

# UNIVERSITA' DEGLI STUDI DI BARI

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## MASTER'S DEGREE COURSE IN PHYSICS

### COURSE PROSPECTUS 2019-2020

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 23<sup>rd</sup> and ends on December 20<sup>th</sup>, 2019. The first exam period begins on January 6<sup>th</sup>, 2020, and ends February 28<sup>th</sup>, 2020 and includes four exam sessions.

The second semester begins on March 5<sup>th</sup> 2020 and ends on June 5<sup>th</sup> 2020. The second exam period begins on June 8<sup>th</sup>, 2020, and ends on September 18<sup>th</sup>, 2020 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).

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 15<sup>th</sup>, 2018, 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 extranumerary 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 2019-2020

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

## CURRICULUM THEORETICAL PHYSICS

### *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 (Metodi Matematici della Fisica)	FIS/02	b	6	5	1		Exam with score
2. Condensed Matter Physics (Struttura della Materia)	FIS/03	b	6	4	1	1	Exam with score
3. Statistical Mechanics (Meccanica Statistica)	FIS/02	b	6	5	1		Exam with score

4. Probabilistic Methods of Physics (Metodi Probabilistici della Fisica)	MAT/06	c	6	5	1		Exam with score
5. Theoretical Physics A (Fisica Teorica mod. A: Teoria Quantistica dei Campi)	FIS/02	b	6	5	1		In course testing

## Semester II

Course title	Details		ECTS				Type of exam
	SSD/ Scientific sector	Type (*)	Tot	Les.	Ex.s	Lab	
5. Theoretical Physics B (Fisica Teorica mod. B: Campi quantistici in interazione)	FIS/02	b	6	5	1		Exam with score
6. Kinetic Theory of Transport Phenomena (Teorie Cinetiche del Trasporto)	CHIM/03	c	6	5	1		Exam with score
7. Computational Physics Laboratory (Laboratorio di Fisica Computazionale)	FIS/01	b	6	4		2	Exam with score
8. Advanced Quantum Mechanics (Meccanica Quantistica Avanzata)	FIS/02	b	6	5	1		Exam with score
9. Advanced Statistical Mechanics (Meccanica Statistica Avanzata)	FIS/02	b	6	5	1		Exam with score

## Second Year

### Semester I

Course title	Details		ECTS				Type of exam
	SSD/ Scientific sector	Type (*)	Tot	Les.	Ex.s	Lab	
10. General Relativity (Relatività Generale)	FIS/02	b	6	5	1		Exam with score
11. Standard Model (Modello Standard)	FIS/02	b	6	5	1		Exam with score
12. Elective courses (see table a) (**)		d	8				Exam with score
Traineeship (Tirocinio)		f	8				Attendance

## Semester II

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

## CURRICULUM NUCLEAR, SUBNUCLEAR AND ASTROPARTICLE PHYSICS (FISICA NUCLEARE, SUBNUCLEARE E ASTROPARTICELLARE)

### 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 (Metodi Matematici della Fisica)	FIS/02	b	6	5	1		Exam with score
2. Condensed Matter Physics (Struttura della Materia)	FIS/03	b	6	4	1	1	Exam with score
3. Elementary Particle Physics (Fisica delle Particelle Elementari)	FIS/01	b	6	5	1		Exam with score
4. Probabilistic Methods of Physics (Metodi Probabilistici della Fisica)	MAT/06	c	6	5	1		Exam with score
5. Theoretical Physics A (Fisica Teorica mod. A: Teoria Quantistica dei Campi)	FIS/02	b	6	5	1		In course testing

#### Semester II

Course title	Details		ECTS				Type of exam
	SSD/ Scientific sector	Type (* )	Tot	Les.	Ex.s	Lab	
5. Theoretical Physics B (Fisica Teorica mod. B: Campi quantistici in interazione)	FIS/02	b	6	5	1		Exam with score
6. Kinetic Theory of Transport	CHIM/03	c	6	5	1		Exam with

Phenomena (Teorie Cinetiche del Trasporto)							score
7. Electronics Laboratory (Laboratorio di Elettronica)	FIS/01	b	6	3		3	Exam with score
8. High Energy Astrophysics (Astrofisica delle Alte Energie)	FIS/04	b	6	5	1		Exam with score
9. Fundamental Interactions Phenomenology (Fenomenologia delle Interazioni Fondamentali)	FIS/01	b	6	5	1		Exam with score

## Second Year

### Semester I

Course title	Details		ECTS				Type of exam
	SSD/ Scientific sector	Type (*)	Tot	Les.	Ex.s	Lab	
10. Nuclei And Particles Detection Laboratory (Laboratorio di Fisica Nucleare e Subnucleare)	FIS/04	b	6	4		2	Exam with score
11. Elective course, to be chosen by the end of the first academic year between:							
Statistical Data Analysis Laboratory (Laboratorio di analisi dati)	FIS/01	b	6	3		3	Exam with score
Data Acquisition Laboratory (Laboratorio di acquisizione dati)	FIS/01	b	6	3		3	Exam with score
12. Elective courses (see table a) (**)		d	8				Exam with score
Traineeship (Tirocinio)		f	8				Attendance

### Semester II

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

## CURRICULUM SOLID STATE PHYSICS AND APPLIED PHYSICS (FISICA DELLA MATERIA E APPLICATA).

(Choice of study plan must be made before the end of the first semester of the first year.)

### CURRICULUM SOLID STATE PHYSICS (FISICA DELLA MATERIA)

#### 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 (Metodi Matematici della Fisica)	FIS/02	b	6	5	1		Exam with score
2. Condensed Matter Physics (Struttura della Materia)	FIS/03	b	6	4	1	1	Exam with score
3. Statistical Mechanics (Meccanica Statistica)	FIS/02	b	6	5	1		Exam with score
4. Probabilistic Methods of Physics (Metodi Probabilistici della Fisica)	MAT/06	c	6	5	1		Exam with score
5. Quantum Field Theory (Teoria Quantistica dei Campi)	FIS/02	b	6	5	1		Exam with score

##### Semester II

Course title	Details		ECTS				Type of exam
	SSD/ Scientific sector	Type (* )	Tot	Les.	Ex.s	Lab	
6. Solid State Physics (Fisica della Stato Solido)	FIS/03	b	6	4	1	1	Exam with score
7. Structural Chemistry (Strutturistica chimica)	CHIM/03	c	6	5	1		Exam with score
8. Electronics Laboratory (Laboratorio di Elettronica)	FIS/01	b	6	3		3	Exam with score
9. Modern Optics (Optica Moderna mod. A Ottica non lineare e Biofotonica mod. B Optoelettronica e Nanotecnologie)	FIS/01	b	6	4	1	1	Exam with score
	FIS/01	b	6	4	1	1	



## Second Year

### Semester I

Course title	Details		ECTS				Type of exam
	SSD/ Scientific sector	Type (*)	Tot	Les.	Ex.s	Lab	
10. Physics of Sensors and Laboratory of Spectroscopy (Fisica dei Sensori e laboratorio di Spettroscopia)	FIS/01	b	6	4		2	Exam with score
11. Modern Optics Laboratory (Laboratorio di Ottica Moderna)	FIS/01	b	6	4		2	Exam with score
12. Elective courses (see table a) (**)		d	8				Exam with score
Traineeship (Tirocinio)		f	8				Attendance

### Semester II

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

## CURRICULUM APPLIED PHYSICS (FISICA APPLICATA)

Courses n. 6, 9 and 10 are substituted respectively by:

6. Semiconductor Devices (Dispositivi a Semiconduttore)	FIS/03	b	6	5	1		Exam with score
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9. Medical Physics (Fisica Medica mod.A: Elaborazione di Segnali e immagini mod. B: Fisica Sanitaria)	FIS/01	b	6	5	1		Exam with score
	FIS/01	b	6	5	1		

10. Data Acquisition Laboratory (Laboratorio di acquisizione dati)	FIS/01	b	6	2		4	Exam with score
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**Table a): Elective courses recommended for all curricula**

Foundations of Quantum Optics (Fondamenti di Ottica Quantistica)	FIS/08	d	4	3		1	Exam with score
Astroparticle Physics (Fisica Astroparticellare)	FIS/02	d	4	4			Exam with score
Cosmology (Cosmologia)	FIS/02	d	4	4			Exam with score
Cosmic Rays Physics (Fisica dei Raggi Cosmici)	FIS/01	d	4	4			Exam with score
Experimental Setup in Nuclear and Subnuclear Physics (Apparati della Fisica Nucleare e Subnucleare)	FIS/04	d	4	4			Exam with score
Nuclear Measurement Techniques (Misure nucleari)	FIS/04	d	4	4			Exam with score
Physics Applications of Group Theory (Applicazioni fisiche della Teoria dei Gruppi)	FIS/02	d	4	4			Exam with score
High Performance Computing in Physics (Calcolo ad alte prestazioni per la Fisica)	FIS/01	d	4	4			Exam with score
Quantum Field Theory - Methods and Applications (Metodi ed applicazioni della teoria dei campi quantistici)	FIS/02	d	4	3	1		Exam with score
Elements of Didactic Methodology in Physics (Elementi di Metodologia Didattica per la Fisica)	FIS/08	d	4	4			Exam with score

## 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.