

UNIVERSITY OF RIJEKA – DEPARTMENT OF PHYSICS
GRADUATE STUDY PROGRAMME PHYSICS AND PHILOSOPHY

MAY 2016.



I. DESCRIPTION OF STUDY PROGRAMME FORM

BASIC INFORMATION	
Title of study programme	Graduate study programme Physics and Philosophy
Study programme coordinator	University of Rijeka
Study programme implementor	Department of Physics of the University of Rijeka (<i>Study programme coordinator</i>) Faculty of Arts and Sciences of the University of Rijeka
Type of study programme	university
Level of study programme	graduate
Academic/professional degree awarded upon completion of study	Master of education for Physics and Philosophy

1. INTRODUCTION

1.1 Reasons for launching the study programme

The rapid growth of science achievements in the fields of natural sciences and technologies requires a long-term and quality education of experts in these fields. Therefore, we propose the university graduate study programme Physics and Philosophy based on the three-year undergraduate study programme of Physics. The latter has been aimed primarily to provide students with the basic knowledge of physics together with the underlying necessary skills in mathematics including the optional subject Philosophy – teacher training. The graduate programme we offer provides the students with more specialized knowledge focused on meeting requirements for teaching profession, which does not preclude by any means a future employment in some other segments of modern society, directed towards development of advanced technologies.

The proposed graduate programme, based on the 45-years of tradition at the University of Rijeka in educational programmes for teachers of natural sciences and mathematics, has been modernized and adapted to suit the requirements of the contemporary educational practice in education of primary and high school teachers. The graduate teacher training study programme Physics and Philosophy for now is a unique study in Croatia, which combines natural sciences and the humanities by introducing students to the philosophy of science. Achievements in natural sciences and mathematics dramatically alter the established notions by transforming the overall physical picture of the world, essentially being the origin of philosophy of nature and of the theory of knowledge. These issues require a thorough philosophical reflection. The interaction between science and philosophy is even more relevant because of ethical dilemmas caused by implementation of science in engineering and technology.

The fundamental knowledge gained during the course of the proposed graduate programme covers:

- the teaching methodology of physics and philosophy with the teaching practice in a real school environment
- the group of pedagogical and psychological courses, the so called teachers module
- a whole series of elective courses associated to the teaching profession and a given specialization,

all of which will make it easier for the future teachers to join the teaching profession and the life-long education in a highly successful and quality way. The full realization of the pedagogical-psychological group of courses, already started during the undergraduate studies within the module for teachers, continues during the graduate studies in full agreement with the curriculum for teaching profession, adopted by the specialist committee of the Faculty of Arts and Sciences of the University of Rijeka and based on the current recommendations for the continuous monitoring and the quality-improvements of the university teaching practice.



1.2 Evaluation of purposefulness in respect to the market needs of public and private sector

The proposed graduate study programme has a potential for securing the sufficient number of physics teachers for primary and high schools, as well as of teachers of humanities (philosophy, ethics, logic) in high schools in the Primorsko-Goranska County and the neighbouring Counties. Given the current world trend to combine the natural with the social sciences and humanities, we expect demand for such qualified personnel in the future.

1.2.1. Connection with the local community (economy, entrepreneurship, civil society)

Currently, there is a great demand in the whole region of our County for the physics teachers, as well as for teachers of humanities. The pedagogic-psychological component of this graduate study programme interconnects the area of natural sciences with the area of education, giving rise to the interdisciplinarity of the whole programme and linking the world of science to the local community and, through it, to the civil society.

1.2.2. Compliance with professional association's requirements (recommendations)

The current proposal of the graduate study programme Physics and Philosophy complies in full with the requests, recommendations and strategic documents of several Croatian professional associations, such as the Croatian Physical Society, the Rijeka Society of Physicists and Mathematicians and the Golden Cut Society from Rijeka. Connection of physics with social and human sciences is known to be a trend in today's world.

1.2.3. Name possible partners outside the higher education system showing interest in the study programme

Currently, all primary and high schools in the Republic of Croatia, having physics and humanities as subjects in their curricula, express the need and interest for the graduate study programme Physics and Philosophy. In addition, the interest is shown by social institutions that have a need for experts in the socio-humanistic orientation.

1.3 Comparability of the study programme with similar programmes of accredited higher education institutions in the Republic of Croatia and the EU (name and explain comparability of the proposed programme with two programmes, whereas at least one of which should be from the EU (provide their web sites))

The graduate study programme Physics and Philosophy (as a possible continuation of a three-year undergraduate study programme Physics at the Department of Physics, University of Rijeka) is comparable with programs in physics and philosophy at York and Oxford. The study programs in physics and philosophy at York and Oxford last four years, after which the student receives the title of Master of Science. These programs are not teacher training, but research programmes, as in the United Kingdom the pedagogical-psychological component of the study is provided after the professional studies through some specialized pedagogical-psychological educational courses (PGCE - Postgraduate Certificat of Education). For this reason, the concept of study at York and Oxford is different from our concept: a small number of more complex and specialized courses that are distributed mainly in the first three years of their programmes, we replace by a larger number of more general courses distributed through three years of undergraduate and two years of graduate study. The main group of subjects in physics and philosophy is identical in all the three programs.

The graduate teacher training study programme Physics and Philosophy is unique in the Republic of Croatia.

The proposed study programme is based on the curricula of several universities:

York (Velika Britanija): <http://www.york.ac.uk/physics/undergraduate/courses/degrees/jointdegrees/physicsphilosophy/>

Oxford (Velika Britanija):

http://www.ox.ac.uk/admissions/undergraduate_courses/courses/physics_and_philosophy/physics_and_3.html

Osijek: <http://www.fizika.unios.hr/>

Split: <http://fizika.pmfst.hr/>

Zagreb: <http://www.phy.hr>

Maribor: <http://www.fizika.uni-mb.si/>

Bochum (Germany): <http://physik.ruhr-uni-bochum.de/>

Bath (United Kingdom): <http://www.bath.ac.uk/physics/>

Prag (Czech Republic): <http://www.mff.cuni.cz/>

Buffalo (USA): <http://electron.physics.buffalo.edu/>



1.4. Openness of the study programme towards horizontal and vertical mobility of students within national and international higher education area

All courses of this two-year graduate programme are planned as one-semester courses, enabling a dynamic exchange of content of courses as well as mobility of students within universities in Croatia and EU countries at any stage during the study programme, subject to the completion of all chosen courses.

The direct enrolment to the proposed graduate study programme in Physics and Philosophy is granted to all students having undergraduate degrees from the undergraduate study programme in Physics from the Department of Physics of the University of Rijeka (optional subject Philosophy, teacher training), as well as students graduated in physics at any university undergraduate study programme with requirement of passing exams related to the differences in the curricula. The students with Master degree can continue their education at related specialized or doctoral studies in Croatia or abroad, subject to requirements of specific higher-education institutions.

During the course of this graduate study programme, students can be redirected to some other graduate study programmes offered by the Department of Physics of the University of Rijeka with requirements of passing some exams related to the differences in the programmes.

1.5. Alignment with the Mission and the Strategy of the University of Rijeka

The proposed study programme is fully compatible with the Mission and the Strategy of the University of Rijeka, while representing at the same time one of the strategic goals of the University, related to the development and growth of natural sciences in relation with humanities, IT literacy, development of new technologies, as well as the continual improvement of the educational system at all levels.

The interdisciplinary and multidisciplinary character of the proposed study programme is assured by the consolidation of the existing staff and knowledge from the University of Rijeka and the promotion of the collaboration with the respectable scientific institutions in Croatia. This will contribute to the harmonic and rapid development of the University of Rijeka, but also to the economical and social development of the city of Rijeka and its surrounding region.

1.6. Institutional strategy for study programmes development

The implementation of the proposed study programme is in accordance with the mission and the strategic goals of the Department of Physics of the University of Rijeka, which insists on the scientific excellence. This goal requires, among other things, the education and training of highly skilled and motivated professional teachers in agreement with requirements of the modern educational practice.

The implemented combination of the naturally interconnected physics with philosophy is unique in the Republic of Croatia. Initially, physics originates from philosophy and moreover, today they are integrated in the overall philosophy of science. By altering the overall physical view of the universe, the modern physics has imposed the need to change the entire philosophical understanding of our world. The cause-and-effect relationship of physics and philosophy is particularly pronounced in quantum physics and special theory of relativity.

The education of students follows the contemporary constructivistic theory of learning and the theory of knowledge and adequately prepares students for implementation of the same educational practice in their future teacher profession. Students showing exceptional affinities and inclination towards the scientific research are introduced to the research projects. Some of them, after completing postgraduate studies and specialization, may find job at the universities or scientific institutes in Croatia or abroad.

1.7. Other important data – according to the coordinator's opinion

The concept and implementation of the proposed graduate programme is a joint project of the Department of Physics of University of Rijeka and of the Faculty of Arts and Sciences of the University of Rijeka.

The proposed graduate study programme has been structured according to recommendations given for Bologna study programmes in EU.



2. GENERAL PART

2.1. Title of study programme

Graduate study programme Physics and Philosophy

2.1.1. Type of study programme

University programme

2.1.2. Level of study programme

Graduate study programme

2.1.3. Area of study programme (scientific/artistic) – indicate the title

Area-Natural sciences, Field- Physics.

Area- Human sciences, Field - Philosophy

Area- Social sciences, Fields- Psychology and Pedagogy.

2.2. Study programme coordinator

University of Rijeka

2.3. Implementor/s of study programme

Department of Physics of the University of Rijeka

Faculty of Arts and Sciences of the University of Rijeka

2.4. Duration of study programme (indicate possibilities of part-time study, long distance study)

Two academic years, i.e. four semesters, primarily as full-time, with a possibility of part-time studies.

2.4.1. ECTS credits – minimal number of credits required for completion of study programme

Minimum of 120 ECTS.

2.5. Enrolment requirements and selection procedure

Direct enrolment for all students having undergraduate degree from the undergraduate study programme Physics from the University of Rijeka (optional subject Philosophy – teacher training) and all students graduated in physics at any undergraduate study programme offered by the Croatian Universities, with requirement of passing exams in differences in curricula.

Selection criteria are based on merits achieved during the undergraduate studies.

2.6. Study programme learning outcomes

2.6.1. Competences which student gains upon completion of study (according to CROQF (HKO): knowledge, skills and competences in a restricted sense –independence and responsibility)

The general competences gained by students upon completion of studies include:

- ability to conduct the teaching duties required for teachers of physics and humanities (philosophy, ethics, logic) in primary and secondary schools in Croatia
- community-responsible work in schools which includes the application of pedagogical-psychological skills in both dealing with children and young people and promoting and popularizing natural sciences and philosophy
- systematic thinking leading to involvement in a range of jobs in educational sector or jobs including knowledge of natural science and philosophy
- analysis of complex systems in nature or society
- knowledge about structure and functioning of physical systems and the ability to apply this knowledge to different areas
- application of practical knowledge
- capability to work independently or as a member of a team on different projects.



The more specific competences gained by students upon completion of studies include:

- knowledge and understanding of fundamental physical concepts and their mathematical foundations
- understanding the connection of physical systems with other systems in nature and society
- understanding and solving of basic physical problems at both the qualitative and quantitative level
- development of skills for displaying and interpreting experimental data
- knowledge of fundamentals of logic and skill to apply its principles,
- knowledge and understanding of the philosophical trends, of the development of the humanities, humanistic concepts and ideas through history,
- knowledge and understanding of the impact of physics on the development of science and technology, the impact of philosophy on the development of science and the impact of physics on philosophy, on philosophy of science and on the development of humanities.

2.6.2. Employment possibility (list of possible employers and compliance with professional association's requirements)

After completion of this two-year graduate programme in Physics and Philosophy, the graduated students are fully qualified for jobs of primary or secondary school teachers of physics as well as teachers of humanities (philosophy, ethics, logic) in schools in Croatia. The fact that this is a double-degree teacher training study programme increases the possibility of employment.

The list of possible employers includes: primary and secondary schools, media and PR, financial institutions (for example banks or the stock exchange), research institutes (for example Institute Ruđer Bošković or Institute of Physics in Zagreb or Science and Technology Park in Rijeka), research and education institutions (University Departments of Physics, Mathematics or Computer Science, all universities or polytechnics having courses of physics, Faculty of Arts and Sciences of the University of Rijeka, IT Academy of the University of Rijeka), Oncology Departments and Departments for Nuclear Medicine in hospitals, laboratories in industries and the private sector dealing with the development of new and advanced materials, social institutions that have a need for experts in the socio-humanistic orientation (Institute of Philosophy).

2.6.3. Possibility of continuation of study on higher level

Masters of education can continue their education at specialist or scientific doctoral studies in Croatia or abroad, subject to the requirements of these institutions. There is also a unique opportunity of doctoral studies in the field of Educational Physics or the Educational Science at some UK or USA Universities, such as University of Maryland in the USA.

2.7. Upon applying for graduate studies list proposer's or other Croatian institution's undergraduate study programmes which enable enrolment to the proposed study programme

Undergraduate study of Physics at the University of Rijeka
Undergraduate study of Physics at the University of Osijek
Undergraduate study of Physics at the University of Split

2.8. Upon application of integrated studies - name reasons for integration of undergraduate and graduate level of study programme

The proposed graduate study programme is not integrated.



3. PROGRAMME DESCRIPTION

3.1. List of compulsory and elective subjects and/or modules (if existing) with the number of active teaching hours required for their implementation and number of ECTS-credits (appendix: Table 1)

Table 3.1., page 7

3.2. Description of each subject (appendix: Table 2)

Appendix 1, Table 3.2., page 13

3.3. Structure of study programme, dynamic of study and students' obligations

Dynamics of study and student's obligations are regulated by the Rules of studies issued by the University of Rijeka and by the programme of each study course. The whole study programme is divided into four semesters, while every study subject is a one-semester course.

3.3.1. Enrolment requirements for the next semester or trimester (course title)

The enrolment requirements are aligned with the Rules of studies issued by the University of Rijeka. The rules related to the enrolment of a specific course, if existing, are given in the description of that particular course.

3.4. List of courses and/or modules student can choose from other study programmes

Elective courses in philosophy in the proposed study programme are the integral part of the graduate programmes offered by the Faculty of Arts and Sciences of the University of Rijeka.

3.5. List of courses and/or modules that can be implemented in a foreign language (specify the language)

All the courses offered by the staff of the Department of Physics of the University of Rijeka can be delivered in English language as consultancies and in agreement with the lecturers.

3.6. Allocated ECTS credits that enable national and international mobility

ECTS credits achieved by students during the study programme (30 ECTS per semester, 120 in total) allow students to change universities and/or study programmes in Croatia or abroad.

3.7. Multidisciplinarity/interdisciplinarity of study programme

The proposed study programme is interdisciplinary and multidisciplinary by its nature and title, as it contains subjects from physics, philosophy and educational sciences and therefore covers the area of natural, human and social sciences. The interdisciplinary and multidisciplinary character of the proposed study programme is also assured by the consolidation of the existing staff and knowledge from the University of Rijeka and by the collaboration with scientific organisations in Croatia.

3.8. Mode of study programme completion

The study programme is completed by a final exam consisting of writing and public defence of the Master's Thesis.

3.8.1. Conditions of approval of final work /thesis and/or final/thesis exam application

The final exam can be approved only to students passing all exams required by the study programme Physics and Philosophy and after completion of written Master's Thesis under mentor's supervision.

3.8.2. Composing and furnishing of final work/thesis

The chosen subject of the Master's Thesis should be announced to the mentor at least 30 days from the beginning of the final, fourth semester. Production and features of the Master's Thesis are regulated by the Set of Rules for Master's Thesis production, issued by the Department of Physics.

3.8.3. Final work/thesis assessment procedure and evaluation and defence of final work/thesis

The mentor constantly evaluates the Master's Thesis during its production, while the final assessment is given by the three-member committee during the public defence of Thesis. The whole procedure for the public defence of the Master's Thesis is regulated by the Set of Rules for Master's Thesis production, issued by the Department of Physics.



TABLE 3.1. : List of compulsory and elective courses and/or modules with weekly teaching hours required and ECTS credits allocated¹

GRADUATE STUDY PROGRAMME PHYSICS AND PHILOSOPHY

LIST OF MODULES/COURSES – COMPULSORY COURSES							
Year of study: 1.							
Semester: 1.							
MODULE	COURSE		L	E	S	ECTS	STATUS ²
	Electrodynamics		3	3	0	7	C
	Demonstration Experiments for Physics Teachers Training		0	0	3	3	C
	Aesthetics		2	0	2	6	C
	Philosophy of Mind		2	0	2	6	C
	Didactics II		2	1	0	4	C
	General pedagogy		2	1	0	4	C

LIST OF MODULES/COURSES – COMPULSORY COURSES							
Year of study: 1.							
Semester: 2.							
MODULE	COURSE		L	E	S	ECTS	STATUS
	Fundamentals of Quantum Mechanics		3	3	0	7	C
	Methods and Strategies in Physics Teaching I		2	0	1	4	C
	Laboratory Experiments for Physics Teachers Training		0	0	3	3	C
	Philosophy of Science		2	0	2	6	C
	20th Century Contemporary Philosophy		2	0	2	6	C
	Elective courses II-FF					4	E

LIST OF MODULES/COURSES – ELECTIVE COURSES II-FF							
Students are required to take 1 course counting for a total of 4 ECTS credits. Course is linked with elective III-FF-A.							
Year of study: 1.							
Semester: 2.							
MODULE	COURSE		L	E	S	ECTS	STATUS
I	Basic electronics		2	1	1	4	E
	Modern Physics II		4	1	0	4	E
	Atomic and Molecular Physics		3	0	1	4	E

¹ The total number of teaching hours for a particular course in semester is obtained multiplying weekly teaching hours by 15.

² **IMPORTANT:** Insert **C** for compulsory course or **E** for elective course.



LIST OF MODULES/COURSES – COMPULSORY COURSES

Year of study: 2.

Semester: 3.

MODULE	COURSE	L	E	S	ECTS	STATUS ³
	Methods and Strategies in Physics Teaching II	2	0	1	3	C
	History of Physics	1	0	1	2	C
	Teaching Methods in Philosophy I	3	1	0	4	C
	Philosophy of Physics	2	0	2	6	C
	Elective courses III-FF-A				4	E
	Elective courses III-FF-B				3	E
	Elective courses III-FF-C				9	E

LIST OF MODULES/COURSES – ELECTIVE COURSES III-FF-A

Students are required to take 1 course counting for a total of 4 ECTS credits. Course is linked with elective II-FF.

Semester: 3.

MODULE	COURSE	L	E	S	ECTS	STATUS
	Electronics laboratory	0	0	4	4	E
	Structure of Matter Lab	0	0	4	4	E

LIST OF MODULES/COURSES – ELECTIVE COURSES III-FF-B

Students are required to take 1 course counting for a total of 3 ECTS credits. Course is linked with elective II-FF.

Semester: 3.

MODULE	COURSE	L	E	S	ECTS	STATUS
	Philosophy of Education	1	0	1	3	E
	Moral Reasoning	1	0	1	3	E
	State, rights, community and individual	1	0	1	3	E
	Critical thinking for Teachers	1	0	1	3	E
	Reading philosophical texts for teaching	1	0	1	3	E
	Contemporary discussions of the philosophy of education	2	0	0	3	E
	Bioethics and Gender Studies	1	0	1	3	E
	Evolution and Values	0	0	2	3	E

LIST OF MODULES/COURSES – ELECTIVE COURSES III-FF-C

Students are required to take at least 1 course counting for a total of 9 or more ECTS credits.

Semester: 3.

MODULE	COURSE	COURSE COORDINATOR	L	E	S	ECTS	STATUS
	Elective course – philosophy ⁴					3	E

L – Lectures, E – Exercises, S – Seminars

³ **IMPORTANT:** Insert **C** for compulsory course or **E** for elective course.

⁴ The list of all elective philosophy courses can be found at p. 11 and 12.



LIST OF MODULES/COURSES – COMPULSORY COURSES

Year of study: 2.

Semester: 4.

MODULE	COURSE	L	E	S	ECTS	STATUS ⁵
	Teaching Practice in Physics	0	3	0	3	C
	School Practice in Philosophy	0	4	0	3	C
	Philosophy of Politics ⁶	2.66	0	1.33	5	C
	Symbolic Logic	2	0	2	6	C
	Graduate Thesis				5	C
	Elective courses IV-FF-A				7	E

L – Lectures, E – Exercises, S – Seminars

LIST OF MODULES/COURSES – ELECTIVE COURSES IV-FF-A

Students are required to take at least 2 courses counting for a total of 7 or more ECTS credits.

Year of study: 2.

Semester: 4.

MODULE	COURSE	L	E	S	ECTS	STATUS
	Conceptual Physics	1	0	1	2	E
	Interdisciplinary Subjects in Physics Teaching	1	0	1	2	E
	Science Popularization	1	0	1	2	E
	Computers in Physics Teaching	1	0	1	2	E
	Elementary Particle Physics	3	0	1	5	E
	Solid State Physics	2	1	1	5	E
	Biophysics	2	0	2	5	E
	Fundamentals of Astronomy and Astrophysics	2	1	1	5	E
	Experimental methods in physics	2	1	1	5	E

⁵ **IMPORTANT:** Insert **C** for compulsory course or **E** for elective course.

⁶ Lectures: 40 h; Seminars: 20 h.



LIST OF ELECTIVE PHILOSOPHY COURSES – ELECTIVE COURSES III-FF-C

Year of study: 2.

Semestar: 3.

MODULE	COURSE	L	E	S	ECTS	STATUS ⁷
	Analytical Marxism ⁸	1.33	0	0.66	3	E
	A priori Classical Texts	0	0	2	3	E
	Atheism-Theism	0	0	2	3	E
	Bioethics and Gender Studies	1	0	1	3	E
	Christian Philosophy ⁹	1.33	0	0.66	3	E
	Continental Philosophy after Hegel	1	0	1	3	E
	Continental Philosophy after Hegel - from Husserl to Habermas	1	0	1	3	E
	Critical thinking	1	0	1	3	E
	Critical thinking for Teachers	1	0	1	3	E
	Consciousness and Content	1	0	1	3	E
	Croatian Philosophy ¹²	1.33	0	0.66	3	E
	Death	0	0	2	3	E
	Dynamic logic	1	0	1	3	E
	Emotions	1	0	1	3	E
	Evolution and Values	0	0	2	3	E
	Free Will	0	0	2	3	E
	Fundamentals of Philosophy I	2	0	0	3	E
	Fundamentals of Philosophy II	2	0	0	3	E
	Fundamental Problems of Metaphysics	0	0	2	3	E
	Introduction to the philosophy of religion ¹³	1.33	0	0.66	3	E
	Introduction to Sociology	2	0	0	3	E
	Kant on Pure Reason	1	0	1	3	E
	Logical Positivism	0	0	2	3	E
	Mathematical Logic	1	0	1	3	E
	Medieval Philosophy ¹³	1.33	0	0.66	3	E
	Moral Reasoning and Moral Reality	0	0	2	3	E
	Paradoxes	0	0	2	3	E
	Perception	1	0	1	3	E
	Philosophy of Language	1	0	1	3	E

⁷ **IMPORTANT:** Insert **C** for compulsory course or **E** for elective course.

⁸ Lectures: 20 h; Seminars: 10 h.

⁹ Lectures: 20 h; Seminars: 10 h.



Philosophy of Literature		0	0	2	3	E
Philosophy of Logic		1	0	1	3	E
Philosophy of Mathematics		1	0	1	3	E
Philosophy of History		1	0	1	3	E
Philosophy of Psychiatry		1	0	1	3	E
Philosophy of Sexuality		1	0	1	3	E
Philosophy of Science: darwinism, molecular biology and medicine		1	0	1	3	E
Philosophical Anthropology		1	0	1	3	E
Philosophical Problems of Science		1	0	1	3	E
Science and Explanation		0	0	2	3	E
Symbolic logic - methatheory		1	0	1	3	E
Sociology of Culture		2	0	0	3	E
Theories of Distributive Justice ¹³		1.33	0	0.66	3	E
Wittgenstein		0	0	2	3	E