

Curriculum Teorico Generale (Theoretical Physics)

For students interested to
theoretical studies in **any** field of physics

- Theory of fundamental interactions
- Statistical mechanics and the physics of complex systems
- General relativity and theoretical astrophysics
- Mathematical physics
- Condensed matter theory
- Theoretical modelling of biological systems
- etc...

How to choose the right curriculum

A given Piano Formativo (PF) can perfectly fit in more than a single curriculum. E.g.

- a PF in theoretical HEP can fit curriculum teorico as well as curriculum in fundamental interactions
- a PF in condensed matter theory can fit curriculum teorico as well as condensed matter curriculum
- etc...

Which one is better to choose? No real difference, don't worry!

Often curriculum teorico is chosen because is more **flexible**

Curriculum Teorico Generale

N.	Insegnamento	CFU	anno	sem.	SSD	eng	ambito
1	Introduction to Quantum Field Theory	6	1	1	FIS/02	Y	caratt.
2	Condensed Matter Physics	6	1	1	FIS/03	Y	caratt.
3	Physics Laboratory I	6	1	1	FIS/01	Y	caratt.
4	Physics Laboratory II	9	1	2	FIS/01	Y	caratt.
5	Gruppo C	6	1	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	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	1/2	1/2			
14	Internship	3	2	1		Y	AAF
15	Thesis Project	38	2	2		Y	AAF

3 courses from group A
2 courses from group B

2 elective courses (scelta libera)

Gruppo A (caratt.)

1	Statistical Mechanics and Critical Phenomena	6	1	1	FIS/02	Y
2	General Relativity (mutuato dal LM-58)	6	1	1	FIS/02	Y
3	Theory of Fundamental Interaction	6	1	2	FIS/02	Y
4	Meccanica Statistica del Non Equilibrio	6	1	2	FIS/02	N
5	Nonlinear Waves and Solitons	6	1	2	FIS/02	Y
6	Statistical Mechanics of Disordered Systems	6	2	1	FIS/02	Y
7	Quantum Field Theory	6	2	1	FIS/02	Y
8	Statistical Physics and Machine Learning	6	2	1	FIS/02	Y

mandatory courses

Gruppo C (aff.-int.)

1	Mathematical Physics	6	1	2	MAT/07	Y
2	Group Theory in Mathematical Physics	6	1	1	MAT/07	Y

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	General Relativity (mutuato dal LM-58)	6	1	1	FIS/02	Y
4	Nonlinear and Quantum Optics	6	1	1	FIS/03	Y
5	Theory of Fundamental Interaction	6	1	2	FIS/02	Y
6	Theoretical Biophysics	6	1	2	FIS/02	Y
7	Meccanica Statistica del Non Equilibrio	6	1	2	FIS/02	N
8	Gravitational waves, compact stars, and black holes	6	1	2	FIS/02	Y
9	Neural Networks	6	1	2	FIS/02	Y
10	Strong Interactions and QCD	6	1	2	FIS/02	Y
11	Condensed Matter Physics II	6	1	2	FIS/03	Y
12	Advanced Machine Learning for Physics	6	1	2	INF/01	Y
13	Physical Cosmology	6	1	2	FIS/05	Y
14	Superconductivity and Superfluidity	6	1	2	FIS/03	Y
15	Many-Body Physics	6	2	1	FIS/03	Y
16	Physics of Complex Systems	6	2	1	FIS/03	Y
17	Quantum Information and Computation	6	2	1	FIS/01	Y
18	Phenomenology of the Standard Model	6	2	1	FIS/02	Y
19	Theory of Stochastic Processes	6	2	1	FIS/02	Y
20	Statistical Mechanics of Disordered Systems	6	2	1	FIS/02	Y
21	Statistical Physics and Machine Learning	6	2	1	FIS/02	Y
22	Physics of Solids	6	2	1	FIS/03	Y

MANDATORY COURSES:

Physics Laboratory

A first semester course (theory) and a second semester course (lab activity): 2 different exams to be taken in the right order!

There are different labs that depend on the chosen curriculum

A) Particle and Astroparticle: Prof. Cavoto

B) Condensed Matter: Prof.ssa Betti

C) Biosystems: Prof. Ortolani

Students in curriculum teorico generale can freely choose the lab which is closer to the subjects in their PF and to their interests

MANDATORY COURSES: Mathematical Physics (Group C)

It is mandatory to take **at least one course** in Group C
(Mathematical Physics)

- Group Theory in Mathematical Theory: Prof. Panati (1 sem)
- Mathematical Physics: Prof. Caglioti (2 sem)

Students in HEP and Astrophysics should take GTMP, while students more interested in Statistical/Mathematical Physics are suggested to take MP

A Piano Formativo containing **both courses** will be accepted

Informatics (INF) courses

- Computing Methods in Physics (1 sem) contains 4 different courses under the same name:
 - Prof. Pannarale, suggested to HEP students
 - Prof. Crisanti, the most theoretical one (no lab classes)
 - Prof.ssa Boeri and Prof. De Michele, more oriented to computational physics and condensed matter
- Advanced Machine Learning for Physics (2 sem)

It is no longer mandatory to take at least one INF course
(the 12 non-FIS CFU rule has been cancelled)

Two “free choice” courses (corsi a scelta libera)

Can be chosen in Groups A, B, C and from other curricula as well from other Lauree Magistrali in Sapienza (e.g. Matematica)

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 / semester?

The curriculum must be balanced: ideally the 12 courses should be divided 4 courses per semester

FIRST year: 5 mandatory courses + English = 37 CFU
3-4 more courses = 18-24 CFU

SECOND year: 3-4 courses = 18-24 CFU
thesis + internship = 41 CFU

strongly unbalanced curricula will not be approved

Choose the thesis during the first semester of the second year

At that time the student will have meet all the teachers of the chosen courses

Courses in the second year present the most advanced arguments and help in choosing the most appropriate thesis subject

The thesis subject should be consistent with the chosen curriculum and with the chosen elective courses

Examples of “typical” Piani Formativi

- High energy physics
- Theoretical astrophysics
- Statistical physics, complex systems
- Mathematical physics

Theoretical HEP

1 year, 1 semester

- Introduction to Quantum Field Theory
- Condensed Matter Physics
- Physics Laboratory 1
- Group Theory in Mathematical Physics
- Computing Methods for Physics

1 year, 2 semester

- Physics Laboratory 2
- Theory of Fundamental Interactions
- Strong Interactions and QCD

2 year, 1 semester

- Phenomenology of the Standard Model
- Quantum Field Theory

+ 1 more from group A

+ 1 free choice course

Theoretical Astrophysics

1 year, 1 semester

- Introduction to Quantum Field Theory
- Condensed Matter Physics
- Physics Laboratory 1
- Group Theory in Mathematical Physics
- Computing Methods for Physics
- General Relativity

2 year, 1 semester

- Quantum field theory
- 1 free course

1 year, 2 semester

- Physics Laboratory 2
- Gravitational waves, compact stars, and black holes
- Theory of Fundamental Interactions
- Physical Cosmology

Statistical Physics, Complex Systems

1 year, 1 semester

- Introduction to Quantum Field Theory
- Condensed Matter Physics
- Physics Laboratory 1
- Computing Methods for Physics
- Statistical Mechanics and Critical Phenomena

1 year, 2 semester

- Physics Laboratory 2
- Mathematical Physics
- Meccanica Statistica del Non Equilibrio
- Theoretical Biophysics / Neural Networks
- Advanced Machine Learning for Physics

2 year, 1 semester

- Statistical Mechanics of Disordered Systems
- Statistical Physics and Machine Learning
- Theory of Stochastic Processes
- Physics of Complex Systems
- Quantum Field Theory

a large number of courses...
you have to choose a subset

Mathematical Physics

1 year, 1 semester

- Introduction to Quantum Field Theory
- Condensed Matter Physics
- Physics Laboratory 1
- Group Theory in Mathematical Physics
- Statistical Mechanics and Critical Phenomena

1 year, 2 semester

- Physics Laboratory 2
- Mathematical Physics
- Nonlinear Waves and Solitons

many courses in the Laurea Magistrale in Matematica

- Istituzioni di Fisica Matematica, Prof. Benedetto
- Sistemi dinamici, Prof. Buttà
- Metodi matematici in meccanica statistica, Prof. Basile
- Metodi matematici in meccanica quantistica, Prof. Teta
- Meccanica dei fluidi e teorie cinetiche, Prof. Cavallaro

Few last suggestions

- Your Piano Formativo can be changed at the beginning of second year.
So don't be too stressed about the choices you make on the first year!
- Don't use the Piano Formativo Individuale as it does not give you more freedom than the standard Piano Formativo. In case you really need to use it, a justification is required.

**FOR QUESTIONS ON THE CURRICULUM
IN THEORETICAL PHYSICS ASK**

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