

UNIVERSITA' DEGLI STUDI DI BARI

MASTER'S DEGREE COURSE IN PHYSICS

COURSE PROSPECTUS 2020-2021

The present document contains information extracted from the Didactic Regulations (*Regolamento Didattico*). Further details on the organizational aspects of the Degree Course can be found there.

DIDACTIC CALENDAR

The training activities are organized in two semesters, devoted exclusively to lessons, exercises and to laboratory activities, followed by a period dedicated to examinations.

The first semester begins on September 21st and ends on December 18th, 2020. The first exam period begins on January 11th, 2021, and ends February 26th, 2021 and includes four exam sessions.

The second semester begins on March 1th 2021 and ends on June 4th 2021. The second exam period begins on June 7th, 2021, and ends on September 17th, 2021 and includes four exam sessions.

The dates and the duration of the exam sessions will be defined by the "Consiglio Interclasse di Fisica" (hereafter referred to as CIF or Council) by the beginning of the year.

ACCESS REQUIREMENTS

Admission to the Master's Degree Course in Physics is unrestricted (no admission test). Students can enrol provided they:

- have completed a Class LT-30 degree (D.M. 270/2004) or Class 25 (D.M. 509/1999) or have an equivalent foreign qualification;
- have achieved a minimum number of credits (ECTS) in the basic courses and characterization activities as specified below: 18 ECTS in MAT/05, 5 in CHIM/03, 45 in FIS/01, 20 in FIS/02, 6 in FIS/03, 6 in the FIS/ 04;

- have an internationally recognized certificate of English language proficiency (European level B2 minimum), to provide at least 15 days in advance the date of the thesis defence.
- for not Italian students, have an internationally recognized certificate of Italian language proficiency (European level B2 minimum), to provide at least 15 days in advance the date of the thesis defence.

If no appropriate original certificate of language is provided, the Council will verify the student's language skills prior to his/her admission.

Moreover, the Master's Degree programme requires:

1. Adequate knowledge of the Mathematical Analysis, Geometry and Linear Algebra as well as of General Chemistry;
2. In-depth knowledge of Classical Mechanics, Thermodynamics, Electromagnetism and Optics;
3. Adequate knowledge of experimental techniques and theoretical approaches in Classical and Modern Physics;
4. Adequate knowledge of basic analog electronics;
5. Adequate knowledge of Relativity, Quantum Mechanics and Mathematical Methods as well as of Statistical Mechanics;
6. Ability in computing.

In special cases, the Council may restrict the student's admission to specific curricula/majors only.

Applications must be sent to "Dipartimento interateneo di Fisica" by September 15th, 2020, including the Transcript of records of the three-year bachelor degree program, with the list of all the exams, issued by the University that released the degree. A committee nominated by the Council will verify whether candidates have the necessary requisites. This process may include an oral interview.

CURRICULA/MAJORS AND INDIVIDUAL STUDY PLANS

The Master's Degree Course Physics is organized in three scientific curricula:

- 1) Theoretical Physics;
- 2) Nuclear, Subnuclear and Astroparticle Physics;
- 3) Solid State Physics and Applied Physics.

Major 3 is further organized in 2 study plans.

Each study plan is organized in compulsory and elective courses.

The CIF suggests a list of elective courses. Students can also choose different courses among those offered by the University of Bari. In accordance with art. 10 DM 270/2004, each student's choice of electives is subject to formal approval by the Council that will verify the coherence of the proposed choice with the overall study plan they have chosen. In cases where students collect more credits than required, the extra credits will be registered in the student career record for further academic purposes. However, the related scores for the extra-numerary credits will not be taken into account for the evaluation of the final grade.

Students may also propose alternative study plans provided they are coherent with the learning objectives of the Master's Degree Course and compliant with law and with the University Didactic Regulations. The proposed study plans must be sent for approval by the end of the first academic year.

CREDITS RECOGNITION

Students who transfer between Degree Courses and/or Universities, as well as students who have attended learning activities offered by other Italian or foreign Universities, can apply to the Council to have previously acquired credits (ECTS) recognized. As a general rule, the CIF guarantees the recognition of the maximum possible number of credits, where necessary, organizing oral interviews for verification of competencies. Students who already have a degree released by another Italian or foreign University can also apply to the Council for Credit recognition and study course abbreviation.

At least 50% of the number of credits obtained in the same scientific sector (SSD) by students who transfer between Degree Courses within the same class will be recognized.

Credits obtained by attending an online Degree Course will be recognized only if the Course is mentioned in the Ministry Regulations art.2, para. 148, of Decree Law 3 October 2006, n.262, converted into Law 24 November 2006, n.286.

Credits that are not recognized by the CIF are registered in the student career record for further academic purposes.

Credits obtained in courses that are not included in the study plan can be used to complete the elective courses. The CIF can approve the admission to the second year if the number of recognized credits is greater than 38.

A maximum of 8 credits per student can be recognized for certified professional skills acquired in University teaching activities, or postsecondary training activities which this university has collaborated in planning and executing, provided they are compliant with the legislation in force.

PREREQUISITES

Students are strongly encouraged to prepare the exams according to the sequence specified in the Study Plan. Students must have passed the exams of the course(s) held in the first semester of the first year belonging to the same SSD before they can be admitted to any other exams in the same SSD.

ECTS AND ATTENDANCE

Each ECTS is equivalent to 25 hours, as detailed below:

| Learning activity | Assisted (With professor) | Individual/Alone |
|-----------------------|---------------------------|------------------|
| In class Lectures | 8 | 17 |
| In class Exercises | 15 | 10 |
| Laboratory Activities | 15 | 10 |
| Final thesis | 0 | 25 |

The credits of a given activity are acquired when the student passes the relative exam or test.

Attendance is strongly recommended. It is mandatory for all laboratory courses. Attendance can be validated if students have attended at least two thirds of the course.

The Council can define specific study plans dedicated to part-time students allowing the required ECTS to be acquired over a longer period of time than the official duration.

Study Plan 2020-2021

Further details can be found on the Master's Degree Course web site.

CURRICULUM THEORETICAL PHYSICS AND COMPLEX SYSTEMS

First Year

Semester I

| Course title | Details | | ECTS | | | | Type of exam |
|-------------------------------------|---------------------------|----------|------|------|------|-----|--------------|
| | SSD/ Scientific sector | Type (*) | Tot | Les. | Ex.s | Lab | |
| 1. Mathematical Methods for Physics | FIS/02 | b | 6 | 5 | 1 | | Exam with |

| | | | | | | | |
|-----------------------------|--------|---|---|---|---|---|-----------------|
| | | | | | | | score |
| 2. Condensed Matter Physics | FIS/03 | b | 6 | 4 | 1 | 1 | Exam with score |
| 3. Statistical Mechanics | FIS/02 | b | 6 | 5 | 1 | | Exam with score |
| 4. Quantum Field Theory | FIS/02 | b | 6 | 5 | 1 | | Exam with score |
| 5. Computational Physics | FIS/01 | b | 6 | 4 | | 2 | Exam with score |

Semester II

| Course title | Details | | ECTS | | | | Type of exam |
|---|---------------------------|----------|------|------|------|-----|-----------------|
| | SSD/ Scientific sector | Type (*) | Tot | Les. | Ex.s | Lab | |
| 6. One Exam between 6.a and 6.b | | | | | | | Exam with score |
| 6.a Probabilistic Methods of Physics | MAT/07 | c | 6 | 5 | 1 | | |
| 6.b Kinetic Theory of Transport Phenomena | CHIM/03 | c | 6 | 5 | 1 | | |
| 7. Critical and Non equilibrium Phenomena | FIS/02 | b | 6 | 5 | 1 | | Exam with score |
| 8. Quantum Information | FIS/02 | b | 6 | 5 | 1 | | Exam with score |
| 9. One exam between 9.a and 9.b | | | | | | | Exam with score |
| 9.a Modeling of Complex Systems | FIS/07 | c | 6 | 5 | 1 | | |
| 9.b Interacting Quantum Fields | FIS/02 | c | 6 | 5 | 1 | | |
| | | | | | | | |

Second Year

Semestre II

| Course title | Details | | ECTS | | | | Type of exam |
|------------------------------------|---------------------------|----------|------|------|------|-----|-----------------|
| | SSD/ Scientific sector | Type (*) | Tot | Les. | Ex.s | Lab | |
| 10. One exam between 10.a and 10.b | | | | | | | Exam with score |
| 10.a Standard Model | FIS/02 | c | 6 | 5 | 1 | | |

| | | | | | | | |
|------------------------------------|--------|---|----|---|---|--|-----------------|
| 10.b Pattern Recognition | FIS/07 | c | 6 | 5 | 1 | | |
| 11. One exam between 11.a and 11.b | | | | | | | Exam with score |
| 11.a Machine Learning for Physics | FIS/07 | c | 6 | 5 | 1 | | |
| 11.b General Relativity | FIS/02 | c | 6 | 5 | 1 | | |
| 12. Free Exams (*) | | d | 12 | | | | Exam with score |
| Trainership | | f | 10 | | | | Attendance |

Semester II

| Course title | Details | | ECTS | | | | Type of exam |
|-------------------|---------------------------|----------|------|------|------|-----|---------------------|
| | SSD/ Scientific sector | Type (*) | Tot | Les. | Ex.s | Lab | |
| Final Examination | | e | 32 | | | | Viva thesis defence |

CURRICULUM PARTICLE ASTROPARTICLE PHYSICS AND ADVANCED TECHNOLOGIES

First Year

Semester I

| Course title | Details | | ECTS | | | | Type of exam |
|------------------------------------|---------------------------|----------|------|------|------|-----|-----------------|
| | SSD/ Scientific sector | Type (*) | Tot | Les. | Ex.s | Lab | |
| 1. Mathematical Methods of Physics | FIS/02 | b | 6 | 5 | 1 | | Exam with score |
| 2. Laboratory of Digital Devices | FIS/01 | b | 6 | 3 | | 3 | Exam with score |
| 3. Quantum Field Theory | FIS/02 | b | 6 | 5 | 1 | | Exam with score |
| 4. Particle Detector Physics | FIS/01 | b | 6 | 5 | | 1 | Exam with score |
| 5. Statistical Data Analysis | FIS/01 | b | 6 | 5 | 1 | | Exam with score |

II semestre

| Course title | Details | | ECTS | | | | Type of exam |
|------------------------------------|---------------------------|----------|------|------|------|-----|-----------------|
| | SSD/ Scientific sector | Type (*) | Tot | Les. | Ex.s | Lab | |
| 6. Elementary Particle Physics | FIS/04 | b | 6 | 5 | 1 | | Exam with score |
| 7. One Exam between 7.a and 7.b | | | | | | | Exam with score |
| 7.a Interacting Quantum Fields | FIS/02 | b | 6 | 5 | 1 | | |
| 7.b Quantum Technologies | FIS/02 | b | 6 | 5 | 1 | | |
| 8. Fundamental Interactions | FIS/04 | b | 6 | 5 | 1 | | Exam with score |
| 9. One exam among 9.a, 9.b and 9.c | | | | | | | Exam with score |

| | | | | | | | |
|-------------------------------|--------|---|---|---|---|--|--|
| 9.a High Energy Astrophysics | FIS/05 | c | 6 | 5 | 1 | | |
| 9.b Collider Particle Physics | FIS/04 | c | 6 | 5 | 1 | | |
| 9.c Computing Technologies | FIS/01 | c | 6 | 5 | 1 | | |

Second Year

Semester I

| Course title | Details | | ECTS | | | | Type of exam |
|--|------------------------------|---------------|------|------|------|-----|-----------------|
| | SSD/ Scientific sector | Type e (*) | Tot | Les. | Ex.s | Lab | |
| 10. Particle and Radiation Detector Laboratory | FIS/01 | b | 6 | 3 | | 3 | Exam with score |
| 11. One exam among 11.a, 11.b and 11.c | | | | | | | Exam with score |
| 11.a Scientific Data Analysis Laboratory | FIS/01 | c | 6 | 2 | | 4 | |
| 11.b Laboratory of Data Acquisition Technologies | FIS/01 | c | 6 | 3 | | 3 | |
| 11.c Health Physics | FIS/07 | c | 6 | 4 | 1 | 1 | |
| 12. free exams (**) | | d | 12 | | | | Exam with score |
| Traineeship | | f | 10 | | | | Attendance |

II semestre

| Moduli e Discipline di Insegnamento | Attività Formative | | Crediti | | | | Prova di Valutazione |
|-------------------------------------|------------------------------|---------------|---------|------|------|-----|----------------------|
| | SSD/ Scientific sector | Type e (*) | Tot | Les. | Ex.s | Lab | |
| Final Examination | | e | 32 | | | | Exam with score |

CURRICULUM CONDENSED MATTER PHYSICS AND PHOTONICS

First Year

Semester I

| Course title | Details | | ECTS | | | | Type of exam |
|---|------------------------------|---------------|------|------|------|-----|-----------------|
| | SSD/ Scientific sector | Type e (*) | Tot | Les. | Ex.s | Lab | |
| 1. e 2. Two exams among 1.2.a 1.2.b and 1.2.c | | | | | | | Exam with score |
| 1.2.a Mathematical Methods of Physics | FIS/02 | c | 6 | 5 | 1 | | |
| 1.2.b Computational Physics | FIS/01 | c | 6 | 4 | | 2 | |
| 1.2.b Laboratory of Digital Devices | FIS/01 | b | 6 | 3 | | 3 | |
| 3. Statistical Mechanics | FIS/02 | c | 6 | 5 | 1 | | Exam with score |
| 4. Quantum Field Theory | FIS/02 | b | 6 | 5 | 1 | | Exam with score |
| 5. Condensed Matter Physics | FIS/03 | b | 6 | 4 | 1 | 1 | Exam with score |

Semester II

| Course title | Details | | ECTS | | | | Type of exam |
|---|------------------------------|---------------|------|------|------|-----|-----------------|
| | SSD/ Scientific sector | Type e (*) | Tot | Les. | Ex.s | Lab | |
| 6 One exam among 6.a, 6.b and 6.c | | | | | | | Exam with score |
| 6.a Critical and Non equilibrium Phenomena | FIS/02 | c | 6 | 5 | 1 | | |
| 6.b Quantum Technologies | FIS/02 | c | 6 | 5 | 1 | | |
| 6.c Spectroscopy and Computer Modeling of Molecular Systems | CHIM/03 | c | 6 | 5 | 1 | | |
| 7. Laboratory of Photonics | FIS/03 | b | 6 | 4 | | 2 | Exam with score |
| 8. Solid State Physics | FIS/03 | b | 6 | 4 | 2 | | Exam with |

| | | | | | | | | |
|---------------------------------------|------------|---|---|---|---|---|--|-----------------------|
| | | | | | | | | score |
| 9.Optoelectronics Nanotechnologies | and FIS/03 | b | 6 | 4 | 1 | 1 | | Exam with score |
| | | | | | | | | |

Second Year

Semester II

| Course title | Details | | ECTS | | | | Type of exam |
|--|------------------------------|---------------|------|------|------|-----|-----------------------|
| | SSD/ Scientific sector | Type e (*) | Tot | Les. | Ex.s | Lab | |
| 10. Laboratory of Quantum Optics | FIS/03 | b | 6 | 4 | | 2 | Exam with score |
| 11 One exam between 11.a and 11.b | | | | | | | Exam with score |
| 11.a Physics of Sensors and Laboratory of Spectroscopy | FIS/03 | c | 6 | 4 | | 2 | |
| 11.b Laboratory of Data Acquisition Technologies | FIS/01 | c | 6 | 3 | | 3 | |
| 12. Free exams | | d | 12 | | | | |
| Traineeship | | f | 10 | | | | Attendan ce |

II semestre

| Course title | Details | | ECTS | | | | Type of exam |
|-------------------|------------------------------|---------------|------|------|------|-----|---------------------------|
| | SSD/ Scientific sector | Type e (*) | Tot | Les. | Ex.s | Lab | |
| Final Examination | | e | 32 | | | | Viva Thesis Defence |

(**): Elective courses recommended for all curricula

| Course title | Details | | ECTS | | | |
|--------------|------------------------------|---------------|------|------|------|-----|
| | SSD/ Scientific sector | Type e (*) | Tot | Les. | Ex.s | Lab |
| Cosmology | FIS/02 | d | 3 | 2 | 1 | |

| | | | | | | |
|---|--------|---|---|---|---|---|
| | | | | | | |
| Deep Learning and Generative Models | FIS/07 | d | 3 | 2 | 1 | |
| Physical Applications of Group Theory | FIS/02 | d | 3 | 2 | 1 | |
| High Performance Computing | FIS/02 | d | 3 | 2 | | 1 |
| Laboratory of Plasma Physics | FIS/03 | d | 3 | 2 | | 1 |
| Heavy Ion Physics | FIS/04 | d | 3 | 2 | 1 | |
| Didactics of Physics | FIS/08 | d | 3 | 2 | 1 | |
| Advanced Programming in C++ | FIS/01 | d | 3 | 2 | | 1 |
| Technologies for Space Applications | FIS/01 | d | 3 | 2 | | 1 |
| Cosmic Ray Physics | FIS/01 | d | 3 | 2 | 1 | |
| Multimessenger Astrophysics | FIS/05 | d | 3 | 2 | 1 | |
| Molecular Dynamics | FIS/07 | d | 3 | 2 | 1 | |
| Advanced Quantum Field Theory | FIS/02 | d | 3 | 2 | 1 | |
| Earth Observation and GIS Data Analysis | FIS/06 | d | 3 | 2 | 1 | |
| Space born radar remote sensing | FIS/06 | d | 3 | 2 | 1 | |
| AI programming in physics | FIS/01 | d | 3 | 2 | | 1 |
| Nuclear Methods in Nuclear Medicine | FIS/07 | d | 3 | 2 | | 1 |

Notes

- a) basic;
- b) characterization;
- c) complementary;
- d) elective;
- e) final thesis;
- f) not included above.

(**) ~~Students must attend the elective activities not later than the first semester of the second year.~~