16	Physics of Complex Systems	6	2	1	FIS/03	Y	
17	Introduction to Particle Physics	6	2	1	FIS/01	Y	
18	Quantum information and Computation	6	2	1	FIS/01	Y	
19	Weak interactions in the standard model and beyond	6	2	1	FIS/02	Y	
20	Introduzione alla teoria dei processi stocastici ed applicazioni alla fisica	6	2	1	FIS/02	N	
21	Statistical Mechanics of Disordered Systems	6	2	1	FIS/02	Y	
22	Introduzione alla gravita' quantistica	6	2	1	FIS/02	Y	

GROUP B: you have to choose 2 courses in this list

WARNING: each course has to be chosen in the right year and in the right semester

GROUP A or B:

1) Electroweak interactions
   [strongly suggested for high-energy physics]. It starts in
   November, when Rel. Quantum Mech (Bonciani) ends.

2) Meccanica Statistica e fenomeni critici
   [strongly suggested for those interested in Statistical
   Mechanics and Complex systems]

3) Relatività Generale
   [strongly suggested for those interested in theoretical
   astrophysics]

Some constraints:

1) "Electroweak interactions" should be taken before "Simmetrie e interazioni fondamentali" and "Weak interactions in the standard model and beyond"

2) "Simmetrie e interazioni fondamentali" should be taken before "Weak interactions in the standard model and beyond"

3) "Quantum electrodynamics" or "Statistical mechanics and critical phenomena" should be taken before "Quantum field theory"

4) "Statistical mechanics and critical phenomena" should be taken before "Statistical mechanics of disordered systems"

5) "Relatività generale" should be taken before "Onde gravitazionali, stelle e buchi neri"

For those who choose the High Energy Physics curriculum (theory) "Introduction to particle physics", (prof. Kado) is strongly suggested (experimental course for theorists)

The course Computing methods for Physics (Prof. Rahthlou) is also suggested for the HEP curriculum

Computing methods for Physics (prof. Crisanti) is indicated for the other curricula in theoretical physics

Computing methods for Physics is labelled as INF and satisfies the NON-FIS constraint

AN EXAMPLE of curriculum in PHYSICS OF FUNDAMENTAL INTERACTIONS

TABLE A	YEAR	SEM.
Electroweak interactions	1	1
Relatività generale	1	1
Nonlinear waves and solitions	1	2
Quantum electrodynamics	1	2
Quantum field theory	2	1

3 courses in this table

TABLE B	YEAR	SEM.
Electroweak interactions	1	1
Computing methods for physics	1	1
Relatività generale	1	1
Quantum electrodynamics	1	2
Simmetrie e interazioni fondamentali	1	2
Weak Interactions in the standard model and beyond	2	1
Introduction to Particle Physics	2	1

2 courses in this table

first year first semester	first year second semester	second year first semester

AN EXAMPLE of curriculum in STATISTICAL MECHANICS/PHYSICS OF COMPLEX SYSTEMS

TABLE A	YEAR	Sem.
Statistical mechanics and critical phenomena	1	1
Computational statistical mechanics	1	2
Meccanica statistica del non equilibrio	1	2
Quantum electrodynamics	1	2
Statistical mechanics of disordered systems	2	1
Quantum field theory	2	1

3 courses in this table

first year
first semester

first year
second semester

second year
first semester

AN EXAMPLE of curriculum in STATISTICAL MECHANICS/PHYSICS OF COMPLEX SYSTEMS

TABLE B	YEAR	Sem.
Biofisica teorica	1	1
Statistical mechanics and critical phenomena	1	1
Computing methods for physics	1	1
Computational statistical mechanics	1	2
Meccanica statistica del non equilibrio	1	2
Neural networks	1	2
Fisica dei sistemi complessi	2	1
Introduzione alla teoria dei processi stocastici ed applicazioni alla fisica	2	1
Statistical Mechanics of Disordered Systems	2	1

2 courses
in this table

☐ first year
first semester

☐ first year
second semester

☐ second year
first semester

AN EXAMPLE of curriculum in THEORETICAL ASTROPHYSICS

TABLE A	YEAR	SEM.
Electroweak interactions	1	1
Relatività generale	1	1
Nonlinear waves and solitons	1	2
Quantum electrodynamics	1	2
Quantum field theory	2	1

3 courses
in this table

TABELLA B	YEAR	Sem
Relatività generale	1	1
Electroweak interactions	1	1
Computing methods for physics	1	1
Onde gravitazionali, stelle e buchi neri	1	2
Quantum electrodynamics	1	2
Simmetrie e interazioni fondamentali	1	2
Weak Interactions in the Standard Model and Beyond	2	1

2 courses
in this table

The 2 elective courses can be chosen in the laurea magistrale in Astronomy and Astrophysics

FOR QUESTIONS ON THE CURRICULUM
IN THEORETICAL PHYSICS:

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