SOFIA UNIVERSITY ST. KLIMENY OHRIDSKI

FACULTY: Physics

C U R R I C U L U M

Approved by:	Approved by the Academic Council with Record of Proceedings № ..... / .....

Professional Field: 4.1 Physical Sciences

Educational and Qualification Degree: „Master”

Area of Study: Physics

P	H	P	4	5	2	1	2	4

/Master’s Degree Program: Quantum Technologies (in English)

Form of Study: full time
Length of Study (number of weeks*/-): 45 weeks (3 semesters)

Professional Qualification: Master in Physics – Quantum Technologies

Qualification Description

Master's Degree Program:

1. Aims and Educational Objectives

The master's program aims to train highly qualified specialists who can successfully work in the field of quantum technologies, including quantum computing, quantum simulations, quantum sensing, quantum communications, quantum control and quantum theory. All lecturers in this master program hold PhD or DCs degrees and have undergone extensive doctoral and/or postdoctoral specializations at renowned universities in Europe.

2. Admission of students (knowledge and skills required for a successful professional realization; general and theoretical background, specific areas of study, etc.)

The Master's program "Quantum Technologies" is intended for specialists with a completed bachelor's degree in the field of physical sciences, as well as bachelors in other related fields (computer science, mathematics, applied mathematics, engineering sciences, etc.).

3. Description of the educational content (knowledge and skills required for a successful professional realization; general and theoretical background, specific areas of study, etc.)

The training is organized in three semesters according to a curriculum in the amount of 780 hours (75 credits) for lecture courses and 60 hours (5 credits) of internship, which ends with a Master Thesis defense (15 credits). All lectures and seminars are in English. The preparation of the Master Thesis is carried out in parallel with classroom training in the third semester. The total number of elective courses is 10, with the minimum number of elective courses being 5 – 1 course (4 credits) in the first semester, 2 courses (10 credits) in the second semester and 2 courses (10 credits) in the third semester.

Students have the right, after an approval by the head of the master's program, to replace two of the optional courses with courses from another master's program in the Faculty of Physics.

The training is carried out by a team of teachers from the Departments of Theoretical Physics, Optics and Spectroscopy, Physics of Condensed Matter and Microelectronics and Teaching Methods in Physics of the Faculty of Physics and the Bulgarian Academy of Sciences.

Of particular importance is the presence of the powerful computing system (Physon cluster) at the Faculty of Physics, as well as the Nestum cluster in Sofia Techpark, which can be used in the training of the students and the preparation of their Master Thesis.

The Master's program has an e-mail address: qinfo@phys.uni-sofia.bg.

4. Professional and general competences, specific competences

The knowledge and skills acquired within the framework of the Master program "Quantum Technologies" allow its graduates to successfully engage in the scientific research process and work on projects in the field of quantum technologies, including quantum computation, quantum metrology, quantum sensing, quantum simulations, quantum communications, quantum cryptography and quantum theory.

5. Professional realization (according to the National Classification of Occupations in the Republic of Bulgaria /based on the International Standard Classification of Occupations (ISCO)/ and in reference to the place of the future specialists in the National Qualifications Framework for higher education and the European Qualifications Framework for higher education)

After successful completion of the program, Masters in "Quantum Technologies" receive a professional qualification that enables them to realize and work as professors in universities, scientists in scientific research institutes and researchers in high-tech companies in the field of quantum technologies.

PHH	1	2	0	1

Program code

Bachelor's Degree Program "Quantum, Nuclear and Particle Physics"

admission winter semester of 2024/2025 academic year

№	Course Code				Course Title	Type- C, E, O	Semester	ECTS credits	Classes - total number					Classes per week	Assessment* - e, ca, ce, cont.
									Total	Lectures	Seminars	Practical Classes/ Observation	Self study		
1	*2*				*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*
Core Subjects															
1	H	2	3	8	Linear Algebra and Analytical Geometry	**C**	**1**	**8**	**240**	**60**	**60**	**0**	**120**	**4+4+0**	E
2	H	2	3	9	Calculus of a Function of a Single Real Variable	**C**	**1**	**8**	**240**	**60**	**60**	**0**	**120**	**4+4+0**	E
3	H	2	3	0	Mechanics	**C**	**1**	**10**	**300**	**45**	**30**	**45**	**180**	**3+2+3**	E
4	H	2	4	1	Programming in Unix Environment	**C**	**1**	**4**	**120**	**30**	**0**	**30**	**60**	**2+0+2**	CE
5	H	2	4	2	Calculus of a Function of Several Real Variables	**C**	**2**	**8**	**240**	**60**	**60**	**0**	**120**	**4+4+0**	E
6	H	2	4	3	Calculus of Complex Functions	**C**	**2**	**4**	**120**	**30**	**30**	**0**	**60**	**2+2+0**	E
7	H	2	4	4	Probability and Statistics in Physics	**C**	**2**	**4**	**120**	**30**	**0**	**30**	**60**	**2+0+2**	E
8	H	2	4	5	Molecular Physics	**C**	**2**	**9**	**270**	**30**	**30**	**45**	**165**	**2+2+3**	E
9	H	2	4	6	Object-oriented Programming	**C**	**2**	**5**	**150**	**45**	**30**	**0**	**75**	**3+2+0**	CE
10	H	2	4	7	Vectors and Tensors	**C**	**3**	**5**	**150**	**30**	**30**	**0**	**90**	**2+2+0**	E
11	H	2	4	8	Ordinary Differential Equations	**C**	**3**	**5**	**150**	**30**	**30**	**0**	**90**	**2+2+0**	E
12	H	2	4	9	Electricity and Magnetism	**C**	**3**	**10**	**300**	**60**	**30**	**45**	**165**	**4+2+3**	E
13	H	2	5	0	Basics of Electronics	**C**	**3**	**6**	**180**	**30**	**0**	**45**	**105**	**2+0+3**	E

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form of assessment:
e-exam, ca-current assessment
ce-combined examination
cont.- continues in the next semester

14	H	2	5	1	Partial Differential Equations	**C**	**4**	**4**	**120**	**30**	**30**	**0**	**60**	**2+2+0**	E
15	H	2	5	2	Theoretical Mechanics	**C**	**4**	**6.5**	**195**	**60**	**30**	**0**	**105**	**4+2+0**	E
16	H	2	5	3	Optics	**C**	**4**	**9.5**	**285**	**60**	**15**	**45**	**165**	**4+1+3**	E
17	H	2	5	4	Programming and Computational Physics	**C**	**4**	**4**	**120**	**30**	**0**	**30**	**60**	**2+0+2**	E
18	H	2	5	5	Atomic Physics and Interaction of Ionizing Radiation with Matter	**C**	**5**	**10**	**300**	**45**	**30**	**45**	**180**	**3+2+3**	E
19	H	2	5	6	Electrodynamics	**C**	**5**	**6**	**180**	**60**	**30**	**0**	**90**	**4+2+0**	E
20	H	2	5	7	Basic Quantum Mechanics	**C**	**5**	**6**	**180**	**60**	**30**	**0**	**90**	**4+2+0**	E
21	H	2	5	8	Nuclear Physics	**C**	**6**	**9.5**	**285**	**45**	**30**	**45**	**165**	**3+2+3**	E
22	H	2	5	9	Advanced Quantum Mechanics	**C**	**6**	**5.5**	**165**	**45**	**30**	**0**	**90**	**3+2+0**	E
23	H	2	6	0	Nuclear Electronics	**C**	**6**	**6**	**180**	**45**	**0**	**45**	**90**	**3+0+3**	E
24	H	2	6	1	Detectors of Ionizing Radiation	**C**	**6**	**5**	**150**	**30**	**30**	**0**	**90**	**2+2+0**	E
25	H	2	6	2	Thermodynamics and Statistical Physics	**C**	**7**	**7**	**210**	**60**	**30**	**0**	**120**	**4+2+0**	E
26	H	2	6	3	Introduction to Particle Physics	**C**	**7**	**7.5**	**225**	**45**	**30**	**30**	**120**	**3+2+2**	E
27	H	2	6	4	Astrophysics	**C**	**7**	**4**	**120**	**45**	**15**	**0**	**60**	**3+1+0**	E
28	H	2	6	5	Dosimetry and Radiation Protection	**C**	**7**	**7.5**	**225**	**45**	**0**	**60**	**120**	**3+0+4**	E
29	H	2	6	6	Advanced Particle Physics	**C**	**8**	**5**	**150**	**45**	**30**	**0**	**75**	**3+2+0**	E
30	H	2	6	7	Theoretical Nuclear Physics	**C**	**8**	**5**	**150**	**45**	**30**	**0**	**75**	**3+2+0**	E
31	H	2	6	8	Experimental Nuclear Physics	**C**	**8**	**6**	**180**	**45**	**0**	**45**	**90**	**3+0+3**	E

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Elective courses - Students may enroll in elective courses from the attached list, or from the general list of elective courses in English for The Faculty of Physics or from the mandatory specialized courses in English for other specialties in the Faculty of Physics. The electable disciplines must carry a minimum of 4 credits in the 3th semester, a minimum of 6 credits in the 4th semester, a minimum of 8 credits in the 5th semester, a minimum of 4 credits in the 6th semester, a minimum of 4 credits in the 7th semester and a minimum of 4 credits in the 8th semester.

1	H	2	6	9	Introduction to Machine Learning	**E**	**3 or 5**	**4**	**120**	**30**	**0**	**30**	**60**	**2+0+2**	CE
2	H	2	7	0	Data Analysis	**E**	**3 or 5**	**4**	**120**	**30**	**0**	**30**	**60**	**2+0+2**	CE
3	H	2	7	1	Relativistic Mechanics	**E**	**4 or 6**	**4**	**120**	**30**	**0**	**30**	**60**	**2+0+2**	E
4	H	2	7	2	Data Bases	**E**	**4**	**4**	**120**	**30**	**0**	**30**	**60**	**2+0+2**	E
5	H	2	7	3	Functional Analysis	**E**	**4**	**3**	**90**	**45**	**0**	**0**	**45**	**3+0+0**	E
6	H	2	7	4	Physical Applications of the Group Theory	**E**	**5 or 7**	**5**	**150**	**45**	**30**	**0**	**75**	**3+2+0**	E
7	H	2	7	5	General Astronomy	**E**	**5**	**4**	**120**	**30**	**0**	**30**	**60**	**2+0+2**	CE
8	H	2	7	6	Nuclear Reactions	**E**	**6**	**4**	**120**	**45**	**0**	**0**	**75**	**3+0+0**	E
9	H	2	7	7	Nuclear Astrophysics	**E**	**6**	**4.5**	**135**	**45**	**15**	**0**	**75**	**3+1+0**	CE
10	H	2	7	8	Introduction to Monte Carlo Simulations of Radiation Transport	**E**	**6**	**4.5**	**135**	**30**	**0**	**30**	**75**	**2+0+2**	CE
11	H	2	7	9	Gravitation	**E**	**6 or 8**	**4**	**120**	**30**	**30**	**0**	**60**	**2+2+0**	E
12	H	2	8	0	Introduction to Quantum Field Theory	**E**	**7**	**6**	**180**	**45**	**30**	**0**	**105**	**3+2+0**	E
13	H	2	8	1	Introduction to Quantum Technologies	**E**	**7**	**5**	**150**	**45**	**30**	**0**	**75**	**3+2+0**	E
14	H	2	8	2	Particle Accelerators	**E**	**7**	**4**	**120**	**45**	**15**	**0**	**60**	**3+1+0**	E
15	H	2	8	3	Cosmology and Elementary Particles	**E**	**8**	**4**	**120**	**45**	**15**	**0**	**60**	**3+1+0**	CE
16	H	2	8	4	Nuclear Symmetries	**E**	**8**	**5**	**150**	**45**	**0**	**30**	**75**	**3+0+2**	E
17	H	2	8	5	Quantum Computation	**E**	**8**	**5**	**150**	**45**	**0**	**30**	**75**	**3+0+2**	CE
18	H	2	8	6	Quantum Simulations and Quantum Metrology	**E**	**8**	**5**	**150**	**45**	**0**	**30**	**75**	**3+0+2**	CE

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cont.- continues in the next semester

Optional courses - Sports classes are compulsory in the first four semesters

1	H	1	5	3	Sport	**O**	**1 - 8**	**1**	**30**	**0**	**30**				CE
2	H	1	5	8	Bulgarian language as a foreign language I	**O**	**1**	**4**	**120**	**0**	**60**	**0**	**60**	**0+4+0**	CE
3	H	1	5	9	Bulgarian language as a foreign language II	**O**	**2**	**4**	**120**	**0**	**60**	**0**	**60**	**0+4+0**	CE
4	H	1	6	0	Bulgarian language as a foreign language III	**O**	**3**	**4**	**120**	**0**	**60**	**0**	**60**	**0+4+0**	CE
5	H	1	6	1	Bulgarian language as a foreign language IV	**O**	**4**	**4**	**120**	**0**	**60**	**0**	**60**	**0+4+0**	CE

Degree Completion

Form of degree completion	ECTS credits	First State Exam Session	Second State Exam Session
Defence of a Diploma thesis	10	July	September

The curriculum has been approved by the Faculty Council, Record of Proceedings № 17 from 12.12.2023

DEAN:.....

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