Undergraduate study programme

PHYSICS

Department of Physics, University of Rijeka
Rijeka, 9 December 2010.

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I. DESCRIPTION OF STUDY PROGRAMME FORM

BASIC INFORMATION	
Title of study programme	**Physics**
Study programme coordinator	**University of Rijeka - Department of Physics**
Study programme implementor	Department of Physics, University of Rijeka (*Study programme coordinator*) Department of Mathematics, University of Rijeka Department of Informatics, University of Rijeka Department of Biotechnology, University of Rijeka Faculty of Arts and Sciences in Rijeka
Type of study programme	university
Level of study programme	undergraduate
Academic/professional degree awarded upon completion of study	**Bachelor of Physics**

1. INTRODUCTION

1.1 Reasons for launching the study programme

To keep up with the fast development in science and technology there is an increased demand for science graduates. The proposed study programme is based on the 45-years long tradition of teacher training in natural sciences and mathematics at the University of Rijeka and on the recent strategy of University of Rijeka which has been emphasising a need for expanding R&D capacities of the Department of Physics. We are committed to our mission to educate a new generation of bachelors that will be equipped with the functional knowledge that will enable them to adapt to demanding future needs of industry and educational institutions.

Within the first three years of undergraduate studies students will be acquainted with the fundamental laws of physics as well as with the supportive sciences such as mathematics and computer science. By introducing a number of problem solving subjects, students will be encouraged to think creatively. To make the physics course attractive to a wider range of interests, in frame of five different optional subjects (*Physics, Environmental science, Mathematics, Computer science* and *Philosophy*), starting from the second year of study, a large number of elective courses are offered. With such a wide choice of subjects we expect an increased interest for physics studies.
After having finished this undergraduate study programme, the students are expected to be able to work effectively in educational and R&D institutions and laboratories as well as in the industry, banks, etc.

Optional subject ***Physics*****:** within this option, students will focus on theoretical and experimental aspects of physics. This option will prepare students for R&D work either locally or in the international arena.

Optional subject ***Environmental science*****:** beside being trained in fundamental physics, students will be acquainted with the basic principles of biology, chemistry, geology and ecology. With these basic skills and knowledge students will be ready to take up jobs like laboratory analysis and data processing in various laboratories, or inspection and controlling service in government offices. The need for this profile was expressed by our County officials. The County is willing to support this initiative as well as by suggesting the course curriculum depending on the future market needs.

Within the three optional subjects, ***Mathematics, Computer science*** and ***Philosophy***, students may choose *teacher training* elective courses. This option within the undergraduate study program, beeing a preparatory step in education of primary and secondary school teachers of physics and related subjects, is particularly significant because the physics teachers are scarce, and it is estimated that this deficit will be even more pronounced in the future.

Instead of teacher training elective courses, students can choose specialised courses, either in mathematics or in computer science or in philosophy, which will make them even more suitable for the current market demands, already existing in Europe and rising in Croatia. For a large number of jobs, like programmers and web site developers in IT oriented SME-s, bachelors with three years of university education are quite adequate.

Once the first three years of undergraduate studies are completed, more ambitious students will be offered two more years of graduate studies covering educational, research and engineering fields. At present, at the University of Rijeka, it is possible to enroll the graduate study programmes in teacher training (*Physics and mathematics, Physics and computer science*) as well as in engineering (*Engineering and physics of materials*).
In addition, new research graduate study programmes (*Physics, Physics and Evironmental Science*) and a teacher training programme (*Physics and Philosophy*) are in preparation.
All in all, students will have a wide choice of subjects to select from. Once they graduate, they will be equipped with the functional knowledge that will enable them for life-long learning, give them the highest possible mobility to work in the challenging new environment.

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

Demand for bachelors in the labor market in Croatia is still building up. Although the european experience shows that the general acceptance of bachelors is a relatively long process, we expect an evidence of increasing interest for our graduates in real time. Once their competencies are recognized by local government institutions and SMEs, we believe them to find employment as associates in educational institutions at all levels, laboratories, inspectorates and government offices, IT industry, as coordinators of production processes and social activities, etc.

We estimate the purposefulness of the proposed undergraduate programme high. The proposed programme insures that bachelors will gain knowledge and skills not only in natural science, but also social and humanities. The ability of logical thinking, of independent problem solving and of linking different contents make the bachelors adequate for employment in industry, public and private sector.

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

The demand for such profiles has been expressed by the local community and by the University of Rijeka as science and education center of the region. The Primorsko-goranska County expressed its interest for multidisciplinary specialists, especially in environmental science, so we expect their corresponding support.

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

The proposed undergraduate programme agrees with the demands, recommendations and strategy of the relevant organizations such as: Croatian Physical Society, Mathematical and Physical Society of Rijeka, Golden Section. The multidisciplinary orientation, being the world wide trend, is belived to be attractive to students.

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

Primorsko-goranska County, City of Rijeka.

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 concept of the proposed undergraduate studies in physics is similar to the corresponding programme of the Faculty of Mathematics and physics in Ljubljana (http://www.fmf.uni-lj.si), which also has different options at the undergraduate level (general physics, astronomy, education). In both programmes there is a number of courses common to all options, courses specific to each particular option, and a certain number of elective courses. An advantage of our undergraduate study programme relative to Ljubljana is greater number of options. Furthermore, unlike Ljubljana, where the choice has to be made at the beginning of the study, we offer the possibility of choice from the second year of study to give the students more time to make their decision.

Our undergraduate program is similar to the corresponding ones from two other croatian universities in Osijek and Split. Although their programs do not offer different options, they, in particular in Split, allow refined differentiation in the third (last) year of the undergraduate study. The core of all mentioned undergraduate studies consisting of courses in physics, mathematics and computer science, is almost identical. Note that our programme offers a greater number of courses in each particular optional subject.

During the preparation of the program we used the curricula of several croatian and foreign universities:
Osijek: http://www.fizika.unios.hr/
Split: http://fizika.pmfst.hr/
Zagreb: http://www.phy.hr
Maribor (Slovenia): http://www.fizika.uni-mb.si/
Bochum (Germany): http://physik.ruhr-uni-bochum.de/
Bath (UK): http://www.bath.ac.uk/physics/
Prag (Chech 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

Students choose the optional subject in the second year. During the undergraduate study it is possibile to change the selected option or to enroll additional courses from other optional subjects. In order to enroll a particular course, account should be taken of prerequisites defined in the course programme. The conditions of transition to a corresponding undergraduate programme at another university is regulated by that university.
Upon completion of the proposed undergraduate study programme *Physics*, it is possible to enroll the graduate study programmes at the Department of Physics, University of Rijeka. Admission to similar and related graduate studies at other high educational institutions in Croatia and beyond, is regulated by the relevant institutions.

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

One of the goals of the University of Rijeka is to create flexible academic profiles at all three levels of university studies, in agreement with the needs of the community, economy and society development. The number and wide range of optional subjects represents the starting point of such education.
In addition, such study represents the indispensable teaching basis for the realization of the scientific-research mission of the University. The study programme is expected to contribute to the implementation of the University in the economy and social development of the community.

1.6 .Institutional strategy for study programmes development

Implementation of the new study programme will significantly increase the quality of the scientific activities at the Department of Physics, which is one of the primary strategic goals of the Department. In addition, raising the quallity of the current teacher training programmes is in interest of the Department and of the wider community.

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

The proposed undergraduate study programme consists of five optional subjects: ***Physics, Environmental Science, Mathematics, Computer science, Philosophy***. The options *Mathematics, Computer science* and *Philosophy* offer additionally a *teacher training orientation*.
Beside courses which are characteristic for each particular optional subject, the common core consists of the following physics and mathematic courses:
Analysis I, Analysis II, Linear Algebra I , Linear Algebra II, Physics I: Mechanics, Physics II: Electricity and Magnetism, Physics III: Waves and Optics, Physics IV: Thermodynamics and Basic Statistical Physics, Physics Laboratory I, Physics Laboratory II, Physics Laboratory III, Physics Laboratory IV, Modern Physics I, Modern Physics II, Classical Mechanics, Data Analysis, Programming, Methodology of Elaborating Professional and Scientific Papers, Undergraduate Thesis.
All options, except for mathematics, have additionally two coursec in comon: Mathematical Methods of Physics I and Mathematical Methods of Physics II.
Pedagogical and psychological courses implemented in this undergraduate study are a part of the teacher training curriculum adopted by the Commission of the Faculty of Arts and Sciences at the University of Rijeka, based on the recent reforms aiming to improve the quality of teaching.

2. GENERAL PART

2.1. Title of study programme

Physics

2.1.1. Type of study programme

university

2.1.2. Level of study programme

undergraduate

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

Natural sciences, the field of physics

2.2. Study programme coordinator

University of Rijeka - Department of Physics

2.3. Implementor/s of study programme

Department of Physics, University of Rijeka (*Study programme coordinator*)
Department of Mathematics, University of Rijeka
Department of Informatics, University of Rijeka
Department of Biotechnology, University of Rijeka
Faculty of Arts and Sciences in Rijeka

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

Undergraduate study Physics takes 3 academic years, i.e., 6 semesters. The programme is primarily designed as a full-time study, with a possibility of part-time studying.

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

Minimum number of ECTS credits required for completion of the undergraduate study programme is 180.

2.5. Enrolment requirements and selection procedure

Applicants who have completed a four-year secondary school and passed the state graduation exam can enroll the undergraduate study programme under valid conditions in agreement with law.

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)

General competences:

Students will be capable to:
-carry out precise measurement, display results in tables and graphs; perfom the statistical data analysis and interprete the results of the measurements; describe and explain the physical phenomena and processes related to specific measurements and discuss causal relationships in given subjects
- define and distinguish the basic concepts and principles of mechanics, heat, electricity, magnetism and optics, and apply them to solve numerical problems;
- define, distinguish and describe the basic concepts of modern physics and apply its laws to solve numerical problems;

Specific competences acoording to the choice of the optional subject:

Physics
- define, distinguish and describe the basic concepts of theoretical physics, of special branches of physics in the elective courses, to become familiar with the experimental methodology of scientific research in the real laboratory environment

Environmental science
- define and distinguish the basic concepts and principles of general, cellular and molecular biology; ecology; geology;
- define and distinguish the basic concepts and principles, derive and interpret the measurements in general, inorganic, organic and analytical chemistry.

Mathematics
- define and distinguish the basic concepts and principles of mathematical analysis, linear algebra, combinatorics, discrete and numerical mathematics, geometry, differential equations, Euclidean spaces, differential geometry and mathematical logic, and apply them to solve numerical problems

Computer science
- define and distinguish the basic concepts of analysis and data processing, programming, basics of digital techniques, dynamic web applications, architecture and computer organization, databases, operating systems, computer networks, algorithms and data structures

Philosophy
- define and distinguish the basic concepts of philosophy, ancient philosophy, ethics and epistemology, the basic concepts of aesthetics, the history of classical German idealism, logic, metaphysics, modern philosophy from Descartes to Kant

*Teacher training (*orientation within the optional subjects *Mathematics, Computer Science* and *Philosophy)*
- Define and distinguish the basic concepts of developmental psychology, psychology of learning and teaching, general pedagogy and didactics

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

Bachelors of physics can be employed in research laboratories of commercial companies to work on development of advanced technologies (Ericsson Nikola Tesla). Further, thev might be included as collaborators in research institutes and high education institutions (Institute Ruđer Bošković, Institute of Physics, universities and high schools), in laboratories and departments of public health institutes. Due to their ability of analytical approach in solving problems, they could also find a job beyond the field of physics (for example, management).
Regarding the particular features of optional subjects, bachelors of physics can also be employed in chemical laboratories (DINA Petrochemical Inc., INA rafinery, public health institutes), in the IT sector, in the Institute of Philosophy, as assistants / teaching associates in primary and secondary schools, in the media (especially for scientific columns).

2.6.3. Possibility of continuation of study on higher level

Depending on the optional subjects and orientation of the undergraduate study, physics bachelors can continue their education in graduate programs of the Department of Physics, University of Rijeka:

- bachelors who have completed one of the teacher training orientation (*Mathematics, Computer Science, Philosophy*) can enroll either a corresponding graduate teacher training study programme (*Physics and Mathematics*, *Physics and Computer Science*) or the graduate study programme *Engineering and physics of materials*. In addition, bachelors who have completed the optional subject *Philosophy* can continue to study Philosophy at the Department of Philosophy at the Faculty of Arts and Sciences in Rijeka, without differential exams. Another possibility is expected to be the graduate study programme *Physics and philosophy* which is in preparation.

- bachelors who have completed the non-teaching optional subjects *Mathematics, Computer Science* and *Philosophy* can enroll either the graduate study programme *Engineering and physics of materials*, or, after passing differential exams in pedagogical and psychological courses, thes can enroll the corresponding graduate teacher training study programme (*Physics and Mathematics, Physics and Computer Science*). Another possibility is expected to be the graduate study programme *Physics and philosophy* which is in preparation. In addition, bachelors who have completed the optional subjects *Philosophy* can continue to study Philosophy at the Department of Philosophy at the Faculty of Arts and Sciences in Rijeka, without differential exams.

- bachelors who have completed the optional subjects *Environmental science* can enroll the graduate study programme *Engineering and physics of materials*. Another possibility is expected to be the graduate study programme *Physics and environmental science* which is in preparation.

- bachelors who have completed the optional subjects *Physics* can enroll the graduate study programme *Engineering and physics of materials*. Another possibility is expected to be graduate study programme *Physics* which is in preparation.

It is possible to enroll the graduate study programmes at the Department of Physics (at the University in Osijek) and at the Department of Physics at the Faculty of Science in Split, under specific conditions of each particular instution.
Also, students may pursue graduate studies abroad, if they fulfill specific enrollment conditions.

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

The proposed study is undergraduate university study.

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

The proposed study 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)

See page 8.

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

Table 2. containing description of all courses in alphabetical order is given in Appendix 2 (page 38)
In electronic form (CD), the tables with description of courses are assorted in directories according to the field (physics, mathematics, computer science, philosophy, enviroment, PPD – pedagogy, psychology, didactics, foreing language)

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

Dynamic of study and students' obligations are determined by the Rulebook of studies at the University of Rijeka and by programmes of individual courses. The undergraduate study programme Physics consists of different optional subjects and orientations, as described in paragraphs 1.1. and 1.7. Students select an optional subject in the second year of study, but it is possible to change the optional subject by passing differential exames.

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

For the enrollment in the higher year of study, minimum of 18 ECTS credits is required (Rulebook of studies at the University of Rijeka). Conditions related to the enrollment of an individuale course, if existing, are given in the programme of the corresponding course.

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

The proposed undergraduate programme, with all its optional subjects and orientations, has such a complex structure, that inclusion of courses from other study programmes is not anticipated.

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

All courses coordinated by teachers from the Department of Physics can be held in english language, in agreement with the related teacher.

3.6. Allocated ECTS credits that enable national and international mobility

All ECTS credits that the student acquires during the study (30 ECTS credits per semester, a total of 180 ECTS for three years) allow the transfer to other universities in Croatia and abroad.

3.7. Multidisciplinarity/interdisciplinarity of study programme

According to its structure, the proposed study programme is based on principles of multidisciplinarity and interdisciplinarity. Courses in physics, mathematics, computer science, chemistry, biology, geology and ecology provide a good scientific basis. Teacher training orientation include courses in humanities and social sciences. The option *Philosophy* is a unique example of combination of the humanistic and natural sciences. The combination of physics with philosophy is unique in Croatia.

3.8. Mode of study programme completion

Undergraduate study programme *Physics* is completed by successful defense of the final thesis.

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

Students receive an approval of final exam after having passed all the exams of the undergraduate study and with completed thesis approved by the supervisor.

3.8.2. Composing and furnishing of final work/thesis

The student is obliged to choose the supervisor and the subject of the thesis at latest till the end of the fifth semester and complete it under the guidance of the supervisor during the last, sixth semesters of the undergraduate study. The thesis consists of theoretical and/or experimental part related to physics. The final form of the thesis should be in agreement with the Rulebook on final thesis at the Department of Physics, University of Rijeka.

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

The supervisor is permanently supervising the work on the thesis. The thesis is defended during the final exam in front of a three-member commission. The procedure of the defence of the thesis is regulated by the Rulebook on final thesis at the Department of Physics, University of Rijeka.

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3.1. List of compulsory and elective courses and/or modules with weekly teaching hours required and ECTS credits allocated[1]

(A) UNDERGRADUATE STUDY PROGRAMME PHYSICS
Optional Subject: Mathematics

LIST OF MODULES/COURSES – COMPULSORY COURSES							
Year of study: 1.							
Semester: 1.							
OPTIONAL SUBJECT	**COURSE**	**COURSE COORDINATOR**	**L**	**E**	**S**	**ECTS**	**STATUS[2]**
Mathematics	Physics I: Mechanics	I. Orlić	3	3	0	9	C
	Analysis I	N. Mujaković	3	3	0	7	C
	Linear Algebra I	R. Sušanj	3	3	0	7	C
	Elective courses I					6	E

L – Lectures, E – Exercises, S – Seminars

LIST OF MODULES/COURSES – ELECTIVE COURSES I							
Students are required to take 2 courses with a total of 6 ECTS credits.							
Year of study: 1.							
Semester: 1.							
OPTIONAL SUBJECT	**COURSE**	**COURSE COORDINATOR**	**L**	**E**	**S**	**ECTS**	**STATUS**
Mathematics	Basic Mathematics	V. Labinac	1	1	0	3	E
	Fundamentals of Computer Science	V. Labinac	1	1	0	3	E
	English for Specific Purposes	O. Vučetić	1	1	0	3	E

L – Lectures, E – Exercises, S – Seminars

[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.

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LIST OF MODULES/COURSES – COMPULSORY COURSES							
Year of study: 1.							
Semester: 2.							
OPTIONAL SUBJECT	**COURSE**	**COURSE COORDINATOR**	**L**	**E**	**S**	**ECTS**	**STATUS[3]**
Mathematics	Physics II: Electricity and Magnetism	M. Petravić	3	3	0	9	C
	Data Analysis	V. Labinac	1	1	0	3	C
	Analysis II	N. Mujaković	3	3	0	7	C
	Linear Algebra II	D. Crnković	3	3	0	7	C
	Programming	M. Matetić	2	2	0	5	C

L – Lectures, E – Exercises, S – Seminars

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

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LIST OF MODULES/COURSES – COMPULSORY COURSES							
Year of study: 2.							
Semester: 3.							
OPTIONAL SUBJECT	**COURSE**	**COURSE COORDINATOR**	**L**	**E**	**S**	**ECTS**	**STATUS**[4]
Mathematics	Physics III: Waves and Optics	R. Jurdana-Šepić	3	2	0	7	C
	Physics Laboratory I	B. Milotić	0	0	3	3	C
	Analysis III	N. Mujaković	3	3	0	7	C
	Combinatorics	S. Rukavina	2	2	0	5	C
	Elective courses III-MAT					10	E

L – Lectures, E – Exercises, S – Seminars

LIST OF MODULES/COURSES – ELECTIVE COURSES III-MAT							
Students are required to take at least 2 courses counting for a total of 10 or more ECTS credits. Students taking the Teachers Training should enrol in courses in pedagogy and psychology of education.							
Year of study: 2.							
Semester: 3.							
OPTIONAL SUBJECT	**COURSE**	**COURSE COORDINATOR**	**L**	**E**	**S**	**ECTS**	**STATUS**
Mathematics	Measurements in Physics	M. Petravić	2	1	1	5	E
	Computational Physics	D. Dominis Prester	2	1	1	5	E
	Introduction to Numerical Mathematics	N. Mujaković	2	2	0	5	E
	Developmental Psychology	S. Smojver-Ažić	2	1	0	5	E
	Educational Psychology I	B. Rončević Zubković	2	1	0	5	E

L – Lectures, E – Exercises, S – Seminars

[4] **IMPORTANT:** Insert **C** for compulsory course or **E** for elective course.

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LIST OF MODULES/COURSES – COMPULSORY COURSES							
Year of study: 2.							
Semester: 4.							
OPTIONAL SUBJECT	**COURSE**	**COURSE COORDINATOR**	**L**	**E**	**S**	**ECTS**	**STATUS**[5]
Mathematics	Physics IV: Thermodynamics and Basic Statistical Physics	N. Orlić	4	2	0	8	C
	Physics Laboratory II	B. Milotić	0	0	3	3	C
	Complex Analysis	N. Grbac	3	2	0	5	C
	Elective courses IV-MAT					12	E

L – Lectures, E – Exercises, S – Seminars

LIST OF MODULES/COURSES – ELECTIVE COURSES IV-MAT							
Students are required to take at least 3 courses counting for a total of 12 or more ECTS credits. Students taking the Teachers Training should enrol in courses in pedagogy and psychology of education.							
Year of study: 2.							
Semester: 4.							
OPTIONAL SUBJECT	**COURSE**	**COURSE COORDINATOR**	**L**	**E**	**S**	**ECTS**	**STATUS**
Mathematics	Astronomy and Astrophysics	D. Kotnik-Karuza	2	0	1	4	E
	Mathematica Software Package	V. Labinac	1	1	0	3	E
	Physics Seminars	V. Labinac	0	0	2	3	E
	Geometry	V. Mikulić Crnković	2	2	0	5	E
	Discrete Mathematics	D. Crnković	2	2	0	5	E
	Educational Psychology II	B. Rončević Zubković	2	1	0	4	E
	Pedagogy	J. Zloković	2	1	0	5	E

L – Lectures, E – Exercises, S – Seminars

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

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LIST OF MODULES/COURSES – COMPULSORY COURSES							
Year of study: 3.							
Semester: 5.							
OPTIONAL SUBJECT	**COURSE**	**COURSE COORDINATOR**	**L**	**E**	**S**	**ECTS**	**STATUS**[6]
Mathematics	Modern Physics I	D. Kotnik-Karuza	4	1	0	5	C
	Classical Mechanics	Z. Kaliman	3	3	0	7	C
	Physics Laboratory III	B. Milotić	0	0	3	3	C
	Differential Equations	N. Grbac	2	2	0	5	C
	Euclidean Spaces	D. Crnković	2	2	0	5	C
	Mathematical Logic	S. Rukavina	2	2	0	6	C

L – Lectures, E – Exercises, S – Seminars

[6] **IMPORTANT:** Insert **C** for compulsory course or **E** for elective course.

LIST OF MODULES/COURSES – COMPULSORY COURSES							
Year of study: 3.							
Semester: 6.							
OPTIONAL SUBJECT	**COURSE**	**COURSE COORDINATOR**	**L**	**E**	**S**	**ECTS**	**STATUS**[7]
Mathematics	Modern Physics II	D. Dominis Prester	4	1	1	6	C
	Physics Laboratory IV	D. Kotnik-Karuza	0	0	4	4	C
	Methodology of Elaborating Professional and Scientific Papers	B. Milotić	1	0	1	1	C
	Introduction to Differential Geometry	V. Mikulić Crnković	3	2	0	7	C
	Undergraduate Thesis					3	C
	Elective courses VI-MAT					8	E

L – Lectures, E – Exercises, S – Seminars

LIST OF MODULES/COURSES – ELECTIVE COURSES VI-MAT							
Students are required to take at least 1 course counting for a total of 8 or more ECTS credits. Students taking the Teachers Training should enrol in courses in pedagogy and psychology of education.							
Year of study: 3.							
Semester: 6.							
OPTIONAL SUBJECT	**COURSE**	**COURSE COORDINATOR**	**L**	**E**	**S**	**ECTS**	**STATUS**
Mathematics	Physics Seminars	V. Labinac	0	0	2	3	E
	Quantum Physics and Applications	Z. Lenac	3	2	0	8	E
	Set Theory	R. Sušanj	2	2	0	5	E
	Didactics I	A. Klapan	2	1	0	5	E

L – Lectures, E – Exercises, S – Seminars

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

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(B) UNDERGRADUATE STUDY PROGRAMME PHYSICS
Optional Subject: Computer Science

LIST OF MODULES/COURSES – COMPULSORY COURSES							
Year of study: 1.							
Semester: 1.							
OPTIONAL SUBJECT	**COURSE**	**COURSE COORDINATOR**	**L**	**E**	**S**	**ECTS**	**STATUS[8]**
Computer Science	Physics I: Mechanics	I. Orlić	3	3	0	9	O
	Analysis I	N. Mujaković	3	3	0	7	O
	Linear Algebra I	R. Sušanj	3	3	0	7	O
	Elective courses I					6	I

L – Lectures, E – Exercises, S – Seminars

LIST OF MODULES/COURSES – ELECTIVE COURSES I							
Students are required to take 2 courses with a total of 6 ECTS credits.							
Year of study: 1.							
Semester: 1.							
OPTIONAL SUBJECT	**COURSE**	**COURSE COORDINATOR**	**L**	**E**	**S**	**ECTS**	**STATUS**
Computer Science	Basic Mathematics	V. Labinac	1	1	0	3	I
	Fundamentals of Computer Science	V. Labinac	1	1	0	3	I
	English for Specific Purposes	O. Vučetić	1	1	0	3	I

L – Lectures, E – Exercises, S – Seminars

[8] **IMPORTANT:** Insert **C** for compulsory course or **E** for elective course.

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LIST OF MODULES/COURSES – COMPULSORY COURSES							
Year of study: 1.							
Semester: 2.							
OPTIONAL SUBJECT	**COURSE**	**COURSE COORDINATOR**	**L**	**E**	**S**	**ECTS**	**STATUS**[9]
Computer Science	Physics II: Electricity and Magnetism	M. Petravić	3	3	0	9	O
	Data Analysis	V. Labinac	1	1	0	3	O
	Analysis II	N. Mujaković	3	3	0	7	O
	Linear Algebra II	D. Crnković	3	3	0	7	O
	Programming	M. Matetić	2	2	0	5	O

L – Lectures, E – Exercises, S – Seminars

[9] **IMPORTANT:** Insert **C** for compulsory course or **E** for elective course.

LIST OF MODULES/COURSES – COMPULSORY COURSES							
Year of study: 2.							
Semester: 3.							
OPTIONAL SUBJECT	**COURSE**	**COURSE COORDINATOR**	**L**	**E**	**S**	**ECTS**	**STATUS**[10]
Computer Science	Physics III: Waves and Optics	R. Jurdana-Šepić	3	2	0	7	O
	Physics Laboratory I	B. Milotić	0	0	3	3	O
	Mathematical Methods of Physics I	V. Labinac	2	2	0	5	O
	Introduction to Digital Systems	I. Ipšić	2	2	0	5	O
	Elective courses III-INF					10	I

L – Lectures, E – Exercises, S – Seminars

LIST OF MODULES/COURSES – ELECTIVE COURSES III-INF							
Students are required to take at least 2 courses counting for a total of 10 or more ECTS credits. Students taking the Teachers Training, should enrol in courses in pedagogy and psychology of education.							
Year of study: 2.							
Semester: 3.							
OPTIONAL SUBJECT	**COURSE**	**COURSE COORDINATOR**	**L**	**E**	**S**	**ECTS**	**STATUS**
Computer Science	Measurements in Physics	D. Dominis Prester	2	1	1	5	I
	Computational Physics	M. Petravić	2	1	1	5	I
	Object-Oriented Programming	V. Topolovec	2	2	0	5	I
	Developmental Psychology	S. Smojver-Ažić	2	1	0	5	I
	Educational Psychology I	B. Rončević Zubković	2	1	0	5	I

L – Lectures, E – Exercises, S – Seminars

[10] **IMPORTANT:** Insert **C** for compulsory course or **E** for elective course.

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LIST OF MODULES/COURSES – COMPULSORY COURSES							
Year of study: 2.							
Semester: 4.							
OPTIONAL SUBJECT	**COURSE**	**COURSE COORDINATOR**	**L**	**E**	**S**	**ECTS**	**STATUS**[11]
Computer Science	Physics IV: Thermodynamics and Basic Statistical Physics	N. Orlić	4	2	0	8	O
	Physics Laboratory II	B. Milotić	0	0	3	3	O
	Mathematical Methods of Physics II	P. Dominis Prester	2	2	0	5	O
	Computer Organization and Arhitecture	I. Ipšić	2	2	0	5	O
	Elective courses IV-INF					9	I

L – Lectures, E – Exercises, S – Seminars

LIST OF MODULES/COURSES – ELECTIVE COURSES IV-INF							
Students are required to take at least 2 courses counting for a total of 9 or more ECTS credits. Students taking the Teachers Training, should enrol in courses in pedagogy and psychology of education.							
Year of study: 2.							
Semester: 4.							
OPTIONAL SUBJECT	**COURSE**	**COURSE COORDINATOR**	**L**	**E**	**S**	**ECTS**	**STATUS**
Computer Science	Astronomy and Astrophysics	D. Kotnik-Karuza	2	0	1	4	I
	Object-Oriented Modeling	V. Topolovec	2	2	0	5	I
	Educational Psychology II	B. Rončević Zubković	2	1	0	4	I
	Pedagogy	J. Zloković	2	1	0	5	I

L – Lectures, E – Exercises, S – Seminars

[11] **IMPORTANT:** Insert **C** for compulsory course or **E** for elective course.

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LIST OF MODULES/COURSES – COMPULSORY COURSES							
Year of study: 3.							
Semester: 5.							
OPTIONAL SUBJECT	**COURSE**	**COURSE COORDINATOR**	**L**	**E**	**S**	**ECTS**	**STATUS**[12]
Computer Science	Modern Physics I	D. Kotnik-Karuza	4	1	0	5	O
	Classical Mechanics	Z. Kaliman	3	3	0	7	O
	Physics Laboratory III	B. Milotić	0	0	3	3	O
	Computer Network I	M. Radovan	2	2	0	5	O
	Introduction to Databases	P. Poščić	2	2	0	5	O
	Operating Systems I	B. Kovačić	2	2	0	4	O

L – Lectures, E – Exercises, S – Seminars

[12] **IMPORTANT:** Insert **C** for compulsory course or **E** for elective course.

LIST OF MODULES/COURSES – COMPULSORY COURSES							
Year of study: 3.							
Semester: 6.							
OPTIONAL SUBJECT	**COURSE**	**COURSE COORDINATOR**	**L**	**E**	**S**	**ECTS**	**STATUS**[13]
Computer Science	Modern Physics II	D. Dominis Prester	4	1	1	6	O
	Physics Laboratory IV	D. Kotnik-Karuza	0	0	4	4	O
	Methodology of Elaborating Professional and Scientific Papers	B. Milotić	1	0	1	1	O
	Algorithms and Data Structures	M. Matetić	2	2	0	5	O
	Multimedia Systems	N. Hoić-Božić	2	2	0	5	O
	Undergraduate Thesis					3	O
	Elective courses VI-INF					7	I

L – Lectures, E – Exercises, S – Seminars

LIST OF MODULES/COURSES – ELECTIVE COURSES VI-INF							
Students are required to take at least 1 course counting for a total of 7 or more ECTS credits. Students taking the Teachers Training, should enrol in courses in pedagogy and psychology of education.							
Year of study: 3.							
Semester: 6.							
OPTIONAL SUBJECT	**COURSE**	**COURSE COORDINATOR**	**L**	**E**	**S**	**ECTS**	**STATUS**
Computer Science	Physics Seminars	V. Labinac	0	0	2	2	I
	Mathematica Software Package	V. Labinac	1	1	0	3	I
	Quantum Physics and Applications	Z. Lenac	3	2	0	8	I
	Data Modeling	M. Pavlić	2	2	0	5	I
	Didactics I	A. Klapan	2	1	0	5	I

L – Lectures, E – Exercises, S – Seminars

[13] **IMPORTANT:** Insert **C** for compulsory course or **E** for elective course.

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(C) UNDERGRADUATE STUDY PROGRAMME PHYSICS
Optional Subject: Philosophy

LIST OF MODULES/COURSES – COMPULSORY COURSES							
Year of study: 1.							
Semester: 1.							
OPTIONAL SUBJECT	**COURSE**	**COURSE COORDINATOR**	**L**	**E**	**S**	**ECTS**	**STATUS**[14]
Philosophy	Physics I: Mechanics	I. Orlić	3	3	0	9	O
	Analysis I	N. Mujaković	3	3	0	7	O
	Linear Algebra I	R. Sušanj	3	3	0	7	O
	Elective courses I					6	I

L – Lectures, E – Exercises, S – Seminars

LIST OF MODULES/COURSES – ELECTIVE COURSES I							
Students are required to take 2 courses with a total of 6 ECTS credits.							
Year of study: 1.							
Semester: 1.							
OPTIONAL SUBJECT	**COURSE**	**COURSE COORDINATOR**	**L**	**E**	**S**	**ECTS**	**STATUS**
Philosophy	Basic Mathematics	V. Labinac	1	1	0	3	I
	Fundamentals of Computer Science	V. Labinac	1	1	0	3	I
	English for Specific Purposes	O. Vučetić	1	1	0	3	I

L – Lectures, E – Exercises, S – Seminars

[14] **IMPORTANT:** Insert **C** for compulsory course or **E** for elective course.

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LIST OF MODULES/COURSES – COMPULSORY COURSES							
Year of study: 1.							
Semester: 2.							
OPTIONAL SUBJECT	**COURSE**	**COURSE COORDINATOR**	**L**	**E**	**S**	**ECTS**	**STATUS**[15]
Philosophy	Physics II: Electricity and Magnetism	M. Petravić	3	3	0	9	O
	Data Analysis	V. Labinac	1	1	0	3	O
	Analysis II	N. Mujaković	3	3	0	7	O
	Linear Algebra II	D. Crnković	3	3	0	7	O
	Programming	M. Matetić	2	2	0	5	O

L – Lectures, E – Exercises, S – Seminars

[15] **IMPORTANT:** Insert **C** for compulsory course or **E** for elective course.

LIST OF MODULES/COURSES – COMPULSORY COURSES							
Year of study: 2.							
Semester: 3.							
OPTIONAL SUBJECT	**COURSE**	**COURSE COORDINATOR**	**L**	**E**	**S**	**ECTS**	**STATUS**[16]
Philosophy	Physics III: Waves and Optics	R. Jurdana-Šepić	3	2	0	7	O
	Physics Laboratory I	B. Milotić	0	0	3	3	O
	Mathematical Methods of Physics I	V. Labinac	2	2	0	5	O
	Introduction into Philosophy	B. Berčić	2	0	2	5	O
	Elective courses III-FIL					10	I

L – Lectures, E – Exercises, S – Seminars

LIST OF MODULES/COURSES – ELECTIVE COURSES III-FIL							
Students are required to take at least 2 courses counting for a total of 10 or more ECTS credits. Students taking the Teachers Training, should enrol in courses in pedagogy and psychology of education.							
Year of study: 2.							
Semester: 3.							
OPTIONAL SUBJECT	**COURSE**	**COURSE COORDINATOR**	**L**	**E**	**S**	**ECTS**	**STATUS**
Philosophy	Measurements in Physics	M. Petravić	2	1	1	5	I
	Computational Physics	D. Dominis Prester	2	1	1	5	I
	Aesthetics	N. Petković	2	0	2	5	I
	Developmental Psychology	S. Smojver-Ažić	2	1	0	5	I
	Educational Psychology I	B. Rončević Zubković	2	1	0	5	I

L – Lectures, E – Exercises, S – Seminars

[16] **IMPORTANT:** Insert **C** for compulsory course or **E** for elective course.

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LIST OF MODULES/COURSES – COMPULSORY COURSES							
Year of study: 2.							
Semester: 4.							
OPTIONAL SUBJECT	**COURSE**	**COURSE COORDINATOR**	**L**	**E**	**S**	**ECTS**	**STATUS**[17]
Philosophy	Physics IV: Thermodynamics and Basic Statistical Physics	N. Orlić	4	2	0	8	O
	Physics Laboratory II	B. Milotić	0	0	3	3	O
	Mathematical Methods of Physics II	P. Dominis Prester	2	2	0	5	O
	Ancient philosophy	N. Smokrović	2	0	2	5	O
	Elective courses IV-FIL					9	I

L – Lectures, E – Exercises, S – Seminars

LIST OF MODULES/COURSES – ELECTIVE COURSES IV-FIL							
Students are required to take at least 2 courses counting for a total of 9 or more ECTS credits. Students taking the Teachers Training should enrol in courses in pedagogy and psychology of education.							
Year of study: 2.							
Semester: 4.							
OPTIONAL SUBJECT	**COURSE**	**COURSE COORDINATOR**	**L**	**E**	**S**	**ECTS**	**STATUS**
Philosophy	Astronomy and Astrophysics	D. Kotnik-Karuza	2	0	1	4	I
	Seminar iz fizike	V. Labinac	0	0	2	2	I
	Programski paket Mathematica	V. Labinac	1	1	0	3	I
	Paradoxes	B. Berčić	0	0	2	3	I
	Svijest i sadržaj	L. Malatesti	1	0	1	3	I
	Temeljni problemi metafizike	B. Berčić	0	0	2	3	I
	Uvod u kritičko mišljenje	M. Trobok	1	0	1	3	I
	Educational Psychology II	B. Rončević Zubković	2	1	0	4	I
	Pedagogy	J. Zloković	2	1	0	5	I

L – Lectures, E – Exercises, S – Seminars

[17] **IMPORTANT:** Insert **C** for compulsory course or **E** for elective course.

LIST OF MODULES/COURSES – COMPULSORY COURSES							
Year of study: 3.							
Semester: 5.							
OPTIONAL SUBJECT	**COURSE**	**COURSE COORDINATOR**	**L**	**E**	**S**	**ECTS**	**STATUS**[18]
Philosophy	Modern Physics I	D. Kotnik-Karuza	4	1	0	5	O
	Classical Mechanics	Z. Kaliman	3	3	0	7	O
	Physics Laboratory III	B. Milotić	0	0	3	3	O
	Ethics[19]	E. Baccarini	2.67	0	1.33	5	O
	Episthemology	S. Prijić-Samaržija	2	0	2	5	O
	Philosophy as a System. History of the Classical German Idealism	P. Šustar	2	0	2	5	O

L – Lectures, E – Exercises, S – Seminars

[18] **IMPORTANT:** Insert **C** for compulsory course or **E** for elective course.
[19] Total lecture hours: 40; Total seminars hours: 20.

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LIST OF MODULES/COURSES – COMPULSORY COURSES							
Year of study: 3.							
Semester: 6.							
OPTIONAL SUBJECT	**COURSE**	**COURSE COORDINATOR**	**L**	**E**	**S**	**ECTS**	**STATUS**[20]
Philosophy	Physics Laboratory IV	D. Kotnik-Karuza	0	0	4	4	O
	Methodology of Elaborating Professional and Scientific Papers	B. Milotić	1	0	1	1	O
	Logic	M. Trobok	2	0	2	6	O
	Metaphysics	B. Berčić	2	0	2	5	O
	Modern Philosophy from Descartes to Kant	S. Prijić-Samaržija	2	0	2	6	O
	Undergraduate Thesis					3	O
	Elective courses VI-FIL					5	I

L – Lectures, E – Exercises, S – Seminars

LIST OF MODULES/COURSES – ELECTIVE COURSES VI-FIL							
Students are required to take at least 1 course counting for a total of 5 or more ECTS credits. Students taking the Teachers Training, should enrol in courses in pedagogy and psychology of education.							
Year of study: 3.							
Semester: 6.							
OPTIONAL SUBJECT	**COURSE**	**COURSE COORDINATOR**	**L**	**E**	**S**	**ECTS**	**STATUS**
Philosophy	Modern Physics II	D. Dominis Prester	4	1	1	6	I
	Didactics I	A. Klapan	2	1	0	5	I

L – Lectures, E – Exercises, S – Seminars

[20] **IMPORTANT:** Insert **C** for compulsory course or **E** for elective course.

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(D) UNDERGRADUATE STUDY PROGRAMME PHYSICS
Optional Subject: Physics

LIST OF MODULES/COURSES – COMPULSORY COURSES							
Year of study: 1.							
Semester: 1.							
OPTIONAL SUBJECT	**COURSE**	**COURSE COORDINATOR**	**L**	**E**	**S**	**ECTS**	**STATUS**[21]
Physics	Physics I: Mechanics	I. Orlić	3	3	0	9	O
	Analysis I	N. Mujaković	3	3	0	7	O
	Linear Algebra I	R. Sušanj	3	3	0	7	O
	Elective Courses I					6	I

L – Lectures, E – Exercises, S – Seminars

LIST OF MODULES/COURSES – ELECTIVE COURSES I							
Students are required to take 2 courses with a total of 6 ECTS credits.							
Year of study: 1.							
Semester: 1.							
OPTIONAL SUBJECT	**COURSE**	**COURSE COORDINATOR**	**L**	**E**	**S**	**ECTS**	**STATUS**
Physics	Basic Mathematics	V. Labinac	1	1	0	3	I
	Fundamentals of Computer Science	V. Labinac	1	1	0	3	I
	English for Specific Purposes	O. Vučetić	1	1	0	3	I

L – Lectures, E – Exercises, S – Seminars

[21] **IMPORTANT:** Insert **C** for compulsory course or **E** for elective course.

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LIST OF MODULES/COURSES – COMPULSORY COURSES							
Year of study: 1.							
Semester: 2.							
OPTIONAL SUBJECT	**COURSE**	**COURSE COORDINATOR**	**L**	**E**	**S**	**ECTS**	**STATUS[22]**
Physics	Physics II: Electricity and Magnetism	M. Petravić	3	3	0	9	O
	Data Analysis	V. Labinac	1	1	0	3	O
	Analysis II	N. Mujaković	3	3	0	7	O
	Linear Algebra II	D. Crnković	3	3	0	7	O
	Programming	M. Matetić	2	2	0	5	O

L – Lectures, E – Exercises, S – Seminars

[22] **IMPORTANT:** Insert **C** for compulsory course or **E** for elective course.

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LIST OF MODULES/COURSES – COMPULSORY COURSES							
Year of study: 2.							
Semester: 3.							
OPTIONAL SUBJECT	**COURSE**	**COURSE COORDINATOR**	**L**	**E**	**S**	**ECTS**	**STATUS[23]**
Physics	Physics III: Waves and Optics	R. Jurdana-Šepić	3	2	0	7	O
	Physics Laboratory I	B. Milotić	0	0	3	3	O
	Mathematical Methods of Physics I	V. Labinac	2	2	0	5	O
	Modern Physics I	D. Kotnik-Karuza	4	1	1	6	O
	Classical Mechanics I	Z. Kaliman	3	3	1	9	O

L – Lectures, E – Exercises, S – Seminars

[23] **IMPORTANT:** Insert **C** for compulsory course or **E** for elective course.

LIST OF MODULES/COURSES – COMPULSORY COURSES							
Year of study: 2.							
Semester: 4.							
OPTIONAL SUBJECT	**COURSE**	**COURSE COORDINATOR**	**L**	**E**	**S**	**ECTS**	**STATUS[24]**
Physics	Physics IV: Thermodynamics and Basic Statistical Physics	N. Orlić	4	2	0	8	O
	Physics Laboratory II	B. Milotić	0	0	3	3	O
	Mathematical Methods of Physics II	P. Dominis Prester	2	2	0	5	O
	Modern Physics II	D. Dominis Prester	4	1	1	6	O
	Classical Mechanics II	Z. Kaliman	3	2	1	8	O

L – Lectures, E – Exercises, S – Seminars

[24] **IMPORTANT:** Insert **C** for compulsory course or **E** for elective course.

LIST OF MODULES/COURSES – COMPULSORY COURSES							
Year of study: 3.							
Semester: 5.							
OPTIONAL SUBJECT	**COURSE**	**COURSE COORDINATOR**	**L**	**E**	**S**	**ECTS**	**STATUS**[25]
Physics	Electrodynamics	P. Dominis Prester	3	3	1	11	O
	Quantum Mechanics	Z. Lenac	4	3	0	11	O
	Physics Laboratory III	B. Milotić	0	0	3	3	O
	Elective courses V-FIZ					5	I

L – Lectures, E – Exercises, S – Seminars

LIST OF MODULES/COURSES – ELECTIVE COURSES V-FIZ							
Students are required to take at least 1 course counting for a total of 5 or more ECTS credits.							
Year of study: 3.							
Semester: 5.							
OPTIONAL SUBJECT	**COURSE**	**COURSE COORDINATOR**	**L**	**E**	**S**	**ECTS**	**STATUS**
Physics	Measurements in Physics	M. Petravić	2	1	1	5	I
	Computational Physics	D. Dominis Prester	2	1	1	5	I
	Introduction to Numerical Mathematics	V. Mikulić Crnković	2	2	0	5	I
	Object-Oriented Programming	V. Topolovec	2	2	0	5	I

L – Lectures, E – Exercises, S – Seminars

[25] **IMPORTANT:** Insert **C** for compulsory course or **E** for elective course.

LIST OF MODULES/COURSES – COMPULSORY COURSES							
Year of study: 3.							
Semester: 6.							
OPTIONAL SUBJECT	**COURSE**	**COURSE COORDINATOR**	**L**	**E**	**S**	**ECTS**	**STATUS**[26]
Physics	Physics Laboratory IV	D. Kotnik-Karuza	0	0	4	4	O
	Laboratory Project	M. Petravić	0	0	2	2	O
	Methodology of Elaborating Professional and Scientific Papers	D. Dominis Prester B. Milotić	1,33	0	2,66	4	O
	Undergraduate Thesis					6	O
	Elective courses VI-FIZ					14	I

L – Lectures, E – Exercises, S – Seminars

LIST OF MODULES/COURSES – ELECTIVE COURSES VI-FIZ							
Students are required to take at least 2 courses counting for a total of 14 or more ECTS credits.							
Year of study: 3.							
Semester: 6.							
OPTIONAL SUBJECT	**COURSE**	**COURSE COORDINATOR**	**L**	**E**	**S**	**ECTS**	**STATUS**
Physics	Elementary Particle Physics	P. Dominis Prester	3	0	1	7	I
	Atomic and Molecular Physics	N. Orlić	2	0	2	7	I
	Astronomy and Astrophysics	D. Kotnik-Karuza	2	1	1	7	I

L – Lectures, E – Exercises, S – Seminars

[26] **IMPORTANT:** Insert **C** for compulsory course or **E** for elective course.

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(E) UNDERGRADUATE STUDY PROGRAMME PHYSICS
Optional Subject: Environmental science

LIST OF MODULES/COURSES – COMPULSORY COURSES							
Year of study: 1.							
Semester: 1.							
OPTIONAL SUBJECT	**COURSE**	**COURSE COORDINATOR**	**L**	**E**	**S**	**ECTS**	**STATUS**[27]
Environmental science	Physics I: Mechanics	I. Orlić	3	3	0	9	O
	Analysis I	N. Mujaković	3	3	0	7	O
	Linear Algebra I	R. Sušanj	3	3	0	7	O
	Elective courses I					6	I

L – Lectures, E – Exercises, S – Seminars

LIST OF MODULES/COURSES – ELECTIVE COURSES I							
Students are required to take 2 courses with a total of 6 ECTS credits.							
Year of study: 1.							
Semester: 1.							
OPTIONAL SUBJECT	**COURSE**	**COURSE COORDINATOR**	**L**	**E**	**S**	**ECTS**	**STATUS**
Environmental science	Basic Mathematics	V. Labinac	1	1	0	3	I
	Fundamentals of Computer Science	V. Labinac	1	1	0	3	I
	English for Specific Purposes	O. Vučetić	1	1	0	3	I

L – Lectures, E – Exercises, S – Seminars

[27] **IMPORTANT:** Insert **C** for compulsory course or **E** for elective course.

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LIST OF MODULES/COURSES – COMPULSORY COURSES							
Year of study: 1.							
Semester: 2.							
OPTIONAL SUBJECT	**COURSE**	**COURSE COORDINATOR**	**L**	**E**	**S**	**ECTS**	**STATUS[28]**
Environmental science	Physics II: Electricity and Magnetism	M. Petravić	3	3	0	9	O
	Data Analysis	V. Labinac	1	1	0	3	O
	Analysis II	N. Mujaković	3	3	0	7	O
	Linear Algebra II	D. Crnković	3	3	0	7	O
	Programming	M. Matetić	2	2	0	5	O

L – Lectures, E – Exercises, S – Seminars

[28] **IMPORTANT:** Insert **C** for compulsory course or **E** for elective course.

LIST OF MODULES/COURSES – COMPULSORY COURSES							
Year of study: 2.							
Semester: 3.							
OPTIONAL SUBJECT	**COURSE**	**COURSE COORDINATOR**	**L**	**E**	**S**	**ECTS**	**STATUS**[29]
Environmental science	Physics III: Waves and Optics	R. Jurdana-Šepić	3	2	0	7	O
	Physics Laboratory I	B. Milotić	0	0	3	3	O
	Mathematical Methods of Physics I	V. Labinac	2	2	0	5	O
	General Chemistry[30]	J. Giacometti	1.33	2	0.67	9	O
	Elective courses III-OKL					5	I

L – Lectures, E – Exercises, S – Seminars

LIST OF MODULES/COURSES – ELECTIVE COURSES III-OKL							
Students are required to take at least 1 course counting for a total of 5 or more ECTS credits.							
Year of study: 2.							
Semester: 3.							
OPTIONAL SUBJECT	**COURSE**	**COURSE COORDINATOR**	**L**	**E**	**S**	**ECTS**	**STATUS**
Environmental science	Measurements in Physics	M. Petravić	2	1	1	5	I
	Computational Physics	D. Dominis Prester	2	1	1	5	I

L – Lectures, E – Exercises, S – Seminars

[29] **IMPORTANT:** Insert **C** for compulsory course or **E** for elective course.
[30] Total lecture hours: 20; Total exercises hours: 30; Total seminars hours: 10.

LIST OF MODULES/COURSES – COMPULSORY COURSES							
Year of study: 2.							
Semester: 4.							
OPTIONAL SUBJECT	**COURSE**	**COURSE COORDINATOR**	**L**	**E**	**S**	**ECTS**	**STATUS**[31]
Environmental science	Physics IV: Thermodynamics and Basic Statistical Physics	N. Orlić	4	2	0	8	O
	Physics Laboratory II	B. Milotić	0	0	3	3	O
	Mathematical Methods of Physics II	P. Dominis Prester	2	2	0	5	O
	Inorganic Chemistry[32]	J. Giacometti	1.33	0	0.67	5	O
	Biology	M. Kovačić	2	0	1	5	O
	General Ecology	M. Kovačić	2	0	1	5	O

L – Lectures, E – Exercises, S – Seminars

[31] **IMPORTANT:** Insert **C** for compulsory course or **E** for elective course.
[32] Total lecture hours: 20; Total seminars hours: 10.

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LIST OF MODULES/COURSES – COMPULSORY COURSES							
Year of study: 3.							
Semester: 5.							
OPTIONAL SUBJECT	**COURSE**	**COURSE COORDINATOR**	**L**	**E**	**S**	**ECTS**	**STATUS**[33]
Environmental science	Modern Physics I	D. Kotnik-Karuza	4	1	0	5	O
	Classical Mechanics	Z. Kaliman	3	3	0	7	O
	Physics Laboratory III	B. Milotić	0	0	3	3	O
	Organic Chemistry [34]	J. Giacometti	1.33	2	0.67	7	O
	Geology[35]	I. Sondi	2	0.33	0.67	4	O
	Cellular and Molecular Biology	A. Radojčić-Badovinac	2	2	0	5	O

L – Lectures, E – Exercises, S – Seminars

[33] **IMPORTANT:** Insert **C** for compulsory course or **E** for elective course.
[34] Total lecture hours: 20; Total exercises hours: 30; Total seminars hours: 10.
[35] Total lecture hours: 30; Total exercises hours: 5; Total seminars hours: 10.

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LIST OF MODULES/COURSES – COMPULSORY COURSES							
Year of study: 3.							
Semester: 6.							
OPTIONAL SUBJECT	**COURSE**	**COURSE COORDINATOR**	**L**	**E**	**S**	**ECTS**	**STATUS**[36]
Environmental science	Modern Physics II	D. Dominis Prester	4	1	1	6	O
	Quantum Physics and Applications	Z. Lenac	3	2	0	8	O
	Physics Laboratory IV	D. Kotnik-Karuza	0	0	4	4	O
	Methodology of Elaborating Professional and Scientific Papers	B. Milotić	1	0	1	1	O
	Analytical Chemistry[37]	J. Giacometti	1.33	2	0.67	7	O
	Undergraduate Thesis					3	O

L – Lectures, E – Exercises, S – Seminars

[36] **IMPORTANT:** Insert **C** for compulsory course or **E** for elective course.
[37] Total lecture hours: 20; Total exercises hours: 30; Total seminars hours: 10.

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Basic description		
Course coordinator	Nikola Petković	
Course title	AESTHETICS	
Study programme	Undergraduate Study Programme Physics	
Course status	Optional	
Year	2. year	
ECTS credits and teaching	***ECTS student 's workload coefficient***	5
	Number of hours (L+E+S)	30 + 0 + 30

1. COURSE DESCRIPTION

1.1. Course objectives

To familiarize students with the historical survey of the subject as well as to introduce the basic twentieth-century aesthetic directions and schools of thought.

1.2. Course enrolment requirements

Although primarily viewed as a philosophical discipline, Aesthetics, as presented in the course, (as far as its applications in particular and theoretical application of practice in general are concerned) corresponds with virtually all the existing branches of creative expression. As such, aside from being offered to Philosophy students, Aesthetics is represented as the relevant subject concerning the students of humanities and liberal arts.

1.3. Expected course learning outcomes

This course offers a rather extensive knowledge about Aesthetics as a discipline. It too, from a practical point of view that explicitly treats the application of certain systems of thought and various schools of interpretation, makes students both comfortable and competent in reading and understanding the variety of art and creative practices.

1.4. Course content

The course is divided in two parts, first ranging from Aristotle to Kant, while the seconds diachronically and substantially links The Enlightenment to the Postmodernism. In the first part, which is more explicitly historical, students are being informed about the development of the aesthetic thought from its very beginnings to the beginnings of Modernity. In its second part—the one that ends in the aesthetics of Postmodernism, the accent shifts from the historical to the problem-based focus, and students are becoming familiar with the following schools and approaches: Marxism and Neo-Marxism, Existentialism, Psychoanalysis, The roots of Postmodernism, Structuralism, Postmodernism, Cultural Studies.

1.5. Teaching ethods	☒ lectures ☒ seminars and workshops ☐ exercises ☐ long distance education ☐ fieldwork	☒ individual assignment ☐ multimedia and network ☐ laboratories ☐ mentorship ☐ other
1.6. Comments		

1.7. Student's obligations

To attend classes, write a term paper and take final exams.

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1.8. Evaluation of student's work

Course attendance	0.4	Activity/Participation	0.4	Seminar paper	0.85	Experimental work	
Written exam	0.85	Oral exam		Essay	0.85	Research	
Project		Sustained knowledge check	1.65	Report		Practice	
Portfolio							

1.9. Assessment and evaluation of student's work during classes and on final exam

Student will be evaluated and assessed during the course and final exam. Maximum total percentage which student can achieve during the lessons is 70%, while the final exam provides 30% at best.
Detailed elaboration of ways of monitoring and evaluation of students' work will be displayed in the Working Plan!

1.10. Assigned reading (at the time of the submission of study programme proposal)

Danko Grlić: Estetika I-IV
Platon (Ion,Gozba, Država (II, III, VII, X)
Aristotel (Poetika, Retorika, izbor)
(Pseudo) Longin (O lijepom i uzvišenom)
Sir Phillip Sidney (An Apology for Poetry)
David Hume (Of the Standard of Taste)
Immanuel Kant (Kritika rasudne moći, izbor)
Percy Bysshe Shelley (izbor iz A Defence of Poetry, or Remarks Suggested by an Essay
Entitled «The Four Ages of Poetry»
Arthur Danto, Preobražaj svakidašnjeg
The Blackwell guide to aesthetics (ur. Peter Kivy)
Aesthetics and the philosophy of art : the analytic tradition : an anthology (ur. Peter Lamarque i Stein Haugom Olsen)
Aesthetics (ur. Susan L. Feagin i Patrick Maynard)

1.11. Optional / additional reading (at the time of proposing study programme)

Marksistički i neomarksistički pristupi
Karl Marx (izbor iz Njemačka ideologija, Prilog kritici političke ekonomije, Kapital)
Antonio Gramsci (izbor iz Quaderni de carcere, «Formacija intelektualca)
Walter Benjamin (The Work of Art in the Age of Mechanical Revolution)
Frederic Jameson (izbor iz The Political Unconscious: Narrative as Socially Symbolic Act, «On Interpretation: Literature as a Socially Symbolic Act», i «Postmodernism and Consumer Society.»

Egzistencijalizam
Jean Paul Sartre Što je to književnost?, Čemu pisati?

Korjeni postmodernizma
Friedrich Nietzsche, Rođenje tragedije
Michel Foucault («Što je autor», Nadzor i kazna (izbor),

Strukturalizam, Postmodenizam
Roland Barthes, «Smrt autora» Jean-François Lyotard «Postmoderno stanje»

Kulturalni Studiji
Hayden White, iz Metahistory «The Historical Text as Literary Artifact»
Stephen Greenblatt, Learning to Curse

Dekonstrukcija/Kolonijalizam/Postkolonijalizam
Jacques Derrida Dissemination (izbor),

Plato's Pharmacy
Pharmacia
The Father of Logos
The Pharmakon
The Pharmakeus

Psihoanaliza/Poststrukturalizam
Sigmund Freud, Tumačenje snova (izbor)
Hélène Cixous Meduzin smijeh
Julia Kristeva Revolucija u pjesničkom jeziku (izbor)
Susan Bordo Unbearable Weight: Feminism, Western Culture, and the Body «The Body as the Reproduction of Femininity»

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
Danko Grlić: Estetika I-IV	1	10
Platon (Ion,Gozba, Država (II, III, VII, X)	1	10
Aristotel (Poetika, Retorika, izbor)	1	10
(Pseudo) Longin (O lijepom i uzvišenom)	1	10

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

The quality course evaluation is planned to be made by the lecturer herself (at the end of the course students will be asked to estimate the content, the methods leading out, teacher's work and the relationship to students), through the analyses of the realization of the expected outcomes of the course and by evaluations done at the Department or/and Faculty level.

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Basic description		
Course coordinator	Maja Matetić	
Course title	ALGORITHMS AND DATA STRUCTURES	
Study programme	Undergraduate Study Programme Physics	
Course status	Compulsory	
Year	3. year	
ECTS credits and teaching	***ECTS student 's workload coefficient***	5
	Number of hours (L+E+S)	30 + 30 + 0

1. COURSE DESCRIPTION

1.1. Course objectives

The course studies the concept of an algorithm, some basic algorithms commonly used in programming, and the efficiency of these algorithms. It introduces abstract data types and the data structures commonly used to represent them. The student should become familiar with the basic data structures, the operations that are naturally connected to these structures, and how they can be used in solving a number of algorithmic problems.

1.2. Course enrolment requirements

Course program is in correlation with the program of the course Programiranje (Programming) which provides the necessary background for this course.

1.3. Expected course learning outcomes

After passing the exam student will be able to:
- use fundamental data types of computing (lists, stacks, queues, priority queues, sets, maps, trees, etc.)
- use major techniques for implementing the fundamental data types (linked lists, binary search trees, hashing, heaps, etc.)
- implement fundamental sorting and searching algorithms of computing and how to analyze them.
- use language-provided data structure libraries
- implement basic algorithm analysis
- identify the most important abstract data types and the ways in which they may be implemented
- describe an implementation using plain natural language or pseudocode.

1.4. Course content

Abstract Data Type. Algorithm Efficiency. Searching. Linear Lists. Stacks. Queues. Recursion. Introduction to Trees. Search Trees. Heaps. Advanced Sorting Concepts. Graphs.

1.5. Teaching methods	☒ lectures ☐ seminars and workshops ☐ exercises ☐ long distance education ☐ fieldwork	☐ individual assignment ☐ multimedia and network ☐ laboratories ☐ mentorship ☐ other
1.6. Comments	Laboratory work will be done in a computer laboratory.	

1.7. Student's obligations

Students are expected to:
- attend classes regularly
- make necessary preparations for classes
- do practical work
- present seminar paper
- pass a final exam.

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1.8. Evaluation of student's work

Course attendance		Activity/Participation	1.00	Seminar paper		Experimental work	
Written exam	1.00	Oral exam	1.00	Essay		Research	
Project		Sustained knowledge check	1.00	Report		Practice	1.00
Portfolio							

1.9. Assessment and evaluation of student's work during classes and on final exam

Assessment and evaluation of student's work will be done through sustained knowledge check (70 points) and the success of final examination (30 point).

Assessment and evaluation of student's work will be done through the success of examinations.

1.10. Assigned reading (at the time of the submission of study programme proposal)

1. Richard F. Gilberg, Behrouz A. Forouzan: Data Structures: A Psuedocode approach with C, Brooks/Cole, 1998.
2. Robert Sedgewick: Algorithms in C, Parts 1-5 (Bundle): Fundamentals, Data Structures, Sorting, Searching, and Graph Algorithms, Addison-Wesley Professional, 2001

1.11. Optional / additional reading (at the time of proposing study programme)

1. Mark Allen Weiss: Data Structures and Algorithm Analysis in C, Addison Wesley, 1996.

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

Quality of the course will be monitored and measured through the success of examinations and through the anonymous inquiry reflecting students opinions regarding the course.

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Basic description		
Course coordinator	Nermina Mujaković	
Course title	ANALYSIS I	
Study programme	Undergraduate Study Programme Physics	
Course status	Compulsory	
Year	1. year	
ECTS credits and teaching	***ECTS student 's workload coefficient***	7
	Number of hours (L+E+S)	45 + 45 + 0

1. COURSE DESCRIPTION

1.1. Course objectives

This course aims to give students the basic knowledge about:
- functions of a real variable,
- numerical sequences,
- differential calculus and its application.

1.2. Course enrolment requirements

Course program is correspondent to the program of similar courses in the other mathematics studies. There exists a correlation with the following courses: Analysis II and Analysis III, Complex Analysis, Differential Geometry, Differential Equations and Numerical Mathematics.

1.3. Expected course learning outcomes

To introduce students to the ideas of formal definitions and rigorous proofs and to develop their powers of logic thinking. To get the knowledge to use Analysis in other disciplines.

1.4. Course content

Real numbers. Axioms of real numbers. Supremum and infimum. Field of complex numbers. Trigonometric form of a complex number. Binomial theorem. Function, bijection, inverse function and composite functions. Sequence and limit. Limit of function in a point. Continuity of function in a point and on closed interval. Continuous and monotone functions. Derivate, basic rules and applications. The intermediate value theorem. Local maximum and minimum. Concavity. Points of inflection. Asymptotes.

1.5. Teaching methods	☒ lectures ☐ seminars and workshops ☒ exercises ☒ long distance education ☐ fieldwork	☒ individual assignment ☒ multimedia and network ☐ laboratories ☐ mentorship ☐ other
1.6. Comments	Students are encouraged to active participate at a class and it influences to a final assessment.	

1.7. Student's obligations

Attendance at all classes and active participation is expected. Student gets a grade after written and oral exam.

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1.8. Evaluation of student's work

Course attendance	0.7	Activity/Participation	0.7	Seminar paper		Experimental work	
Written exam	3.5	Oral exam	1.5	Essay		Research	
Project		Sustained knowledge check	0.6	Report		Practice	
Portfolio							

1.9. Assessment and evaluation of student's work during classes and on final exam

Student will be evaluated and assessed during the course and final exam. Maximum total percentage which student can achieve during the lessons is 70%, while the final exam provides 30% at the best.
Detailed elaboration of ways of monitoring and evaluation of students' work will be displayed in the Working Plan.

1.10. Assigned reading (at the time of the submission of study programme proposal)

S. Kurepa: Matematička analiza I, II, Tehnička knjiga, Zagreb.(more publications)
B. P. Demidovič: Zadaci i riješeni primjeri iz više matematike, Tehnička knjiga, Zagreb (more publications)

1.11. Optional / additional reading (at the time of proposing study programme)

S. Lang: A first Course in Calculus 5th ed. Springer 1986.

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
S. Kurepa: Matematička analiza I, II, Tehnička knjiga, Zagreb.(more publications)	1	10
B. P. Demidovič: Zadaci i riješeni primjeri iz više matematike, Tehnička knjiga, Zagreb (more publications)	1	10

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

- questionnaire at the end of the course aimed to assess students' understanding,
- questionnaire designed to evaluate course program, lectures and lecture materials, teaching methods and interaction with students.

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Basic description		
Course coordinator	Nermina Mujaković	
Course title	ANALYSIS II	
Study programme	Undergraduate Study Programme Physics	
Course status	Compulsory	
Year	1. year	
ECTS credits and teaching	***ECTS student 's workload coefficient***	7
	Number of hours (L+E+S)	45 + 45 + 0

1. COURSE DESCRIPTION

1.1. Course objectives

- learning of numeric series, function sequences and series theory
- learning of integration methods
- learning applications of integration

1.2. Course enrolment requirements

Program of Analysis II is correlated with other mathematical courses, especially Analysis I and Analysis III, Complex Analysis, Differential Geometry, Differential Equations and Numerical Mathematics. Prerequisite courses: Analysis I.

1.3. Expected course learning outcomes

After completing this course students will be able to:
- know and understand notions of numeric series, function sequences and series theory
- know how to use different integration methods and its various applications.

1.4. Course content

Indefinite integral. Integration methods. Definite integral. Newton-Leibniz formula. Integrability of monotone and continuous functions. Applications of integration. Improper integrals. Numeric series and convergence criteria. Sequences and series of functions. Convergence and uniform convergence of function series. Taylor's Theorem. Power series and Taylor series of elementary functions. Fourier series.

1.5. Teaching methods	☒ lectures ☐ seminars and workshops ☒ exercises ☒ long distance education ☐ fieldwork	☒ individual assignment ☒ multimedia and network ☐ laboratories ☐ mentorship ☐ other
1.6. Comments	Students' work is continually observed. Integral part of observing and evaluating of students is the quality of active contribution in work on the lectures and exercises. Student's integral knowledge is evaluated in the exam.	

1.7. Student's obligations

Every student is obliged to fulfill conditions for signature in Analysis II and to pass the exam. Conditions for signature: Students are expected to attend and actively participate at all classes. Exam: written and oral.

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1.8. Evaluation of student's work

Course attendance	0.7	Activity/Participation	0.7	Seminar paper		Experimental work	
Written exam	3.5	Oral exam	1.5	Essay		Research	
Project		Sustained knowledge check	0.6	Report		Practice	
Portfolio							

1.9. Assessment and evaluation of student's work during classes and on final exam

Student will be evaluated and assessed during the course and final exam. Maximum total percentage which student can achieve during the lessons is 70%, while the final exam provides 30% at the best.
Detailed elaboration of ways of monitoring and evaluation of students' work will be displayed in the Working Plan.

1.10. Assigned reading (at the time of the submission of study programme proposal)

S. Kurepa: Matematička analiza I, II, Tehnička knjiga, Zagreb.(more publications)
B. P. Demidovič: Zadaci i riješeni primjeri iz više matematike, Tehnička knjiga, Zagreb (more publications)

1.11. Optional / additional reading (at the time of proposing study programme)

S. Lang: A first Course in Calculus 5th ed. Springer 1986.

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
S. Kurepa: Matematička analiza I, II, Tehnička knjiga, Zagreb.(more publications)	1	10
B. P. Demidovič: Zadaci i riješeni primjeri iz više matematike, Tehnička knjiga, Zagreb (more publications)	1	10

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

After the last lecture of the course students will be asked to fulfill a questionnaire about the quality of the lectures. At the end of each semester results of the exams will be analyzed.

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Basic description		
Course coordinator	Nermina Mujaković	
Course title	ANALYSIS III	
Study programme	Undergraduate Study Programme Physics	
Course status	Compulsory	
Year	2. year	
ECTS credits and teaching	***ECTS student 's workload coefficient***	7
	Number of hours (L+E+S)	45 + 45 + 0

1. COURSE DESCRIPTION

1.1. Course objectives

This course aims to give students the basic knowledge about:
- -sequences in R^n,
- -real and vector functions of one or several variables,
- -differential calculus and its application,
- -multiple Riemann's integrals and applications.

1.2. Course enrolment requirements

Course program is correspondent to the program of similar courses in the other mathematics studies. There exists a correlation with the following courses: Analysis I and Analysis II, Complex Analysis. This course is based to Analysis I and Analysis II.

1.3. Expected course learning outcomes

- To introduce students to the ideas of formal definitions and rigorous proofs and to develop their powers of logic thinking.
- To get the knowledges to use differential and integral calculus in other disciplines.

1.4. Course content

Limit and continuity of real and vector functions of one or several variables. Differential and partial derivations. Schwartz's theorem. The intermediate value theorem and its consequences. The implicit function theorem. The inverse function theorem. Maximum and minimum of a function. Taylor's theorem. Sequences and compact sets in R^n. Continuous functions on a compact. Multiple Riemann's integrals. Vector functions. Curves and integrals by curves. Vector and scalar fields. Green's theorem.

1.5. Teaching methods	☒ lectures ☐ seminars and workshops ☒ exercises ☒ long distance education ☐ fieldwork	☒ individual assignment ☒ multimedia and network ☐ laboratories ☐ mentorship ☐ other
1.6. Comments	Students are encouraged to active participate at a class and it influences to a final assessment.	
1.7. Student's obligations		

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Attendance at all classes and active participation is expected. Student gets a grade after written and oral exam.

1.8. Evaluation of student's work

Course attendance	0.8	Activity/Participation	0.8	Seminar paper		Experimental work	
Written exam	3.4	Oral exam	1.5	Essay		Research	
Project		Sustained knowledge check	0.5	Report		Practice	
Portfolio							

1.9. Assessment and evaluation of student's work during classes and on final exam

Student will be evaluated and assessed during the course and final exam. Maximum total percentage which student can achieve during the lessons is 70%, while the final exam provides 30% at the best.
Detailed elaboration of ways of monitoring and evaluation of students' work will be displayed in the Working Plan.

1.10. Assigned reading (at the time of the submission of study programme proposal)

1. S. Kurepa: Matematička analiza, Tehnička knjiga, Zagreb, 1975.
2. S. Mardešić: Matematička analiza, I. dio, Školska knjiga, Zagreb, 1974.

1.11. Optional / additional reading (at the time of proposing study programme)

V. A. Zoric :Matematyceskih analiz, I. Nauka, Moskva, 1981.

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
S. Kurepa: Matematička analiza III, Tehnička knjiga , Zagreb (više izdanja)	10	10
S. Mardešić: Matematička analiza, I. dio, Školska knjiga, Zagreb (više izdanja)	5	10

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

- questionnaire at the end of the course aimed to assess students' understanding,
- questionnaire designed to evaluate course program, lectures and lecture materials, teaching methods and interaction with students.

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Basic description		
Lecturer	Jasminka Giacometti	
Course title	ANALYTICAL CHEMISTRY	
Study programme	Undergraduate Study Programme Physics	
Course status	Compulsory	
Academic year	3. year	
Course grading and contact hours	***ECTS student 's workload coefficient***	7
	Number of hours (L+E+S)	20+30+10

1. COURSE DESCRIPTION

1.1. Course objectives

Adoption of basic competences necessary for the selection of an analytical method and its application for quantitative analysis, including familiarization with the mechanisms, which determine chemical equilibria in solution (acid-base equilibria, precipitation, complexation, heterogeonous equilibria)

1.2. Conditions for enrollment

Passed exam from the course General Chemistry, Inorganic Chemistry course attendance and positively continuous tests resolved.

1.3. Expected learning outcomes for the course

A1, A3, A4, A5, A6, A7, C1, C2, C3, C4.
- Determine and calculate the error in Analytical chemistry;
- Conduct statistical evaluation of data;
- To distinguish and define the qualitative and quantitative chemical analysis;
- Define and implement a volumetric titration;
- Describe heterogeneous equilibrium and gravimetric analysis;
- Define and implement the oxidation-reduction titration;
- Describe the spectroscopic methods and point to the application;
- Describe chromatographic methods and point to the application.

1.4. Course description

Chemicals, apparatus and basic procedures in analytical chemistry
Errors in analytical chemistry and statistical evaluation of data
Sampling and analysis of environmental
Qualitative and quantitative chemical analysis
Acid-base titration
Complexometric titration
Gravimetric analysis and sedimentation equilibrium
Precipitation titration
Redox and potentiometric titration
Spectroscopic methods
Sample preparation for analysis
Chromatographic methods of analysis
Lab

1.5. Teaching methods		
	☒ Lectures	☒ Case study
	☐ Seminars and workshops	☐ Multimedia, internet
	☒ Practical	☒ Laboratory

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	☒ E-learning ☐ Fieldwork	☐ Tutorial ☐ Others _____
1.6. Comments		

1.7. Student obligations

Attending lectures, seminars and laboratory exercises and exams.

1.8. Grading assessment

Class attendance	X	Activity		Seminar paper	X	Experimental work	X
Test	X	Oral exam		Essay		Research	
Project		Coninuous evaluation	X	Report		Practical work	
Portfolio							

1.9. Assessment and evaluation of students' work during the semester and final exam

Feedback from the subject of Analytical Chemistry provides complete information about the candidate's success, and includes evaluation of the results conducted through continuous education and the final exam.
Continuing education consists of assessment of the results obtained on laboratory exercises (20 points), continuous assessment, which consists of 4 test consisting of 6 simple and 4 complex tasks (30 points), seminar (15 points) and regular attendance (5 points) , for a total continuous education contributes to 4.9 ECTS.
The final examination contributes 30 points and consists of a written and / or oral part, or 2.1 ECTS.
Criteria for evaluation complies with the criteria of undergraduate study: A (5) - 80-100%, B (4) - 70-79,99%, C (3) - 60 to 69.99%, D (2) - 50-59 , 99%, E (2) - 40 to 49.99%, F and FX - (1). On the final exam students must solve 50% of exam.

1.10. Required texts (at the time of registration of a program proposal)

1. Skoog, D.A., West, D.M., Holler, F.J., Osnove analitičke kemije, Prvo izdanje (hrvatsko), Školska knjiga, Zagreb, 1999.
2. Giacometti, J., Priručnik za vježbe iz kemije za studente medicinsko-laboratorijske dijagnostike, Medicinski fakultet u Rijeci, 2007.
3. Nastavni materijali nalaze se na Sveučilišnom centru za e-učenje MudRi (http://mudri.uniri.hr, za pristup je potreban AAI korisnički račun)

1.11. Additional reading (when receiving the proposal of a program)

1. Christian, G.: Analytical Chemistry, 6th Edition, Wiley, 2003

1.12. Number of copies required literature in relation to the number of students who currently attend classes in the subject

Title	*Number of copies*	*Number of students*

1.13. Quality assurance

Quality performance is monitored by student evaluation, which include monitoring of teaching and curriculum, students passing the exams, individual performance appraisals of teachers (each student) conducted by student polls.

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Basic description		
Course coordinator	Nenad Smokrović	
Course title	ANCIENT PHILOSOPHY	
Study programme	Undergraduate Study Programme Physics	
Course status	Compulsory	
Year	2. year	
ECTS credits and teaching	***ECTS student 's workload coefficient***	5
	Number of hours (L+E+S)	30 + 0 + 30

1. COURSE DESCRIPTION

1.1. Course objectives

- introducing students with the beginnings of the Western philosophical thought, philosophical origin and source
- introducing students with basic positions, ways of argumentation and criticisms of the most important ancient philosophers, Socrates, Plato and Aristotle
- development of skills in reading, understanding and interpreting texts
- development of independent and critical thinking
- development of clarity and preciseness in written and oral expression of philosophical arguments

1.2. Course enrolment requirements

History of Philosophy 1 corresponds to with the most of the curriculum (Ontology, Ethics, Epistemology, Philosophy of Politics, Philosophy of Psychology, Logic, Aesthetics, etc.).

1.3. Expected course learning outcomes

It is expected the students will acquire skills in reading, understanding and interpreting of classical philosophical texts.

1.4. Course content

Course content is divided in core and elective.
Core content.
(1) Introduction to ancient philosophy. Periodization of ancient philosophy. Peculiarities of ancient approach to philosophy. Differences between ancient and modern philosophy.
(2) Socrates. The basics of the Socratic ethics and the foundation of the Socratic way of argumentation. Texts: Plato, *Apology* and *Protagoras*.
(3) Plato.
(a) The birth of Plato's metaphysics and epistemology from Socratic problems and approaches. Text: *Meno*.
(b) Foundations of Plato's ethics. Text: *Republic* (books II, IV, VIII-IX)
(c) Foundations of Plato's metaphysics and epistemology. Text: *Republic* (books V-VII)
(4) Aristotle
(a) Aristotle's understanding of philosophy. Review of origins of philosophy and the Presocratics. Text: *Metaphysics* (book A)
(b) Foundations of Aristotle's philosophy of nature. Causes and teleology. Text: *Metaphysics* (book A), *Physics* (book II)
(c) Foundations of Aristotle's metaphysics. Text: *Categories* (chapters 1-5), selected chapters from *De Anima* (book II)
(d) Foundations of Aristotle's ethics. Happiness and virtue. Text: *Nicomachean Ethics* (books I-II)
Elective content
(1) The Presocratics. Text: Diels, *Presocratics*.

(2) Epicurean ethics. Text: Epikur, *Pismo Menekeju* (u Diogen Laertije, *Životi filozofa*), Ciceron, *O krajnostima dobra i zla* (knj. I i II)
(3) Stoics' ethics. Text: Epiktet, *Priručnik*; Seneka, *Pisma Luciliju* (16, 33. i 47. pismo u Bošnjak, *Filozofija od Aristotela do renesanse*); Ciceron, *O krajnostima dobra i zla* (knj. III i IV).
Students can in agreement with a teacher choose one of proposed topics from core or elective content as a theme for seminar paper (see bellow).

1.5. Teaching ethods	☒ lectures ☒ seminars and workshops ☐ exercises ☐ long distance education ☐ fieldwork	☒ individual assignment ☐ multimedia and network ☐ laboratories ☒ mentorship ☒ consultations
1.6. Comments		

1.7. Student's obligations

(1) Regular class attendance.
(2) Active class participation.
(3) Regular reading of the given literature.
(4) Homework assignments.
(5) Seminar paper.
(6) Taking of final written exam.

1.8. Evaluation of student's work

Course attendance		Activity/Participation	0.85	Seminar paper	1.25	Experimental work	
Written exam	1.65	Oral exam		Essay		Research	
Project		Sustained knowledge check	1.25	Report		Practice	
Portfolio							

1.9. Assessment and evaluation of student's work during classes and on final exam

Student will be evaluated and assessed during the course and final exam. Maximum total percentage which student can achieve during the lessons is 70%, while the final exam provides 30% at best.
Detailed elaboration of ways of monitoring and evaluation of students' work will be displayed in the Working Plan!

1.10. Assigned reading (at the time of the submission of study programme proposal)

Platon, Obrana Sokratova, preveo L. Boršić, Zagreb, 2000.
Platon, Protagora / Sofist, preveli K. Rac i M. Sironić, Zagreb, 1975. (samo Protagora)
Platon, Menon, preveo i priredio F. Grgić, Zagreb, 1997.
Platon, Država, preveo M. Kuzmić, Zagreb, 1977. ili 1997. (knj. II, IV-IX)
Aristotel, Metafizika, preveo T. Ladan, Zagreb, 1992. (knj. A)
Aristotel, Fizika, preveo T. Ladan, Zagreb, 1992. (knj. II)
Aristotel, Kategorije, preveo i priredio F. Grgić, Zagreb, 1992. (pogl. 1-5)
Aristotel, O duši / Nagovor na filozofiju, preveli M. Sironić i D. Novaković, Zagreb, 1987, 21996. (samo odabrana pogl. iz O duši)
Aristotel, Nikomahova Etika, preveo T. Ladan, Zagreb, 1992. (knj. I i II)

1.11. Optional / additional reading (at the time of proposing study programme)

Diels, H., Predsokratovci: fragmenti, Zagreb, 1983.
Ciceron, O krajnostima dobra i zla, Sarajevo, 1975.
Diogen Laertije, Životi i mišljenja istaknutih filozofa, prev. A. Vilhar, Beograd, 1979, 31985.
Epiktet, Priručnik, preveo i priredio P. Gregorić, Zagreb, 2005.

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Bošnjak, B., Filozofija od Aristotela do renesanse: i odabrani tekstovi filozofa, Zagreb, 41983 (Filozofska hrestomatija 2).
Kraut, R. "Introduction to the study of Plato", u R. Kraut (ur.), The Cambridge Companion to Plato, Cambridge, 1992. (fotokopija prijevoda dostupna je u skriptarnici)
Barnes, J., Aristotel, Zagreb, 1995.
Barnes, J., "Uvod u Aristotelovu metafiziku", u P. Gregorić i F. Grgić (ur.), Aristotelova Metafizika: zbirka rasprava, Zagreb, 2003.
Brunschwig, J. i D. Sedley, "Uvod u helenističku filozofiju", u P. Gregorić, F. Grgić i M. Hudoletnjak Grgić (ur.), Helenistička filozofija: epikurovci, stoici, skeptici, Zagreb, 2005.

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
Platon, Obrana Sokratova, preveo L. Boršić, Zagreb, 2000.	1	10
Platon, Protagora / Sofist, preveli K. Rac i M. Sironić, Zagreb, 1975. (samo Protagora)	1	10
Platon, Menon, preveo i priredio F. Grgić, Zagreb, 1997.	1	10
Platon, Država, preveo M. Kuzmić, Zagreb, 1977. ili 1997. (knj. II, IV-IX)	1	10

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

The quality of the course will be assessed by means of the questionnaire and according to other prescriptions of the University.

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Basic description		
Course coordinator	Dubravka Kotnik Karuza	
Course title	ASTRONOMY AND ASTROPHYSICS	
Study programme	Undergraduate Study Programme Physics	
Course status	Elective	
Year	2. year	
ECTS credits and teaching	***ECTS student 's workload coefficient***	4
	Number of hours (L+E+S)	30+0+15

1. COURSE DESCRIPTION

1.1. Course objectives

Introduce the students to general astronomy, its basic methods and instruments, with an emphasis on the recent development in astrophysical research.

1.2. Course enrolment requirements

No formal prerequisites. Knowledge of general physics is assumed.

1.3. Expected course learning outcomes

The students are expected the dynamic and physical properties of different components of the Universe and to improve their knowledge of areas of physics which are necessary to understand them. The course should encourage their interest for the scientific and technical achievements of modern astrophysical research. They should be able to:

1. Describe the electromagnetic and corpuscular cosmic radiation and the possibility of detection
2. Define the units and describe the methods of measurement of astronomical distances
3. Define the coordinate systems intended to specify the positions on the celestial sphere
4. Describe the phenomena related to the rotation and revolution of Earth (apparent planet motion, eclipses, sidreal and synodic period, precession)
5. Describe the structure and function of telescope, interferometers and detectors used in optical, radio-, IR, UV and γ-spectral regions. Give the representative examples.
6. Describe the instruments for observations of the Sun
7. Define the apparent magnitude m and the absolute magnitude $M = f(m,d)$
8. Describe the standard UBV system
9. Derive the relation between apparent magnitude and radiant flux and define the colour indices
10. Describe the dynamic properties and elements of orbits of the solar system bodies
11. Describe the Keppler's laws of šlanetary motion, Newton's law of universal gravitation, virial theorem and cosmic velocities
12. Classify the planets according to their physical properties and list the methods of studying them
13. Describe the determination of temperature and pressure in planetary atmospheres, discuss their composition and the conditions of their survival
14. Describe the formation of the solar system
15. Describe the moons of the planets
16. Describe the dynamic and physical properties of comets and meteors and their relationship
17. Describe the dynamic and physical properties of asteroids and meteorits and their relationship
18. List the general properties of the Sun and its atmosphere
19. Describe the solar activity

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20. Describe the stellar characteristics which are derived from observations
21. Classify the stars according to their spectra and explain the Hertzsprung Russell diagram
22. List the basic relations of the theory of stellar structure
23. Describe the degenerate gas in white dwarfs
24.Analyze the stellar energy sources and their relation with stellar evolution
25. Describe the variable stars
26. Explain the Cepheid distance scale
27. Describe the general features and structure of the Milky way
28. Define the stellar associations
29. Describe the morphologic classification of galaxies
30. Explain the Hubbble law and extragalactic distance scale
31. Define the clusters of galaxies

1.4. Course content

Astronomical distances, units and methods of measurement. Instruments. Methods (spectroscopy, photometry). Solar system: dynamic and physical characteristics. Sun. stars: spectral classification, HR diagram. Stellar structure and evolution. Interstellar matter. Milky way. Extragalactic systems.

1.5. Teaching methods	☒ lectures ☒ seminars and workshops ☐ exercises ☐ long distance education ☐ fieldwork	☐ individual assignment ☐ multimedia and network ☐ laboratories ☐ mentorship ☐ other
1.6. Comments		

1.7. Student's obligations

Course attendance, seminar paper and its oral presentation, verification of the aquired knowledge through written tests and to pass the final course exam.

1.8. Evaluation of student's work

Course attendance	0,5	Activity/Participation		Seminar paper	1	Experimental work	
Written exam		Oral exam	2	Essay		Research	
Project		Sustained knowledge check	0,5	Report		Practice	
Portfolio							

1.9. Assessment and evaluation of student's work during classes and on final exam

The students' work is being permanently assessed and evaluated through written tests. The total number of credits a student can achieve during the course (reviewed activities specified in the table), refer to the points earned on the final exam as 70:30.

1.10. Assigned reading (at the time of the submission of study programme proposal)

B.W.Carroll, D.A.Ostlie: An introduction to modern astrophysics, Addison-Wesley, 2007
V. Vujnović: Astronomija I, Školska knjiga, Zagreb 1989.
V. Vujnović: Astronomija II, Školska knjiga, Zagreb 1990.

1.11. Optional / additional reading (at the time of proposing study programme)

Hoyle F.: Astronomija, Marjan tisak, Split, 2005
Couper H., Henbest N.: Enciklopedija svemira, Zagreb, Znanje, 2004
A.Unsold, B.Baschek: The new cosmos, Springer 1991.
M. Harwit: Astrophysical concepts, Springer 1988.

E. Boehm-Vitensee: Introduction to stellar astrophysics, Cambridge University press 1989.
H. Scheffler, H. Elsasser: Physics of the Galaxy and Interstellar matter, Springer 1987.
P. Lena: Observational astrophysics, Springer 1988.
H. Karttunen, P. Kroger, M. Pontanen, K.J. Donner: Fundamental astronomy, Springer 1994.

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
B.W.Carroll, D.A.Ostlie: An introduction to modern astrophysics, Addison-Wesley, 2007	1	5
V. Vujnović: Astronomija I, Školska knjiga, Zagreb 1989.	5	5
V. Vujnović: Astronomija II, Školska knjiga, Zagreb 1990.	3	5

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

The quality of the course will be permanently verified by the student's progress which is assessed through exams and other achievement records (written tests and discussions during the seminars).
At the final exam knowledge of the properties of different cosmic objects as well as of the scientific and technical achievements of modern astrophysical research is expected.
Additional feedback on quality and efficiency of the course is gained by implementation of a students' questionnaire at the end of the course.

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Basic description		
Course coordinator	Dubravka Kotnik Karuza	
Course title	ASTRONOMY AND ASTROPHYSICS	
Study programme	Undergraduate Study Programme Physics	
Course status	Elective	
Year	3. year	
ECTS credits and teaching	***ECTS student 's workload coefficient***	7
	Number of hours (L+E+S)	30+15+15

1. COURSE DESCRIPTION

1.1. Course objectives

Introduce the students to general astronomy, its basic methods and instruments, with an emphasis on the recent development in astrophysical research.

1.2. Course enrolment requirements

No formal prerequisites. Knowledge of general physics is assumed.

1.3. Expected course learning outcomes

The students are expected the dynamic and physical properties of different components of the Universe and to improve their knowledge of areas of physics which are necessary to understand them. The course should encourage their interest for the scientific and technical achievements of modern astrophysical research. They should be able to:

1. Describe the electromagnetic and corpuscular cosmic radiation and the possibility of detection
2. Define the units and describe the methods of measurement of astronomical distances
3. Define the coordinate systems intended to specify the positions on the celestial sphere
4. Describe the phenomena related to the rotation and revolution of Earth (apparent planet motion, eclipses, sidreal and synodic period, precession)
5. Describe the structure and function of telescope, interferometers and detectors used in optical, radio-, IR, UV and γ-spectral regions. Give the representative examples.
6. Describe the instruments for observations of the Sun
7. Define the apparent magnitude m and the absolute magnitude $M = f(m,d)$
8. Describe the standard UBV system
9. Derive the relation between apparent magnitude and radiant flux and define the colour indices
10. Describe the dynamic properties and elements of orbits of the solar system bodies
11. Describe the Keppler's laws of šlanetary motion, Newton's law of universal gravitation, virial theorem and cosmic velocities
12. Classify the planets according to their physical properties and list the methods of studying them
13. Describe the determination of temperature and pressure in planetary atmospheres, discuss their composition and the conditions of their survival
14. Describe the formation of the solar system
15. Describe the moons of the planets
16. Describe the dynamic and physical properties of comets and meteors and their relationship
17. Describe the dynamic and physical properties of asteroids and meteorits and their relationship
18. List the general properties of the Sun and its atmosphere
19. Describe the solar activity

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20. Describe the stellar characteristics which are derived from observations
21. Classify the stars according to their spectra and explain the Hertzsprung Russell diagram
22. Derive the basic equations of the theory of stellar structure
23. Describe the degenerate gas in white dwarfs
24.Analyze the stellar energy sources and their relation with stellar evolution
25. Describe the variable stars
26. Explain the Cepheid distance scale
27. Describe the general features and structure of the Milky way
28. Define the stellar associations
29. Describe the morphologic classification of galaxies
30. Describe active galaxies and quasars
31. Explain the Hubbble law and extragalactic distance scale
32. Define the clusters of galaxies
33. Describe the Big Bang theory and related observations

1.4. Course content

Astronomical distances, units and methods of measurement. Instruments. Methods (spectroscopy, photometry). Solar system: dynamic and physical characteristics. Sun. stars: spectral classification, HR diagram. Stellar structure and evolution. Interstellar matter. Milky way. Extragalactic systems. Cosmology.

1.5. Teaching methods	☒ lectures ☒ seminars and workshops ☒ exercises ☐ long distance education ☐ fieldwork	☐ individual assignment ☐ multimedia and network ☐ laboratories ☐ mentorship ☐ other
1.6. Comments		

1.7. Student's obligations

Course attendance, seminar paper and its oral presentation, verification of the aquired knowledge through written tests and to pass the final course exam.

1.8. Evaluation of student's work

Course attendance	0,7	Activity/Participation	0,7	Seminar paper	1,4	Experimental work	
Written exam		Oral exam	2,8	Essay		Research	
Project		Sustained knowledge check	1,4	Report		Practice	
Portfolio							

1.9. Assessment and evaluation of student's work during classes and on final exam

The students' work is being permanently assessed and evaluated through written tests. The total number of credits a student can achieve during the course (reviewed activities specified in the table), refer to the points earned on the final exam as 70:30.

1.10. Assigned reading (at the time of the submission of study programme proposal)

B.W.Carroll, D.A.Ostlie: An introduction to modern astrophysics, Addison-Wesley, 2007
V. Vujnović: Astronomija I, Školska knjiga, Zagreb 1989.
V. Vujnović: Astronomija II, Školska knjiga, Zagreb 1990.

1.11. Optional / additional reading (at the time of proposing study programme)

Hoyle F.: Astronomija, Marjan tisak, Split, 2005

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Couper H., Henbest N.: Enciklopedija svemira, Zagreb, Znanje, 2004
A.Unsold, B.Baschek: The new cosmos, Springer 1991.
M. Harwit: Astrophysical concepts, Springer 1988.
E. Boehm-Vitensee: Introduction to stellar astrophysics, Cambridge University press 1989.
H. Scheffler, H. Elsasser: Physics of the Galaxy and Interstellar matter, Springer 1987.
P. Lena: Observational astrophysics, Springer 1988.
H. Karttunen, P. Kroger, M. Pontanen, K.J. Donner: Fundamental astronomy, Springer 1994.

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
B.W.Carroll, D.A.Ostlie: An introduction to modern astrophysics, Addison-Wesley, 2007	1	5
V. Vujnović: Astronomija I, Školska knjiga, Zagreb 1989.	5	5
V. Vujnović: Astronomija II, Školska knjiga, Zagreb 1990.	3	5

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

The quality of the course will be permanently verified by the student's progress which is assessed through exams and other achievement records (solving problems during the course exercises and written tests).
At the final exam knowledge of the properties of different cosmic objects as well as of the scientific and technical achievements of modern astrophysical research is expected.
Additional feedback on quality and efficiency of the course is gained by implementation of a students' questionnaire at the end of the course.

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Basic description		
Course coordinator	Nada Orlić	
Course title	ATOMIC AND MOLECULAR PHYSICS	
Study programme	Undergraduate Study Programme Physics	
Course status	Elective	
Year	3. year	
ECTS credits and teaching	***ECTS student 's workload coefficient***	7
	Number of hours (L+E+S)	30+0+30

1. COURSE DESCRIPTION

1.1. Course objectives

Objectives of this course are to:
- create more completely picture about atomic and molecular processes,
- develop an interest and emotion for experimental work in physics.

1.2. Course enrolment requirements

This course presumes fundamental knowledge in physics as well as knowledge from previous mathematical courses.

1.3. Expected course learning outcomes

After passing the examination students will be able to:
- describe and analyze continous and discret spectra of radiation,
- describe and analyze atomic spectra of hydrogen,
- describe and analyze spectra of alkali elements,
- describe and analyze atoms in electric and magnetic fields,
- define and distinguish chemical connections,
- describe the fundamental ideas and properties of lasers,
- derive the conditions of laser existence,
- describe an equipment and methods of modern spectroscopy,
- observe the feature of spectroscopy in order to receive information about structure of matter.

1.4. Course content

Fundamentals of atomic physics. Energy levels in atoms. One-electron atoms: interaction with electromagnetic radiation, fine and hyperfine structure of spectra, interaction with outside fields: Zeeman effect, Stark effect and Lamb's shift. Two-electron atoms and their spectra. Perturbation and variation methods. Many electron atoms. Structure of molecules. Chemical connections. Molecular spectra (electronic, vibrational and rotational). Born-Oppenheimer approximation. Collision's processes. Lasers. Equipment and methods of modern spectroscopy. Applications of atomic and molecular physics in other fields of science.

1.5. Teaching methods	☒ lectures ☒ seminars and workshops ☐ exercises ☐ long distance education ☐ fieldwork	☒ individual assignment ☒ multimedia and network ☐ laboratories ☒ mentorship ☐ other
1.6. Comments	The course consists from lectures, seminars and exercises adopted to attain outcomes specified before.	

1.7. Student's obligations

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Student's obligations consist in attendance at all classes in accordance to regulation of study. Active participation is expected. Final written and oral exam is obliged.

1.8. Evaluation of student's work

Course attendance	0.50	Activity/Participation	1.00	Seminar paper	2.00	Experimental work	
Written exam		Oral exam	2.00	Essay		Research	
Project		Sustained knowledge check	1.50	Report		Practice	
Portfolio		Substantive work					

1.9. Assessment and evaluation of student's work during classes and on final exam

Students work will be evaluated and assessed during the semester and final exam. Total number of credits a student can achieve during the semester is 70 (to assess the activities listed in the table), while during the final examination can achieve 30 points. The detailed working out ways of monitoring and evaluation of student's work will appear in the performing level courses.

1.10. Assigned reading (at the time of the submission of study programme proposal)

Foot, C., *Atomic Physics*, Oxford U.P., 2004.
Silfvast, W. T., *Laser Fundamentals*, Cambridge University Press, 2004.
Thorne, A.P., Litzen, U., Johansson, S., *Spectrophysics*, Springer Verlag, Berlin 1999.

1.11. Optional / additional reading (at the time of proposing study programme)

Bransden B.H., Joachain C.J., *Physics of Atoms and Molecules*, Prentice Hall, 2003.
Demtoroeder, W., *Laser Spectroscopy*, Springer-Verlag, Berlin,1996.
Budker, D., Kimball, D. F., DeMille, D. P., *Atomic physics: An exploration through problems and solutions*, Oxford U.P., 2004.
Chang, W.S.C., *Principles of Lasers and Optics*, Cambridge University Press, 2005.

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
Foot, C., *Atomic Physics*, Oxford U.P., 2004.	1	5
Silfvast, W. T., *Laser Fundamentals*, Cambridge University Press, 2004.	1	
Thorne, A.P., Litzen, U., Johansson, S., *Spectrophysics*, Springer Verlag, Berlin 1999.	1	

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

Student's portfolio: Continuous assessment of student's work.
Questionnaires: Questionnaire on student's expectations at the beginning of the course. Questionnaire at the end of the course designed to evaluate quality of course programme, lectures and lecture materials, teaching methods and interaction with students. After oral exam student is asked to comment course programme and to give suggestions about lecture materials, teaching methods and possible individual difficulties met during process of learning.

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Basic description		
Course coordinator	Velimir Labinac	
Course title	BASIC MATHEMATICS	
Study programme	Undergraduate Study Programme Physics	
Course status	Elective	
Year	1. year	
ECTS credits and teaching	***ECTS student 's workload coefficient***	3
	Number of hours (L+E+S)	15 + 15 + 0

1. COURSE DESCRIPTION

1.1. Course objectives

The main objectives of the course Basic Mathematics are to renew and to supplement basic knowledge of secondary school mathematics. The course will definitely help students to master more advanced topics from higher courses (Mathematical Analysis I, II, Linear Algebra I, II). An oral exam will not include the mathematical proofs of some theorems which will be presented on lectures. Instead, students will be asked to know only basic definitions and facts necessary to solve concrete problems. On the other hand, homework will contain usual problems as well as elementary proofs. It is important that students understand the logic of mathematical reasoning IF - THEN so they could use it to solve problems in physics.

1.2. Course enrolment requirements

Students can enrol this course at no additional requirements.

1.3. Expected course learning outcomes

After completing the course and passing the exam, it is expected that students will be able:

- to state the principle of mathematical induction and apply it to simple problems;
- to define of elementary functions and to draw appropriate graphs for: linear, quadratic, cubic, exponential, logarithmic, hyperbolic, inverse hyperbolic, trigonometric and inverse trigonometric function;
- to specify the basic properties of complex numbers and basic operations with them;
- to solve a simple system of linear equations, to solve quadratic and cubic equations, and use the software package Mathematica (SOLVE command) to solve complex algebraic equations;
- to solve the basic transcendental equations involving exponential, logarithmic and trigonometric functions;
- to state the fundamental theorem of algebra;
- to recognize arithmetic and geometric sequence and use the known formulas for the finite arithmetic and geometric series;
- to solve typical problems of plane trigonometry and prove the validity of the simple trigonometric identities;
- to know algebraic equations and the basic properties of line, circle, parabola, ellipse and hyperbola;
- to define the notions of derivative, indefinite and definite integral, to know basic rules for differentiaion and calculation of indefinite integrals, and apply them to simple problems from general physics.

1.4. Course content

Fundamentals of mathematical logic. Sets, relations, functions and numbers. Methods of proof. Elementary number theory. Definitions of elementary functions, graphs, and the associated properties: polynomial, rational, irrational, exponential, logarithmic, trigonometric, inverse trigonometric, hyperbolic and area functions. Complex numbers.

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Sequences and series. Inequalities. Algebraic and transcendental equations and inequalities. Trigonometric identities. Plane trigonometry. Analytical geometry in the plane. The basics of calculus.

1.5. Teaching methods	☒ lectures ☒ seminars and workshops ☒ exercises ☒ long distance education ☐ fieldwork	☒ individual assignment ☒ multimedia and network ☐ laboratories ☒ mentorship ☐ other
1.6. Comments		

1.7. Student's obligations

Students are obligated:

- to attend regularly and to participate actively in lectures and exercises;
- to do their homework independently;
- to write a brief 5 min seminar paper with PowerPoint presentation; seminar topics will include additional topics or proofs of simple theorems;
- to pass two midterms and final oral exam.

1.8. Evaluation of student's work

Course attendance	0.2	Activity/Participation	0.3	Seminar paper	0.4	Experimental work	
Written exam	0.5	Oral exam	0.9	Essay		Research	
Project		Sustained knowledge check	0.5	Report	0.2	Practice	
Portfolio							

1.9. Assessment and evaluation of student's work during classes and on final exam

Student will be evaluated and assessed during the course and final exam. Maximum total percentage which student can achieve during the lessons is 70%, while the final exam provides 30% at best.
Detailed elaboration of ways of monitoring and evaluation of students' work will be displayed in the Working Plan!

1.10. Assigned reading (at the time of the submission of study programme proposal)

Bronshtein I. N., et al., *Handbook of Mathematics*, 4th edition, Golden Marketing, Zagreb, 2004. (in croatian)

1.11. Optional / additional reading (at the time of proposing study programme)

Antonov N, i dr., *Problems in Elementary Mathematics for Home Study*, Mir Publishers, Moscow, 1982.
Baranov I., Bogatyrev G., Bokovnev O., *Mathematics for Pre-college Students*, Mir Publishers, Moscow, 1985.
Dorofeev G., *Elementary Mathematics – Selected Topics and Problem Solving*, 4th ed., Mir Publishers, Moscow, 1988.
Kruglak H., Moore J.T. *Schaum's Outline of Theory and Problems of Basic Mathematics*, 2nd ed., McGraw-Hill, New York, 1998.
Kutepov A., Rubanov A., *Problem book: Algebra and Elementary Functions*, Mir Publishers, Moscow, 1978.
Lidsky V., i dr., *Problems in Elementary Mathematics*, Mir Publishers, Moscow, 1973.
Litvinenko V., Mordkovich *A.*, *Solving Problems in Algebra and Trigonometry*, Mir Publishers, Moscow, 1987.
Mintaković S., Ćurić F., *Matematika sa zbirkom zadataka*, 6. izdanje, Školska knjiga, Zagreb, 2003.
Moyer R. E., Ayres F. Jr., *Schaum's Outline of Trigonometry*, 4nd ed., McGraw-Hill, New York, 2009.
Pavković B. Veljan D., *Elementarna matematika I*, Školska knjiga, Zagreb, 1995.
Pavković B. Veljan D., *Elementarna matematika II*, Školska knjiga, Zagreb, 1995.
Pavković B., Svrtan D., Veljan D., *Matematika 3. – zbirka zadataka*, Školska knjiga, Zagreb, 1995.
Prilepko A. I., *Problem Book in High-School Mathematics*, Mir Publishers, Moscow, 1985.
Rich B., *Schaum's Outline of Theory and Problems of Review of Elementary Mathematics*, 2nd ed., McGraw-Hill, New York, 1997.
Safier F., *Schaum's Outline of Precalculus*, 2nd ed., McGraw-Hill, New York, 2009.

Schmidt P., Steiner R. V., *Schaum's Outline of Mathematics for Physics Students*, McGraw-Hill, New York, 2007.
Shklyarsky D. O., *Selected Problems and Theorems in Elementary Mathematics – Arithmetics and Algebra*, Mir Publishers, Moscow, 1979.
Sošić M., Marinović, *Repetitorij s riješenim zadacima iz matematike*, Filozofski fakultet u Rijeci, Rijeka, 2004.
Yakovlev G. N., *High-School Mathematics*, part 1, Mir Publishers, Moscow, 1988.
Yakovlev G. N., *High-School Mathematics*, part 2, Mir Publishers, Moscow, 1988.

WWW
http://mthwww.uwc.edu/wwwmahes/files/math01.htm
http://freebookcentre.net/Mathematics/Trigonometry-Books-Download.html
http://www.cosc.brocku.ca/~duentsch/papers/methprimer1.html
http://web.math.hr/nastava/em/

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
Bronshtein I. N., et al., *Handbook of Mathematics*, 4th edition, Golden Marketing, Zagreb, 2004. (in croatian)	3	10-20

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

Regular monitoring of the student's activity and attitude towards work. In the last week of classes, anonymous surveys will be conducted in which students will evaluate the quality of teaching. At the end of each semester (1 March and 30 September of the current academic year) student' success in examinations will be analyzed.

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Basic description		
Course coordinator	Marcelo Kovačić	
Course title	Biology	
Study programme	Undergraduate Study Programme Physics	
Course status	Compulsory	
Year	2. year	
ECTS credits and teaching	***ECTS student 's workload coefficient***	5
	Number of hours (L+E+S)	30 + 15 + 0

1. COURSE DESCRIPTION

1.1. Course objectives

Course objective is to give to the students a basic knowledge on contents and terminology of modern biological science indispensable for the understanding of biological processes taking place in nature. Acquired knowledge is essential for the understanding of biology related courses given during the study programme.

1.2. Course enrolment requirements

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1.3. Expected course learning outcomes

Students are expected to develop:
a) general ability:
-know how to search and analyze information from different sources;
-to interrelate theoretical and practical knowledge;
-work efficiently in groups and in autonomous;
-good oral and written expression.

b) specific ability:
-Understanding of concepts and main branches of biology;
-knowledge of differences between prokaryotic and eukaryotic cells;
-understand the organisation of eukaryotic cells;
- understand the flow of genetic information;
- recognition of the main morphological and anatomical characters of plants and animals;
- knowledge of the principles of classification, systematic of living beings;
-understand the basic principles of evolution.

1.4. Course content

Introduction: periods in chemical and biological evolution on earth (from organic molecules to first living cells) Prokaryotic and eukaryotic cells. Biochemical composition of the cell. Organisation of eukaryotic cell (cell membrane, cytosol, cytoskeleton, endoplasmic reticulum and ribosomes, Golgi apparatus, lysosomes and endosomes, mitochondria, chloroplasts, nucleus and nucleolus, chromatin and generation of chromosomes, cell cycle). Energy flow in the cell. Nucleic Acids structure and function. Genes and flow of genetic information. Introduction to microscopy. Main anatomical and morphological properties of plants and animals. Systematic of living organisms, phylogenetics. Genetic structure of populations. Principles of developmental biology. Main principles of evolution.

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1.5. Teaching methods	☒ lectures ☒ seminars and workshops ☐ exercises ☐ long distance education ☐ fieldwork	☒ individual assignment ☐ multimedia and network ☐ laboratories ☐ mentorship ☐ other
1.6. Comments		

1.7. Student's obligations

Attendance and active participation in class works. Presentation of seminar paper. Success in written and oral exam.

1.8. Evaluation of student's work

Course attendance	0.5	Activity/Participation	0.5	Seminar paper	1.0	Experimental work	
Written exam	1.0	Oral exam	1.0	Essay		Research	
Project		Sustained knowledge check	0.5	Report	0.5	Practice	
Portfolio							

1.9. Assessment and evaluation of student's work during classes and on final exam

Student will be evaluated and assessed during the course and final exam. Maximum total percentage which student can achieve during the lessons is 70%, while the final exam provides 30% at best.
Detailed elaboration of ways of monitoring and evaluation of students' work will be displayed in the Working Plan!

1.10. Assigned reading (at the time of the submission of study programme proposal)

Berns, M., W. (1997). Stanica. Školska knjiga, Zagreb.
Cooper, G., .M., Hausman, R., E. (2004). Stanica molekularni pristup. Medicinska naklada, Zagreb.
Levine, R., P. (1982). Genetika. Školska knjiga, Zagreb
Habdija, I., Primc Habdija, B., Radanović, I., Vidaković, J., Kučinić, M., Špoljar, M., Matoničkin, R. , Miliša, M. (2004). Protista-Protozoa i Metazoa-Invertebrata. Funkcionalna grana i praktikum. Meridijani, Samobor.
Magdefrau, K., Ehrendorfer, F. (1988). Botanika. Sistematika, evolucija i geobotanika. Školska knjiga, Zagreb.
Denfer, D., Ziegler, H. 1991: Botanika. Morfologija i fiziologija. 3. izdanje. Zagreb, Školska knjiga.
Matoničkin, I., Erben, R. (2002). Opća zoologija. Školska knjiga, Zagreb.

1.11. Optional / additional reading (at the time of proposing study programme)

Campbell, N.A., J.B.Reece, J., B., Jackson, R., B., Cain, M., L., Urry, L., A., Wassermann S. A., Minorsky, P., V. (2007). Biology. 8th ed.. Addison Wesley Longman, ed.
Klug, W., S., Cummings, M., R., Spencer, C., Palladino, M., A. (2009). Essentials of Genetics. 9th ed.. Benjamin Cummings ed.
Halliburton, R. (2004). Introduction to population genetics. Pearson Education, ed.

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

Regular monitoring of the student's activity and attitude towards work. In the last week of classes, anonymous surveys will be conducted in which students will evaluate the quality of teaching. At the end of each semester (1 March and 30 September of the current academic year) student' success in examinations will be analyzed.

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Basic description		
Course coordinator	Anđelka Radojčić Badovinac	
Course title	CELLULAR AND MOLECULAR BIOLOGY	
Study programme	Undergraduate Study Programme Physics	
Course status	Compulsory	
Year	3. year	
ECTS credits and teaching	***ECTS student 's workload coefficient***	5
	Number of hours (L+E+S)	30+30+0

1. COURSE DESCRIPTION

1.1. Course objectives

Students will become familiar with basic concepts of the modern biological sciences, whose achievements are necessary for the understanding, diagnosis and treatment of disease in man and are the foundation of biotechnology. Students will learn basics of cell biology, molecular biology and genetics with special emphasis on the important molecular mechanisms that are integral factors in different areas of biological science.

1.2. Course enrolment requirements

None.

1.3. Expected course learning outcomes

Students should acquire basic theoretical knowledge about biological processes, learn about experimental approach and acquire terminology necessary for reading biomedical contemporary literature. Thus they shall become competent to follow other subjects as well as new trends in biomedicine. Moreover they will acquire knowledge about basic laboratory instruments and techniques (e.g. microscope, preparation of smears...); basic techniques and methods in DNA analysis will be presented to them (PCR, restriction).

1.4. Course content

Course is designed to teach students about the basic concepts of the contemporary biological science. Evolution (from molecule to primary cell, from prokaryotes to eukaryotes) cell study methods (light and electron microscopy, cell culture, fractionating, radioisotope technique, autoradiography, cytofluorimetry) basic organization of eukaryote cell (cell membrane structure, small and large cell transport through the cell membrane), internal organization of eukaryote cells (cytosol, cytoskeleton, endoplasmic reticule and ribosome, Golgi apparatus, lysosomes, endosomes, mitochondria, chloroplasts, cell nucleus and nucleolus, chromatin organization and chromosome formation and cell cycles), basic biological mechanisms (replication, transcription, translation and genetic recombination), mutation at the molecular level, DNA repair mechanisms, genotoxicology (genotoxic effects of radiation, chemical genotoxic effects and viruses as genotoxic agents), basics of molecular genetics, recombinant DNA technology. Genetics is studied in context of the latest achievements in molecular biology, recombinant DNA technology, proteomics and genomics. The impact of the environmental pollutants to human genom will be addressed as well.

1.5. Teaching methods	☒ lectures ☒ seminars and workshops ☐ exercises ☐ long distance education ☐ fieldwork	☒ individual assignment ☐ multimedia and network ☐ laboratories ☐ mentorship ☐ other

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1.6. Comments	Students shall be taught biology accordingly to the problem-based approach in order to develop their critical thinking and communication skills which shall facilitate their mastering of the course as well as lifetime implementation of that knowledge. In seminars students are encouraged to actively discuss and solve problems/cases related to subjects and prepare presentations alone or in teams. The lecture format is supplemented with in-class exercises, discussion, finding the most useful sites from the web, video, field trips.

1.7. Student's obligations

Attendance at all classes and active participation is expected. Final written and oral exam.

1.8. Evaluation of student's work

Course attendance	0.50	Activity/Participation	0.50	Seminar paper	1.00	Experimental work	
Written exam	2.00	Oral exam	1.00	Essay		Research	
Project		Sustained knowledge check		Report		Practice	
Portfolio							

1.9. Assessment and evaluation of student's work during classes and on final exam

In accordance with evaluation rules at the University of Rijeka.

1.10. Assigned reading (at the time of the submission of study programme proposal)

1. Cooper GM i Hausman RE: Stanica - molekularni pristup; Medicinska naklada, Zagreb, 2004. (The Cell - a molecular approach, Washington D.C., ASM Press)

1.11. Optional / additional reading (at the time of proposing study programme)

Cox TM i Sinclair J: Molekularna biologija u medicini. Urednici hrvatskog izdanja Stipan Jonjić, Pero Lučin, Vesna Crnek-Kunstelj i Luka Traven. Medicinska naklada, Zagreb, 2000.

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

Questionnaire at the end of the course designed to evaluate quality of course program, lectures and lecture materials, teaching methods and interaction with students.

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Basic description		
Course coordinator	Zoran Kaliman	
Course title	CLASSICAL MECHANICS	
Study programme	Undergraduate Study Programme Physics	
Course status	Compulsory	
Year	3. year	
ECTS credits and teaching	***ECTS student 's workload coefficient***	7
	Number of hours (L+E+S)	45+45+0

1. COURSE DESCRIPTION

1.1. Course objectives

Developing mechanical concepts. To acquaint the students with mathematical skills as the basis for the theoretical physics.

1.2. Course enrolment requirements

Prerequisites for this course are following: *Mathematical Analysis I, II, Linear Algebra I, II, Physics I*.
Course is in correlation with Classical mechanics 2, *Electrodynamics* and *Quantum Mechanics*.

1.3. Expected course learning outcomes

Tensor calculus

1. To write correct tensor equation.
2. To compere tensor with matrix calculus.
3. To calculate physical quantities with tensors.
4. To define and apply del operator.
5. To examine properties of the force.

Newton's mechanics

6. Define Newton's laws
7. To apply Newton's laws on concrete problems.
8. To derive and describe conservation laws.
9. To connect concepts learned in General physics with new mathematical apparatus.

Analytical mechanics

10. To derive analytical mechanics equations.
11. To apply equations on specific problems.
12. To compare these methods between themselves and with Newton's laws.
13. To derive and solve equations for the problem of small oscillations. To find frequencies and normal coordinates.
14. To derive Lagrange and Hamilton equations for continuum systems.

Central forces

15. To derive equations for different kind of central forces.
16. To define, derive, explain and apply Kepler's laws.
17. To define cross section.
18. To calculate center of mass and moments of inertia for different bodies.

Motion in noninertial systems

19. To derive equations of motion in accelerated coordinate system.
20. To derive Lagrangian and Hamiltonian in noninertial systems.
21. To derive equation and explain motion of Foucault pendulum.

Special relativity

22. To describe Michelson-Morley experiment.

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23. To define Einstein's postulates of special relativity.
24. To derive and apply Lorentz transformations and consequences.

1.4. Course content

Tensor calculus: Vector and tensors, vector analysis. Newtonian theory: Newton's laws and application. Analytical mechanics: Lagrangian method, constraints, Hamilton's equations. Small oscillations. Central forces: two body problem, Kepler's laws. Classical scattering theory. Motion in noninertial systems: Accelerated coordinate systems. Dynamics in a rotating coordinate system. Particle motion near surface of the Earth. The Faucault pendulum. Theory of special relativity: Lorentz transformations, Consequences of Lorentz transformations.

1.5. Teaching methods	☒ lectures ☐ seminars and workshops ☒ exercises ☐ long distance education ☐ fieldwork	☒ individual assignment ☐ multimedia and network ☐ laboratories ☒ mentorship ☐ other
1.6. Comments		

1.7. Student's obligations

- Attendance at all classes and active participation is expected.
- Students should solve, write home works
- Students should pass two preliminary exams (written exam) is solving of numerical exercises.
- Final oral exam.

1.8. Evaluation of student's work

Course attendance	0.5	Activity/Participation	1.0	Seminar paper		Experimental work	
Written exam	2.0	Oral exam	3.0	Essay		Research	
Project		Sustained knowledge check	0.5	Report		Practice	
Portfolio							

1.9. Assessment and evaluation of student's work during classes and on final exam

Students will be evaluated during lectures and on final exam. Maximum percentage during lectures is 70%, and on final exam 30%. On final exam student should have at least 50% point to pass.
Detailed elaboration will be given in executive program.

1.10. Assigned reading (at the time of the submission of study programme proposal)

1. Kaliman Z., *Teorijska mehanika*, Filozofski fakultet u Rijeci, Rijeka, 2002.
2. Spiegel M. R., *Theoretical mechanics*, Schaum Outline Series, McGraw-Hill Book Company, New York, 1967.
3. Wells D. A., *Lagrangian Dynamics*, Schaum Outline Series, McGraw-Hill Book Company, USA, 1967.

1.11. Optional / additional reading (at the time of proposing study programme)

1. Bradbury T. C., *Theoretical Mechanics*, John Wiley and Sons, New York, 1968.
2. Chow T. L., *Classical Mechanics*, John Wiley and Sons, USA, 1995.
3. Barger V. D., Olsson M. O., *Classical mechanics, a modern perspectives*, McGraw-Hill Book Company, New York, 1995.
4. Jose J. V., Saletan E. J., *Classical Dynamics: A Contemporary Approach*, Cambridge Univ Pr, 1998.
5. Feynman R., *Osobitosti fizikalnih zakona*, Školska knjiga, Zagreb, 1991.
6. Goldstein H., *Classical Mechanics,* Addison-Wesley Publishing Company, USA, 2nd edition, 1980.
7. Janković Z., *Teorijska mehanika*, Skripta PMF, Sveučilišna naklada Liber, Zagreb, 1976.
8. Landau L. D., Lifšic E. M., *Mehanika*, Građevinska knjiga, Beograd, 1961.
9. Supek I., *Teorijska fizika i struktura materije*, Tisak, Zagreb, 1974.

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
1. Kaliman Z., *Teorijska mehanika*, Filozofski fakultet u Rijeci, Rijeka, 2002.	10	10-15

2. Spiegel M. R., *Theoretical mechanics*, Schaum Outline Series, McGrawHill Book Company, New York, 1967.	3	10-15
3. Wells D. A., *Lagrangian Dynamics*, Schaum Outline Series, McGraw-Hill Book Company, USA, 1967.	3	10-15

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

Discussions with the students, questionnaires, achievements on the exams. Regular monitoring students' activities.

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Basic description		
Course coordinator	Zoran Kaliman	
Course title	CLASSICAL MECHANICS I	
Study programme	Undergraduate Study Programme Physics	
Course status	Compulsory	
Year	2. year	
ECTS credits and teaching	***ECTS student 's workload coefficient***	9
	Number of hours (L+E+S)	45+45+15

1. COURSE DESCRIPTION

1.1. Course objectives

Developing mechanical concepts. To acquaint the students with mathematical skills as the basis for the theoretical physics.

1.2. Course enrolment requirements

Prerequisites for this course are following: *Mathematical Analysis I, II, Linear Algebra I, II, Physics I*.
Course is in correlation with Classical mechanics 2, *Electrodynamics* and *Quantum Mechanics*.

1.3. Expected course learning outcomes

Tensor calculus

1. To write correct tensor equation.
2. To compere tensor with matrix calculus.
3. To calculate physical quantities with tensors.
4. To define and apply del operator.
5. To examine properties of the force.

Newton's mechanics

6. Define Newton's laws
7. To apply Newton's laws on concrete problems.
8. To derive and describe conservation laws.
9. To connect concepts learned in General physics with new mathematical apparatus.

Analytical mechanics

10. To derive analytical mechanics equations.
11. To apply equations on specific problems.
12. To compare these methods between themselves and with Newton's laws.
13. To derive and solve equations for the problem of small oscillations. To find frequencies and normal coordinates.
14. To derive Lagrange and Hamilton equations for continuum systems.

Central forces

15. To derive equations for different kind of central forces.
16. To define, derive, explain and apply Kepler's laws.
17. To define cross section.
18. To calculate center of mass and moments of inertia for different bodies.

Motion in noninertial systems

19. To derive equations of motion in accelerated coordinate system.
20. To derive Lagrangian and Hamiltonian in noninertial systems.
21. To derive equation and explain motion of Foucault pendulum.

Special relativity

22. To describe Michelson-Morley experiment.

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23. To define Einstein's postulates of special relativity.
24. To derive and apply Lorentz transformations and consequences.

1.4. Course content

Tensor calculus: Vector and tensors, vector analysis. Newtonian theory: Newton's laws and application. Analytical mechanics: Lagrangian method, constraints, Hamilton's equations. Small oscillations. Central forces: two body problem, Kepler's laws. Classical scattering theory. Motion in noninertial systems: Accelerated coordinate systems. Dynamics in a rotating coordinate system. Particle motion near surface of the Earth. The Faucault pendulum. Theory of special relativity: Lorentz transformations, Consequences of Lorentz transformations.

1.5. Teaching methods	☒ lectures ☒ seminars and workshops ☒ exercises ☐ long distance education ☐ fieldwork	☒ individual assignment ☐ multimedia and network ☐ laboratories ☒ mentorship ☐ other
1.6. Comments		

1.7. Student's obligations

- Attendance at all classes and active participation is expected.
- Students should solve, write home works
- Students should pass two preliminary exams (written exam) is solving of numerical exercises.
- Final oral exam.

1.8. Evaluation of student's work

Course attendance	0.5	Activity/Participation	1.0	Seminar paper	1.0	Experimental work	
Written exam	2.0	Oral exam	3.5	Essay		Research	
Project		Sustained knowledge check	1.0	Report		Practice	
Portfolio							

1.9. Assessment and evaluation of student's work during classes and on final exam

Students will be evaluated during lectures and on final exam. Maximum percentage during lectures is 70%, and on final exam 30%. On final exam student should have at least 50% point to pass.
Detailed elaboration will be given in executive program.

1.10. Assigned reading (at the time of the submission of study programme proposal)

1. Kaliman Z., *Teorijska mehanika*, Filozofski fakultet u Rijeci, Rijeka, 2002.
2. Spiegel M. R., *Theoretical mechanics*, Schaum Outline Series, McGraw-Hill Book Company, New York, 1967.
3. Wells D. A., *Lagrangian Dynamics*, Schaum Outline Series, McGraw-Hill Book Company, USA, 1967.

1.11. Optional / additional reading (at the time of proposing study programme)

1. Bradbury T. C., *Theoretical Mechanics*, John Wiley and Sons, New York, 1968.
2. Chow T. L., *Classical Mechanics*, John Wiley and Sons, USA, 1995.
3. Barger V. D., Olsson M. O., *Classical mechanics, a modern perspectives*, McGraw-Hill Book Company, New York, 1995.
4. Jose J. V., Saletan E. J., *Classical Dynamics: A Contemporary Approach*, Cambridge Univ Pr, 1998.
5. Feynman R., *Osobitosti fizikalnih zakona*, Školska knjiga, Zagreb, 1991.
6. Goldstein H., *Classical Mechanics,* Addison-Wesley Publishing Company, USA, 2nd edition, 1980.
7. Janković Z., *Teorijska mehanika*, Skripta PMF, Sveučilišna naklada Liber, Zagreb, 1976.
8. Landau L. D., Lifšic E. M., *Mehanika*, Građevinska knjiga, Beograd, 1961.
9. Supek I., *Teorijska fizika i struktura materije*, Tisak, Zagreb, 1974.

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
1. Kaliman Z., *Teorijska mehanika*, Filozofski fakultet u Rijeci, Rijeka, 2002.	10	10-15

2. Spiegel M. R., *Theoretical mechanics*, Schaum Outline Series, McGrawHill Book Company, New York, 1967.	3	10-15
3. Wells D. A., *Lagrangian Dynamics*, Schaum Outline Series, McGraw-Hill Book Company, USA, 1967.	3	10-15

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

Discussions with the students, questionnaires, achievements on the exams. Regular monitoring students' activities.

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Basic description		
Course coordinator	Zoran Kaliman	
Course title	CLASSICAL MECHANICS II	
Study programme	Undergraduate Study Programme Physics	
Course status	Compulsory	
Year	2. year	
ECTS credits and teaching	***ECTS student 's workload coefficient***	8
	Number of hours (L+E+S)	45 + 30 + 15

1. COURSE DESCRIPTION

1.1. Course objectives

To teach students some advanced topics in broad area of classical mechanics. Training students to independently analyze and solve involved realistic problems, not only in the realm of classical mechanics, but also in other contexts in which one can use mathematical techniques developed during the course. To acquaint students with knowledge necessary for understanding advanced theoretical courses.

1.2. Course enrolment requirements

Physics I. Cannot be taken before *Classical Mechanics I.*

1.3. Expected course learning outcomes

After completing the course students will be able:
- to independently solve problems in the field of classical mechanics, which is the basis of many phenomena and technical applications
- to analyze and solve problems in the other branches of science and engineering, which demand mathematical techniques developed during the course
- to take advanced courses in theoretical physics, such as *Quantum Mechanics, Electrodynamics, Statistical Physics,* and some specialized courses.

Students will be trained for independent analyzing, modelling and solving problems by using mathematical techniques that have wide range of application in different scientific disciplines. In this way course intensively develops general competences.

1.4. Course content

Dynamics of rigid bodies: Translations and rotations. Euler equations. Euler angles. Top. Gyroscope precession.
Canonical formalism: Phase space. Canonical variables. Liouville's theorem. Principal function. Hamilton-Jacobi equation. Separation of variables. Action-angle variables. Adiabatic invariants.
Nonlinearity, nonintegrability and chaos.
Special relativity: Minkowski space. Tensors. Lagrange formulation. Kinematics of scattering and decay of particles. Dynamics. Gravity and Einstein relativity.
Symmetries and conservation laws: Symmetries in Lagrange formulation. Noether's theorem. Space-time and internal symmetries. Conserved quantities as symmetry group generators.
Continuum mechanics: Continuum description. Deformations. Stress tensor. Equations of motion for elastic solid bodies. Fluids. Waves. Field theory.

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1.5. Teaching methods	☒ lectures ☒ seminars and workshops ☒ exercises ☐ long distance education ☐ fieldwork	☒ individual assignment ☐ multimedia and network ☐ laboratories ☐ mentorship ☐ other
1.6. Comments		

1.7. Student's obligations

Active participation, doing home assignments and tests, preparing one seminar with presentation, passing the final exam.

1.8. Evaluation of student's work

Course attendance		Activity/Participation	0.5	Seminar paper	1	Experimental work	
Written exam		Oral exam	2.5	Essay		Research	
Project		Sustained knowledge check	4	Report		Practice	
Portfolio							

1.9. Assessment and evaluation of student's work during classes and on final exam

Students will be evaluated and valued continuously during the course through home assignments and periodic tests. They have to write one seminar, which should be presented in front of the class. Eventually, there will be final exam, depending on the success during the course. Activities during the course bring at least 70% of the total mark.

1.10. Assigned reading (at the time of the submission of study programme proposal)

1. Landau L. D., Lifšic E. M., *Mehanika*, Građevinska knjiga, Beograd, 1961.
2. Goldstein H., Poole C., Safko J., *Classical Mechanics,* Addison-Wesley Publishing Company, USA, 3rd edition, 2000.
3. Taylor J. R., *Classical Mechanics,* University Science Books, 2005.

1.11. Optional / additional reading (at the time of proposing study programme)

1. Jose J. V., Saletan E. J., *Classical Dynamics: A Contemporary Approach*, Cambridge Univ. Press, 1998.
2. Kaliman Z., *Teorijska mehanika*, Filozofski fakultet u Rijeci, Rijeka, 2002.
3. Alligood K. T., Sauer T. D., Yorke J. A., *Chaos: An Introduction to Dynamical Systems,* Springer-Verlag, NewYork,Inc., 1996.
4. Arnol'd V. I., *Mathematical Methods of Classical Mechanics,* 2. izdanje, Springer, 1989.

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
Landau L.D., Lifšic E.M., *Mehanika*	3	
Goldstein H., Poole C., Safko J., *Classical Mechanics*	2	
Taylor J.R., *Classical Mechanics*	0	

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

Consultations, standard anonymous student questionnaires, discussions after the final exam.

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Basic description		
Course coordinator	Sanja Rukavina	
Course title	COMBINATORICS	
Study programme	Undergraduate Study Programme Physics	
Course status	Compulsory	
Year	2. year	
ECTS credits and teaching	***ECTS student 's workload coefficient***	5
	Number of hours (L+E+S)	30 + 30 + 0

1. COURSE DESCRIPTION

1.1. Course objectives

In this course we will study and apply combinatorial techniques in a variety of settings.

1.2. Course enrolment requirements

The program is correspondent to the program of other mathematical courses, especially to Discrete mathematics.

1.3. Expected course learning outcomes

After completing this class, students should be able to:

- describe and compare various forms of the Pigeonhole principle,
- discuss and solve different counting problems,
- apply recursive relations and generating functions in solving mathematical problems,
- analyse problems; formulate them into mathematical terms and use the appropriate strategies to solve them; verify and interpret the solutions; and present their mathematical arguments and solutions in a logical and clear fashion.

1.4. Course content

Pigeonhole principle. Ramsey theorem. Basic counting techniques. Permutations and combinations of the sets and multisets. Binomial and multinomial coefficients. Including-excluding principle and applications. Möbius inversion. Reccurence relations. Generating functions. Some combinatorial structures.

1.5. Teaching methods	☒ lectures ☐ seminars and workshops ☒ exercises ☒ long distance education ☐ fieldwork	☒ individual assignment ☒ multimedia and network ☐ laboratories ☐ mentorship ☐ other
1.6. Comments	Student's activities are evaluated during the semester. Final exams are written and oral.	

1.7. Student's obligations

Attendance at all classes and active participation is expected; final written and oral exam.

1.8. Evaluation of student's work

Course attendance	0.55	Activity/Participation	0.55	Seminar paper		Experimental work	

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Written exam	2.0	Oral exam	1.3	Essay		Research	
Project		Sustained knowledge check	0.6	Report		Practice	
Portfolio							

1.9. Assessment and evaluation of student's work during classes and on final exam

Student will be evaluated and assessed during the course and final exam. Maximum total percentage which student can achieve during the lessons is 70%, while the final exam provides 30% at the best.
Detailed elaboration of ways of monitoring and evaluation of students' work will be displayed in the Working Plan.

1.10. Assigned reading (at the time of the submission of study programme proposal)

1. D.Veljan, Kombinatorna i diskretna matematika, Algoritam, Zagreb, 2001.
2. M.Cvitković, Kombinatorika, zbirka zadataka, Element, Zagreb, 2001.

1.11. Optional / additional reading (at the time of proposing study programme)

1. D. Žubrinić, Diskretna matematika. Element, Zagreb, 1997.
2. D.Veljan, Kombinatorika s teorijom grafova, Školska knjiga, Zagreb, 1989.

2.1. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
D.Veljan, Kombinatorna i diskretna matematika, Algoritam, Zagreb, 2001.	5	10
M.Cvitković, Kombinatorika, zbirka zadataka, Element, Zagreb, 2001.	5	10

2.2. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

After the last lecture of the course students will be asked to fulfill a questionnaire about the quality of the lectures. At the end of each semester results of the exams will be analyzed.

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Basic description		
Course coordinator	Neven Grbac	
Course title	COMPLEX ANALYSIS	
Study programme	Undergraduate Study Programme Physics	
Course status	Compulsory	
Year	2. year	
ECTS credits and teaching	***ECTS student 's workload coefficient***	5
	Number of hours (L+E+S)	45 + 30 + 0

1. COURSE DESCRIPTION

1.1. Course objectives

- learning characteristics of vector functions
- learning of curve integrals
- learning of Laurent series of function and Residue Theorem

1.2. Course enrolment requirements

Program of Complex Analysis is correlated with other mathematical courses, especially with Analysis I, Analysis II and Analysis III. Prerequisite courses: Analysis I, Analysis II and Analysis III.

1.3. Expected course learning outcomes

After completing this course students will be able to:
- know and understand basic characteristics of vector functions
- know and understand curve integrals
- know and understand Laurent series of function and Residue Theorem

1.4. Course content

Holomorphic functions. Cauchy- Riemann's conditions. Elementary functions. Cauchy's Theorem. Curve index. Cauchy's Integral Formula. Morera's Theorem. Function series. Derivation and integration of function series. Series expansion of holomorphic function and power series. Liouville's Theorem. Laurent series. Singularities and their classification. Residue Theorem and applications. Poles of meromorphic finctions. Rouche's Theorem. Open Map Theorem. Maximum modules principle. Schwartz's Lemma.

1.5. Teaching methods	☒ lectures ☐ seminars and workshops ☒ exercises ☐ long distance education ☐ fieldwork	☒ individual assignment ☐ multimedia and network ☐ laboratories ☐ mentorship ☐ other
1.6. Comments	Students' work is continually observed. Integral part of observing and evaluating of students is the quality of active contribution in work on the lectures and exercises. Student's integral knowledge is evaluated in the exam.	

1.7. Student's obligations

Every student is obliged to fulfill conditions for signature in Complex Analysis and to pass the exam. Conditions for signature: Students are expected to attend and actively participate at all classes. Exam: written and oral.

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1.8. Evaluation of student's work

Course attendance	0.6	Activity/Participation	0.6	Seminar paper		Experimental work	
Written exam	1.4	Oral exam	2.0	Essay		Research	
Project		Sustained knowledge check	0.4	Report		Practice	
Portfolio							

1.9. Assessment and evaluation of student's work during classes and on final exam

Student will be evaluated and assessed during the course and final exam. Maximum total percentage which student can achieve during the lessons is 70%, while the final exam provides 30% at the best.
Detailed elaboration of ways of monitoring and evaluation of students' work will be displayed in the Working Plan.

1.10. Assigned reading (at the time of the submission of study programme proposal)

1. H. Kraljević, S. Kurepa, Matematička analiza IV (funkcije kompleksne varijable), Tehnička knjiga, Zagreb, 1984.
2. N. Elezović, D. Petrizio, Funkcije kompleksne varijable zbirka zadataka, Element, Zagreb, 1994.

1.11. Optional / additional reading (at the time of proposing study programme)

1. Ž. Marković, Uvod u višu analizu, Sveučilište u Zagrebu, Zagreb, 1965.
2. I.C. Burkill, H. Burkill, A second course in mathematical analysis, Camridge Univ. Press, 1970.
3. Schaum's outline series, Theory and problems of complex variables, McGraw-Hill book company, USA, 1964.

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
H. Kraljević, S. Kurepa, Matematička analiza IV (funkcije kompleksne varijable), Tehnička knjiga, Zagreb, (više izdanja)	5	10
N. Elezović, D. Petrizio, Funkcije kompleksne varijable zbirka zadataka, Element, Zagreb, (više izdanja)	5	10

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

After the last lecture of the course students will be asked to fulfill a questionnaire about the quality of the lectures. At the end of each semester results of the exams will be analyzed.

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Basic description		
Course coordinator	Dijana Dominis Prester	
Course title	COMPUTATIONAL PHYSICS	
Study programme	Undergraduate Study Programme Physics	
Course status	Elective	
Year	2. year 3. year	
ECTS credits and teaching	***ECTS student 's workload coefficient***	5
	Number of hours (L+E+S)	30+15+15

1. COURSE DESCRIPTION

1.1. Course objectives

Learning of methods for solving physical problems using numerical methods. Learing and application of different optimization methods. Training programming skills.

1.2. Course enrolment requirements

General Physics Courses, Introductory Computer Science. Bascis of computer programming is desired, but not a requirement.

1.3. Expected course learning outcomes

Students will be expected to describe numerical methods in physics and mathematics, write simple computer codes using simulations, use existing packages for simulationa, animation and visualization, define optimization, distinghish different optimization methods, describe genetic algorithms, write a computer code which optimizes a non-liner problem using a chosen optimization methods, and perform a computational analysis of simulated and measured data using programming in FORTRAN.

1.4. Course content

Basics of FORTRAN. Numerical methods in physics and mathematics. Monte Carlo simulation. Animation and visualisation of computer simulations. Numerical optimization methods of solving multidimenzional physical problems. Simplex algorithm. Neural networks. Genetic algorithms. Simulations in high-energy physics and astrophysics. Computationl analysis of simulated and measured physical data.

1.5. Teaching methods	☒ lectures ☒ seminars and workshops ☒ exercises ☒ long distance education ☐ fieldwork	☒ individual assignment ☒ multimedia and network ☐ laboratories ☐ mentorship ☐ other
1.6. Comments	The course will be subject to changes and continuous improvements, depending on the availability of new software and hardware.	

1.7. Student's obligations

Course attendance, homework, individual project.

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1.8. Evaluation of student's work

Course attendance	0.5	Activity/Participation	0.5	Seminar paper		Experimental work	
Written exam	0.5	Oral exam	1.0	Essay		Research	
Project	1.0	Sustained knowledge check	0.5	Report		Practice	1.0
Portfolio							

1.9. Assessment and evaluation of student's work during classes and on final exam

Manner of knowledge checking: class participation, homework, project, written and oral exam. Student's work will be evaluated during the semester, and during the final exam.

1.10. Assigned reading (at the time of the submission of study programme proposal)

1. Course Web page
2. H. Gould and J. Tobochnik, An Introduction to Computer Simulation Methods, Addison-Wesley, Reading, Massachusetts
3. M. Metcalf, Fortran 90 Tutorial, CERN

1.11. Optional / additional reading (at the time of proposing study programme)

1. W. H. Press, B. P. Flannery, S. A. Teukolsky, W. T. Vetterling, *Numerical Recipes*, Cambridge University Press
2. D. Frenkel, B. Smit, *Understanding Molecular Simulation (from algorithms to applications)*, Academic Press
3. M. P. Allen, D. J. Tildesley, *Computer Simulation of Liquids*, Clarendon Press, Oxford
4. D. C. Rapaport, *The Art of Molecular Dynamics Simulation*, Cambridge University Press
5. S. E. Koonin, *Computational Physics*, Benjamin Cummings
6. D. W. Heermann, Computer Simulation Methods in Theoretical Physics, Springer-Verlag, Berlin

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

Interaction with students and student-faculty team work on quality of teaching process. Anonymous questionnaires on quality of teaching. Flexible adaptation of teaching to interests and needs of students.

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Basic description		
Course coordinator	Mario Radovan	
Course title	COMPUTER NETWORKS I	
Study programme	Undergraduate Study Programme Physics	
Course status	Compulsory	
Year	3. year	
ECTS credits and teaching	***ECTS student 's workload coefficient***	5
	Number of hours (L+E+S)	30 + 30 + 0

1. COURSE DESCRIPTION

1.1. Course objectives

The aim of this course is to present basic knowledge about computer networks and computer-based communication systems. Technological elements and basic principles of functioning of computer networks of various kinds and extents are presented and explained. Technological and structural features of computer networks, presented in this course, form the basis for the presentation of the organizational, security and application elements of computer networks, which are presented in the course "Computer networks 2".

1.2. Course enrolment requirements

In this course is presented the basic knowledge about computer networks. The contents of this course draws on the contents of those courses which deal with information systems, computer architecture and computer programming. It is desirable that students pass the exams in these courses before they sign up for this course.

1.3. Expected course learning outcomes

Students will acquire basic knowledge about the elements and architecture of computer networks and about the structural features of the computer communication systems. Students will learn and be able to explain the technological basis and the principles of functioning of computers networks of various kinds and extents, specified in the "Course content" below. Students will be able to use in their own the elements, methods and services which are put forward in the "Course content".

1.4. Course content

(1) Network systems: basic concepts and principles of functioning; types of computer networks. (2) Performances and sharing of resources; network layers and protocols. (3) Layers of the OSI model and of the Internet (TCP/IP) model. (4) Physical layer of the network: data carriers and coding methods. (5) Data link layer: creation of frames; detection of errors and their correction. (6) Local area networks: Ethernet, Token Ring, and other (MAN) ring networks. (7) Packet switching and circuit switching; source routing. (8) Extended LANs; ATM system; routers, interfaces and ports. (9) Composite networks: principles and methods of connecting networks of different kinds. (10) Structure of the IP packet; the address space of the Internet. (11) Intradomain (interior) routing. (12) Subnetworks and classless routing. (13) Principles of interdomain routing. (14) Wireless networks: Bluetooth, Wi-Fi, WiMAX. (15) Systems of mobile telephony.

1.5. Teaching methods	☒ lectures ☐ seminars and workshops ☒ exercises ☐ long distance education ☐ fieldwork	☐ individual assignment ☐ multimedia and network ☐ laboratories ☐ mentorship ☒ other - consultations
1.6. Comments		

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1.7. Student's obligations

Students must attend exercises. A student ought to pass the written (practical) part of the exam, as the precondition to take the final oral part of the exam, in which the complete knowledge of the student is evaluated and the final grade is established.

1.8. Evaluation of student's work

Course attendance	1.00	Activity/Participation		Seminar paper		Experimental work	
Written exam	1.00	Oral exam	1.00	Essay		Research	
Project		Sustained knowledge check	2.00	Report		Practice	
Portfolio							

1.9. Assessment and evaluation of student's work during classes and on final exam

The activities of a student, related to this course will be evaluated during the lectures and at the final exam. Total number of points that a student can get during the lectures is 70 (activities indicated in the table are evaluated), while at the final exam a student can get 30 points. A more detailed elaboration of the way of montoring and evaluation of the student's activities will be given in the implementation plan.

1.10. Assigned reading (at the time of the submission of study programme proposal)

Radovan, M.: *Računalne mreže (1)*, Rijeka: Digital Point tiskara, 2010. (* Radovan, M.: *Computer networks (1)*; the book is also available on the Internet. *)

1.11. Optional / additional reading (at the time of proposing study programme)

Kurose, F. J., Ross, W. K.: *Computer Networking: A Top-Down Approach Featuring the Internet, 5th Edition*, Pearson Addison Wesley, 2009.
Peterson, L. L., Davie, B. S.: *Computer Networks: A System Approach, 4th Edition*, Morgan Kaufmann Publishers, 2007.
Tanenbaum, A. S.: *Computer Networks, 4th Edition*, Prentice Hall, 2003.

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
Radovan, M.: *Računalne mreže (1)*, Rijeka: Digital Point tiskara, 2010. (*Radovan, M.: *Computer networks (1)*; the book is also available on the Internet.*)	4 (+ Internet)	10

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

During the last week of lectures an anonymous survey will be taken, in which the students will evaluate the quality of the given lectures. An analysis of the success of the students on the exam, as well as at the practice related to the teaching, will also be made.

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Basic description		
Course coordinator	Ivo Ipšić	
Course title	COMPUTER ORGANIZATION AND ARCHITECTURE	
Study programme	Undergraduate Study Programme Physics	
Course status	Compulsory	
Year	2. year	
ECTS credits and teaching	***ECTS student 's workload coefficient***	5
	Number of hours (L+E+S)	30 + 30 + 0

1. COURSE DESCRIPTION

1.1. Course objectives

The aim of the course is to introduce basic computer structure and organisation principles.

1.2. Course enrolment requirements

The course corresponds to the course Introduction to Digital Systems.

1.3. Expected course learning outcomes

The students will have basic knowledge of computer system architectures and organization.

1.4. Course content

History of Computers. Architecture of a simple microprocessor. The central processing unit. Arithmetic – logic unit. Instruction set. Addressing modes and formats. Von Neumann computer model. System Buses. Memories. Input/Output. Operating system support. Microprocessor programming.

1.5. Teaching methods	☒ lectures ☐ seminars and workshops ☒ exercises ☐ long distance education ☐ fieldwork	☐ individual assignment ☐ multimedia and network ☐ laboratories ☒ mentorship ☐ other
1.6. Comments		

1.7. Student's obligations

It is compulsory for students to attend exercises. A student has to pass the written (practical) part of the examination which regards the exercises, as the precondition to take the oral part of examination where the complete knowledge of the student is examined and evaluated.

1.8. Evaluation of student's work

Course attendance	1.25	Activity/Participation		Seminar paper		Experimental work	
Written exam	1.25	Oral exam		Essay		Research	
Project		Sustained knowledge check	2.50	Report		Practice	
Portfolio							

1.9. Assessment and evaluation of student's work during classes and on final exam

Version 1 with final exam: Student's work is evaluated during the semester and on the final exam. Total number of points during the semester is 70 and on the final exam 30.
The detailed scheme for student's evaluation and assessing will be presented in the implementation plan for the course

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1.10. Assigned reading (at the time of the submission of study programme proposal)

S. Ribarić. Naprednije arhitekture mikroprocesora, Element Zagreb, 1997.
S. Ribarić. Arhitekture računala RISC i CISC, Školska knjiga Zagreb, 1996.

1.11. Optional / additional reading (at the time of proposing study programme)

W. Stallings. Computer Organization and Architecture, Prentice Hall, 2000.
A.S. Tannenbaum, J. Goodman: Structured Computer Organisation, Prentice Hall, 1999.

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
S. Ribarić. Naprednije arhitekture mikroprocesora, Element Zagreb, 1997.	1	10
S. Ribarić. Arhitekture računala RISC i CISC, Školska knjiga Zagreb, 1996	1	10

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

Anonymous poll in the end of semester. Statistical reports on results obtained on quizzes, partial exams, homework and final project. In the end statistical report on passing.

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Basic description		
Course coordinator	Luca Malatesti	
Course title	CONSCIOUSNESS AND CONTENT	
Study programme	Undergraduate Study Programme Physics	
Course status	Optional	
Year	2. year	
ECTS credits and teaching	***ECTS student 's workload coefficient***	3
	Number of hours (L+E+S)	15 + 0 + 15

1. COURSE DESCRIPTION

1.1. Course objectives

The module aims to introduce and explore in some depth some relevant streams of the contemporary philosophical debate on the nature of consciousness, its relation to the intentional and representational features of the mind, and its place in the natural world.

During the course, you will be encouraged to think critically and philosophically about the issues, evaluate and produce arguments, and you will be expected to do the same in assessment.

1.2. Course enrolment requirements

The course activities, from teaching to assessed work, will be in English. Moreover, no alternative course material in Croatian will be available. It is strongly advised that only students who can self certificate their comprehension of spoken and written English at an intermediate or advanced level can enrol. However, the course does not presuppose capacities or experience in philosophical writing in English.

1.3. Expected course learning outcomes

The course aims at promoting your knowledge of the following notions relative to the topics covered in the lectures (please see course content below): philosophers, doctrines, concepts, arguments. Specifically, the course aims at promoting the following capacities:

1. *Philosophers:* capacity to associate them to the specific doctrines, arguments, concepts in philosophy of mind that were considered in the course. Some (rough) idea of when they proposed these positions or arguments.
2. *Doctrines*: ability to state in a concise, clear, and rigorous way the specific problem they aim to solve and their main theses.
3. *Concepts:* ability to define or characterize them in a concise, clear and rigorous ways and give appropriate examples.
4. *Arguments* (for a solution of a philosophical problem, objections and replies):
    1. Ability to present their structure, clarify their premises and their conclusion.
    2. Ability to assess their validity (whether they logically lead to their conclusion) and soundness (if they are valid, whether their premises are true).
        - This assessment does not necessarily require the students' capacity to offer original lines of though. An intelligent and reasoned use of what they take to be the strongest objections in the assigned core readings is sufficient. In particular, selecting the appropriate objections to

the different arguments and doctrines will require thinking about the relations between topics discussed in different seminars.

1.4. Course content

- Different forms of physicalism in philosophy of mind
- Consciousness: preliminary clarifications
- The knowledge argument
- Different accounts of knowing *what it is like to have* an experience
- Demonstrative and indexical thoughts
- Experience and demonstrative thought – Robert Stalnaker's proposal
- Saul Kripke's modal arguments against physicalism
- David Chalmers's modal argument against physicalism
- Replies to the modal arguments
- The representational accounts of experience: Michael Tye's PANIC theory
- The naturalisation of content
- Objections the representational accounts of experience
- Conceptual and non-conceptual content
- The non-conceptual content of experience
- Objections to the non-conceptual content of experiences

1.5. Teaching methods	☒ lectures ☒ seminars and workshops ☐ exercises ☐ long distance education ☐ fieldwork	☒ individual assignment ☐ multimedia and network ☐ laboratories ☐ mentorship ☐ other
1.6. Comments	Lecture notes and some materials will be available on Mudri: http://mudri.uniri.hr/	

1.7. Student's obligations

To satisfy the course duties, and thus get the signature to receive the final mark, it is required that students:

- attend regularly lectures and seminars,
- prepare for the seminars to read the assigned materials (even if she is not delivering a presentation),
- deliver the seminar presentation,
- take the two written tests.
- Submit at least an initial draft of their essay

1.8. Evaluation of student's work

Course attendance	1.12	Activity/Participation		Seminar paper	1.0	Experimental work	
Written exam	0.38	Oral exam		Essay	1.12	Research	
Project		Sustained knowledge check		Report	0.38	Practice	
Portfolio							

1.9. Assessment and evaluation of student's work during classes and on final exam

Activity	Contribution to ECTS credits	Learning Outcomes	Percentage
Attendance	1,12		
Oral presentation in the seminar (in English or Croatian)	0,38		
Written test 1	0,19	1,2,3,4.1	20
Written test 2	0,19	1,2,3,4.1	30
Essay (in English or Croatian): 2000 words.	1,12	1,2,3,4.1, 4.2.	50
TOTAL	3		100

1.10. Assigned reading (at the time of the submission of study programme proposal)

(Material needed to prepare for the tests and main reading for writing the essay)

Balog, K. 1999. "Conceivability, Possibility, and the Mind Body Problem." *The Philosophical Review* 108, 4: 497-528.
Bermúdez, J. L. 1998. *The Paradox of Self-Consciousness*. Cambridge (Mass.): MIT Press (Excerpts from chapter 3 and 4).
Chalmers, D. 1996. *The Conscious Mind. In Search of a Fundamental Theory*. New York and London: Oxford University Press (Excerpts from chapters 3 and 4).
McDowell, J. 1994. *Mind and World*. Cambridge MA: Harvard University Press (Lecture III).
Papineau, D. 2002. *Thinking about Consciousness*. Oxford: Clarendon Press (Chapter 1 and Appendix).
Stalnaker, R. C. 2008. *Our Knowledge of the Internal World*. Oxford: Clarendon Press Oxford (Chapter 2 and 4).
Tye, M. 2000. *Consciousness, Color, and Content*. Cambridge (Mass.) and London: MIT Press (Chapter 3 and 4).

1.11. Optional / additional reading (at the time of proposing study programme)

Alter, T. 2007. "On the Conditional Analysis of Phenomenal Concepts." *Philosophical Studies* 134: 235-253.
Balog, K. 1999. "Conceivability, Possibility, and the Mind Body Problem." *The Philosophical Review* 108, 4: 497-528.
Block, N. 2003. "Mental Paint." In H. M. and R. B., eds. *Essays on the Philosophy of Tyler Burge*. Cambridge (Mass.): MIT Press.
Clark, A. 2000. *A Theory of Sentience*. Oxford: Oxford University Press (Chapter 1).
Dretske, F. 1995. *Naturalizing the Mind*. Cambridge (Mass.): MIT Press (Chapter 1).
Horgan, T. and Tienson, J. 2002 "The Intentionality of Phenomenology ant the Phenomenology of Intentionality." In Chalmers, D. ed. 2002. *Philosophy of Mind: Classical and Contemporary Readings*. New York, NY: Oxford University Press, 520-533.
Kripke, S. 1971. "Identity and Necessity." In N. Munitz, ed. *Identity and Individuation*. New York: New York University Press.
Lewis, D. 1990. "What Experience Teaches." In W. Lycan, ed. Mind and Cognition. Oxford: Blackwel, 499-519. Reprinted in N. Block, and O. Flanagan and G. Güzeldere, eds. The Nature of Consciousness. Cambridge (Mass.): MIT Press, 1997, 580-595. P. Ludlow, Y. Nagasawa, D. Stoljar, eds. There's Something About Mary: Essays on Phenomenal Consciousness and Frank Jackson's Knowledge Argument. Cambridge (Mass.): MIT Press, 2004, 77-103.
Perry, J. 2001. *Knowledge, Possibility and Consciousness: The 1999 Jean Nicod Lectures.* Cambridge (Mass.): MIT Press (Excerpts from Chapters 5, 6, and 7).
Peacocke, C. 2001. "Does perception have a nonconceptual content?" *Journal of Philosophy 98*: 239-264.
Siewert, C. 1998. *The Significance of Consciousness*. Princeton (NJ): Princeton University Press (Chapter 7).

Stoljar, D. 2001. "The Conceivability Argument and two Conceptions of the Physical." *Philosophical Perspectives: Metaphysics* 15: 393-413.

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

The quality of the course is monitored and assessed by means of students' anonymous questionnaire.
This questionnaire will concern the organisation and delivery of lectures, the contents of the course, the relationship of the teacher with the students (availability, readiness to explain again covered materials, overall atmosphere in the class etc.), the quality of student assessment, the quality and quantity of the assigned literature, and the achievement of the planned outcomes that are stated in this programme.

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Basic description		
Course coordinator	Velimir Labinac	
Course title	DATA ANALYSIS	
Study programme	Undergraduate Study Programme Physics	
Course status	Compulsory	
Year	1. year	
ECTS credits and teaching	***ECTS student 's workload coefficient***	3
	Number of hours (L+E+S)	15 + 15 + 0

1. COURSE DESCRIPTION

1.1. Course objectives

The main objective of the course is to introduce students to essential statistical methods and their application to analysis of physical measurements. In particular, students will be introduced to error analysis which forms a basis for work in a laboratory. Additionally, the elementary probability theory is necessary to comprehend the basic principles of statistical physics and quantum mechanics.

1.2. Course enrolment requirements

There are no prerequisites for the course enrolment. The course starts in the 2nd semester of 1st undergraduate year so that only high-school mathematics and basics of calculus will be required for the most part the theory. Knowledge of elementary probability theory and statistics from high-school is welcome.

1.3. Expected course learning outcomes

After passing the exam, student will be able:

1. to calculate the basic statistics of samples;
2. to define the theoretical (a priori) and empirical probability (a posteriori);
3. to calculate elementary examples in probability using combinatorial counting;
4. to know the basic statistical distributions and their properties;
5. to use the error analysis for writing laboratory exercises reports;
6. to use the method of least squares to fit linear or a nonlinear function on measured data;
7. to enumerate and explain several methods for estimating parameters of a data set;
8. to apply Hi-squared test distribution for comparison of empirical and theoretical frequencies, the variance of the sample and the theoretical variance and test of homogeneity of empirical data.

1.4. Course content

Descriptive Statistics: types of data, measures of central tendency and dispersion, more then one variable. *Elementary Probability Theory*: random experiments, sample space, combinatorics, conditional probability and Bayes' theorem, Bernoulli's scheme, random variables, mathematical expectation and variance, the axiomatic approach to probability theory. *Theoretical Distributions*: Binomial, Poisson, Gaussian (normal) distribution, and other distributions which are important for physics. *Error Analysis*: estimating uncertainties, propagation of errors, random and statistical errors, the examples are made in Microsoft Excel spreadsheets. *Statistical Estimation Theory*: properties of estimators, estimating the mathematical expectation and variance, the method of maximum likelihood, estimator parameters of normal distribution, the method of moments. *The Method of Least Squares*: the straight line fit, the Hi-squared distribution, the non-linear fit, the examples are made in the software package Mathematica (commands: FIT, FINDFIT). *Statistical Decision Theory*: hypothesis testing, interpretation of the experiment, the accuracy of the adjustment of theoretical

distribution to empirical data, Neyman-Pearson test, the Hi-squared test, the Kolmogorov test, the Student t test, the F and U tests.

1.5. Teaching methods	☒ lectures ☐ seminars and workshops ☒ exercises ☒ long distance education ☐ fieldwork	☒ individual assignment ☒ multimedia and network ☐ laboratories ☐ mentorship ☐ other
1.6. Comments		

1.7. Student's obligations

Students are obliged:

- to attend regularly and to participate actively in lectures and exercises;
- to do their homework independently;
- to pass two midterm exams and final oral exam.

1.8. Evaluation of student's work

Course attendance	0.3	Activity/Participation	0.3	Seminar paper		Experimental work	
Written exam	1.0	Oral exam	1.0	Essay		Research	
Project		Sustained knowledge check	0.4	Report		Practice	
Portfolio							

1.9. Assessment and evaluation of student's work during classes and on final exam

Student will be evaluated and assessed during the course and final exam. Maximum total percentage which student can achieve during the lessons is 70%, while the final exam (oral) provides 30% at the best.
Detailed elaboration of ways of monitoring and evaluation of students' work will be displayed in the Working Plan.

1.10. Assigned reading (at the time of the submission of study programme proposal)

Barlow R., *Statistics - A Guide to the Use of Statistical Methods in the Physical Sciences*, John Wiley, New York, 1989.
Taylor, J. R., *An Introduction to Error Analysis*, 2nd ed., University Science Books, Sausalito, 1997.

1.11. Optional / additional reading (at the time of proposing study programme)

Bevington P. R., Robinson K. D., *Data reduction and Error Analysis for Physical Scineces*, 3rd ed., Mcgraw-Hill, New York, 2003.
Chung K. L., Aitsahilia F., *Elementary Probability Theory*, 4th ed., Springer USA, New York, 2003.
Drosg M., *Dealing with Uncertainties - A Guide to Error Analysis*, 2ed.,Springer, Berlin, 2009.
Fornasini P., *The Uncertainty in Physical Measurements An Introduction to Data Analysis in the Physics Laboratory*, Springer, Berlin, 2008.
Kirkup L., Frenkel R. B., *An Introduction to Uncertainty in Measurement Using the Gum*, Cambridge University Press, Cambridge, 2006.
Lyons L., *A practical guide to data analysis for physical science students*, Cambridge University Press, Cambridge, 1991.
Meyer S. L., *Data Analysis for Scientists and Engineers*, John Wiley, New York, 1975.
Pauše Ž., *Uvod u matematičku statistiku*, Školska knjiga, Zagreb, 1993.
Pavlić I., *Statistička teorija i primjena*, Tehnička knjiga, Zagreb, 1988.
Rabinovich S. G., *Measurement Errors and Uncertainties - Theory and Practice*, 3rd ed., Springer, Berlin, 2005.
Ross S. M., *Introduction to Probability Models*, 10th ed., Academic Press, New York, 2009.
Spiegel M. R., *Schaum's Outline of Probability and Statistics*, 3rd ed., Mcgraw-Hill, New York, 2009.
Spiegel M. R., *Schaum's Outline of Statistics*, 4th ed., Mcgraw-Hill, New York, 2008.
Stanford J. L., *Statistical Methods for Physical Science*, Academic Press, San Diego, 1994.

WWW
http://www.upscale.utoronto.ca/PVB/Harrison/ErrorAnalysis/
http://documents.wolfram.com/applications/eda/
http://phys.columbia.edu/~tutorial/

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
Barlow R., *Statistics - A Guide to the Use of Statistical Methods in the Physical Sciences*, John Wiley, New York, 1989.	1	10
Taylor, J. R., *An Introduction to Error Analysis*, 2nd ed., University Science Books, Sausalito, 1997.	1	10

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

Regular monitoring of the student's activity and attitude towards work. In the last week of classes, anonymous surveys will be conducted in which students will evaluate the quality of teaching. At the end of each semester (1 March and 30 September of the current academic year) student' success in examinations will be analyzed.

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Basic description		
Course coordinator	Mile Pavlić	
Course title	DATA MODELING	
Study programme	Undergraduate Study Programme Physics	
Course status	Elective	
Year	3. year	
ECTS credits and teaching	***ECTS student 's workload coefficient***	5
	Number of hours (L+E+S)	30+30+0

1. COURSE DESCRIPTION

1.1. Course objectives

- Introducing students to documentation analysis and data model design procedures, for the purpose of organizing databases and preparation for application programming.
- Making student competent and independent in analyzing and interviewing users, producing data model and converting it into relational database scheme.
- Creating design-oriented way of thinking, featured with high level of critical attitude towards obtained models.

1.2. Course enrolment requirements

1.3. Expected course learning outcomes

After completing course Data modeling, students are expected to be capable of:
- Comprehensive "reading" of completed data models,
- Interviewing users independently, analyzing documentation and producing a data model
- Defining relational database scheme

1.4. Course content

System data modeling, methods for data modeling, activities in phases of data modeling development life cycle, analysis of data and documentation contents of a business system.
Conceptual modeling, abstractions, entity-relations method, entities, relations, attributes, restrictions in model, cardinality of relation types, cardinality of attributes, key candidate of entity type, translation of data model obtained using entities-relations into relational data model; Analysis of document data and respective modeling, Independent and team modeling. Data dictionary. Detailed design. Modeling exercises.
Methods: Entities and relations, Structural chart, Relational method, Extended relational method.

1.5. Teaching methods	☒ lectures ☐ seminars and workshops ☒ exercises ☐ long distance education ☒ fieldwork	☒ individual assignment ☐ multimedia and network ☐ laboratories ☐ mentorship ☒ other
1.6. Comments	During exercises, students both independently and in teams model various documents collected in the field (actual companies).	

1.7. Student's obligations

Students should actively participate in all forms of works, produce a seminar paper and pass the exam consisting of written and oral part.

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1.8. Evaluation of student's work

Course attendance	1.00	Activity/Participation	0.75	Seminar paper	1.00	Experimental work	
Written exam	1.00	Oral exam	1.00	Essay		Research	
Project		Sustained knowledge check	0.25	Report		Practice	
Portfolio							

1.9. Assessment and evaluation of student's work during classes and on final exam

Continuous cooperation with students and continuous monitoring of their engagements and advancement in mastering required knowledge provide continuous follow-up of students' works and activities.
Candidates must pass the Databases exam in order to register for the Data modeling exam.

1.10. Assigned reading (at the time of the submission of study programme proposal)

Kalpić, D., Fertalj, K., Projektiranje informacijskih sustava, FER, Zagreb,
http://www.zpm.fer.hr/courses/pis/ , 09.02.2004. (15.10.2004).
Pavlić, M., Razvoj informacijskih sustava - projektiranje, praktična iskustva, metodologija, Znak, Zagreb, 1996.

1.11. Optional / additional reading (at the time of proposing study programme)

Strahonja,V., Varga, M., Pavlić,M., Projektiranje informacijskih sustava, INA-INFO, Zagreb, 1992.
Radovan, M., Projektiranje informacijskih sustava, Informator, Zagreb, 1993.
Tkalec, S., Relacijski model podataka, Informator, Zagreb, 1988.
Vetter, M.: Strategy for Data Modelling, Application and Enterprise-wide, John Wiley and sons, Chichester, 1987.

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

During the last week of classes, a poll will be conducted, where students would evaluate the quality of classes. Students' achievements will be analyzed.

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Basic description		
Course coordinator	Sanja Smojver-Ažić	
Course title	DEVELOPMENTAL PSYCHOLOGY	
Study programme	Undergraduate Study Programme Physics	
Course status	Elective	
Year	2. year	
ECTS credits and teaching	***ECTS student 's workload coefficient***	5
	Number of hours (L+E+S)	30 + 15 + 0

1. COURSE DESCRIPTION

1.1. Course objectives

Introduce student with basic knowledge about student development necessary for understanding process of teaching and education. Apply this knowledge in understanding educational process and understanding age appropriate tasks. Understanding normative development and individual differences. Development of skills for evaluation of age appropriate educational procedures in teaching children and adolescents.

1.2. Course enrolment requirements

Without requirements.

1.3. Expected course learning outcomes

After finishing this course student should be able to:
1. describe main aspects of development in children and adolescent
2. differentiate normative and individual development
3. understand individual differences between children and adolescents
4. analyze role of family and school in child and adolescent development and interaction between them

1.4. Course content

Developmental theories. Physical growth and development: puberty. Cognitive development. Development of intelligence. Emotional development. Moral development. Development of self-concept. Gender differences. Family and relations with parents. School and teachers. Peers relations and development. Developmental tasks in adolescence. Stress in adolescence. Adolescent adjustment.

1.5. Teaching methods	☒ lectures ☐ seminars and workshops ☒ exercises ☐ long distance education ☐ fieldwork	☒ individual assignment ☒ multimedia and network ☐ laboratories ☐ mentorship ☐ other
1.6. Comments		

1.7. Student's obligations

They are expected regular attendance and active participation on class activities and write essay. Students are expected to apply for written examination during the semester. At the end of the semester students should pass written and oral exam.

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1.8. Evaluation of student's work

Course attendance	0.80	Activity/Participation	0.40	Seminar paper		Experimental work	
Written exam	1.00	Oral exam		Essay	0.80	Research	
Project		Sustained knowledge check	1.00	Report		Practice	
Portfolio		Written assignments	1.00				

1.9. Assessment and evaluation of student's work during classes and on final exam

Student work will be evaluated through semester and on final exam. During the semester students can get 70% and on final exam 30% of points. Detailed elaboration of monitoring and evaluation of students' work will be elaborated in the Syllabus.

1.10. Assigned reading (at the time of the submission of study programme proposal)

- Vasta, R., Haith, M.M., Miller, S.A. (1998). Dječja psihologija. Jastrebarsko, Slap.
- Lacković-Grgin, K. (2006). Psihologija adolescencije. Jastrebarsko, Slap. (str.53-70; 103-226)
- Vizek-Vidović, V., Rijavec, M. Vlahović-Štetić, V., Miljković, D. (2003). Psihologija obrazovanja. Zagreb: VERN (41-105)

1.11. Optional / additional reading (at the time of proposing study programme)

- Bastašić, Z. (1995). Pubertet i adolescencija. Zagreb: Školska knjiga.
- Buggle, F. (2002). Razvojna psihologija Jeana Piageta. Jastrebarsko: Slap.
- Buljan-Flander, G., Kocijan-Hercigonja, D. (2003). Zlostavljanje i zanemarivanje djece, Zagreb: Marko.M.,
- Juul, J. (1995). Vaše kompetentno dijete. Zagreb: Educa.
- Klarin, M. (2006). Razvoj djece u socijalnom kontekstu. Jastrebarsko: Slap
- Lacković-Grgin, K. (2000). Stres u djece i adolescenata. Jastrebarsko, Slap.
- Lacković-Grgin, K. (1993). Samopoimanje mladih, Jastrebarsko, Slap.
- Olweus (1998). Nasilje među djecom u školi. Zagreb: Školska knjiga.
- Raboteg-Šarić, Z. (1995). Psihologija altruizma. Zagreb: Alinea
- Salovey, P. (1999). Emocionalni razvoj i emocionalna inteligencija. Zagreb: Educa.
- Zarevski, P. (2000). Struktura i prirode inteligencije. Jastrebarsko, Slap

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
Vasta, R., Haith, M.M., Miller, S.A. (1998). Dječja psihologija. Jastrebarsko, Slap. (str. 24-62, 107-120,191-207, 253-399, 446-644)	13	80
Lacković-Grgin, K. (2006). Psihologija adolescencije. Jastrebarsko, Slap. (str.53-70; 103-226)	4	80
Vizek-Vidović, V., Rijavec, M. Vlahović-Štetić, V., Miljković, D. (2003). Psihologija obrazovanja. Zagreb: VERN (41-105)	22	80

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

Quality will be evaluated with questionnaire designed to evaluate course program, teaching methods and interaction with student at the end of the course. Also, it will be evaluated through discussion with student during the semester.

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Basic description		
Course coordinator	Anita Klapan	
Course title	DIDACTICS I	
Study programme	Undergraduate Study Programme Physics	
Course status	Elective	
Year	3. year	
ECTS credits and teaching	***ECTS student 's workload coefficient***	5
	Number of hours (L+E+S)	30 + 15 + 0

1. COURSE DESCRIPTION

1.1. Course objectives

The aim of the course is to introduce students to the didactics concept and subject; to introduce theoretical and methodological foundations of didactics and teaching the basic concepts; to familiarize students with the learning systems of education and teaching with a critical and creative attitude towards the didactic theory and practice; to become familiar with the process of planning and programming classes (curricular approach) and to be able to create the curriculum, to meet with the theory of curriculum; to get acquainted with the elements of teaching situations and other educational situations; to become familiar with the process of communication in teaching; to learn about the elements that affect the educational atmosphere; to be able to transfer and interference in the knowledge of didactics in different situations of teaching and educational process; to motivate the research in didactics and teaching call.

1.2. Course enrolment requirements

Program of course is coupled to and correspond with the relevant body of knowledge in philosophy (especially gnoseology and logic), psychology (educational psychology), pedagogy, school pedagogy, teaching methods and some other disciplines are included in the area of educational sciences. Program of course corresponds with compulsory and elective courses teaching modules.

1.3. Expected course learning outcomes

Students will be able:

- to identify didactics as a pedagogical discipline and its relationship to other disciplines
- to identify and explain the relationship between didactics and methodology
- to define and explain the basic concepts of teaching
- to identify and analyze cause-effect relationships between different phenomena of didactic
- to explain and compare different teaching theories, trends, models and systems
- to differentiate types of teachers and explain their impact on the teaching process
- to enumerate and analyze the perspectives of teaching
- to enumerate and describe the elements of the teaching process
- to describe the phases, approaches and aspects of planning and programming process
- to define the concept of curriculum, and state and explain the types of curriculum
- to explain and analyze the curricular approach in the planning and programming
- to specify and analyze the components of the National Curriculum Framework
- to explain and analyze the concept of educational standards and analyze their impact on the teaching process
- to properly define the goals and learning outcomes
- to explain and compare the various theories of choice of teaching content
- to explain the learning principles in teaching and learning
- to create and analyze the performance program for one subject
- to describe models of communication

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- to identify problems in the communication process
- to define and analyze the concept of educational ecology
- to identify and describe factors that influence on the creation of the educational atmosphere

1.4. Course content

- methodological and epistemological foundations of didactics
- basic learning concepts and learning systems
- teaching theories, trends, models and systems
- types of teachers and teaching perspectives
- planning and programming of teaching
- National Curriculum Framework
- educational standards
- learning principles in teaching
- communication processes in teaching
- educational ecology

1.5. Teaching methods	☒ lectures ☒ seminars and workshops ☒ exercises ☐ long distance education ☐ fieldwork	☒ individual assignment ☐ multimedia and network ☐ laboratories ☐ mentorship ☐ other
1.6. Comments		

1.7. Student's obligations

Requirements:
- regular attendance and active participation of students in all modes of teaching and learning
- make a presentation and review of the National Curriculum Framework
- create and analyze the performance program (curricula) for one subject
- knoweledge test
- read and study the compulsory literature and materials from lectures and exercises
- passing the written and oral exams

1.8. Evaluation of student's work

Course attendance	0.50	Activity/Participation	0.50	Seminar paper		Experimental work	
Written exam	1.00	Oral exam	1.00	Essay		Research	
Project		Sustained knowledge check	1.00	Report	0.50	Practice	0.50
Portfolio							

1.9. Assessment and evaluation of student's work during classes and on final exam

I. Final exam
The student in the subject will be evaluated and assessed during the course and final exam. The total number of credits a student can achieve during the course was 70 (assessed activities highlighted in the table), while the final exam can achieve 30 points.
II. No exam
The student in the subject will be evaluated and assessed during the course. The total number of credits a student can get is 100 (evaluating the activities highlighted in the table).

1.10. Assigned reading (at the time of the submission of study programme proposal)

- Bognar, L., Matijević, M. (2002), Didaktika. Zagreb: Školska knjiga. (selected topics)
- Lavrnja, I. (1998), Poglavlja iz didaktike. Rijeka: Pedagoški fakultet. (selected topics)
- Previšić, V. (ur.) (2007), Kurikulum: Teorije – Metodologija – Sadržaj – Struktura. Zagreb: Zavod za pedagogiju Filozofskog fakulteta Sveučilišta u Zagrebu, Školska knjiga. (selected topics)

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1.11. Optional / additional reading (at the time of proposing study programme)

- Bezić, K., Strugar, V. (1998), Učitelj za treće tisućljeće. Zagreb: HPKZ.
- Bežen, A., Jelavić, F., Kujundžić, N., Pletenac, V. (1991), Osnove didaktike. Zagreb: Školske novine.
- Jelavić, F. (1994), Didaktičke osnove nastave. Jastrebarsko: Slap.
- Jensen, E. (2003), Super-nastava. Zagreb: Educa.
- Kramar, M. (1993), Načrtovanje in priprava izobraževalno-vzgojnega dela v šoli. Novo mesto, Nova Gorica: Educa.
- Kyriacou, C. (1995), Temeljna nastavna umijeća. Zagreb: Educa.
- Marentič-Požarnik, B., Strmčnik, F., Cencič, M., Blažič, M. (1991), Izbrana poglavlja iz didaktike. Novo mesto: Pedagoška obzorja.
- Marsh, J.C. (1994), Kurikulum: temeljni pojmovi. Zagreb: Educa.
- Meyer, H. (2002), Didaktika razredne kvake.Rasprave o didaktici, metodici i razvoju škole. Zagreb: Educa.
- Pastuović, N. (1999), Edukologija. Zagreb: Znamen.
- Terhart, E. (2001), Metode poučavanja i učenja. Zagreb: Educa.

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

The structure, scope and nature of defining the obligations of students allow the implementation of requirements for continuous monitoring of students in all aspects of its progress in the context of this case. Instrument monitoring and a basis for student assessment is monitoring protocol that will be for courses designed for each student.
The work of teachers will be evaluated by students, in the middle of the semester and at the end of the semester. For the purposes of the above evaluation the teacher is required to develop appropriate evaluation forms or use already existing, and to analyze the collected evaluation forms.
Students will be able to their suggestions and comments affect change or adjustment of the teaching process to their needs. Evaluation at the end of the semester is planned to assess the fulfillment of educational goals and aims, appropriate use of the proposed forms and methods of teaching during the semester.

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Basic description		
Course coordinator	Neven Grbac	
Course title	DIFFERENTIAL EQUATIONS	
Study programme	Undergraduate Study Programme Physics	
Course status	Compulsory	
Year	3. year	
ECTS credits and teaching	***ECTS student 's workload coefficient***	5
	Number of hours (L+E+S)	30 + 30 + 0

1. COURSE DESCRIPTION

1.1. Course objectives

This course aims to give students the basic knowledge about:
- existence and uniqueness of a solution of ordinary differential equations,
- ordinary differential equations of the first order,
- ordinary differential equations of higher orders,
- systems of differential equations,
- applications in the physical sciences.

1.2. Course enrolment requirements

Course program is correspondent to the program of similar courses in the other mathematics studies. There exists a correlation with the other mathematics course, particularly with Differential Geometry. The mathematical tools that we use for this course include elements of Analysis I, Analysis II and Analysis III.

1.3. Expected course learning outcomes

To have the knowledge to use Differential Equations in the physical and other sciences.

1.4. Course content

Basic concepts and definitions. Solution of a differential equation of the first order: Existence and uniqueness of the solution. Equations with variables separable. Homogeneous equations. Linear equations. Total differential equations. The integrating factor. Problems in trajectories. Equations of higher orders: Equations solvable by a highest derivative. Linear differential equations of the n-th order. The Lagrange method. Homogeneous and nonhomogeneous linear equations with constant coefficients.Systems of differential equations: Normal systems. Existence and uniqueness of the solution. Equations in the mathematical physics.

1.5. Teaching methods	☒ lectures ☒ seminars and workshops ☒ exercises ☐ long distance education ☐ fieldwork	☒ individual assignment ☐ multimedia and network ☐ laboratories ☐ mentorship ☐ other
1.6. Comments	Students are encouraged to active participate at a class and it influences to a final assessment.	

1.7. Student's obligations

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Attendance at all classes and active participation is expected. Student gets a grade after written and oral exam.

1.8. Evaluation of student's work

Course attendance	0.5	Activity/Participation	0.5	Seminar paper		Experimental work	
Written exam	2.1	Oral exam	1.3	Essay		Research	
Project		Sustained knowledge check	0.6	Report		Practice	
Portfolio							

1.9. Assessment and evaluation of student's work during classes and on final exam

Student will be evaluated and assessed during the course and final exam. Maximum total percentage which student can achieve during the lessons is 70%, while the final exam provides 30% at the best.
Detailed elaboration of ways of monitoring and evaluation of students' work will be displayed in the Working Plan.

1.10. Assigned reading (at the time of the submission of study programme proposal)

F. R. Giordino, M.D. Weir. Differential equations: a modeling approach, Addison-Wesley Publshing Company, Inc, 1991.
A. C. King, I. Billingham, S.R. Otto: Differential equations: linear, nonlinear, ordinarry, partial, Cambridge University Press, 2003.

1.11. Optional / additional reading (at the time of proposing study programme)

S. Pontrjagin: obyknovennye differencialnye uravnenina, Nauka, Moskva, 1970.
G. Birkhoff, G.C. Rota: Ordinary differential equations, Blaisdell, Waitham, Mass, 1969.
C. R. Wylie: Differential equations, Mc Graw Hill, New York , 1979.
I. Aganović, K. Veselić: Linearne diferencijalne jednadžbe, Element, Zagreb, 1997.

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
F. R. Giordino, M.D. Weir. differntial equations: a modeling approach, Addison-Wesley Publshing Company, Inc, 1991.	5	10
A. C. King, I. Billingham, S.R. Otto: Differential equations: linear, nonlinear, ordinarry, partial, Cambridge University Press, 2003.	5	10

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

- questionnaire at the end of the course after aimed to assess students' understanding,
- questionnaire designed to evaluate course program, lectures and lecture materials, teaching methods and interaction with students.

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Basic description		
Course coordinator	Dean Crnković	
Course title	DISCRETE MATHEMATICS	
Study programme	Undergraduate Study Programme Physics	
Course status	Elective	
Year	2. year	
ECTS credits and teaching	***ECTS student 's workload coefficient***	5
	Number of hours (L+E+S)	30 + 30 + 0

1. COURSE DESCRIPTION

1.1. Course objectives

Introduction to:
- basic definitions from graph theory
- planar, Eulerian, and Hamiltonian graphs
- Kruskal's and Dijkstra's algorithms
- colouring vertices and edges
- combinatorial structures

1.2. Course enrolment requirements

The program is correspondent to the program of other mathematical courses, especially to Combinatorics and Set Theory.

1.3. Expected course learning outcomes

After completing this course students will be able to understand and apply basic theorems of graph theory. They will be acquainted with some combinatorial structures.

1.4. Course content

Introduction. Basic definitions and properties of graphs. Incidence and adjacency matrices. Vertex degree. Walks, paths and cycles. Trees. Eulerian and Hamiltonian graphs. Connectivity. Colouring. Chromatic polynomial. Planar graphs. Euler's formula. Plato's solids. Matching. Digraphs. Block designs, finite geometries, matroids. Coding theory. Algorithms. Finite automata. NP-completeness.

1.5. Teaching methods	☒ lectures ☐ seminars and workshops ☒ exercises ☒ long distance education ☐ fieldwork	☒ individual assignment ☒ multimedia and network ☐ laboratories ☐ mentorship ☐ other
1.6. Comments	Student's activities are evaluated during the semester. Final exams are written and oral.	

1.7. Student's obligations

Students must attend the lectures and participate in all activities required for the course. Exam: written and oral.

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1.8. Evaluation of student's work

Course attendance	0.55	Activity/Participation	0.55	Seminar paper		Experimental work	
Written exam	2.0	Oral exam	1.3	Essay		Research	
Project		Sustained knowledge check	0.6	Report		Practice	
Portfolio							

1.9. Assessment and evaluation of student's work during classes and on final exam

Student will be evaluated and assessed during the course and final exam. Maximum total percentage which student can achieve during the lessons is 70%, while the final exam provides 30% at the best.
Detailed elaboration of ways of monitoring and evaluation of students' work will be displayed in the Working Plan.

1.10. Assigned reading (at the time of the submission of study programme proposal)

1. D.Veljan: Kombinatorika i diskretna matematika, Algoritam, Zagreb, 2001.
2. D.Veljan: Kombinatorika s teorijom grafova, Školska knjiga, Zagreb, 1989.

1.11. Optional / additional reading (at the time of proposing study programme)

1. N.Biggs: Discrete Mathematics, Clarendon Press, Oxford, 1989.
2. R.Diestel: Graph Theory, Second edition, Springer-Verlag, New York, 2000.
3. R.Balakrishnan, K.Ranganathan: A Textbook of Graph Theory, Springer-Verlag, Heidelberg, 2000.
4. R.Balakrishnan: Schaum's outline of Graph Theory: Included Hundreds of Solved Problems, McGraw-Hill, New York, 1997.
5. C.L. Liu: Elements of Discrete Mathematics, McGraw-Hill, New York, 1987.
6. L.Lovasz: Combinatorial Problems and Exercises, North-Holland, Amsterdam, 1979.
7. F.Robert: Applied Combinatorics, Prentice Hall, Englewood Cliffs, 1984.

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
D.Veljan: Kombinatorika i diskretna matematika, Algoritam, Zagreb, 2001.	5	10
D.Veljan: Kombinatorika s teorijom grafova, Školska knjiga, Zagreb, 1989. Zagreb, 1981.	5	10

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

After the last lecture of the course students will be asked to fulfill a questionnaire about the quality of the lectures. At the end of each semester results of the exams will be analyzed.

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Basic description		
Course coordinator	Barbara Rončević Zubković	
Course title	EDUCATIONAL PSYCHOLOGY I	
Study programme	Undergraduate Study Programme Physics	
Course status	Elective	
Year	2. year	
ECTS credits and teaching	***ECTS student 's workload coefficient***	5
	Number of hours (L+E+S)	30 + 15 + 0

1. COURSE DESCRIPTION

1.1. Course objectives

The objective of this course is to get the students acquainted with different theories of learning and their implications for teaching. The aim is also that students understand information processing during complex cognitive skills and apply effective cognitive and metacognitive learning strategies.

1.2. Course enrolment requirements

1.3. Expected course learning outcomes

Students will be able to:
- describe and understand the principles of classical and operant conditioning in classroom settings
- describe and explain social-cognitive theory of learning
- describe and explain information processing theory of learning and constructivistic theory of learning
- plan lecture according to constructivistic learning design
- apply learning strategies
- describe and explain implications of different learning theories to teaching
- describe factors that affect knowledge evaluation
- differentiate between norm-referenced and criterion-referenced testing

1.4. Course content

1.5. Teaching methods	☒ lectures ☐ seminars and workshops ☒ exercises ☐ long distance education ☐ fieldwork	☒ individual assignment ☒ multimedia and network ☐ laboratories ☐ mentorship ☐ other
1.6. Comments		

1.7. Student's obligations

Students are required to attend classes regularly and actively participate. They are required to complete written assignments based on classroom practices, and pass two written preliminary exams during semester and final exam.

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1.8. Evaluation of student's work

Course attendance	1.00	Activity/Participation	1.20	Seminar paper		Experimental work	
Written exam	0.50	Oral exam	0.50	Essay		Research	
Project		Sustained knowledge check	1.80	Report		Practice	
Portfolio							

1.9. Assessment and evaluation of student's work during classes and on final exam

Students are required to complete written assignments based on classroom practices, and pass two written preliminary exams during semester and final exam.

1.10. Assigned reading (at the time of the submission of study programme proposal)

Kolić-Vehovec, S. (1999). *Edukacijska psihologija*. Filozofski fakultet, Rijeka.
Vizek-Vidović, V., Vlahović-Štetić, V., Rijavec, M., Miljković, D. (2003). *Psihologija obrazovanja*. Zagreb: IEP.

1.11. Optional / additional reading (at the time of proposing study programme)

Anderson, J.R. (1995). *Learning and memory: an integrated approach*. New York: John Wiley and Sons, Inc.
Bigge, M.L., Shermis, S.S. (1999). *Learning theories for teachers*. New York: Addison Wesley Longman, Inc
Desforges, C. (2001). *Uspješno učenje i poučavanje : psihologijski pristupi*. Zagreb: Educa.
Howe, M.J.A. (2002). *Psihologija učenja: priručnik za nastavnike*. Jastrebarsko: Naklada Slap.
Mackintosh, N.J., Colman, A.M. (1995). *Learning and skills*. London: Longman.
Slavin, R.E. (1997). *Educational psychology: theory and practice*. Boston: Allyn and Bacon.
Zarevski, P. (1994). *Psihologija pamćenja i učenja*. Jastrebarsko: Slap.

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
Kolić-Vehovec, S. (1999). *Edukacijska psihologija*. Rijeka: Filozofski fakultet.	13	
Vizek-Vidović, V., Vlahović-Štetić, V., Rijavec, M., Miljković, D. (2003). *Psihologija obrazovanja*. Zagreb: IEP.	22	

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

Course quality will be assessed based on students' achievement on written assignments, exams, and on students' evaluation of the course.

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Basic description		
Course coordinator	Barbara Rončević Zubković	
Course title	EDUCATIONAL PSYCHOLOGY II	
Study programme	Undergraduate Study Programme Physics	
Course status	Elective	
Year	2. year	
ECTS credits and teaching	***ECTS student 's workload coefficient***	4
	Number of hours (L+E+S)	30 + 15 + 0

1. COURSE DESCRIPTION

1.1. Course objectives

The aim of this course is that students become acquainted with different students' characteristics (abilities, motivation, personality traits) that contribute to individual differences in academic achievement among students. The students will also be acquainted with the effects of classroom social climate on academic performance, as well as with different approaches to classroom management.

1.2. Course enrolment requirements

1.3. Expected course learning outcomes

Students will be able to:
- Explain the construct of intelligence and its relation with academic achievement
- To design classroom lesson according to multiple intelligence theory
- Understand the relationship between self-concept and academic achievement
- Describe and understand motivational factors of learning outcomes
- Differentiate categories of social status in classroom and plan methods for social status improvement
- Understand components of student-teacher relationship
- Apply social skills in order to establish positive social interactions in classroom and change undesirable students' behaviors
- Understand different approaches to discipline management

1.4. Course content

1.5. Teaching methods	☒ lectures ☐ seminars and workshops ☒ exercises ☐ long distance education ☐ fieldwork	☒ individual assignment ☒ multimedia and network ☐ laboratories ☐ mentorship ☐ other
1.6. Comments		

1.7. Student's obligations

Students are required to attend classes regularly and actively participate. They are required to complete written assignments based on classroom practices, and pass two written preliminary exams during semester and final exam.

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1.8. Evaluation of student's work

Course attendance	0.80	Activity/Participation	1.00	Seminar paper		Experimental work	
Written exam	0.60	Oral exam		Essay	0.20	Research	
Project		Sustained knowledge check	1.40	Report		Practice	
Portfolio							

1.9. Assessment and evaluation of student's work during classes and on final exam

Students are required to complete written assignments based on classroom practices, and pass two written preliminary exams during semester and final exam.

1.10. Assigned reading (at the time of the submission of study programme proposal)

Kolić-Vehovec, S. (1999). *Edukacijska psihologija*. Filozofski fakultet, Rijeka.
Vizek-Vidović, V., Vlahović-Štetić, V., Rijavec, M., Miljković, D. (2003). *Psihologija obrazovanja*. Zagreb: IEP.

1.11. Optional / additional reading (at the time of proposing study programme)

Kroflin, L., Nola, D. (Ed.). (1987). *Dijete i kreativnost*. Zagreb: Globus.
Janković, J. (1996). *Zločesti đaci genijalci*. Zagreb: Alinea.
Neill, S. (1994). *Neverbalna komunikacija u razredu*. Zagreb: Educa.
Pintrich, P.R., Schunk, D.H. (1996). *Motivation in education: Theory, research and application*. Englewood Clifs, HJ: Prentice Hall.
Rathvon, N. (2003). *Effective School Interventions: Strategies for Enhancing Academic Achievement and Social Competence.* New York: The Guilford Press.
Salovey, P., Sluyter, D.J. (1999). *Emocionalni razvoj i emocionalna inteligencija. Pedagoške implikacije*. Zagreb: Educa.
Winkel, R. (1996). *Djeca koju je teško odgajati*. Zagreb: Educa.
Slavin, R.E. (1997). *Educational psychology: theory and practice*. Boston: Allyn and Bacon.

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
Kolić-Vehovec, S. (1999). *Edukacijska psihologija*. Rijeka: Filozofski fakultet.	13	
Vizek-Vidović, V., Vlahović-Štetić, V., Rijavec, M., Miljković, D. (2003). *Psihologija obrazovanja*. Zagreb: IEP.	22	

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

Course quality will be assessed based on students' achievement on written assignments, exams, and on students' evaluation of the course.

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Basic description		
Course coordinator	Predrag Dominis Prester	
Course title	ELECTRODYNAMICS	
Study programme	Undergraduate Study Programme Physics	
Course status	Compulsory	
Year	3. year	
ECTS credits and teaching	***ECTS student 's workload coefficient***	11
	Number of hours (L+E+S)	45 + 45 + 15

1. COURSE DESCRIPTION

1.1. Course objectives

- Giving the basic knowledge of classical electrodynamics and special theory of relativity
- Connecting the exact theoretical results with the relevant objects from electricity and magnetism that students have learned in earlier courses (Physics I-III)

1.2. Course enrolment requirements

Physics I-III, Mathematical methods in physics I.

1.3. Expected course learning outcomes

- Understanding the idea how simple and basic equations for the electromagnetic field, with the help of mathematical methods, can explain complex physical phenomena.
- Understanding the significance of the exact definition of physical quantities for their correct interpretation.

1.4. Course content

1. Electrostatics
Coulomb law. Electric field. Scalar potential. Equations of electrostatics. Energy. Multipole expansion. Electrostatics in media. Dielectrics. Boundary conditions.
2. Magnetostatics
Electric current. Continuity equation. Magnetic field and force. Vector potential. Equations of magnetostatics. Magnetostatics in media. Diamagnetism. Paramagnetism. Ferromagnetism.
3. Maxwell equations
Faraday law of induction. Energy of magnetic field. Maxwell equations. 4-potential. Gauge transformations. Poynting theorem. Conservation laws. Electrodynamics in the media.
4. Radiation
Retarded and advanced potentials. Dipole approximation. Radiation reaction force.
5. Special relativity
Kinematics and dynamics. 4-vectors and tensors. Lorenz transformations of fields, charge density and currents. Covariant formulation of electrodynamics.

1.5. Teaching methods	☒ Lectures ☒ seminars and workshops ☒ exercises ☐ long distance education ☐ fieldwork	☒ individual assignment ☐ multimedia and network ☐ laboratories ☐ mentorship ☐ other
1.6. Comments		

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1.7. Student's obligations

Active participation, doing home assignments and tests, preparing one seminar with presentation, passing the final exam.

1.8. Evaluation of student's work

Course attendance		Activity/Participation	0.5	Seminar paper	1.5	Experimental work	
Written exam		Oral exam	3	Essay		Research	
Project		Sustained knowledge check	6	Report		Practice	
Portfolio							

1.9. Assessment and evaluation of student's work during classes and on final exam

Students will be evaluated and valued continuously during the course through home assignments and periodic tests. They have to write one seminar, which should be presented in front of the class. Eventually, there will be final exam, depending on the success during the course. Activities during the course bring at least 70% of the total mark.

1.10. Assigned reading (at the time of the submission of study programme proposal)

1. Griffiths D. J., *Introduction to Electrodynamics*, 3. izdanje, Prentice-Hall, New Jersey, 1999.

1.11. Optional / additional reading (at the time of proposing study programme)

1. Jackson J. D., *Classical Electrodynamics*, 3. izdanje, John Wiley, New York, 1999.
2. Nayfeh M. H., Brussel M. K., *Electricity and Magnetism,* John Wiley and Sons, 1985.
3. Wegner F., http://www.tphys.uni-heidelberg.de/~wegner/e.dyn/

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
Griffiths D. J., *Introduction to Electrodynamics*	3	10

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

Consultations, standard anonymous student questionnaires, discussions after the final exam.

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Basic description		
Course coordinator	Predrag Dominis Prester	
Course title	ELEMENTARY PARTICLE PHYSICS	
Study programme	Undergraduate Study Programme Physics	
Course status	Elective	
Year	3. year	
ECTS credits and teaching	***ECTS student 's workload coefficient***	7
	Number of hours (L+E+S)	45 + 0 + 15

1. COURSE DESCRIPTION

1.1. Course objectives

Unified view of our current understanding of fundamental forces in nature. Basic understanding of the structure of micro-world and its importance for the structure of the Universe. Introduction to the main ideas and theoretical frameworks used in our description of elementary particles and fundamental interactions.

1.2. Course enrolment requirements

Physics I – III, *Classical Mechanics I*. Cannot be taken before courses *Electrodynamics* and *Quantum mechanics*.

1.3. Expected course learning outcomes

General understanding of connection between phenomena in the nature and the underlying fundamental forces and elementary particles, and mathematical formalism used in this description. Knowledge of the basic facts about microscopic world and its importance for the understanding of the history, presence, and future of the Universe. Ability to understand and solve elementary problems in the framework of the Standard Model of elementary particles physics.

1.4. Course content

1. Fundamental forces in Nature – domains and ranges, coupling constants.
2. Quantum field theory – particles as excitations of quantized fields, antiparticles, importance of symmetries
3. Processes with particles – decays, scattering, cross-sections, bound states, introduction to Feynman diagrams
4. Quantum electrodynamics – gauge symmetry, Compton scattering, positronium
5. Strong force – quark picture, quantum cromodynamics for pedestrians, quark confinement, asymptotic freedom
6. Weak force - β-decay, electroweak unification, spontaneous breaking of symmetry, Higgs boson, Standard model
7. Gravitation – force by curving space-time, differences with strong and electroweak description
8. Exciting future – important experiments, unification of forces?

1.5. Teaching methods	☒ lectures ☒ seminars and workshops ☒ exercises ☐ long distance education ☐ fieldwork	☒ individual assignment ☐ multimedia and network ☐ laboratories ☐ mentorship ☐ other
1.6. Comments		

1.7. Student's obligations

Active participation, home and class assignments, preparing one seminar with presentation, passing final exam.

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1.8. Evaluation of student's work

Course attendance		Activity/Participation	0.5	Seminar paper	2.5	Experimental work	
Written exam		Oral exam	2	Essay		Research	
Project		Sustained knowledge check	2	Report		Practice	
Portfolio							

1.9. Assessment and evaluation of student's work during classes and on final exam

Students will be evaluated and valued continuously during the course through home assignments and periodic tests. They have to write at least one seminar, which should be publicly presented. Eventually, there will be final exam, depending on the success during the course. Activities during the course bring at least 70% of the total mark.

1.10. Assigned reading (at the time of the submission of study programme proposal)

1. Picek I., *Fizika elementarnih čestica*, Kratis, 1997.
2. Cottingham W. N., Greenwood D. A., *An Introduction to The Standard Model of Particle Physics,* 2. izdanje, Cambridge University Press, 2007.

1.11. Optional / additional reading (at the time of proposing study programme)

1. Griffiths D., *Introduction to elementary particles,* 2. izdanje, Wiley–VHC, 2008.
2. http://particleadventure.org/

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
Picek I, *Fizika elementarnih čestica*	3	7
Cottingham W. N., Greenwood D. A., *An Introduction to The Standard Model of Particle Physics*	1	7

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

Consultations, standard anonymous student questionnaires, discussions after the final exam.

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Basic description		
Course coordinator	Olga Vučetić	
Course title	ENGLISH FOR SPECIFIC PURPOSES	
Study programme	Undergraduate Study Programme Physics	
Course status	Elective	
Year	1. year	
ECTS credits and teaching	***ECTS student 's workload coefficient***	3
	Number of hours (L+E+S)	15+15+0

1. COURSE DESCRIPTION

1.1. Course objectives

This upper-intermediate course covers a wide range of topics concerning the science of physics. Its aims are:

- to introduce the vocabulary of physics,
- to practice the knowledge of the words in larger context;
- to introduce gramatical structures used in scientific texts;
- to develop comprehension and reading skills using a wide variety of authentic texts related to physics;
- to develop the ability of communication concerning various topics;
- to provide practice in writing instructions, descriptions and explanations about topics in physics;
- to develop the skill of writing various coherent texts: essays, letters, CV;

1.2. Course enrolment requirements

Knowledge of English at intermediate level.

1.3. Expected course learning outcomes

Students are expected to:

- know most vocabulary relating to physics;
- be able to read and understand authentic texts from newspapers, popular science magazines, Internet;
- be able to give instructions and explanations concerning the field of physics;
- engage in communication activities relating to everyday and specialized topics;
- write various texts: descriptions, summaries, essays.

1.4. Course content

Topics in Physics - Physics and physicists; Matter; Atoms, elements and compounds; States and properties; Changing states; Electricity and magnetism; Metals and plastics; Mass; Energy; Forces and motion; Energy and machines; Nuclear Fission; Nuclear fussion; Light and sight; Sound and hearing; Space-time; Energy sources and pollution; Earth movements; Solar system
Grammar - Tenses: present, past, future; Modal verbs; Passive; Infinitive and –ing-forms; Relative clauses; Conditional clauses; Nouns and articles; Adjectives and adverbs; Prepositions; Linking words
Writing - Explanation; Instruction; Description;Summary; Essay; Letters;Curriculum Vitae
Additional materials (for reading and listening) - BBC World service; CNN; Science Daily

1.5. Teaching methods		
	☒ lectures	☒ individual assignment
	☐ seminars and workshops	☒ multimedia and network
	☒ exercises	☐ laboratories
	☐ long distance education	☐ mentorship
	☐ fieldwork	☐ other

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1.6. Comments	The number of students should be limited to 20 per group. The classes should be held in a computer-equipped classroom.

1.7. Student's obligations

Students should attend all classes. Students are expected to participate in class activities and to carry out all required tasks. Students should hand in papers by the due date.

1.8. Evaluation of student's work

Course attendance	1.00	Activity/Participation	0.20	Seminar paper	0.20	Experimental work	
Written exam	0.60	Oral exam		Essay	0.20	Research	
Project		Sustained knowledge check	0.80	Report		Practice	
Portfolio							

1.9. Assessment and evaluation of student's work during classes and on final exam

1.10. Assigned reading (at the time of the submission of study programme proposal)

Kelly, K., *Science, Macmillan Vocabulary Practice Series*, Macmillan Publishers Ltd., 2008., Oxford
Mascull, B., *Key Words in Science and Technology*, HarperCollins Publishers, 1997., London
Murphy, R., *English Grammar in Use*, Cambridge University Press, 1995.
Oxford Advanced Learner's Dictionary, Oxford University Press, 2005.
Filipović, R., Englesko-hrvatski rječnik, Školska knjiga, Zagreb, 1999
http://www.teachnet.ie/torourke/Physicswebsite/homepage.htm
http://www.bbc.co.uk/news/
www.englishpage.com
http://essayinfo.com/essays/
http://scienceinschool.org/
http://www.sciencedaily.com/http://dictionary.cambridge.org/
http://www.macmillandictionary.com/
http://www.babylon.com/define/85/science-dictionary.html
http://www.eudict.com/index.php
http://www.encyclopedia.com/

1.11. Optional / additional reading (at the time of proposing study programme)

Bolitho, A.R., Sandler, P.L., *Study English for Science*, Longman, Essex, 1997
Eastwood, J., *Oxford Practice Grammar*, Oxford University Press, Oxford, 2003
Bujas, Ž., *Veliki hrvatsko-engleski rječnik*, Nakladni zavod Globus, Zagreb, 2001.
http://www.merriam-webster.com/
http://en.wikipedia.org/wiki/Physics
www.englishclub.com
http://teachersnetwork.org/lessonplans/LessonPlanResults.cfm
http://www.michellehenry.fr/science.htm

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
Kelly, K., *Science, Macmillan Vocabulary Practice Series*, Macmillan Publishers Ltd., 2008., Oxford	1	
Mascull, B., *Key Words in Science and Technology*, HarperCollins Publishers, 1997., London	1	
Murphy, R., *English Grammar in Use*, Cambridge University Press, 1995.	1	
Filipović, R., Englesko-hrvatski rječnik, Školska knjiga, Zagreb, 1999	4	

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

Students' work and development will be monitored by means of: Group and individual discussions after each lesson (when necessary); uestionnaires after each unit and at the end of the course.

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Basic description		
Course coordinator	Snježana Prijić-Samaržija	
Course title	EPISTEMOLOGY	
Study programme	Undergraduate Study Programme Physics	
Course status	Compulsory	
Year	3. year	
ECTS credits and teaching	***ECTS student 's workload coefficient***	5
	Number of hours (L+E+S)	30 + 0 + 30

1. COURSE DESCRIPTION

1.1. Course objectives

- To introduce in the fundamental epistemological issues
- To develop the capacity to analyze and interpret philosophical papers
- To develop critical thinking through analysis of epistemological problems in ex cathedra lectures, seminars, debates and work in discussion groups
- To develop independent and creative application of acquired knowledge, and to develop the capacity of further research about the problems through individual tutorial work with interested students

1.2. Course enrolment requirements

This course, as one of the most fundamental philosophical discipline, correlates with majority of courses which examine history of philosophy (especially with Modern Philosophy from Descartes to Kant and Contemporary philosophy), but also with other courses which are concerned with the problems of cognition and mental phenomena such as Philosophy of mind, Perception, Emotions, Cognitive science and computer metaphor, A priori cognition, Cognition and logic and Philosophy of language).

1.3. Expected course learning outcomes

- to develop the skills of analytical and critical thinking about the epistemological issues
- to obtain an appropriate level of knowledge in the domains of epistemology
- the acquiring of methodologies of scientific and philosophical reasoning
- to develop the skills of work on original scientific and philosophical literature
- to develop the capacity of confronting opposite approach and to defiance of their own
- to develop the awareness of the importance of argumentative discussion

1.4. Course content

1. ***Introduction to the terminology and traditional problems***: knowledge, truth, justification, belief, sources of knowledge, cognitive faculties, the scope of knowledge; epistemic responsibility, etc.
2. ***Introduction to traditional epistemological positions and most prominent representatives***: empiricism (F. Bacon, J. Locke, G. Berkeley, D. Hume and T. Reid), rationalism (R. Descartes and G.W. Leibniz, I. Kant), irrationalism (A... Augustin, A. Schopenhauer), nativism (from Plato to J.Fodor and N.Chomsky), etc.
3. ***Skepticism:*** ancient and modern skepticism (Piron, Agripa, R. Descartes, D. Hume, B. Stroud, P. Unger), variety of skepticism; closure principle (G.E. Moore); skepticism and naturalism (D. Hume, L. Wittgenstein, P. Strawson); Theories of relevant alternatives (J.L. Austin, R. Nozick, A. Goldman), contextualism (K. DeRose, S. Cohen), relativism (M. Williams, S. Stich), semantical approaches to skepticism (H. Putnam, D. Davidson).

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4. ***Descriptive and normative epistemology***: theories of justification and theories of truth; coherentism (W.O.Quine, K. Lehrer, L. BonJour etc..), fundationalism (A. J. Ayer, W. Alston, C.I. Lewis etc.), reliabilism (F. Dretske, D.M.Armstrong, A.I.Goldman etc.) theories of truth: correspondence, coherence, deflational theory, pragmatic theory, verificationist's theory, etc.), internalism and externalism, (D. Armstrong. A.I.Goldman, R. Chisholm, K. Lehrer, H. Kornblith).
5. ***Naturalism and normativism in epistemology***; naturalizing epistemology project (W.O.Quine, F.Dretske, Ph. Kitcher, A.Goldman etc.); epistemology and empirical science; normativism and deontological approach (J. Kim, L. Bonjour, R. Chisholm etc.); virtue epistemology (E. Sosa, L. Zagzebski)
6. ***Realism and anti-realism in epistemology***: ontological and epistemological realism and anti-realism; objective and true description of external world, subjectivism, projectivism (J. Locke, G. Berkeley, I. Kant, H. Reichenbach, H. Putnam, S. Blackburn, M. Devitt, C.Wright, R. Fumerton etc.)
7. ***Faculties of knowledge and cognitive capacities:*** perception, reason/inference, memory, intuitions, consciousness, testimony; ecological approach to visual perception (J.J.Gibson), constructivists' theory (R.L.Gregory, modular theory of J. Fodor), dual-aspect theory (J. Norman), causal theory of perception (H.P. Grice), direct and indirect realism; theories about a priori (S.A. Kripke, Ph. Kitcher etc.); theories about memory (M. Dummet, T. Burge); theories about introspection (T. Burge, P. Boghossian); theories of rationality (D.Davidson, R.Chisholm, S. Stich, J. Elster etc.); heuristics of Khaneman and Tversky, etc.)
8. ***Social epistemology***: Veritism (A.I. Goldman); Strong program (D.Bloor. B.Barnes, S. Shapin); nature and epistemic status of testimony (D.Hume, Th.Reid, R.Descartes, J.Locke, C.A.J. Coady, T. Burge, M. Dummett, A. Plantinga, etc.), rational consensus (C. Wagner i K.Lehrer); experts (G. Pappas, A.I. Goldman), etc.
9. ***Special issues:*** synthetic and analytic judgments (I.Kant, Wienna circle, W.O.Quine), intentionality (J. Searle), definition of knowledge (E.Gettier, R. Nozick), evolutional epistemology (K. Popper, Campbell, E.Sober, S.Stich), rationality of emotions (R. de Sousa), epistemology, philosophy of mind, philosophy of science, methodology and logic, etc.

1.5. Teaching ethods	☒ lectures ☒ seminars and workshops ☐ exercises ☒ long distance education ☐ fieldwork	☒ individual assignment ☒ multimedia and network ☐ laboratories ☐ mentorship ☒ consultations
1.6. Comments	• Methodically complex approach, which unifies individual and group work, is preferred. • Successful work reacquires computer skills (Internet) and English language competence. • Evaluation is based on the continuous assessment of the students' work. • Consultations and successful participation in the discussion groups are the aspects of active participation. • In a case of tutorial work, student's work on the published articles or participation on the (international) conferences is of the highest respect.	

1.7. Student's obligations

- Regular and active participation on lecture's class and discussion groups (including consultations)
- An essay (5-15 pages)
- Consultations during the work on the seminar papers
- Written and oral exam at the end of course (written exam could be substituted by several seminar papers, essays or short written tests during the semester)
- To the most interested students, additional individual work with the supervisor is offered.

1.8. Evaluation of student's work

Course attendance	0.85	Activity/Participation	0.85	Seminar paper		Experimental work	
Written exam	0.85	Oral exam		Essay	0.85	Research	
Project		Sustained knowledge check	1.6	Report		Practice	

Portfolio							

1.9. Assessment and evaluation of student's work during classes and on final exam

Student will be evaluated and assessed during the course and final exam. Maximum total percentage which student can achieve during the lessons is 70%, while the final exam provides 30% at best.
Detailed elaboration of ways of monitoring and evaluation of students' work will be displayed in the Working Plan!

1.10. Assigned reading (at the time of the submission of study programme proposal)

Zvonimir Čuljak (ur.), Vjerovanje, opravdanje i znanje: Suvremene teorije znanja i epistemičkog opravdanja Zagreb, Ibis grafika, 2003.
Johnatan Dancy: Uvod u suvremenu spoznajnu teoriju, Zagreb, Hrvatski sudiji, 2001.
J. Greco i E. Sosa (ur.), Epistemologija: Vodič u teorije znanja, Zagreb, Jesenski i Turk, 2004.
Snježana Prijić: Oko i svijet, Rijeka, 1995.
Snježana Prijić-Samaržija: Društvo i spoznaja, Zagreb, 2000.

1.11. Optional / additional reading (at the time of proposing study programme)

Rene Descartes: Meditacije o prvoj filozofiji, u E. Husserl, Kartezijanske meditacije, Zagreb, SSO, 1975.
John Locke: Ogled o ljudskom razumu I i II, Beograd, Kultura,1962.
David Hume: Istraživanje o ljudskom razumu, Zagreb, Naprijed,1988
George Berkeley: Odabrane filozofske rasprave (Rasprava o načelima ljudske spoznaje, Tri dijaloga između Hylasa i Philonousa), Zagreb, KruZak,1999.
Gottfried Wilhelm Leibniz: Novi ogled o ljudskom razumu, Sarajevo, Veselin Masleša, 1986.
Platon: Država, Zagreb, Liber, 1977.
Platon: Teetet, u Platon, Phileb i Teetet, Zagreb, Naprijed, 1979.
Platon, Menon, Beograd, BIGZ, 1970.
Aristotel: O duši , u Aristotel: O duši/Nagovor na filozofiju, Zagreb, Naprijed, 1987.
I. Kant: Kritika čistog uma, Zagreb, Matica Hrvatska,1987.
L. Witgenstein: Filozofska istraživanja, Zagreb, Nakladni Zavod Globus, 1998.

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W. O.Quine: Riječ i predmet, Zagreb, KruZak ,1999.
T. Kuhn: Struktura znanstvenih revolucija, Zagreb, Jesenski i Turk, Hrvatsko sociološko društvo, 1999.
W.James: Pragmatizam, Zagreb, Ibis grafika, 2001.
N. Chomsky: Gramatika i um, Beograd, Nolit, 1972.
G. Petrović: Od Lockea do Ayera, Beograd, Kultura, 1964.
G. Petrović: Suvremena filozofija, Zagreb: Školska knjiga, 1979.
G.E. Moore, "The Defence of Common Sense", London, Contemporary British Philosophy, 1925.
T. Reid, Inquiry and Essays, u R. E. Beanblossom i K. Lehrer (ur)., Hacket Publishing Company, Indianapolis, 1983.
J. Kim & E. Sosa (ur.), Epistemology: An Antology, London, Blackwell, 2000
S. Bernecker & F. Dretske (ur.), Knowledge: Readings in contemporary epistemology, Oxford, Oxford University Press, 2000
R. Audi: Epistemology, London, Rautledge, 2003
Linda M. Alcoff (ur.), Epistemology: The Big Questions, London, Blackwell, 1998
L. BonJour: The Structure of Empirical Knowledge, Cambridge, Mass, Harvard University Press, 1985.
F. Dretske: Knowledge and the Flow of Information, Cambridge, MA, MIT Press, 1981
A.I.Goldman, A., (1986), Epistemology and Cognition, Cambriddge, MA: Harvard University Press
G. Harman: Change in View, Cambridge, MA: MIT Press, 1986
Naturalizing Epistemology, Hilary Kornblith (ur.), Cambridge, MA: Harvard University Press, 1985
W.O. Quine: Ontological Relativity and Other Essays, New York, Columbia University Press,1969
S. Stich: Fragmentation of Reason, Cambridge, MA: Bradford Books/MIT Press, 1990
C. Wagner i K. Lehrer: Rational Consensus in Science and Society, Dordrecht, 1981.
C.A.J. Coady: Testimony: A Philosophical study, Oxford, 1992.
Bender, J.W., (ur), The Current State of the Coherence Theory, Dordrecht, Kluwer Academic Publishers, 1989.

Fricker, E. (1995) , "Telling and Trusting: Reductionism and Anti-Reductionism in the Epistemology of Testimony", Mind, Vol. 104. br. 414.
Kitcher, P., (1990) , "The Division of Cognitive Labour", The Journal of Philosophy, Vol. LXXXVII, br. 1.
Lehrer, K., i Wagner, C., (1981) , Rational Consensus in Science and Society, Dordrecht, Reidel Publishing Company.
Lewis, C.I., "The Bases of Empirical Knowledge", u Empirical Knowledge, ur. Chisholm, R.M. i Schwartz, R.J., New Jersey, Englewood Cliffs, 1973.
Moser, P. K., (1985) , Empirical Justification, Dordrecht, D. Reidel Publishing Company.
Pettit, P. (1993) , Common Mind, Oxford, Oxford University Press.
Plantinga, A., (1994), Warrant and Proper Function, Oxford, Oxford University Press.
Pollock, J., (1974), Knowledge and Justification, Priceton, Princeton University Press;
Popper, K.R., (1972) , Objective Knowledge, Oxford, Oxford University Press.
Sosa, E., (1991) , Knowledge in Perspective, Cambridge, Cambridge University Press

(obvezna i dopunska literatura će se nadopunjavati obzirom na nova izdanja i prijevode)

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
Zvonimir Čuljak (ur.), Vjerovanje, opravdanje i znanje: Suvremene teorije znanja i epistemičkog opravdanja Zagreb, Ibis grafika, 2003	1	10
Johnatan Dancy: Uvod u suvremenu spoznajnu teoriju, Zagreb, Hrvatski sudiji, 2001.	1	10
J. Greco i E. Sosa (ur.), Epistemologija: Vodič u teorije znanja, Zagreb, Jesenski i Turk, 2004.	1	10

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

- Lecturer self-evaluation
- The results in attaining the course objectives
- Official and anonymous evaluation that is accomplished by Philosophy Department and Faculty of Philosophy

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Basic description		
Course coordinator	Elvio Baccarini	
Course title	ETHICS	
Study programme	Undergraduate Study Programme Physics	
Course status	Compulsory	
Year	3. year	
ECTS credits and teaching	***ECTS student 's workload coefficient***	5
	Number of hours (L+E+S)	40 + 0 + 20

1. COURSE DESCRIPTION

1.1. Course objectives

The course objective is for students to get acquainted with, understand and analyze the basic concepts and problems that are presented in the course *Ethics*.

1.2. Course enrolment requirements

The course *Ethics* corresponds to the similar contents of other philosophy courses held at other universities. It correlates, first of all, with the course *Philosophy of Politics* held within the undergraduate program of philosophy. It partly cuts across the contents of the courses such as *Epistemology, Ontology and Philosophy of language*, as well as other courses from the field of ethics, which are offered as electives within the program of philosophy. The program of the course *Ethics* correlates with the courses of practical ethics on particular universities (for example, *Medical ethics* on Faculty of Medicine). Since this course is a part of an undergraduate program, and involves contents that are not especially covered during high school education, special prerequisites, besides general knowledge from high school, are not expected.

1.3. Expected course learning outcomes

After the accomplishment of the student requirements in the course it is expected:

- that students get acquainted with the basic methodological approaches to philosophy discussions on morality (stressing the importance of knowledge from other fields: theory of knowledge, ontology, philosophy of language, logic) and develop critical attitude about it;
- that students learn dominant moral theories, and individually try to determine which of these theories can, to the greatest extent, offer the critical basis for their initial moral intuitions (in other words, to determine whether they should revise their moral intuitions after being acquainted with moral theories);
- - that the students are able to apply moral theories to the actual situations.

1.4. Course content

The first part of the course deals with metaethical problems, namely, philosophical (epistemological, ontological, linguistic-philosophical, logical) discussion on ethics. Some of the most important positions in this domain are to be presented and discussed.

- *cognitivism* (the theory according to which one is able to have moral knowledge): this position is going to be presented in the form of (i) intuitionism and (ii) naturalistic realism (at least some of our moral beliefs are true);
- *noncognitivism* (according to which the function of moral discourse is to express one's subjective states, emotions or universal prescriptions): antirealism (there is no moral reality);

Even though the focus is on the contemporary discussions, for each considered approach, the connection with classics in the history of philosophy is pointed out:

- the connection between Plato, Reid and contemporary intuitionism;

- the connection between Hume and contemporary emotivism;
- the connection between Aristotelian-Thomist tradition and forms of naturalistic aristotelianism.

Within this framework, after the introduction in which Kant's model in its basic elements is considered, we will discuss the contemporary versions of Kantian models:

- rationalistic (the correct moral convictions are reached by deduction (Hare, Gewirth);
- constructivist (Rawls, Korsgaard).

After discussing aforementioned metaethical positions, we consider the distinction between relativism and universalism. As a separate issue the relation between ethics and psychology is to be analyzed, namely, the discussion about the motivational power of moral convictions. Furthermore, the distinction between internalism (the position according to which moral beliefs are motivational) and externalism (the positon according to which the relation between moral beliefs and motivation is contingent) is to be examined.

The following unit is dedicated to the presentation and discussion of moral theories:

- Kantian, namely, deontological theories (where the basic ethical notions of "duty" and "law" are dominant, and which are above individual preferences and instincts, as well as utility);
- utilitarianism (a set of theories which place the maximization of pleasure, happiness, preference etc. as the central notion of morality);
- virtue ethics (in which the basic criterion is the affirmation of virtues, whether they are considered to be related to human nature, or considered to be dependent on particular societies);
- the notion of "good".

Finally, the discussion from applied ethics is presented to the students. The topics are:
social inequalities and poverty, environmental ethics, bioethics issues (the notion of a person who has rights or moral value, abortion, physician assisted conception, the application of genetics, the issue of death, euthanasia, human organ transplantation, the right to medical treatment), the moral problem of sexuality and the gender relation, equality, inverted discrimination, animal rights, business ethics, crime and punishment, morality and politics, ethics of war.

1.5. Teaching ethods	☒ lectures ☒ seminars and workshops ☐ exercises ☐ long distance education ☐ fieldwork	☒ individual assignment ☐ multimedia and network ☐ laboratories ☐ mentorship ☒ consultations
1.6. Comments		

1.7. Student's obligations

The students are required to attend class and complete their assignments. They are required to hand in a seminar paper, under the guidance of their teacher. The students are expected to read the assigned literature throughout the course, so they can actively participate in class. The final exam is mandatory.

1.8. Evaluation of student's work

Course attendance	1.66	Activity/Participation	0.25	Seminar paper	0.42	Experimental work	
Written exam	1.25	Oral exam		Essay		Research	
Project		Sustained knowledge check	1.42	Report		Practice	
Portfolio							

1.9. Assessment and evaluation of student's work during classes and on final exam

Student will be evaluated and assessed during the course and final exam. Maximum total percentage which student can achieve during the lessons is 70%, while the final exam provides 30% at best.
Detailed elaboration of ways of monitoring and evaluation of students' work will be displayed in the Working Plan!

1.10. Assigned reading (at the time of the submission of study programme proposal)

Frankena, W.K., Etika, KruZak, Zagreb 1998.
A. Miller, An Introduction to Contemporary Metaethics, Oxford, Polity, 2003.

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Singer, P., Praktična etika, KzuZak, Zagreb, 2003.

1.11. Optional / additional reading (at the time of proposing study programme)

Aristotel, Nikomahova etika, Sveučilišna naklada Liber, Zagreb 1982.
Baccarini, E., Moralni sudovi, Hrvatski kulturni dom, Rijeka 1994.
Coady, C.A.J. i O'Keefe, M. (ur.), Terorizam i pravednost, KruZak, Zagreb, 2004.
Gewirth, A., Osnova i sadržaj ljudskih prava, u Matulović, M. (ur.), Ljudska prava, Izdavački centar Rijeka, Rijeka 1992
Hare, R.M., Kako racionalno odlučiti o moralnim pitanjima, "Agora", 6, 1998, 17-26.
Kant, I., Osnove metafizike ćudoređa, Igitur, Zagreb 1995 ili Utemeljenje metafizike ćudoređa, u Talanga, J. (ur.), Klasični tekstovi iz etike, Sveučilište u Zagrebu Hrvatski studiji, Zagreb 2001.
Levy, N., Moralni relativizam, Jesenski i Turk, Zagreb 2004.
MacIntyre, A., U potrazi za vrlinom, Kruzak, 2002..
Prijić, S. (ur.), Pobačaj. Za i protiv, Hrvatski kulturni dom, Rijeka 1995.
Primorac, I. (ur.), Suvremena filozofija seksualnosti, Zagreb, KruZak, 2003.

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
Frankena, W.K., Etika, KruZak, Zagreb 1998.	1	10
A. Miller, An Introduction to Contemporary Metaethics, Oxford, Polity, 2003.	1	10
Singer, P., Praktična etika, KzuZak, Zagreb, 2003.	1	10

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

Quality assurance of the course will be focused on student experience and intellectual development. Related to this, the questionnaire is to be made, the purpose of which is: for the students to evaluate the teaching skills, interaction with the students; learn the teaching material; institutional environment. Both the early evaluation (3 to 5 weeks after beginning of the course) and the evaluation at the end of the course is possible. Discussions aimed at pointing out the reasons which led to the creation of certain attitudes toward the course are to be held (group, as well as individual). Head of the course will rely on observations of other teachers, collegues and experts. The relevant factor for quality assurance and successfulness of the course is going to be the results achieved by the students: grading and evaluating the students' work, which can provide information on possible shortcomings of the course content, or difficulties in understanding some parts of the teaching material; portfolio of each student (monitoring the progress).

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Basic description		
Course coordinator	Dean Crnković	
Course title	EUKLIDEAN SPACES	
Study programme	Undergraduate Study Programme Physics	
Course status	Compulsory	
Year	3. year	
ECTS credits and teaching	***ECTS student 's workload coefficient***	5
	Number of hours (L+E+S)	30 + 30 + 0

1. COURSE DESCRIPTION

1.1. Course objectives

Objective of this course is to introduce basic properties of affine spaces and Euclidean spaces.

1.2. Course enrolment requirements

The program is correspondent to the program of other mathematical courses, especially to Linear Algebra I, Linear Algebra II and Geometry.

1.3. Expected course learning outcomes

After completing this course students will be able to understand basic properties of affine and Euclidean spaces.

1.4. Course content

Definition of affine and Euclidean spaces. Affine subspaces (k-planes). Intersection and sum of affine subspaces and their dimension. Parallel planes. Coordinates. Transformation of coordinates. Convexity. Half spaces. Parallelotops. Simplexes. Affine mappings. Translation. Euclidean spaces. Distance and angle between planes. Orthogonal planes. Volume of parallelotop and simplex. Isometries. Classification of isometries of Euclidean space.

1.5. Teaching methods	☒ lectures ☐ seminars and workshops ☒ exercises ☒ long distance education ☐ fieldwork	☒ individual assignment ☒ multimedia and network ☐ laboratories ☐ mentorship ☐ other
1.6. Comments	Student's activities are evaluated during the semester. Final exams are written and oral.	

1.7. Student's obligations

Students must attend the lectures and participate in all activities required for the course. Exam: written and oral.

1.8. Evaluation of student's work

Course attendance	0.55	Activity/Participation	0.55	Seminar paper		Experimental work	
Written exam	2.0	Oral exam	1.3	Essay		Research	
Project		Sustained knowledge check	0.6	Report		Practice	
Portfolio							

1.9. Assessment and evaluation of student's work during classes and on final exam

Student will be evaluated and assessed during the course and final exam. Maximum total percentage which student can achieve during the lessons is 70%, while the final exam provides 30% at the best.
Detailed elaboration of ways of monitoring and evaluation of students' work will be displayed in the Working Plan.

1.10. Assigned reading (at the time of the submission of study programme proposal)

1. S. Kurepa: Konačno dimenzionalni vektorski prostori i primjene, Liber, Zagreb, 1992.
2. M. Polonijo et al., Euklidski prostori, skripta, http://web.math.hr/nastava/eukl/EP.pdf

1.11. Optional / additional reading (at the time of proposing study programme)

1. M.Audin: Geometry, Springer-Verlag, Heidelberg, 2002.
2. D.M.Bloom: Linear Algebra and Geometry, Cambridge University Press, Cambridge, 1988.
3. K.W.Gruenberg, A.J.Weir: Linear Geometry, Springer, New York, 1977.
4. P.J.Ryan, Euclidean and non-Euclidean Geometry – an analytic approach, Cambridge Univ. Press, Cambridge, 1991.

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
S. Kurepa: Konačno dimenzionalni vektorski prostori i primjene, Liber, Zagreb, (više izdanja)	5	10
M. Polonijo et al., Euklidski prostori, skripta	5	10

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

After the last lecture of the course students will be asked to fulfill a questionnaire about the quality of the lectures. At the end of each semester results of the exams will be analyzed.

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Basic description		
Course coordinator	Velimir Labinac	
Course title	FUNDAMENTALS OF COMPUTER SCIENCE	
Study programme	Undergraduate Study Programme Physics	
Course status	Elective	
Year	1. year	
ECTS credits and teaching	***ECTS student 's workload coefficient***	3
	Number of hours (L+E+S)	15 + 15 + 0

1. COURSE DESCRIPTION

1.1. Course objectives

The main objectives of the course Fundamentals of Computer Science are to introduce students to basic concepts of computer science, to explain how a computer works and to practice the use of software packages Microsoft Office, CorelDraw Graphics Suite, OriginLab and others, which are needed to write the final thesis. The course is designed for students who feel that they have not acquired elementary knowledge about computers in high school. On this premise lectures and exercises are designed: lectures include a wide range of topics from computer science without going into details, and the exercises include work with the most popular programs that are based on Linux or Microsoft Windows operating system (OS).

1.2. Course enrolment requirements

Students can enrol this course at no additional requirements.

1.3. Expected course learning outcomes

After completion of the course and exam students are expected:

- to recognize and distinguish the basic concepts of computer science;
- to possess basic knowledge of computer architecture;
- to know how to use Microsoft Windows OS;
- to know how to write text with formulas, tables and figures in a text editor Microsoft Word;
- to know how to write text with formulas, tables and to import figures in a text editor Latex;
- to know how to do simple calculations with a group of data in Microsoft Excel spreadsheets, and to plot a graph elementary functions using Excel or OriginLab at the level required for the course Physics Laboratory;
- to know how to make a simple PowerPoint presentation;
- to possess basic knowledge about Linux OS and OpenOffice software package.

1.4. Course content

Lectures: Introduction. Storing data. Data processing. Operating systems. Computer networks and the Internet. Algorithms. Programming languages. Software engineering. Data abstraction. Database. Computer graphics. Artificial intelligence. Theory of computation.
Exercises: Working in Microsoft Windows OS. Writing text, equations and tables in Microsoft Word and Latex (Mikex distribution). Templates in Microsoft Word. PowerPoint presentations. Calculating with a group of data and plotting graphs in Microsoft Excel. Graphing software package OriginLab. Creating simple drawings in the software package CorelDraw Graphics Suite. Working in Linux OS (presumably openSUSE Linux OS) with most popular software packages.

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1.5. Teaching methods	☒ lectures ☒ seminars and workshops ☒ exercises ☒ long distance education ☐ fieldwork	☒ individual assignment ☒ multimedia and network ☐ laboratories ☐ mentorship ☒ practicum
1.6. Comments		

1.7. Student's obligations

Students are obligated:

- to attend regularly and to participate actively in lectures and exercises;
- to do practicum exercises and their homework independently;
- to make a brief seminar paper with PowerPoint presentation;
- to pass preliminary exam and final oral exam.

1.8. Evaluation of student's work

Course attendance	0.2	Activity/Participation	0.3	Seminar paper	0.8	Experimental work	
Written exam	0.5	Oral exam	0.5	Essay		Research	
Project		Sustained knowledge check	0.5	Report	0.2	Practice	
Portfolio							

1.9. Assessment and evaluation of student's work during classes and on final exam

Student will be evaluated and assessed during the course and final exam. Maximum total percentage which student can achieve during the lessons is 70%, while the final exam (written and oral) provides 30% at best.
Detailed elaboration of ways of monitoring and evaluation of students' work will be displayed in the Working Plan!

1.10. Assigned reading (at the time of the submission of study programme proposal)

Brookshear J. G., *Computer Science – An Overview*, 10th ed., Pearson Education, Boston, 2009.

1.11. Optional / additional reading (at the time of proposing study programme)

B. Forouzan, F. Mosharraf, *Foundations of Computer Scinece*, Cengage Learning, London, 2008.
Budin L., *Informatika 1*, Element, Zagreb, 2002.
Dale N., Lewis J., *Computer Science Illuminated*, Jones and Barlett, Sudbury, 2002.
Grundler D., Blagojević L., *Informatika 1*, Školska knjiga, Zagreb, 2007.
Grundler D., *Kako radi računalo*, PRO-MIL, Varaždin, 2004.
Gvozdanović T., *e-Citizen*, PRO-MIL, Varaždin, 2005.
Reynolds C., Tymann P., *Principles of Computer Science*, McGraw-Hill, New York, 2008.
Tyson H., *Word 2007 Bible*, Wiley Publishing, New York, 2007.
Walkenbach J., *Excel 2007 Bible*, Wiley Publishing, New York, 2007.
Walkenbach J., Tyson H, *Office 2007 Bible*, Wiley Publishing, New York, 2007.

WWW
http://academicearth.org/
http://web.math.hr/nastava/rp1p/
http://www.fpz.hr/~goldh/racun200910/

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
Brookshear J. G., *Computer Science – An Overview*, 10th ed., Pearson Education, Boston, 2009.	1	10-15

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1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences
Regular monitoring of the student's activity and attitude towards work. In the last week of classes, anonymous surveys will be conducted in which students will evaluate the quality of teaching. At the end of each semester (1 March and 30 September of the current academic year) student' success in examinations will be analyzed.

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Basic description		
Lecturer	Jasminka Giacometti	
Course title	GENERAL CHEMISTRY	
Study programme	Undergraduate Study Programme Physics	
Course status	Compulsory	
Academic year	2. year	
Course grading and contact hours	***ECTS student 's workload coefficient***	9
	Number of hours (L+E+S)	20+30+10

1. COURSE DESCRIPTION

1.1. Course objectives

Mastering the basics of chemistry and chemical calculations, acquiring basic skills in laboratory work.

1.2. Course enrolment requirements

Achieved admission to undergraduate study.

1.3. Expected learning outcomes for the course

After passing the exam, students will be able to:
- Explain the electronic structure of atoms and the position of elements in the periodic table;
- Explain the properties of elements based on electronic structure;
- Define the types of chemical bonds and predict chemical properties;
- Explain the properties of substances, depending on the physical condition;
- Distinguish between and explain protolytic, oxidation-reduction reactions and complex;
- Define the rate of chemical reactions and explain the impact of various factors on the rate of chemical reactions;
- Distinguish between weak and strong electrolytes;
- Explain the equilibrium in solutions of weak electrolyte;
- Distinguish between and explain the internal energy, enthalpy, free energy and entropy;
- Solve simple numerical problems in areas that have worked in theory;
- Independently performed experiments that were included in the content subjects and to evaluate and discuss the results.

1.4. Course description

Atoms, molecules and ions
Chemical bonding and states of matter
Stoichiometry
Solutions and their properties
Chemical equilibrium and kinetics
Acids, bases, salts
Equilibrium in aqueous solution: acid-base balance, heterogeneous equilibrium
Spontaneity, entropy and free energy
Electrochemistry

1.5. Teaching methods	☒ Lectures ☒ Seminars and workshops ☒ Practical ☒ E-learning ☐ Fieldwork	☐ Case study ☐ Multimedia, internet ☐ Laboratory ☐ Tutorial ☐ Others _____

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1.6. Comments	No comments.

1.7. Student obligations

Attending lectures, seminars, laboratory exercises, and writing a seminar and exam.

1.8. Grading assesment

Class attendance	X	Activity		Seminar paper	X	Experimental work	X
Test	X	Oral exam	X	Essay		Research	
Project		Continuous evaluation	X	Report		Practical work	
Portfolio							

1.9. Assessment and evaluation of students' work during the semester and final exam

Feedback from the subject of General Chemistry provides complete information about the candidate's success, and includes evaluation of the results conducted through continuous education and the final exam.

Continuing education consists of assessment of the results obtained on laboratory exercises (20 points), continuous assessment, which consists of 4 test consisting of 6 simple and 4 complex tasks (30 points), seminar (15 points) and regular attendance (5 points) , for a total continuous education contributes to 6.3 ECTS.

The final examination contributes 30 points and consists of a written and / or oral part, or 2.7 ECTS.

Criteria for evaluation complies with the criteria of undergraduate study: A (5) - 80-100%, B (4) - 70-79,99%, C (3) - 60 to 69.99%, D (2) - 50-59 , 99%, E (2) - 40 to 49.99%, F and FX - (1). On the final exam students must solve 50% of exam.

1.10. Required texts (at the time of registration of a program proposal)

1. Filipović, I; Lipanović, S.: Opća i anorganska kemija I, Školska knjiga, Zagreb, 1991
2. Giacometti, J., Zbirka zadataka iz kemije za studente medicinsko-laboratorijske dijagnostike, Medicinski fakultet u Rijeci, 2009.
3. Vježbe iz opće i anorganske kemije – Interna skripta, Zavod za opću i anorgansku kemiju, Fakultet kemijskog inženjerstva i tehnologije, Sveučilište u Zagrebu, 2009

1.11. Additional reading (when receiving the proposal of a program)

1. Zumdahl, S. Steven; Zumdahl, A. Susan: *Chemistry*: 6th Edition, New York, Houghton Mifflin Company, 2003.
2. Chang, R.: General Chemistry-The Essential Concepts, McGraw-Hill, Inc., New York, 2006.

1.12. Number of copies required literature in relation to the number of students who currently attend classes in the subject

Title	*Number of copies*	*Number of students*

1.13. Quality assurance

Quality performance is monitored by student evaluation, which include monitoring of teaching and curriculum, students passing the exams, individual performance appraisals of teachers (each student) conducted by student polls.

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Basic description		
Course coordinator	Marcelo Kovačić	
Course title	GENERAL ECOLOGY	
Study programme	Undergraduate Study Programme Physics	
Course status	Compulsory	
Year	2. year	
ECTS credits and teaching	***ECTS student 's workload coefficient***	3
	Number of hours (L+E+S)	15 + 15 + 0

1. COURSE DESCRIPTION

1.1. Course objectives

Course objective is to give basic knowledge on ecology. Acquired knowledge is essential for the understanding of diversity, complexity and dynamics taking place in ecosystems.

1.2. Course enrolment requirements

General biology.

1.3. Expected course learning outcomes

Students are expected to develop:
a) general ability:
-know how to search and analyze information from different sources;
-to interrelate theoretical and practical knowledge;
-work efficiently in groups and in autonomous;
-good oral and written expression.

b) specific ability:
-theoretical understanding of ecology, its concepts and its main branches;
-knowledge of abiotic elements of ecology;
-knowledge of elements regulating the adaptation of individual to environmental conditions;
-use of population models;
-knowledge of existing biomes.

1.4. Course content

Introduction: what means ecology? Branches of ecology: autoecology, demecology, sinecology. Definition of concepts: organism (individual), population, community (biocenosys), ecosystem, biosphere. Abiotic and biotic Ecological factors. Biogeochemical cycles. Community and biotope. Response of organisms on environmental conditions. Ecology of organism: adaptation, interaction, ekotypes. Production and transfer of energy. Ecosystem organization. Trophic levels and dynamic. Genetic structure of populations. Structure and dynamics of populations. Population models. Selectivity. Competition. Ecological niche. Community structure and succession. Ecological diversity and its measurement. Biomes.

1.5. Teaching methods	☒ lectures ☒ seminars and workshops ☐ exercises ☐ long distance education	☐ individual assignment ☐ multimedia and network ☐ laboratories ☐ mentorship

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	☐ fieldwork	☐other
1.6. Comments		

1.7. Student's obligations

Students are obligated:

- to attend regularly and to participate actively in lectures and exercises;
- to do their homework independently;
- to write a brief 5 min seminar paper with PowerPoint presentation; seminar topics will include additional topics or proofs of simple theorems;
- to pass two midterms and final oral exam.

1.8. Evaluation of student's work

Course attendance	0.5	Activity/Participation	0.5	Seminar paper	1.0	Experimental work	
Written exam	1.5	Oral exam	1.5	Essay		Research	
Project		Sustained knowledge check	0.5	Report		Practice	
Portfolio							

1.9. Assessment and evaluation of student's work during classes and on final exam

Student will be evaluated and assessed during the course and final exam. Maximum total percentage which student can achieve during the lessons is 70%, while the final exam provides 30% at best.
Detailed elaboration of ways of monitoring and evaluation of students' work will be displayed in the Working Plan!

1.10. Assigned reading (at the time of the submission of study programme proposal)

Begon, M., Harper, J. L. and Townsend, C. R., 1996. Ecology: Individuals, Populations and Communities, 3rd ed. Blackwell, London.
Ricklefs, R. E., 1990. Ecology, W.H. Freeman and Company, New York.

1.11. Optional / additional reading (at the time of proposing study programme)

Dodson, S. I., Allen, T. F. H., Carpenter, S. R., Ives, A. R., Jeanne, R. L., Kitchell, J. F., Langston, N. E. and Turner, M. G., 1998. Ecology, Oxford University Press.
Krebs, J.R. and Davies, N. B., 1993. An Introduction to Behavioural Ecology, 3rd ed. Blackwell Scientific Publication, Oxford.

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

Regular monitoring of the student's activity and attitude towards work. In the last week of classes, anonymous surveys will be conducted in which students will evaluate the quality of teaching. At the end of each semester (1 March and 30 September of the current academic year) student' success in examinations will be analyzed.

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Basic description		
Course coordinator	Jasminka Zloković	
Course title	GENERAL PEDAGOGY	
Study programme	Undergraduate Study Programme Physics	
Course status	Elective	
Year	2. year	
ECTS credits and teaching	***ECTS student 's workload coefficient***	5
	Number of hours (L+E+S)	30 + 15 + 0

1. COURSE DESCRIPTION

1.1. Course objectives

The aim of the course is to make students familiar with basic approaches, concepts and classifications in pedagogy, and to form a critical attitude towards the reality of education in contemporary society.
Subject General pedagogy corresponds primarily with courses that deal with the history of pedagogy and pedagogy as a scientific system.

1.2. Course enrolment requirements

None.

1.3. Expected course learning outcomes

Students are expected to develop the following general competencies:
- Ability of operative thinking (induction, analysis, synthesis, comparison, evaluation ...);
- Analyzing the complexity of the phenomenon of education;
- Ability to plan and organize;
- The ability to apply the ideas in the analysis of practice;
- Ability to manage information and their presentation.

Considering the specific competencies, it is expected that students can:
- Describe, define and explain the phenomenon of education;
- Analyze the phenomenon of education in the examples and cases;
- Formulate and present ideas, engage in polemics and dialogue

1.4. Course content

Pedagogy as a science (the subject, objectives, methodology, pedagogy position in the science system, the system of pedagogical disciplines, pedagogical terminology system). Breeding and reproduction of human life. Education as a humanistic and social phenomenon. The essential characteristics of human beings - anthropological basis of education. Education – Constituent of sociality and culture (socialization, inculturation, enculturation, assimilation, individuation). The essential determinants of education. Education as a vital need in a community (the functionality, intentionality, institutionalization, formalization of educational practice). Education: Influences of heritage and social environment. Education as a social function. Education as a menagement. Education as the development (preparation for life, developing from within, shaping and forming capabilities, reconstruction of experience, emancipation). The educational objectives, ideals and mission. Educational environments: a large social group, the educational potential of family, peers, school environment, mass-media, environment in their free time, working and professional environment, the environment for children with special needs. The current educational problems and some forms of asocial behavior of children and youth-violence, addiction, early sexual activity, truancy from school and other programs of primary, secondary and tertiary

prevention. Family and School Partnership. Educational style. Models of establishing discipline. Ecological model of care for children and young people.

1.5. Teaching methods	☒ lectures ☒ seminars and workshops ☐ exercises ☐ long distance education ☐ fieldwork	☒ individual assignment ☒ multimedia and network ☐ laboratories ☒ mentorship ☐ other
1.6. Comments	Over the course, lectures and seminars will be conducted, and students will be referred to an independent tasks and the use of online sources - the Internet. Part of teaching will be done in consultation form, a part of the materials for teaching students will be available on the web-site cases.	

1.7. Student's obligations

To carry out the study commitment, it is necessary that the student:
- Regularly attends and actively participates in teaching;
- Writes and presents seminars;
- Pass the preliminary exams;
- Pass the written exam.

1.8. Evaluation of student's work

Course attendance	1.00	Activity/Participation	1.00	Seminar paper		Experimental work	
Written exam		Oral exam		Essay		Research	
Project		Sustained knowledge check	2.00	Report		Practice	1.00
Portfolio							

1.9. Assessment and evaluation of student's work during classes and on final exam

Variant 1 (Final exam), students work on the case will be evaluated and assessed during the course and final exam. The total number of credits a student can achieve during the course is 70 (assessed activities highlighted in the table), while through the final exam student can achieve 30 points.

1.10. Assigned reading (at the time of the submission of study programme proposal)

- Giesecke, H.(1993), Uvod u pedagogiju, Zagreb Educa
- Gudjons, H.(1994), Pedagogija - temeljna znanja, Zagreb, Educa
- Mušanović, M., Rosić, V.(2003), Opća pedagogija (skripta). Rijeka: Filozofski fakultet u Rijeci
- Rosić, V., Zloković, J. (2002). Prilozi obiteljskoj pedagogiji. Filozofski fakultet u Rijeci, Žagar, d.o.o., Rijeka (odabrana poglavlja - Obitelji i djeca u Riziku, Suradnja obitelji i škole).
- Katz, L. G., McClellan, E. (1999), Poticanje razvoja dječje socijalne kompetencije. Zagreb: Educa, str.15-98.

1.11. Optional / additional reading (at the time of proposing study programme)

- Bratanić, M. (1991) Mikro-pedagogija. Zagreb: Školska knjiga
- Brajša-Žganec (2003). Dijete i obitelj – emocionalni i socijalni razvoj. Jastrebarsko, Naklada Slap, str. 15-70, 147-173.
- Rafajac, B.: (1991) Odgoj kao razvoj autonomne vrijednosne svijesti. Rijeka: Pedagoški fakultet u Rijeci,
- Polić, M. (1993) Odgoj I svije(s)t. Zagreb: Hrvatsko filozofsko društvo
- Švajcer, V. (1964) Grupa kao subjekt obrazovanja., Zagreb: Matica hrvatska
- Janković, J. (2000), Pristupanje obitelji: sistemski pristup. Zagreb: Alinea, str. 15-50.
- Sheridan, M. D. (1998), Dječji razvoj od rođenja do pete godine: kako se djeca razvijaju i napreduju. Zagreb: Educa, str. 20-40.
- Neill, A.S. (1988): Slobodna djeca Samerhila. Beograd: BIGZ

- Winkel, R. (1996): Djeca koju je teško odgajati. Zagreb: Educa
- Madelin, A. (1991): Osloboditi školu. Zagreb: Educa
- Zloković, J., Bilić, V. (2004). Fenomen maltretiranja djece. Oblici pomoći djeci, obitelji i školi. Zagreb, Ljevak.
- Zloković, J. (2009). Nasilje djece nad roditeljima - Obiteljska tajna?,Rijeka, Zambelli.

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
Gudjons, H.(1994), Pedagogija - temeljna znanja, Zagreb, Educa	5	10
Mušanović, M., Rosić, V.(2003), Opća pedagogija (skripta). Rijeka: Filozofski fakultet u Rijeci	5	10
Rosić, V., Zloković, J. (2002). Prilozi obiteljskoj pedagogiji. Filozofski fakultet u Rijeci, Žagar, d.o.o., Rijeka (odabrana poglavlja - Obitelji i djeca u Riziku, Suradnja obitelji i škole). Katz, L. G., McClellan, E. (1999), Poticanje razvoja dječje socijalne kompetencije. Zagreb: Educa, str.15-98.	20 3	10 10

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

Quality of course performance will be monitored and recorded systematically during the teaching process. For the periodically evaluation of the quality, surveys, questionnaires, rating scales and discussions will be used. Comments, suggestions and information from the evaluation procedures will be applied to improve teaching, lectures and other teaching methods.

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Basic description		
Course coordinator	Ivan Sondi	
Course title	GEOLOGY	
Study programme	Undergraduate Study Programme Physics	
Course status	Compulsory	
Year	3. year	
ECTS credits and teaching	***ECTS student 's workload coefficient***	4
	Number of hours (L+E+S)	30+5+10

1. COURSE DESCRIPTION

1.1. Course objectives

Introduction to principles of geology and related geosciences.

1.2. Course enrolment requirements

Completed courses: Principles of Chemical Science, Principles of Biology, Physics I

1.3. Expected course learning outcomes

Basic knowledge in geology and fundamentals of nature sciences. Introduction to applied geology and it's role in technical sciences; mining, construction, hydrology and environmental management and protection. These are basic conditions to be met for working in the economy and education.

1.4. Course content

Introduction to geology. History of geology. The formation of Earth and of the Solar System: the Earth's interior. Geologic build / composition of land and oceans. Dynamic of the Earth's crust: plate tectonics, earthquakes, volcanism. Basic structure elements of lithosphere. Geomorphology. Rocks and minerals. Geodynamic processes and the formation of the Earth's surface. Physical and chemical weathering of rocks and minerals. The hydrologic cycle. Sediments, sedimentary rocks and sedimentation processes. Diagenesis. The environments and facies. The geochemical cycle. A survey of geological structures of a terrain: geological maps, profiles and columns. Principles of stratigraphic geology: geologic time scale, determination of age and the reconstruction of sequence in geologic history. Life on Earth: fossils and evolution. Climate changes. Geologic hazards. Environmental geology.

1.5. Teaching methods

☒ lectures	☐ individual assignment
☒ seminars and workshops	☐ multimedia and network
☒ exercises	☐ laboratories
☐ long distance education	☐ mentorship
☐ fieldwork	☐ other

1.6. Comments

1.7. Student's obligations

Lecture and exercises attendance, seminar paper and oral exame.

1.8. Evaluation of student's work

Course attendance	0.40	Activity/Participation		Seminar paper	0.80	Experimental work	
Written exam	0.80	Oral exam	1.60	Essay		Research	

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Project		Sustained knowledge check	0.40	Report		Practice	
Portfolio							

1.9. Assessment and evaluation of student's work during classes and on final exam

To achieve better learning outcome, students will be encouraged on continuity in their work and promptness in accomplishing their obligations. This would also be a necessary requirement for taking the final exam and would effect the final grade. The total amount of credits that students can achieve performing their work is listed in the table above.

1.10. Assigned reading (at the time of the submission of study programme proposal)

Plummer, C., McGeary, D., Carlson, D.H., 2003. Physical Geology. McGraw-Hill Companies, Inc., p. 574
Herak, M., 1990. Geologija. Školska knjiga Zagreb, p. 433

1.11. Optional / additional reading (at the time of proposing study programme)

Marshak, S., 2004. Essentials of Geology. W.W. Norton & Company, p 536.
Montgomery, C.W., 2007. Environmental Geology. McGraw-Hill Companies, Inc., p. 556.

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

The course comprehension will be monitored during classes, exercises and through written exams and seminar paper. The effectiveness of the course will be graded by students after final lecture through an anonymous questionnaire.

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Basic description		
Course coordinator	Vedrana Mikulić Crnković	
Course title	GEOMETRY	
Study programme	Undergraduate Study Programme Physics	
Course status	Elective	
Year	2. year	
ECTS credits and teaching	***ECTS student 's workload coefficient***	5
	Number of hours (L+E+S)	30 + 30 + 0

1. COURSE DESCRIPTION

1.1. Course objectives

The aim of this course is to acquaint the students with certain geometrical facts and to provide a link between classical geometry and modern geometry, with the aim of preparing students for further study and research.

1.2. Course enrolment requirements

The program is correspondent to the program of other mathematical courses, especially to Linear Algebra I, Linear Algebra II and Euclidean Spaces.

1.3. Expected course learning outcomes

After completing this class, students should be able to:
- recognize and compare different geometries,
- analise problems; formulate them into mathematical terms and use the appropriate strategies to solve them; verify and interpret the solutions; and present their mathematical arguments and solutions in a logical and clear fashion.

1.4. Course content

Historical introduction. Three approaches to the study of geometry. Plane Euclidean geometry. Geometry on the sphere. Incidence. Distance. Perpendicular lines. The projective plane. Incidence. Homogeneous coordinates. Desargues' theorem. The projective group. Elliptic geometry. The hyperbolic plane. Incidence. Distance. Klein's model.

1.5. Teaching methods	☒ lectures ☐ seminars and workshops ☒ exercises ☒ long distance education ☐ fieldwork	☒ individual assignment ☒ multimedia and network ☐ laboratories ☐ mentorship ☐ other
1.6. Comments	Student's activities are evaluated during the semester. Final exams are written and oral.	

1.7. Student's obligations

Attendance at all classes and active participation is expected; final written and oral exam.

1.8. Evaluation of student's work

Course attendance	0.55	Activity/Participation	0.55	Seminar paper		Experimental work	

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Written exam	2.0	Oral exam	1.3	Essay		Research	
Project		Sustained knowledge check	0.6	Report		Practice	
Portfolio							

1.9. Assessment and evaluation of student's work during classes and on final exam

Student will be evaluated and assessed during the course and final exam. Maximum total percentage which student can achieve during the lessons is 70%, while the final exam provides 30% at the best.
Detailed elaboration of ways of monitoring and evaluation of students' work will be displayed in the Working Plan.

1.10. Assigned reading (at the time of the submission of study programme proposal)

A. I. Fetisov, O euklidskoj i neeuklidskim geometrijama, Školska knjiga, Zagreb, 1981.
P.J.Ryan, Euclidean and non-Euclidean Geometry – an Analytic Approach, Cambridge Univ. Press, Cambridge, 1991.

1.11. Optional / additional reading (at the time of proposing study programme)

Euclides, Elementi 1-6, prevela M. Hudoletnjak Grgić, Kruzak d.o.o., Zagreb, 1999.
K. Horvatić, Linearna algebra, I. dio, Matematički odjel PMF-a Sveučilišta u Zagrebu i Hrvatsko matematičko društvo, Zagreb, 1995.
Znam, Š, i ostali, Pogled u povijest matematike, Tehnička knjiga, Zagreb, 1989.

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
A. I. Fetisov, O euklidskoj i neeuklidskim geometrijama, Školska knjiga, Zagreb, 1981.	1	10
P.J.Ryan, Euclidean and non-Euclidean Geometry – an Analytic Approach, Cambridge Univ. Press, Cambridge, 1991.	1	10

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

After the last lecture of the course students will be asked to fulfill a questionnaire about the quality of the lectures. At the end of each semester results of the exams will be analyzed.

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Basic description		
Lecturer	Jasminka Giacometti	
Course title	INORGANIC CHEMISTRY	
Study programme	Undergraduate Study Programme Physics	
Course status	Compulsory	
Academic year	2. year	
Course grading and contact hours	***ECTS student 's workload coefficient***	5
	Number of hours (L+E+S)	20+0+10

1. COURSE DESCRIPTION

1.1. Course objectives

Introduce students to the properties of chemical elements and their compounds using. Understanding the trends of changes in chemical and physical properties of compounds within the group and period. Introduction to some aspects of bioinorganic chemistry, organometallic compounds, and theoretical models of structures, industrial and analytical aspects inorganic chemistry.

1.2. Conditions for enrollment

Attending and positively resolved continuous knowledge item General Chemistry.

1.3. Expected learning outcomes for the course

After passing the exam, students will be able to:
- Explain the connection between structure and properties of solids;
- Connect the crystal structure of the minerals in nature;
- Compare the basic types of compounds that form a particular group of the periodic table of elements;
- Explain their structure and properties;
- Explain the structure of complex compounds on the basis of ligand field theory;
- Define the heterogeneous catalysts, and to clarify the mechanism of catalysis and the application of catalysts;
- Solve simple numerical problems in areas that are theoretically analyzed.

1.4. Course description

Structure and properties of solids
Crystals
Hydrogen
Metals
Boron and the carbon group elements
Nitrogen and oxygen group elements
Halogens and noble gases
Complexes
Organometallics
Catalysts

1.5. Teaching methods	☒ Lectures ☐ Seminars and workshops ☒ Practical ☒ E-learning ☐ Fieldwork	☒ Case study ☐ Multimedia, internet ☐ Laboratory ☐ Tutorial ☐ Others_____
1.6. Comments	Laboratory exercises are thematically related to the subject of analytical chemistry and wil' take place within the course of Analytical Chemistry.	

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1.7. Student obligations

Attending lectures, seminars and laboratory exercises and exams.

1.8. Grading assessment

Class attendance	X	Activity	X	Seminar paper		Experimental work	
Test	X	Oral exam	X	Essay	X	Research	
Project		Continuous evaluation	X	Report		Practical work	
Portfolio							

1.9. Assessment and evaluation of students' work during the semester and final exam

Feedback from the subject of Inorganic Chemistry provides complete information about the candidate's success, and includes evaluation of the results conducted through continuous education and the final exam.
Continuing education is composed of assessment of results achieved with continuous assessment consisting of 3 tests consisting of 6 simple and 4 complex tasks (30 points), essay (20 points), activities in class (15) and regular attendance (5 points) a total of continuous education contributes with 3.5 ECTS.
The final examination contributes 30 points and consists of a written and / or oral part, 1.5 ECTS.
Criteria for evaluation complies with the criteria of undergraduate study: A (5) - 80-100%, B (4) - 70-79,99%, C (3) - 60 to 69.99%, D (2) - 50-59 , 99%, E (2) - 40 to 49.99%, F and FX - (1). On the final exam students must solve 50% of exam.

1.10. Required texts (at the time of registration of a program proposal)

1. I. Filipović, S. Lipanović, Opća i anorganska kemija II, Školska knjiga, Zagreb, 1991

1.11. Additional reading (when receiving the proposal of a program)

1. D.F. Shriver, P.W. Atkins, Inorganic chemistry, Oxford University press, Third edition, 1999
2. D. Grdenić: Molekule i kristali, 5. obnovljeno i dopunjeno izdanje, Školska knjiga, Zagreb 2006.

1.12. Number of copies required literature in relation to the number of students who currently attend classes in the subject

Title	*Number of copies*	*Number of students*

1.13. Quality assurance

Quality performance is monitored by student evaluation, which include monitoring of teaching and curriculum, students passing the exams, individual performance appraisals of teachers (each student) conducted by student polls.

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Basic description		
Course coordinator	Boran Berčić	
Course title	INTRODUCTION INTO PHILOSOPHY	
Study programme	Undergraduate Study Programme Physics	
Course status	Compulsory	
Year	2. year	
ECTS credits and teaching	***ECTS student 's workload coefficient***	5
	Number of hours (L+E+S)	30 + 0 + 30

1. COURSE DESCRIPTION

1.1. Course objectives

Student should became acquainted with basic philosophical problems and their solutions, understand the importance and implications of certain solutions, accept basic philosophical terminology and understand the importance of precise usage of these terms, develop capacity of argumentation, develop skills of reading and understanding philosophical tests.

1.2. Course enrolment requirements

Since the aim of this course is introductory, the course is directly correlated with all other courses in the program.

1.3. Expected course learning outcomes

Student should get the systematic insight into the main problems of philosophy, the most known theories and solutions of these problems became aware of the main problems with these theories and solutions. This should help student during the rest of the program.

1.4. Course content

1) Scepticism and the Existence of the External World: What is the difference between "external" and "internal" world, is the external world really as it looks like, why should we justify our belief in its existence? Different reactions to this problem: naive and critical realism, idealism, phenomenalism, idealism, verificationism.
2) Scepticism about Other Minds: What is the difference between man and machine, if there is such a difference? Essentially private nature of mental states, privileged access, first person and third person perspective.
3) Relation between Mind and Body: Is mind the same thing as body or it is something different, am I the same as my body? Different theories: dualism, physicalism, functionalism, behaviorism, eliminative reductionism, antireductionist arguments.
4) Meaning of Words: What are meanings and where they are, in things, in our minds, are they abstract? Referential and descriptive theory of meaning.
5 Wright and Wrong: Why be moral, why act morally? Golden rule, categorical imperative, subjectivism and objectivism, relativism and universalism.
6) Justice: How to distribute goods among individuals? Are social differences justified? How to justify punishment? Different theories of distributive and retributive justice.
7) Determinism and the Freedom of Will: Could we have done something else? Do we act freely and in what sense? The dilemma of determinism: our actions are free neither if they are caused nor if they are not caused. Compatibilism and libertarianism. Is determinism compatible with moral responsibility?
8) Death: Is our own unexistence concievable? Should we be afraid of our own death? How to explain the asymmetry between our past and future nonexistence?
9) Meaning of life: Is the search for the meaning of life legitimate at all? If there is such a thing as a meaning of life, is it

subjective or objective? Is life absurd? Are only eternal things meaningful?
10) Mathematics: Why 2 and 2 makes 4? What makes it true? Why we believe it is true? Different theories: empiricism, nominalism, conceptualism, platonism.

1.5. Teaching ethods	☒ lectures ☒ seminars and workshops ☐ exercises ☐ long distance education ☐ fieldwork	☐ individual assignment ☐ multimedia and network ☐ laboratories ☐ mentorship ☐ other
1.6. Comments	The content of the course may be modified depending on the available literature and the capacity of students to read literature on foreign languages.	

1.7. Student's obligations

Student should attain classes and seminars, write a paper and present it, pass the oral exam.

1.8. Evaluation of student's work

Course attendance	0.85	Activity/Participation		Seminar paper	0.85	Experimental work	
Written exam		Oral exam	3.3	Essay		Research	
Project		Sustained knowledge check		Report		Practice	
Portfolio							

1.9. Assessment and evaluation of student's work during classes and on final exam

Student will be evaluated and assessed during the course and final exam. Maximum total percentage which student can achieve during the lessons is 70%, while the final exam provides 30% at best.
Detailed elaboration of ways of monitoring and evaluation of students' work will be displayed in the Working Plan!

1.10. Assigned reading (at the time of the submission of study programme proposal)

Lecture notes on CD will be given to students.

1.11. Optional / additional reading (at the time of proposing study programme)

Thomas Nagel: Što sve to znači?, KruZak, Zagreb, 2002.
Nigel Warburton: Filozofija - osnove, KruZak, Zagreb, 1999.
Simon Blackburn: Poziv na misao, AGM, Zagreb, 2002.
Cornman, Lehrer & Pappas: Philosophical Problems and Arguments – An Introduction, Hacket Publishing Co, 1992.
John Hospers: An Introduction to Philosophical Analysis, London, 1977.
Robert M. Martin: There Are Two Errors In The The Title Of This Book, a sourcebook of philosophical puzzles, paradoxes and problems, Ontario, Canada, 1992.
Jonathan Westphal: Philosophical Propositions, Routledge, 1998.
Thomas Mautner: The Penguin Dictionary of Philosophy, Penguin Books, 2000.
Simon Blackburn: Oxford Dictionary of Philosophy, Oxford University Press, 1996.

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

At the end of the course students shall anonymously write their comments on the course

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Basic description		
Course coordinator	Patrizia Poščić	
Course title	INTRODUCTION TO DATABASES	
Study programme	Undergraduate Study Programme Physics	
Course status	Compulsory	
Year	3. year	
ECTS credits and teaching	***ECTS student 's workload coefficient***	5
	Number of hours (L+E+S)	30+30+0

1. COURSE DESCRIPTION

1.1. Course objectives

- Introduce students to basic concepts of database theory with emphasize on relational databases
- Make students competent for independent work with relational databases (SQL)

1.2. Course enrolment requirements

1.3. Expected course learning outcomes

After completing the course and meeting requirements in respect to course Introduction to Databases, students are expected to be capable of:
- Defining and updating relational database (SQL)
- Conducting relational algebra operation in relational database model
- Access database using various program tools

1.4. Course content

Introduction to databases. Database concepts. Relational data model. Relational algebra. Operations in relational model. Non-procedural languages for processing relational database – SQL. Integrity rules in relational data model. Concept of null value and incomplete information. Elements of dependency theory. Normalization; Normal forms. Temporal databases. Introduction to object-relational database. Basic of physical organization, B-tree, R-trees.

1.5. Teaching methods	☒ lectures ☐ seminars and workshops ☒ exercises ☐ long distance education ☐ fieldwork	☒ individual assignment ☐ multimedia and network ☐ laboratories ☐ mentorship ☒ other
1.6. Comments	During exercises, students are introduced to relational database - Oracle SQL. Students are prepared to independently produce an application along with drawing up and producing a relational database.	

1.7. Student's obligations

Students should actively participate in all forms of works, pass the exam consisting of written and oral part. During exercises, students shall produce a complete works, thus proving their capabilities in using software independently.

1.8. Evaluation of student's work

Course attendance	1.00	Activity/Participation	0.75	Seminar paper		Experimental work	
Written exam	0.50	Oral exam	0.50	Essay		Research	

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Project		Sustained knowledge check	1.25	Report		Practice	1.00
Portfolio							

1.9. Assessment and evaluation of student's work during classes and on final exam

1.10. Assigned reading (at the time of the submission of study programme proposal)

M.Varga: Baze podataka; konceptualno, logičko i fizičko modeliranje podataka, DRIP, Zagreb, 1994.
M. Radovan: Baza podataka - relacijski pristup i SQL, Informator, Zagreb, 1993.
S. Tkalac: Relacijski model podataka, DRIP, Zagreb, 1992.

1.11. Optional / additional reading (at the time of proposing study programme)

D. Maier: The Theory of Relational Databases, Computer Science Press, Rockville, 1983.
P. Atzeni, V. De Antonellis: Relational Database Theory; The Benjamin/Cummings Publ. Co., 1993.
A.U. Tansel et.al.: Temporal Databases, The Benjamin/Cummings Publ. Co., 1993.

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*

1. 13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

During the last week of classes, a poll will be conducted, where students would evaluate the quality of classes. Students' achievements will be analyzed.

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Basic description		
Course coordinator	Vedrana Mikulić Crnković	
Course title	INTRODUCTION TO DIFFERENTIAL GEOMETRY	
Study programme	Undergraduate Study Programme Physics	
Course status	Compulsory	
Year	3. year	
ECTS credits and teaching	***ECTS student 's workload coefficient***	7
	Number of hours (L+E+S)	45 + 30 + 0

1. COURSE DESCRIPTION

1.1. Course objectives

- acquisition a fundamental terms of curves in the plane and in the space and theirs differential attributes
- acquisition a fundamental terms of surface, her submitting, differential attributes and a special category of surfaces
- acquisition a types of curves on surfaces

1.2. Course enrolment requirements

Program of the course Introduction to Differential Geometry is in the correlation with other mathematical courses, especially with the courses: Analysis II, Analysis III and Linear Algebra I.

1.3. Expected course learning outcomes

After completing this course students will be able to understand basic properties of curves and surfaces and to apply this knowledge.

1.4. Course content

Vector fields. Covariant derivatives. Curves in the plane and in the space. Curvature of curves. Frenet's formulas. Fundamental theorems of theory of curves. Surfaces. The tangent plane to surface. The first and the second quadratic form of a surface. The shape operator of a surface. The spectar of shape operator. The total (Gaussian) and mean curvatures. The three fundamental forms. The types of curves on surfaces: asymptotic curves, geodesic curves. A special category of surfaces: surfaces of constant curvature, ruled surfaces, revolution surfaces.

1.5. Teaching methods	☒ lectures ☒ seminars and workshops ☒ exercises ☐ long distance education ☐ fieldwork	☒ individual assignment ☒ multimedia and network ☐ laboratories ☐ mentorship ☐ other
1.6. Comments		

1.7. Student's obligations

Attendance at all classes and active participation is expected. Participation in continuous assessment and final written and oral exam.

1.8. Evaluation of student's work

Course attendance	0.7	Activity/Participation	0.7	Seminar paper	0.35	Experimental work	
Written exam	2.1	Oral exam	2.1	Essay		Research	
Project		Sustained knowledge check	1.05	Report		Practice	
Portfolio							

1.9. Assessment and evaluation of student's work during classes and on final exam

Student will be evaluated and assessed during the course and final exam. Maximum total percentage which student can achieve during the lessons is 70%, while the final exam provides 30% at the best.
Detailed elaboration of ways of monitoring and evaluation of students' work will be displayed in the Working Plan.

1.10. Assigned reading (at the time of the submission of study programme proposal)

1. Gray, Modern Differential Geometry of Curves and Surfaces with *Mathematica*, CRC Press, Boca Raton-Boston London-New York-Washington, 1998.
2. Kamenarović, Diferencijalna geometrija, Sveučilište u Rijeci, Pedagoški fakultet, Rijeka, 1990.
3. B. Žarinac-Frančula, Diferencijalna geometrija, Zbirka zadataka i repetitorij, Sveučilište u Zagrebu, Geodetski fakultet, Zagreb, 1980.

1.11. Optional / additional reading (at the time of proposing study programme)

1. B. O'Neill, Elementary Differential Geometry, Academic Press, New York-San Francisko-London, 1966.
2. M. P. do Carmo, Differential Geometry of Curves and Surfaces, Prentice Hall, 1976.
3. J. A. Thorpe, Elementary Topics in Differential Geometry, Undergraduate Texts in Mathematics, Springer Verlag, 1994.
4. Pressley, Elementary Differential Geometry, Undergraduate Mathematics Series, Springer Verlag, 2001.
5. W. Kuhnel, Differential Geometry: Curves - Surfaces - Manifolds, American Mathematical Society, 2002.
6. J. Oprea, Differential Geometry and Its Applications, 2nd edition, Prentice Hall, 2003.
7. D. W. Henderson, Differential Geometry: A Geometric Introduction, Prentice Hall, 1998.
8. S.-S. Chern, W. H. Chen, K. S. Lan, Lectures on Differential Geometry, World Scientific Publishing, 1999.
9. M. Berger, Panoramic View of Riemannian Geometry, Springer Verlag, 2003.
10. R. S. Miliman, G. D. Parker, Elements of Differential Geometry, Prentice-Hall, Engelwood Cliffs - New Yersey, 1997.

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
A. Gray, Modern Differential Geometry of Curves and Surfaces with *Mathematica*, CRC Press, Boca Raton-Boston-London-New York-Washington, 1998.	1	10
I. Kamenarović, Diferencijalna geometrija, Sveučilište u Rijeci, Pedagoški fakultet, Rijeka, 1990.	5	10

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

After the last lecture of the course students will be asked to fulfill a questionnaire about the quality of the lectures. At the end of each semester results of the exams will be analyzed.

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Basic description		
Course coordinator	Ivo Ipšić	
Course title	INTRODUCTION TO DIGITAL SYSTEMS	
Study programme	Undergraduate Study Programme Physics	
Course status	Compulsory	
Year	2. year	
ECTS credits and teaching	***ECTS student 's workload coefficient***	5
	Number of hours (L+E+S)	30 + 30 + 0

1. COURSE DESCRIPTION

1.1. Course objectives

The aim of this course is to present the fundamental knowledge about digital systems and their functioning.

1.2. Course enrolment requirements

1.3. Expected course learning outcomes

The students will be introduced to basic terms in digital system design.

1.4. Course content

Information and number systems. Design of combinational logic. Boolean algebra basics. Truth tables. K Maps. Arithmetic Logic unit. Decoders. Multiplexers. Read Only memory. Sequential Devices. Flip-Flops. Combinations of Flip-Flops. Programmable Array Logic. Gate Arrays. Design of simple state machines.

1.5. Teaching methods

☒ lectures	☐ individual assignment
☐ seminars and workshops	☐ multimedia and network
☒ exercises	☐ laboratories
☐ long distance education	☐ mentorship
☐ fieldwork	☐ other

1.6. Comments

1.7. Student's obligations

It is compulsory for students to attend exercises. A student has to pass the written (practical) part of the examination which regards the exercises, as the precondition to take the oral part of examination where the complete knowledge of the student is examined and evaluated.

1.8. Evaluation of student's work

Course attendance	0.85	Activity/Participation		Seminar paper		Experimental work	
Written exam	1.10	Oral exam	1.40	Essay		Research	
Project		Sustained knowledge check	1.65	Report		Practice	
Portfolio							

1.9. Assessment and evaluation of student's work during classes and on final exam

Version 1 with final exam: Student's work is evaluated during the semester and on the final exam. Total number of points during the semester is 70 and on the final exam 30.
The detailed scheme for student's evaluation and assessing will be presented in the implementation plan for the course.

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1.10. Assigned reading (at the time of the submission of study programme proposal)

J. Župan, M. Tkalić, M. Kunštić. *Logičko projektiranje digitalnih sustava*, Školska knjiga, Zagreb, 1995.
U. Peruško: *Digitalna elektronika*, Školska knjiga, Zagreb, 1996.

1.11. Optional / additional reading (at the time of proposing study programme)

J.E. Palmer, D.E. Perlman. *Introduction to Digital Systems*. McGraw-Hill, 1993.

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
J. Župan, M. Tkalić, M. Kunštić. *Logičko projektiranje digitalnih sustava*, Školska knjiga, Zagreb, 1995.	1	10
U. Peruško: *Digitalna elektronika*, Školska knjiga, Zagreb, 1996.	1	10

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

During the last week of classes, a poll will be conducted, where students would evaluate the quality of classes. Students' achievements will be analyzed.

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Basic description		
Course coordinator	Nermina Mujaković	
Course title	INTRODUCTION TO NUMERICAL MATHEMATICS	
Study programme	Undergraduate Study Programme Physics	
Course status	Elective	
Year	2. year	
ECTS credits and teaching	***ECTS student 's workload coefficient***	5
	Number of hours (L+E+S)	30 + 30 + 0

1. COURSE DESCRIPTION

1.1. Course objectives

- theoretical knowledge of polynomial interpolation of function and practical usage of learned methods
- theoretical knowledge of numerical solution of non-linear and algebraic equations and practical usage of learned methods
- theoretical knowledge of numerical integration and practical usage of learned methods

1.2. Course enrolment requirements

Program of the course Introduction to Numerical Mathematics is in correlation with the other courses of mathematics and with the courses of computer science.

1.3. Expected course learning outcomes

After completing this course, it is expected students to understand numerical methods for polynomial interpolation, non-linear equations and integrals and to be able to apply those methods in practice.

1.4. Course content

Errors, estimation of error, floating-point arithmetic, stability of numerical algorithms on computer. Interpolation, polynomial interpolation, cubic spline interpolation, convergence, estimation of error. Determination of solutions of non-linear equations, Newton's method, function iteration method. Numerical methods for polynomial equations. Numerical integration. Newton-Cotes's formulas, Gauss's formulas, convergence, estimation of error.

1.5. Teaching methods	☒ lectures ☒ seminars and workshops ☒ exercises ☒ long distance education ☐ fieldwork	☒ individual assignment ☒ multimedia and network ☐ laboratories ☐ mentorship ☐ other
1.6. Comments	Student's work and activity in class are constantly monitored. Knowledge of student is evaluated at the exam.	

1.7. Student's obligations

Students are obligated to attend classes, actively participated in any form of work that is required and pass the exam. Exam: Written and oral exam. During the semester students are getting homework assignments and good grades of those assignments can get them acquittal of written exam.

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1.8. Evaluation of student's work

Course attendance	0.7	Activity/Participation	0.7	Seminar paper	1.2	Experimental work	
Written exam	0.6	Oral exam	0.6	Essay		Research	
Project		Sustained knowledge check	1.2	Report		Practice	
Portfolio							

1.9. Assessment and evaluation of student's work during classes and on final exam

Student will be evaluated and assessed during the course and final exam. Maximum total percentage which student can achieve during the lessons is 70%, while the final exam provides 30% at the best.
Detailed elaboration of ways of monitoring and evaluation of students' work will be displayed in the Working Plan.

1.10. Assigned reading (at the time of the submission of study programme proposal)

1. Rudolf Scitovski: Numerička matematika, Elektrotehnički fakultet Osijek, Osijek, 2004.
2. Ivan Ivanšić: Numerička matematika, Element, Zagreb, 1998.

1.11. Optional / additional reading (at the time of proposing study programme)

1. 1. H.Rutishauser: Vorlesungen uber numerische Mathematik I, Birkhauser, Verlag, Basel, 1976.
2. 2. J.Stoer, R. Bulirsch: Introduction to Numerical Analysis, Second edition, Springer-Verlag, New York, 1991.
3. 3. W.A.Smith: Elementary numerical analysis, Harper Row Publishers, New York, 1979.

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
Rudolf Scitovski: Numerička matematika, Elektrotehnički fakultet Osijek, Osijek, 2004.	5	10
Ivan Ivanšić: Numerička matematika, Element, Zagreb, 1998.	5	10

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

After the last lecture of the course students will be asked to fulfill a questionnaire about the quality of the lectures. At the end of each semester results of the exams will be analyzed.

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Basic description		
Course coordinator	Mladen Petravić	
Course title	LABORATORY PROJECT	
Study programme	Undergraduate Study Programme Physics	
Course status	Compulsory	
Year	3. year	
ECTS credits and teaching	***ECTS student 's workload coefficient***	2
	Number of hours (L+E+S)	0+0+30

1. COURSE DESCRIPTION

1.1. Course objectives

The prime aims of this subject are to introduce to the students the basic concepts of the experimental research in real, laboratory environment and to show them how to apply the knowledge gained during their undergraduate studies to solve some real physical problems.

1.2. Course enrolment requirements

No formal prerequisites. Knowledge of general and theoretical physics according to the study programme is assumed.

1.3. Expected course learning outcomes

-describe the research project, experimental technique and apparatus
-develop specific skills in carrying out experiment, gaining competence in statistical analysis, display and interpretation of experimental results
-connect theory with experiment
-getting insight in the scientific methodology of natural sciences

1.4. Course content

Students will undertake one of the experimental laboratory projects offered by the experimental laboratories of the Department of Physics.

1.5. Teaching methods	☐ lectures ☒ seminars and workshops ☐ exercises ☐ long distance education ☐ fieldwork	☒ individual assignment ☐ multimedia and network ☒ laboratories ☒ mentorship ☐ other
1.6. Comments		

1.7. Student's obligations

By the end of the semester, the students are required to present a short talk on one of the following subjects: description of the research project, description of the experimental technique and apparatus or description of measurements and data analysis.

1.8. Evaluation of student's work

Course attendance	0.5	Activity/Participation		Seminar paper	0.5	Experimental work	1
Written exam		Oral exam		Essay		Research	
Project		Sustained knowledge check		Report		Practice	
Portfolio							

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1.9. Assessment and evaluation of student's work during classes and on final exam

The student's work will be evaluated during the work in the laboratory and through the presentation of seminar.

1.10. Assigned reading (at the time of the submission of study programme proposal)

Literature will be given according to the choice of the project.

1.11. Optional / additional reading (at the time of proposing study programme)

Literature will be given according to the choice of the project.

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

Laboratory work includes mentorship and consulting work with the student, monitoring the student's activities and attitude towards work, which leads to gaining feedback on performance and progress.

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Basic description		
Course coordinator	Rene Sušanj	
Course title	LINEAR ALGEBRA I	
Study programme	Undergraduate Study Programme Physics	
Course status	Compulsory	
Year	1. year	
ECTS credits and teaching	***ECTS student 's workload coefficient***	7
	Number of hours (L+E+S)	45 + 45 + 0

1. COURSE DESCRIPTION

1.1. Course objectives

- to learn elementary notions of vector spaces and linear operators
- to learn characteristics of linear operators and matrices

1.2. Course enrolment requirements

Course program is correspondent to the program of other mathematics' studies, especially to Linear algebra II, Euclidean Spaces and Analysis I.

1.3. Expected course learning outcomes

After completing this class, students are expected to know the basis of vector spaces, linear operators and matrices. Students have to be able to use learned material for doing exercises.

1.4. Course content

Basis algebraic structures, vector space, base and dimension, subspace, factor space, linear operators, description of linear operator in different bases, inverse of operator, minimal polynomial, rank and defect of operator, rank of matrix.

1.5. Teaching methods	☒ lectures ☐ seminars and workshops ☒ exercises ☒ long distance education ☐ fieldwork	☒ individual assignment ☒ multimedia and network ☐ laboratories ☐ mentorship ☐ other
1.6. Comments	Students' work is followed continuously. The main part of the evaluation and assessment of students is the quality of active participation in lectures and exercises. The complete knowledge of students is evaluated on the exam.	

1.7. Student's obligations

Every student have to satisfy student's obligations: attendance at all classes and active participation. Exam: written and oral.

1.8. Evaluation of student's work

Course attendance	0.7	Activity/Participation	0.7	Seminar paper		Experimental work	
Written exam	2.6	Oral exam	1.8	Essay		Research	
Project		Sustained knowledge check	1.2	Report		Practice	

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Portfolio							

1.9. Assessment and evaluation of student's work during classes and on final exam

Student will be evaluated and assessed during the course and final exam. Maximum total percentage which student can achieve during the lessons is 70%, while the final exam provides 30% at the best.
Detailed elaboration of ways of monitoring and evaluation of students' work will be displayed in the Working Plan.

1.10. Assigned reading (at the time of the submission of study programme proposal)

1. S. Kurepa: Uvod u linearnu algebru, Školska knjiga, Zagreb, 1975.
2. K. Horvatić: Linearna algebra I, II i III, Sveučilište u Zagrebu, PMF, Matematički odjel, Zagreb, 1995.

1.11. Optional / additional reading (at the time of proposing study programme)

1. J. Dieudonne: Linearna algebra i elementarna geometrija, Školska knjiga, Zagreb, 1977.
2. L. Čaklović: Zbirka zadataka iz linearne algebre, Školska knjiga, Zagreb, 1976.
3. S.Kurepa: Konačnodimenzionalni vektorski prostori, Liber, Zagreb, 1992.

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
S.Kurepa: Uvod u linearnu algebru, Školska knjiga, Zagreb, (više izdanja).	5	25-30
K.Horvatić: Linearna algebra I, II i III, Sveučilište u Zagrebu, PMF, Matematički odjel, Zagreb, (više izdanja).	5	25-30

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

After the last lecture of the course students will be asked to fulfill a questionnaire about the quality of the lectures. At the end of each semester results of the exams will be analyzed.

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Basic description		
Course coordinator	Dejan Crnković	
Course title	LINEAR ALGEBRA II	
Study programme	Undergraduate Study Programme Physics	
Course status	Compulsory	
Year	1. year	
ECTS credits and teaching	***ECTS student 's workload coefficient***	7
	Number of hours (L+E+S)	45 + 45 + 0

1. COURSE DESCRIPTION

1.1. Course objectives

- to acquaint students with basics of systems of linear equations, matrices, determinants and linear operators

1.2. Course enrolment requirements

The program is correspondent to the program of other mathematical courses, especially Analysis I, Analysis II and Euclidean Spaces. Prerequisite for this course is Linear Algebra I.

1.3. Expected course learning outcomes

After completing this course students will be able to understand and apply basic properties of linear operators, matrices and determinants, and to solve a system of linear equation and analyze its solution.

1.4. Course content

Solving systems of linear equations, the existence and properties of solutions of such systems, matrices and determinants, Schwartz-Cauchy-Bunjakovski inequality, norm, metric functions, Gram-Schmidt orthogonalization process, quadratic forms.

1.5. Teaching methods	☒ lectures ☐ seminars and workshops ☒ exercises ☒ long distance education ☐ fieldwork	☒ individual assignment ☒ multimedia and network ☐ laboratories ☐ mentorship ☐ other
1.6. Comments	Student's activities are evaluated during the semester. Final exams are written and oral.	

1.7. Student's obligations

Students must attend the lectures and participate in all activities required for the course. Exam: written and oral.

1.8. Evaluation of student's work

Course attendance	0.7	Activity/Participation	0.7	Seminar paper		Experimental work	
Written exam	2.6	Oral exam	1.8	Essay		Research	
Project		Sustained knowledge check	1.2	Report		Practice	
Portfolio							

1.9. Assessment and evaluation of student's work during classes and on final exam

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Student will be evaluated and assessed during the course and final exam. Maximum total percentage which student can achieve during the lessons is 70%, while the final exam provides 30% at the best.
Detailed elaboration of ways of monitoring and evaluation of students' work will be displayed in the Working Plan.

1.10. Assigned reading (at the time of the submission of study programme proposal)

1. S. Kurepa: Uvod u linearnu algebru, Školska knjiga, Zagreb, 1975.
2. K. Horvatić: Linearna algebra I, II i III, Sveučilište u Zagrebu, PMF, Matematički odjel, Zagreb, 1995.

1.11. Optional / additional reading (at the time of proposing study programme)

1. J. Dieudonne: Linearna algebra i elementarna geometrija, Školska knjiga, Zagreb, 1977.
2. L. Čaklović: Zbirka zadataka iz linearne algebre, Školska knjiga, Zagreb, 1976.
3. S. Kurepa: Konačnodimenzionalni vektorski prostori, Liber, Zagreb, 1992.

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
S.Kurepa: Uvod u linearnu algebru, Školska knjiga, Zagreb, (više izdanja).	5	25-30
K.Horvatić: Linearna algebra I, II i III, Sveučilište u Zagrebu, PMF, Matematički odjel, Zagreb, (više izdanja).	5	25-30

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

After the last lecture of the course students will be asked to fulfill a questionnaire about the quality of the lectures. At the end of each semester results of the exams will be analyzed.

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Basic description		
Course coordinator	Majda Trobok	
Course title	LOGIC	
Study programme	Undergraduate Study Programme Physics	
Course status	Compulsory	
Year	3. year	
ECTS credits and teaching	***ECTS student 's workload coefficient***	6
	Number of hours (L+E+S)	30 + 0 + 30

1. COURSE DESCRIPTION

1.1. Course objectives

The objectives of the course Logic are to introduce students with the foundations of classical, informal logic and to make them able to understand the importance of valid argumentations not just in philosophical texts but in general too. The objective of the course Logic is, also, to introduce the students to the basic notions of symbolic prepositional logic.

1.2. Course enrolment requirements

The logic course program corresponds with all the other courses since logical knowledge/argumentation is used in all fields of philosophical judgment as well as in all scientific domains.

1.3. Expected course learning outcomes

It is expected from students to develop the necessary knowledge for the usage of valid conclusions, to be able to identify the logical mistakes in verbal and written argumentations and to learn how to recognize the steps in single argumentations in different philosophical texts.
It is also expected from students to learn the basic notions of set theory in order to be able to apply them in logic.
It is expected that students will learn the basic notions and technical skills necessary for the usage of symbolic logic in argumentations.
It is also expected that students will be able to fully understand the Syntax-Semantics distinction.

1.4. Course content

- Introduction (What is logic? Meaning and importance).
- Utterances, sentences, propositions.
- Arguments. Diagramming arguments. Arguments and explanations – differences.
- Inductive and deductive arguments. Truth and validity.
- Set Theory.
- Deduction: categorical propositions and categorical syllogism. Venn's diagram.
- Fallacies.

Symbolic Logic – Propositional Logic
- The alphabet of Prepositional Logic
- Truth Tables.
- Testing for Validity: The Semantical Method.
- Testing Arguments for Validity: The Syntactical Approach. Natural Deduction.
- Elementary Meta-theory for the Propositional Calculus. Consistency and Completeness Proof of Propositional Logic

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1.5. Teaching ethods	☒ lectures ☒ seminars and workshops ☐ exercises ☐ long distance education ☐ fieldwork	☒ individual assignment ☒ multimedia and network ☐ laboratories ☐ mentorship ☒ consultations
1.6. Comments	It is necessary to provide for students the possibility to work on computers in order for them to be able to use the available logical software and the Internet.	

1.7. Student's obligations

Attending classes is compulsory.
During each term there are two brief written examinations, which offer a possibility to students to be released from the written exam.
The final exam is both written (unless students reach a sufficient number of points though the two brief written examinations) and oral.

1.8. Evaluation of student's work

Course attendance	0.5	Activity/Participation	1.0	Seminar paper		Experimental work	
Written exam	3.0	Oral exam		Essay		Research	
Project		Sustained knowledge check	1.5	Report		Practice	
Portfolio							

1.9. Assessment and evaluation of student's work during classes and on final exam

Student will be evaluated and assessed during the course and final exam. Maximum total percentage which student can achieve during the lessons is 70%, while the final exam provides 30% at best.
Detailed elaboration of ways of monitoring and evaluation of students' work will be displayed in the Working Plan!

1.10. Assigned reading (at the time of the submission of study programme proposal)

Copi, I.M., Cohen, C., Introduction to Logic, Macmillan Publishing Company.
Newton-Smith, W.H., Logic - An Introductiory Course, Routledge.

1.11. Optional / additional reading (at the time of proposing study programme)

Acock, M., 1985, Informal Logic. Examples and Exercises, Wadsworth Publishing Company. (log)
Fogelin R.J. i Sinnott-Amstrong W., 2001, Understanding Arguments. An Introduction to Informal Logic, Wadsworth Group/Thomson Learning. (log)
Gensler, H.J., 2002, Introduction to Logic, Routledge. (log+simb)
Guttenplan, S., 1997, The Languages of Logic, Blackwell Publishers Ltd.
Hodges W., 2001, Logic. An Introduction to Elementary Logic, Penguin Books.
Kamke, E., 1950, Theory of Sets, Dover Publications, Inc.
Kurepa, Đ., 1951, Teorija skupova, Školska knjiga Zagreb.
Lepore, E., 2000, Meaning and Argument. An Introduction to Logic Through Language, Blackwell Publishing
Monk, J.D., 1969, Introduction to Set Theory, McGraw-Hill Book Company
Morse, a.P., 1965, A Theory of Sets, academic Press.
Nolt, J., Royatyn D. i Varzi A., 1998, Logic - Schaum's Outline Series, McGraw-Hill
Pinter, C.C., 1971, Set Theory, Addison-Welsey Publishing Company.
Quine, W. Van O., 1998, Elementary Logic, Harvard University Press.
Smith, P., 2003, An Introduction to Formal Logic, Cambridge University Press.
Tomassi, P., 1999, Logic, Routledge

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
Copi, I.M., Cohen, C., Introduction to Logic, Macmillan Publishing Company.	1	10

Newton-Smith, W.H., Logic - An Introductiory Course, Routledge.	1	10

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

The quality course evaluation is planned to be made by the lecturer herself (at the end of the course students will be asked to estimate the content, the methods leading out, teacher's work and the relationship to students), through the analyses of the realization of the expected outcomes of the course and by evaluations done at the Department or/and Faculty level.

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Basic description		
Course coordinator	Velimir Labinac	
Course title	MATHEMATICA SOFTWARE PACKAGE	
Study programme	Undergraduate Study Programme Physics	
Course status	Elective	
Year	2. year 3. year	
ECTS credits and teaching	***ECTS student 's workload coefficient***	3
	Number of hours (L+E+S)	15 + 15 + 0

1. COURSE DESCRIPTION

1.1. Course objectives

The main objectives of the course are to introduce students to the basics of the software package Mathematica Wolfram and to instruct them how to apply Mathematica in solving problems related to calculus and linear algebra. In this way, students gain basic knowledge about using Mathematica for analytical and numerical calculations in physics.

1.2. Course enrolment requirements

The course assumes basic knowledge of high school computer science and the use of Microsoft Windows OS. It is recommended (but not required) that students pass exams of the first year courses Mathematical Analysis I, II and Linear Algebra I, II before attending this course.

1.3. Expected course learning outcomes

After passing the exam, student will be able:

1. to use Mathematica for simple symbolic and numerical calculations;
2. to plot graphs of functions in 2-D and 3-D inculidng plot options (for example, draw graphs in color ,...);
3. to calculate derivatives and indefinite integrals of more complicated functions symbolically;
4. to calculate numerically the definite integral of continuous function;
5. to carry out various mathematical operations with matrices (a product of matrices, the calculation of eigenvalues,...);
6. to solve the system of linear and nonlinear equations symbolically or numerically, if neccesary;
7. to use lists and tables in simple examples.

1.4. Course content

Basic operations with numbers, mathematical expressions and functions: computing with numbers and embedded functions, graphing, solving equations (commands: N, FACTOR, EXPAND, SIMPLIFY, PLOT, PLOT3D, SHOW, SOLVE, NSOLVE). *Introduction to lists and tables*: lists and operations on lists (commands: TABLE, TAKE, PART, MAP). *Matrices and vectors*: an introduction to computing with matrices and vectors, systems of linear equations, eigenvalues and eigenvectors (commands: MATRIXFORM, DET, EIGENSYSTEM). *Calculus*: limits and continuity, differentiation, integration, series (commands: LIMIT, D, INTEGRATE, SERIES). *Differential equations*: first and second order differential equations, systems of differential equations (commands: DSOLVE, NDSOLVE).

1.5. Teaching methods		
	☒ lectures	☒ individual assignment
	☒ seminars and workshops	☒ multimedia and network
	☒ exercises	☐ laboratories

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	☒ long distance education ☐ fieldwork	☐ mentorship ☒ practicum
1.6. Comments		

1.7. Student's obligations

Students are obligated:

- to attend regularly and to participate actively in lectures and exercises;
- to do their homework independently;
- to write a seminar with PowerPoint presentation with the use of Mathematica in a concrete example of physics;
- to pass preliminary exam and final oral exam.

1.8. Evaluation of student's work

Course attendance	0.2	Activity/Participation	0.3	Seminar paper	0.8	Experimental work	
Written exam	0.5	Oral exam	0.5	Essay		Research	
Project		Sustained knowledge check	0.5	Report	0.2	Practice	
Portfolio							

1.9. Assessment and evaluation of student's work during classes and on final exam

Student will be evaluated and assessed during the course and final exam. Maximum total percentage which student can achieve during the lessons is 70%, while the final exam (oral and written) provides 30% at best.
Detailed elaboration of ways of monitoring and evaluation of students' work will be displayed in the Working Plan!

1.10. Assigned reading (at the time of the submission of study programme proposal)

Abell M. L., Braselton J. P., *Matematica by Example*, 4th. ed., Elsevier Academic Press, Burlington, 2009.

1.11. Optional / additional reading (at the time of proposing study programme)

Bauman G., *Mathematica for Theoretical Physics – Classical Mechanics and Nonlinear Dyanmics*, 2nd ed., Springer, Berlin, 2005.
Bauman G., *Mathematica for Theoretical Physics – Electrodynamics, Quantum Mechanics, General Relativity, and Fractals*, 2nd ed., Springer, Berlin, 2005.
Don E., *Schaum's Outline of Mathematica*, 2nd ed., Mcgraw-Hill, New York, 2009.
Dubin D., *Numerical and analytical methods for scientists and engineers using mathematica*, Wiley, New York, 2003.
Hoste J. *Mathematica Demystified*, Mcgraw-Hill, New York, 2009.
Ruskeepää H., *Mathematica Navigator*, 3rd ed., Elsevier Academic Press, Burlington, 2009.
Tam P. T., *A Physicist's Guide to Mathematica*, 2nd ed., Elsevier Academic Press, Burlington, 2008.

WWW
http://functions.wolfram.com/
http://demonstrations.wolfram.com/
http://mathworld.wolfram.com/
http://integrals.wolfram.com/index.jsp

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
Abell M. L., Braselton J. P., *Matematica by Example*, 4th. ed., Elsevier Academic Press, Burlington, 2009.	1	10

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1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences
Regular monitoring of the student's activity and attitude towards work. In the last week of classes, anonymous surveys will be conducted in which students will evaluate the quality of teaching. At the end of each semester (1 March and 30 September of the current academic year) student' success in examinations will be analyzed.

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Basic description		
Course coordinator	Sanja Rukavina	
Course title	MATHEMATICAL LOGIC	
Study programme	Undergraduate Study Programme Physics	
Course status	Compulsory	
Year	3. year	
ECTS credits and teaching	***ECTS student 's workload coefficient***	6
	Number of hours (L+E+S)	30 + 30 + 0

1. COURSE DESCRIPTION

1.1. Course objectives

- to acquaint students with basic notions of mathematical logic

1.2. Course enrolment requirements

The programme of the course Set theory is in correlation with the other mathematical courses, especially Set theory and Algebra.

1.3. Expected course learning outcomes

After completing this course students will be able to understand and apply basic notions of mathematical logic.

1.4. Course content

Classical sentential logic: syntax, semantics, alternational and conjunctional normal form, Craig lemma, compactness theorem, validity tests, Hilbert's formal system for sentential logic (deduction theorem, soundness and completeness theorems). First order logic: syntax, semantics, prenex normal form, validity test for first order logic, , Hilbert's formal system for first order logic (deduction theorem, soundness theorem), generalized completeness theorem (sketch of Henkin's proof). Consequences: Gödel's completeness theorem, compactness theorem. Limits of first order logic.

1.5. Teaching methods	☒ lectures ☐ seminars and workshops ☒ exercises ☒ long distance education ☐ fieldwork	☒ individual assignment ☒ multimedia and network ☐ laboratories ☐ mentorship ☐ other
1.6. Comments	Student's activities are continuously being monitored. Quality of student's active participation during classes and exercises is a component of the monitoring and evaluation. Complete knowledge of the student is evaluated at the exam.	

1.7. Student's obligations

Students must attend the lectures and participate in all activities required for the course. Exam: written and oral.

1.8. Evaluation of student's work

Course attendance	0.5	Activity/Participation	0.5	Seminar paper		Experimental work	
Written exam	2.4	Oral exam	1.4	Essay		Research	
Project		Sustained knowledge check	1.2	Report		Practice	

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Portfolio							

1.9. Assessment and evaluation of student's work during classes and on final exam

Student will be evaluated and assessed during the course and final exam. Maximum total percentage which student can achieve during the lessons is 70%, while the final exam provides 30% at the best.
Detailed elaboration of ways of monitoring and evaluation of students' work will be displayed in the Working Plan.

1.10. Assigned reading (at the time of the submission of study programme proposal)

1. J.Bell, M.Machover: A Course in Mathematical Logic,North-Holland,1977.
2. M. Vuković: Matematička logika I - Skripta, Zgb2000., PMF, Zagreb

1.11. Optional / additional reading (at the time of proposing study programme)

1. A.G.Hamilton: Logic for Mathematicians ,Cambridge,1988.
2. E.Mendelson: Introduction to Mathematical Logic ,NY,1964.
3. Joel V.Robbin: Mathematical Logic,NY,1969.

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
J.Bell, M.Machover: A Course in Mathematical Logic,North-Holland,1977.	1	10
M.Vuković: Matematička logika I - Skripta,Zgb2000., PMF, Zagreb	5	10

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

After the last lecture of the course students will be asked to fulfill a questionnaire about the quality of the lectures. At the end of each semester results of the exams will be analyzed.

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Basic description		
Course coordinator	Velimir Labinac	
Course title	MATHEMATICAL METHODS OF PHYSICS I	
Study programme	Undergraduate Study Programme Physics	
Course status	Compulsory	
Year	2. year	
ECTS credits and teaching	***ECTS student 's workload coefficient***	5
	Number of hours (L+E+S)	30 + 30 + 0

1. COURSE DESCRIPTION

1.1. Course objectives

The main objectives of the course are:

- to provide students with knowledge in the calculus of functions of several variables, vector analysis, tensor calculus and calculus of variations as a basis for further study in theoretical physics;
- to introduce students to the physical content and applications of these topics.

1.2. Course enrolment requirements

No prerequisites are required. However, it is recommended taking the exam of Mathematical Analysis I, II, Linear Algebra, II as soon as possible. The course is correlated with Mathematical Methods of Physics II and Classical Mechanics.

1.3. Expected course learning outcomes

After passing the exam, the student will be able:

1. to calculate simple and more complex problems in the calculus of functions of several variables;
2. to know and derive basic identities of the nabla operator, and apply them in curvilinear coordinate systems: spherical, cylindrical and generalized coordinates;
3. to explain and apply the basic theorems of vector analysis: divergence theorem, Stokes' theorem ,...;
4. to calculate the simple problems of tensor calculus and calculus of variations and to state some famous variational principles in physics.

1.4. Course content

Partial differentiation. Taylor's theorem for functions of several variables. Extrema of functions of several variables. Conditional extremes. Multiple integrals. Applications of multiple integrals in physics. Change of variables in multiple integrals. Vectors. Vector functions. Space curves. Frenet trihedron. Frenet-Serret formulas. Surfaces. Coordinate curves. Normal and tangent plane of smooth surfaces. Scalar and vector fields. Nabla operator. Formulas and identities with nabla. Dirac delta function. Curvilinear coordinates and the nabla operator. Line integrals. Green's theorem in the plane. Conservative fields and scalar potentials. Surface integrals. Geometrical definitions for the grad, div and curl. Divergence theorem. Stokes' theorem. Examples of the divergence theorem and Stokes' theorem in physics. Tensors. Cartesian tensors. The algebra of tensors. The metric tensor. Derivatives of basis vectors and Christoffel symbols. Calculus of variations. The Euler-Lagrange equation. Variational principles in physics.

1.5. Teaching methods	☒ lectures ☒ seminars and workshops ☒ exercises ☒ long distance education	☒ individual assignment ☒ multimedia and network ☐ laboratories ☐ mentorship

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	☐ fieldwork	☐ other
1.6. Comments	Seminars and reports (5-10 minutes) will consist of additional topics that are not covered during the course.	

1.7. Student's obligations

- regular attendance of lectures and exercises
- students are required to solve, write and submit specified number (usually 10) of homework on time
- to write a seminar with PowerPoint presentation and refer it to the class
- to pass two midterm written exams and the final oral exam

1.8. Evaluation of student's work

Course attendance	0.2	Activity/Participation	0.3	Seminar paper	0.8	Experimental work	
Written exam	1.5	Oral exam	1.5	Essay		Research	
Project		Sustained knowledge check	0.5	Report	0.2	Practice	
Portfolio							

1.9. Assessment and evaluation of student's work during classes and on final exam

Student will be evaluated and assessed during the course and final exam. Maximum total percentage which student can achieve during the lessons is 70%, while the final exam provides 30% at best.
Detailed elaboration of ways of monitoring and evaluation of students' work will be displayed in the Working Plan!

1.10. Assigned reading (at the time of the submission of study programme proposal)

Riley K. F., Hobson M. P. Bence S. J., *Mathematical Methods for Physics and Engineering*, 3rd ed., Cambridge University Press, Cambridge, 2006.

1.11. Optional / additional reading (at the time of proposing study programme)

Arfken G. B., Weber H. J., *Mathematical methods for physicists*, 6th ed., Academic Press, London, 2005.
Butkov E., *Mathematical Physics*, Addison-Wesley, Reading, 1968.
Callahan J. J., *Advanced Calculus A Geometric View*, Springer-Verlag, Heidelberg, 2010.
Chow T. L., *Mathematical Methods for Physicists: A Concise Introduction*, Cambridge University Press, Cambridge, 2000.
Demidovič B. P., i dr., *Zadaci i riješeni primjeri iz matematičke analize za tehničke fakultete*, Golden marketing, Zagreb, 2003.
Duistermaat J. J., Kolk J. A. C., *Multidimensional Real Analysis I: Differentiation*, Cambridge University Press, Cambridge, 2004.
Duistermaat J. J., Kolk J. A. C., *Multidimensional Real Analysis II: Integration*, Cambridge University Press, Cambridge, 2004.
Javor P., *Matematička analiza 2*, Element, Zagreb, 2004.
Kreyszig E., *Advanced Engineering Mathematics*, John Wiley, New York, 2006. (ili starije izdanje)
Kurepa S., *Matematička analiza, Treći dio - funkcije više varijabli*, Tehnička knjiga, Zagreb, 1989.
Lang S., *Calculus of Several Variables*, Springer USA, New York, 1987.
Mathews J., Walker R. L., *Mathematical Methods of Physics*, Addison-Wesley, Reading, 1970.
Miličić P. M., Uščumlić M. P., *Zbirka zadataka iz više matematike II*, Naučna knjiga, Beograd, 1986.
Van Brunt B., *The Calculus of Variation*, Springer-Verlag, Heidelberg, 2006.
Wong C. W., *Introduction to Mathematical Physics*, Oxford University Press, Oxford, 1991.
Zorich V. A., *Mathematical Analysis I*, Springer-Verlag, Heidelberg, 2004.
Zorich V. A., *Mathematical Analysis II*, Springer-Verlag, Heidelberg, 2004.

WWW
http://www.physics.miami.edu/~nearing/mathmethods/
http://www.maths.mq.edu.au/~wchen/ln.html

http://www.its.caltech.edu/~sean/book/unabridged.html
http://eqworld.ipmnet.ru/index.htm

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
Riley K. F., Hobson M. P. Bence S. J., *Mathematical Methods for Physics and Engineering*, 3rd ed., Cambridge University Press, Cambridge, 2006.	1	15-20

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

Regular monitoring of the student's activity and attitude towards work. In the last week of classes, anonymous surveys will be conducted in which students will evaluate the quality of teaching. At the end of each semester (1 March and 30 September of the current academic year) student' success in examinations will be analyzed.

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Basic description		
Course coordinator	Predrag Dominis Prester	
Course title	MATHEMATICAL METHODS IN PHYSICS II	
Study programme	Undergraduate Study Programme Physics	
Course status	Compulsory	
Year	2. year	
ECTS credits and teaching	***ECTS student 's workload coefficient***	5
	Number of hours (L+E+S)	30 + 30 + 0

1. COURSE DESCRIPTION

1.1. Course objectives

To acquaint the students with mathematical skills which are important not only in theoretical physics, but also in other disciplines of natural sciences, modern economics, finance, etc.

1.2. Course enrolment requirements

Cannot be taken before *Mathematical Methods in Physics I.*

1.3. Expected course learning outcomes

After completing the course student will be able to apply some medium-advanced mathematical techniques to problems in theoretical physics, other natural sciences, modern economics etc.

1.4. Course content

Differential equations. Ordinary differential equations. Classification. Solution. Existence and uniqueness of solutions of first-order equations. Techniques for solving equations of first-order, and some special higher-order cases. Laplace transform. Solving by series expansion. Introduction to numerical methods. Partial differential equations. Green's functions.
Complex analysis. Complex functions. Cauchy-Riemann relations. Multivalued functions. Riemann sheets. Complex integrals. Cauchy integral formula. Laurent expansion. Residue theorem. Poles of meromorphic function. Evaluation of definite integrals. Fourier transform. Selected special functions.

1.5. Teaching methods		
	☒ lectures	☒ individual assignment
	☐ seminars and workshops	☐ multimedia and network
	☒ exercises	☐ laboratories
	☐ long distance education	☐ mentorship
	☐ fieldwork	☐ other

1.6. Comments

1.7. Student's obligations

Active participation, doing home assignments and tests, passing the final exam.

1.8. Evaluation of student's work

Course attendance		Activity/Participation	0.5	Seminar paper		Experimental work	
Written exam		Oral exam	1.5	Essay		Research	
Project		Sustained knowledge check	3	Report		Practice	
Portfolio							

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1.9. Assessment and evaluation of student's work during classes and on final exam

Students will be evaluated and valued continuously during the course through home assignments and periodic tests, and eventually also at the final exam. Activities during the course bring at least 70% of the total mark.

1.10. Assigned reading (at the time of the submission of study programme proposal)

Boas M. L., *Mathematical Methods in the Physical Sciences*, 3rd edition, Wiley, 2005.

1.11. Optional / additional reading (at the time of proposing study programme)

Arfken G. B., Weber H. J., *Mathematical Methods for Physicists*, 6th edition, Academic Press, London, 2005.
Riley K. F., Hobson M. P. Bence S. J., *Matehematical Methods for Physics and Engineering*, Cambridge University Press, Cambridge, 2006.
Kreyszig E., *Advanced Engineering Mathematics*, John Wiley, New York, 2010.
Butkov E., *Mathematical Physics*, Addison-Wesley, Reading, 1968.
Mathews J., Walker R. L., *Mathematical Methods of Physics*, Addison-Wesley, Reading, 1970.

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
Boas M.L., Mathematical Methods in the Physical Sciences	2	10-15

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

Consultations, standard anonymous student questionnaires, discussions after the final exam.

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Basic description		
Course coordinator	Mladen Petravić	
Course title	MEASUREMENTS IN PHYSICS	
Study programme	Undergraduate Study Programme Physics	
Course status	Elective	
Year	2. year 3. year	
ECTS credits and teaching	***ECTS student 's workload coefficient***	5
	Number of hours (L+E+S)	30+15+15

1. COURSE DESCRIPTION

1.1. Course objectives

The main goal of this course is to show to students the importance of experiments and measurements of physical quantities in development, testing and verifying of theoretical models. The course includes the basic concepts of Metrology and measurements methods from antics to modern time. Key experiments preceding development of fundamental physical laws or concepts, such as Newton laws, Maxwell equations or Bohr's model of atom. Examples of planning and design of experiments are given by the discovery of electron, proton, neutron and positron and measurements of their properties and by examples of measurements of mechanical, electrical, magnetic and optical properties of materials. Several modern analytical techniques using beams of atomic particles for the characterisation of materials, available in several Laboratories in Croatia, are introduced.

1.2. Course enrolment requirements

Basic concepts in scientific measurements
Measurements methods from Antics to modern time
Key experiments preceding development of fundamental physical laws or concepts
Discovery of electron, proton, neutron and positron and measurements of their properties
Beams of atomic particles for the characterisation of materials
Examples of measurements of mechanical, electrical, magnetic and optical properties of materials

1.3. Expected course learning outcomes

Develop understanding and interest for measurements; gain knowledge about key experiments in history of physics; recognise the key role of experiments and measurements in discovery of physical phenomena and the creation and verification of a physical theory.

1.4. Course content

1.5. Teaching methods		
	☒ lectures ☐ seminars and workshops ☒ exercises ☒ long distance education ☐ fieldwork	☐ individual assignment ☐ multimedia and network ☐ laboratories ☒ mentorship ☐ other
1.6. Comments		

1.7. Student's obligations

Regular attendance of classes
Presentation of one seminar paper

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Pass two written exams with numerical problems
Pass an oral exam

1.8. Evaluation of student's work

Course attendance	0.5	Activity/Participation	0.5	Seminar paper		Experimental work	
Written exam	1.5	Oral exam	1.5	Essay		Research	
Project		Sustained knowledge check	1	Report		Practice	
Portfolio							

1.9. Assessment and evaluation of student's work during classes and on final exam

Active participation of students in classes and project work, with presentations of seminars. Acquirement, analysis and synthesis of competences in topics being taught via readings of bibliographical references. Discussion of these topics on lectures and exercises (1 ECTS) as well as via written and oral presentations, partial and final exams (4 ECTS).

1.10. Assigned reading (at the time of the submission of study programme proposal)

1. A. S. Morris, Measurement & Instrumentation Principles, Butterwort-Heinemann, Oxford, (2001).

1.11. Optional / additional reading (at the time of proposing study programme)

1. Springer Handbook of Materials Measurement Methods, Springer, Berlin, (2006).

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
1.A. S. Morris, Measurement & Instrumentation Principles, Butterwort-Heinemann, Oxford, (2001).	1	3

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

Interaction with students and student-faculty team work on quality of teaching process. Anonymous questionnaires on quality of teaching. Flexible adaptation of teaching to interests and needs of students. Analysis of passing rates.

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Basic description		
Course coordinator	Boran Berčić	
Course title	METAPHYSICS	
Study programme	Undergraduate Study Programme Physics	
Course status	Compulsory	
Year	3. year	
ECTS credits and teaching	***ECTS student 's workload coefficient***	5
	Number of hours (L+E+S)	30 + 0 + 30

1. COURSE DESCRIPTION

1.1. Course objectives

To acquaint student with the fundamental problems and solutions in metaphysics, to clarify the implications that metaphysical theory has to the overall picture of the world, to clarify the implications that metaphysical theory has to the other fields of philosophy: philosophy of mind, epistemology, philosophy of science, ethics, meta-ethics, etc.

1.2. Course enrolment requirements

Program of the course is correlated with the programs of several other courses in philosophy: Introduction to philosophy, Epistemology, Philosophy of Science, Philosophy of Mind, Logic, etc.

1.3. Expected course learning outcomes

Understanding of the basic problems of metaphysics, understanding of the implications that metaphysical theory has to other fields in philosophy, understanding of the ontological commitment of claims and theories.

1.4. Course content

1) Criteria of existence: causal criterion of existence, inference to the best explanation, Ockham's razor.
2) Existence of abstract entities: realism and nominalism about entities of mathematics, logic, semantics and ethical values.
3) Appearance and Reality: reasons for the distinction, scientific image and manifest image, is there synthetic *a priori* knowledge?
4) Things, properties, relations, facts, states of affaires, processes
5) Substance, essence and accident
6) Criterion of identity: physical objects, persons.
7) Categories
8) Universals: realism and nominalism about universals.
9) Natural kinds and essentialism: realism and nominalism about kinds, real and nominal essences, contemporary essentialism.
10) Causality: understood as constant conjunction, INUS-condition, counterfactual understanding, probabilistic understanding.
11) Space and time: absolute and relative understanding of space and time, McTaggart's paradox, asymmetries in time.
12) Semantics, logic and ontology
13) Determinism and freedom of the will: libertarianism, compatibilism, Newcomb's paradox, fatalism.
14) Reduction, emergence and supervenience: reductionism and antireductionism about mental states, abstract entities, values.
15) The existence of God: presumption of atheism, explanatory force of theistic explanations, "Fine-tuning" argument,

ontological argument.
16) Theories of truth: redundancy theory, correspondence, coherence, pragmatic, semantic, truth-makers and truth-bearers.
16) Critique of metaphysics: Kant's critique, critique of Logical Positivists.

1.5. Teaching ethods	☒ lectures ☒ seminars and workshops ☐ exercises ☐ long distance education ☐ fieldwork	☐ individual assignment ☐ multimedia and network ☐ laboratories ☐ mentorship ☐ other
1.6. Comments		

1.7. Student's obligations

Student should attain classes and seminars, write a paper and present it, pass the oral and written exam.

1.8. Evaluation of student's work

Course attendance	0.85	Activity/Participation		Seminar paper	0.85	Experimental work	
Written exam		Oral exam	3.3	Essay		Research	
Project		Sustained knowledge check		Report		Practice	
Portfolio							

1.9. Assessment and evaluation of student's work during classes and on final exam

Student will be evaluated and assessed during the course and final exam. Maximum total percentage which student can achieve during the lessons is 70%, while the final exam provides 30% at best.
Detailed elaboration of ways of monitoring and evaluation of students' work will be displayed in the Working Plan!

1.10. Assigned reading (at the time of the submission of study programme proposal)

E.J. Lowe: A Survey of Metaphysics, Oxford University Press, 2002.
Crane Tim & Farkas Katalin (ed): Metaphysics: A Guide and Anthology, Oxford University Press, 2004. (selekcija)
Jaegwon Kim i Ernest Sosa: Metaphysics, Blackwell, 2002. (selekcija)

1.11. Optional / additional reading (at the time of proposing study programme)

Neven Sesardić: Fizikalizam, Beograd, 1984.
Peter Strawson: Analiza i metafizika, KruZak, Zagreb, 1999.
Richard Taylor: Metaphysics, New Jersey, 1963.
Keith Campbell: Metaphysics, Dickenson Publishing Company, 1976.
Michael Loux: Metaphysics, Routledge, 2002.

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
E.J. Lowe: A Survey of Metaphysics, Oxford University Press, 2002.	1	10
Crane Tim & Farkas Katalin (ed): Metaphysics: A Guide and Anthology, Oxford University Press, 2004. (selekcija)	1	10
Jaegwon Kim i Ernest Sosa: Metaphysics, Blackwell, 2002. (selekcija)	1	10

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

At the end of the course students shall anonymously write their comments on the course.

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Basic description		
Course coordinator	Branka Milotić	
Course title	METHODOLOGY OF ELABORATING PROFESSIONAL AND SCIENTIFIC PAPERS	
Study programme	Undergraduate Study Programme Physics	
Course status	Compulsory	
Year	3. year	
ECTS credits and teaching	***ECTS student 's workload coefficient***	1
	Number of hours (L+E+S)	15 + 0 + 15

1. COURSE DESCRIPTION

1.1. Course objectives

The primary objective of the course is to teach students to solve problems independently, to deal with theoretical and practical research problems, which do not have to be original. To teach students to write professional thesis, and give them introducion to the principles of professional thesis writing and train them to write structured thesis.

1.2. Course enrolment requirements

Admission to the third year of undergraduate studies in physics

1.3. Expected course learning outcomes

At the end of the course, students will be able to:
independently write a professional paper, define the objectives and tasks of the professional paper, search and use the mother tongue and foreign language literature and other sources of knowledge independently, write a conspectus theme and concept of work, apply different levels of physical facilities, adjust the content of the application threads, apply and extend the knowledge acquired during their studies on specific topic (procedural knowledge), process expertise (theoretical or theoretical-practical) problems, professionally and methodically articulate the selected topic, with arguments to interpret cause-effect relationships, use metrology of legally prescribed units, correctly use mathematical apparatus and mathematical terminology, distinguish technical terminology from the termes of standard language, to use scientific language correctly and easily communicate professionally, process statistical data, graphically display and interpret data properly process and display the illustrations (tables, graphs, functions, charts, diagrams, drawings, photographs, diagrams, pictures), clearly, simply and concisely express thoughts, style, grammatically and spelling correctly write any text, properly cite references and orally present the work.

1.4. Course content

Collecting and studying the literature. Writing conspectus of topics and concepts. Articulation and writing of professional thesis. The structure of the professional and scientific thesis. Relating cause and effect. Cohesion and unity of the text. Preparation of illustrations. Documentation basics (citation and bibliography). Writing of the final paper. Expert editorial (correcting inappropriate content and complement the professional content). Metrological correctness. Spelling, grammar and style and language intervention (clarity, simplicity and conciseness of expression of thought). Content outside (cover) and inside pages of action. Making PwPt of presentation and presentation of content and structure of work in front of other students.

1.5. Teaching methods		
	☒ lectures	☒ individual assignment
	☒ seminars and workshops	☒ multimedia and network
	☐ exercises	☐ laboratories
	☐ long distance education	☒ mentorship
	☐ fieldwork	☐ other

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1.6. Comments	Classes are taught in the teaching space in the library with the technical assistance contractor seminars.

1.7. Student's obligations

Students must choose a topic area of expertise and labor to collect and study literature, to write a conceptual paper and submitt it for supervision, after which the student works indipendently. Students are continuously monitored, and their work is cheked for metrological terminology correctness and the principles of writing a professional paper. Student has to demonstrate the outcome of his/hers work in oral presentation, in front of the colleagues and tutors.

1.8. Evaluation of student's work

Course attendance	0,3	Activity/Participation	0,2	Seminar paper		Experimental work	
Written exam		Oral exam		Essay		Research	
Project		Sustained knowledge check		Report		Practice	
Portfolio		Preparation and presentation of	0,5				

1.9. Assessment and evaluation of student's work during classes and on final exam

The work and progress of students is monitored continuously through periodical review of their work.

1.10. Assigned reading (at the time of the submission of study programme proposal)

R. Zelenika: Metodologija i tehnologija izrade znanstvenog i stručnog djela, Ekonomski fakultet Sveučilišta u Rijeci, Rijeka. 2000.
K. Ražnjević: Jedinice Međunarodnog sustava (SI) i mjerne jedinice u Hrvatskoj, Axiom, Zagreb, 1997.
http://web.efzg.hr/dok/dokumenti/efzg_diplomski_seminarski_upute.pdf
http://www.vus-ck.hr/docs/Od_teme_do_diplomskog_rada.doc

1.11. Optional / additional reading (at the time of proposing study programme)

Dictionary of the Croatian language
Dictionary of foreign words,
Spelling Croatian Language

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
R. Zelenika: Metodologija i tehnologija izrade znanstvenog i stručnog djela, Ekonomski fakultet Sveučilišta u Rijeci, Rijeka. 2000	2	6
K. Ražnjević: Jedinice Međunarodnog sustava (SI) i mjerne jedinice u Hrvatskoj, Axiom, Zagreb, 1997.	3	6

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

Discussion of the criteria, the structure of the topic to be treated. Students and leader comment and evaluate the work and its presentation.

Activity that is evaluated	SHARE ACTIVITY IN ECTS POINTS MAX.	NUMBER OF POINTS
Course attendance	0.3	40
Activity/Participation	0.2	30
Preparation and presentation of	0,5	30
TOTAL	1	100

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Basic description		
Course coordinator	Dijana Dominis Prester and Branka Milotić	
Course title	METHODOLOGY OF WRITING AND PRESENTING OF A PROFESSIONAL AND A SCIENTIFIC WORK	
Study programme	Undergraduate Study Programme Physics	
Course status	Compulsory	
Year	3. year	
ECTS credits and teaching	***ECTS student 's workload coefficient***	4
	Number of hours (L+E+S)	20 + 0 + 40

1. COURSE DESCRIPTION

1.1. Course objectives

Teaching students to solve problems independently, to deal with theoretical and practical research problems, which do not have to be original. Teaching students to write a professional thesis, and giving them an introduction to the principles of professional thesis writing. Training them to write a structured thesis. Training them for presenting scientific research results in seminars and conference talks. Preparing students for the bachelor and master thesis defence.

1.2. Course enrolment requirements

Admission to the third year of undergraduate studies in physics. Basic knowledge of computer usage.

1.3. Expected course learning outcomes

At the end of the course, students will be able to:
Independently write a professional paper, define the objectives and tasks of the professional paper, search and use the mother tongue and foreign language literature and other sources of knowledge independently, write a conspectus theme and concept of work, apply different levels of physical facilities, adjust the content of the application threads, apply and extend the knowledge acquired during their studies on specific topic (procedural knowledge), process expertise (theoretical or theoretical-practical) problems, professionally and methodically articulate the selected topic, with arguments to interpret cause-effect relationships, use metrology of legally prescribed units, correctly use mathematical apparatus and mathematical terminology, distinguish technical terminology from the terms of standard language, to use scientific language correctly and easily communicate professionally, process statistical data, graphically display and interpret data properly process and display the illustrations (tables, graphs, functions, charts, diagrams, drawings, photographs, diagrams, pictures), clearly, simply and concisely express thoughts, style, grammatically and spelling correctly write any text, properly cite references and orally present the work.
Prepare and give a seminar and a talk at a conference in the given time, presenting own or other people's scientific research results. Learn to distinguish scientific from popular talks, take part in the discussions after the talks, and distinguish presenting their own results from presenting other people's results.

1.4. Course content

Collecting and studying the literature. Writing conspectus of topics and concepts. Articulation and writing of professional thesis. The structure of the professional and scientific thesis. Relating cause and effect. Cohesion and unity of the text. Preparation of illustrations. Documentation basics (citation and bibliography). Writing of the final paper. Expert editorial (correcting inappropriate content and complement the professional content). Metrological correctness. Spelling, grammar and style and language intervention (clarity, simplicity and conciseness of expression of thought). Content outside (cover) and inside pages of action. Methods of presenting of scientific results in a seminar. Preparing presentations in Power point, Open office and Latex. Giving a seminar in front of the audience with video recording, and paralel usage of a computer with a projector and a blackboard. Analysis of the given seminars. Basics of giving speeches. Communication at international conferences.

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1.5. Teaching methods	☒ lectures ☒ seminars and workshops ☐ exercises ☐ long distance education ☐ fieldwork	☒ individual assignment ☒ multimedia and network ☐ laboratories ☒ mentorship ☐ other
1.6. Comments	Classes are taught in the teaching space in the library with the technical assistance contractor seminars.	

1.7. Student's obligations

Class attendance. Choosing a topic area of expertise and labor to collect and study literature, writing a conceptual paper and submitting it for supervision, independent work on a written thesis. Students are continuously monitored, and their work is checked for metrological terminology correctness and the principles of writing a professional paper. Student has to demonstrate the outcome of his/hers work in oral presentation, in front of the colleagues and tutors.
Attendance of seminars of the other class participants is mandatory. Active participation in discussions is expected.

1.8. Evaluation of student's work

Course attendance	0.5	Activity/Participation	0.5	Seminar paper	1.0	Experimental work	
Written exam		Oral exam		Essay		Research	
Project		Sustained knowledge check		Report		Practice	
Portfolio		Preparation and presentation of	2.0				

1.9. Assessment and evaluation of student's work during classes and on final exam

The work and progress of students is monitored continuously through periodical review of their work. Student can obtain up to 100% of the grade during the semester, by fulfilling the obligations given above. Instead of the final exam student will present a seminar.

1.10. Assigned reading (at the time of the submission of study programme proposal)

R. Zelenika: Metodologija i tehnologija izrade znanstvenog i stručnog djela, Ekonomski fakultet Sveučilišta u Rijeci, Rijeka. 2000.
K. Ražnjević: Jedinice Međunarodnog sustava (SI) i mjerne jedinice u Hrvatskoj, Axiom, Zagreb, 1997.
http://web.efzg.hr/dok/dokumenti/efzg_diplomski_seminarski_upute.pdf
http://www.vus-ck.hr/docs/Od_teme_do_diplomskog_rada.doc

1.11. Optional / additional reading (at the time of proposing study programme)

Dictionary of the Croatian language
Dictionary of foreign words,
Spelling Croatian Language
http://www.utoledo.edu/as/physast/activities/physicsseminarheader.html
http://cnx.org/content/m16186/latest/
http://www.aps.org/careers/guidance/index.cfm
Together with their supervisor and the lecturer, students will choose the seminar topic. They will be advised the most recent scientific publications in the chosen field as the additional reading.

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
R. Zelenika: Metodologija i tehnologija izrade znanstvenog i stručnog djela, Ekonomski fakultet Sveučilišta u Rijeci, Rijeka. 2000	2	6
K. Ražnjević: Jedinice Međunarodnog sustava (SI) i mjerne jedinice u Hrvatskoj, Axiom, Zagreb, 1997.	3	6

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

Discussion of the criteria, the structure of the topic to be treated. Students and leader comment and evaluate the work and its presentation. Interaction with students and student-faculty team work on quality of teaching process. Anonymous questionnaires on quality of teaching. Flexible adaptation of teaching to interests and needs of students.

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Basic description		
Course coordinator	Dubravka Kotnik Karuza	
Course title	MODERN PHYSICS I	
Study programme	Undergraduate Study Programme Physics	
Course status	Compulsory	
Year	3. year	
ECTS credits and teaching	***ECTS student 's workload coefficient***	5
	Number of hours (L+E+S)	60+15+0

1. COURSE DESCRIPTION

1.1. Course objectives

Introduce the students to modern physics, evolving from semiclassical physics to quantum theory, with special reference to crucial experiments as well as to instruments and devices which are based on principles and laws of modern physics.

1.2. Course enrolment requirements

Students must have passed the exam in Physics I, II, III and IV.

1.3. Expected course learning outcomes

The students are expected to understand the basic principles of semiclassical and quantum physics and to describe the structure and function of modern instruments and devices which are based on these principles., They should be able to explain the crucial experiments in modern physics as well as the phenomena and processes in gases and in crystalline solids. In detail, the students are expected to be able to:

1.Describe the structure of atoms and Periodic table of the elements
2.Compare the semiclasic and quantum-mechanical models of atoms
3.Explain the spectrum of hydrogen using the Bohr theory
4.Desribe the Franck-Hertz experiment and discuss the result
5. Analyze the hydrogenlike atoms
6.Describe atomic collisions of first and second order and the resultant processes (emission and absorption of light), collisional ionization and recombination in triple collisions, photoionization, radiative recombination, Brehmsstrahlung
7.Explain the Moseley law
8. Explain the dublet features in the spectra of alkali atoms
9. Define and describe the metastable states
10. Explain the function of the He-Ne gas laser
11. Describe the magnetic properties of matter on atomic scale
12. Define the Bohr magneton
13. Describe the Stern-Gerlach experiment and discuss the result
14. Describe the Zeeman effect
15. Explain the Pauli exclusion principle
16. Explain and give experimental evidence for the dual nature of light and matter
17. Describe the Heisenberg's uncertainty principle
18. Solve the Schrödinger equation for a free particle, particle in a box, potential well and potential barrier
19. Describe the structure and function of electron microscope and scanning tunneling microscope
20. Find the quantum-mechanical solution of the harmonic oscillator
21. Describe the determination of the crystalline structure by the diffraction method

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22. Describe different types of bonds between atoms in crystals
23. Make a distinction among crystals according to their conductivity and its temperature dependence
24. Explain the origin of energy bands in solids
25. Derive the relation for the electron energy distribution in metals and define the Fermi energy
26. Describe the difference between several types of electron emission
27. Define the resistivity, mobility and conductivity of the charge carriers
28. Describe the intrinsic and extrinsic semiconductors
29. Explain the Hall effect
30. Describe the structure and explain the function of a semiconductor diode, LED diode, photodiode, semiconductor laser
31. Explain the structure and function of a bipolar junction and a field-effect transistor
32. Describe the integrated circuits

1.4. Course content

Atomic structure and Periodic table of elements. Bohr theory. X-ray spectra
Atomic processes. Atoms with more than one electron. Atoms in electric and magnetic field
Wave-particle dualism for light and matter.
Wavemechanical quantum theory. Uncertainty principle. Schrödinger equation.
Condensed matter. Metals. Semiconductors. Semiconductor devices

1.5. Teaching methods	☒ lectures ☐ seminars and workshops ☒ exercises ☐ long distance education ☐ fieldwork	☐ individual assignment ☐ multimedia and network ☐ laboratories ☐ mentorship ☐ other
1.6. Comments		

1.7. Student's obligations

Students are obliged to attend the course, to undergo verification of the acquired knowledge through written tests and to pass the final course exam.

1.8. Evaluation of student's work

Course attendance	0,5	Activity/Participation	0,5	Seminar paper		Experimental work	
Written exam	1	Oral exam	2	Essay		Research	
Project		Sustained knowledge check	1	Report		Practice	
Portfolio							

1.9. Assessment and evaluation of student's work during classes and on final exam

The students' work is being permanently assessed and evaluated through written tests. The total number of credits a student can achieve during the course (reviewed activities specified in the table), refer to the points earned on the final exam as 70:30.

1.10. Assigned reading (at the time of the submission of study programme proposal)

Halliday D., Resnick R., Walker J., *FUNDAMENTALS OF PHYSICS* , 6th ed., J.Wiley and Sons Inc., New York , 2003.
Young H.D., Freedman R.A., UNIVERSITY PHYSICS, 9th ed., Addison-Wesley Publishing Company, Inc, 1996.
Krane K.S.: MODERN PHYSICS, John Wiley & Sons, Inc., New York , 1996.
Thorne A., Litzén U. , Johansson S., *SPECTROPHYSICS*, Springer-Verlag, 1999
Haken H., Wolf H.C., *ATOMIC AND QUANTUM PHYSICS,* 2nd ed., Springer-Verlag, 1984

1.11. Optional / additional reading (at the time of proposing study programme)

Cutnell J.D., Johnson K.W: Physics, 7th ed, J.Wiley and Sons Inc., New York, 2007.
K. Seeger: *SEMICONDUCTOR PHYSICS*, Springer 1991
Beiser A., THEORY AND PROBLEMS OF PHYSICAL SCIENCE, Schaum's Outline Series, McGraw-Hill, 1974
http://www.physics.nmt.edu/~raymond
http://www.croeos.net/

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
Halliday D., Resnick R., Walker J., *FUNDAMENTALS OF PHYSICS* , 6th ed., J.Wiley and Sons Inc., New York , 2003.	2	7
Young H.D., Freedman R.A., UNIVERSITY PHYSICS, 9th ed., Addison-Wesley Publishing Company, Inc, 1996.	1	7
Krane K.S.: Modern Physics, John Wiley & Sons, Inc., New York , 1996.	1	7
Thorne A., Litzén U. , Johansson S., *SPECTROPHYSICS*, Springer-Verlag, 1999	1	7
Haken H., Wolf H.C., *ATOMIC AND QUANTUM PHYSICS,* 2nd ed., Springer-Verlag, 1984	1	7

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

The quality of the course will be permanently verified by the student's progress which is assessed through exams and other achievement records (solving problems during the course exercises and written tests).
Additional feedback on quality and efficiency of the course is gained by implementation of a students' questionnaire at the end of the course.

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Basic description		
Course coordinator	Dubravka Kotnik Karuza	
Course title	MODERN PHYSICS I	
Study programme	Undergraduate Study Programme Physics	
Course status	Compulsory	
Year	2. year	
ECTS credits and teaching	***ECTS student 's workload coefficient***	6
	Number of hours (L+E+S)	60+15+15

1. COURSE DESCRIPTION

1.1. Course objectives

Introduce the students to modern physics, evolving from semiclassical physics to quantum theory, with special reference to crucial experiments as well as to instruments and devices which are based on principles and laws of modern physics.

1.2. Course enrolment requirements

Students must have passed the exam in Physics I and Physics II.

1.3. Expected course learning outcomes

The students are expected to understand the basic principles of semiclassical and quantum physics and to describe the structure and function of modern instruments and devices which are based on these principles., They should be able to explain the crucial experiments in modern physics as well as the phenomena and processes in gases and in crystalline solids. In detail, the students are expected to be able to:

1.Describe the structure of atoms and Periodic table of the elements
2.Compare the semiclasic and quantum-mechanical models of atoms
3.Explain the spectrum of hydrogen using the Bohr theory
4.Desribe the Franck-Hertz experiment and discuss the result
5. Analyze the hydrogenlike atoms
6.Describe atomic collisions of first and second order and the resultant processes (emission and absorption of light), collisional ionization and recombination in triple collisions, photoionization, radiative recombination, Brehmsstrahlung
7.Explain the Moseley law
8. Explain the double features in the spectra of alkali atoms
9. Define and describe the metastable states
10. Explain the function of the He-Ne gas laser
11. Describe the magnetic properties of matter on atomic scale
12. Define the Bohr magneton
13. Describe thei Stern-Gerlach experiment and discuss the result
14. Describe the Zeeman effect
15. Explain the Pauli exclusion principle
16. Explain and give experimental evidence for the dual nature of light and matter
17. Describe the Heisenberg's uncertainty principle
18. Solve the Schrödinger equation for a free particle, particle in a box, potential well and potential barrier
19. Describe the structure and function of electron microscope and scanning tunneling microscope
20. Find the quantum-mechanical solution of the harmonic oscillator
21. Derive the quantum-mechanical solution for the hydrogen atom

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22. Describe the determination of the crystalline structure by the diffraction method
23. Describe different types of bonds between atoms in crystals
24. Make a distinction among crystals according to their conductivity and its temperature dependence
25. Explain the origin of energy bands in solids
26. Derive the relation for the electron energy distribution in metals and define the Fermi energy
27. Describe the difference between several types of electron emission
28. Define the resistivity, mobility and conductivity of the charge carriers
290. Describe the intrinsic and extrinsic semiconductors
30. Derive expressions for the concentracion of free charge carriers in semiconductors
31. Explain the Hall effect
32. Describe the structure and explain the function of a semiconductor diode, LED diode, photodiode, semiconductor laser
33. Explain the structure and function of a bipolar junction and a field-effect transistor
34. Describe the integrated circuits

1.4. Course content

Atomic structure and Periodic table of elements. Bohr theory. X-ray spectra
Atomic processes. Atoms with more than one electron. Atoms in electric and magnetic field
Wave-particle dualism for light and matter.
Wavemechanical quantum theory. Uncertainty principle. Schrödinger equation.
Condensed matter. Metals. Semiconductors. Semiconductor devices

1.5. Teaching methods	☒ lectures ☒ seminars and workshops ☒ exercises ☐ long distance education ☐ fieldwork	☐ individual assignment ☐ multimedia and network ☐ laboratories ☐ mentorship ☐ other
1.6. Comments		

1.7. Student's obligations

Students are obliged to attend the course, to undergo verification of the aquired knowledge through written tests, to write and present a seminar paper and to pass the final course exam.

1.8. Evaluation of student's work

Course attendance	0,5	Activity/Participation	0,5	Seminar paper	1	Experimental work	
Written exam	1	Oral exam	2	Essay		Research	
Project		Sustained knowledge check	1	Report		Practice	
Portfolio							

1.9. Assessment and evaluation of student's work during classes and on final exam

The students' work is being permanently assessed and evaluated through written tests. The total number of credits a student can achieve during the course (reviewed activities specified in the table), refer to the points earned on the final exam as 70:30.

1.10. Assigned reading (at the time of the submission of study programme proposal)

Halliday D., Resnick R., Walker J., *FUNDAMENTALS OF PHYSICS* , 6th ed., J.Wiley and Sons Inc., New York , 2003.
Young H.D., Freedman R.A., UNIVERSITY PHYSICS, 9th ed., Addison-Wesley Publishing Company, Inc, 1996.
Krane K.S.: MODERN PHYSICS, John Wiley & Sons, Inc., New York , 1996.
Thorne A., Litzén U. , Johansson S., *SPECTROPHYSICS*, Springer-Verlag, 1999
Haken H., Wolf H.C., *ATOMIC AND QUANTUM PHYSICS,* 2nd ed., Springer-Verlag, 1984

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1.11. Optional / additional reading (at the time of proposing study programme)

Cutnell J.D., Johnson K.W: PHYSICS, 7th ed, J.Wiley and Sons Inc., New York, 2007.
K. Seeger: *SEMICONDUCTOR PHYSICS*, Springer 1991
Beiser A., THEORY AND PROBLEMS OF PHYSICAL SCIENCE, Schaum's Outline Series, McGraw-Hill, 1974
http://www.physics.nmt.edu/~raymond
http://www.croeos.net/

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
Halliday D., Resnick R., Walker J., *FUNDAMENTALS OF PHYSICS* , 6th ed., J.Wiley and Sons Inc., New York , 2003.	2	7
Young H.D., Freedman R.A., UNIVERSITY PHYSICS, 9th ed., Addison-Wesley Publishing Company, Inc, 1996.	1	7
Krane K.S.: Modern Physics, John Wiley & Sons, Inc., New York , 1996.	1	7
Thorne A., Litzén U. , Johansson S., *SPECTROPHYSICS*, Springer-Verlag, 1999	1	7
Haken H., Wolf H.C., *ATOMIC AND QUANTUM PHYSICS*, 2nd ed., Springer-Verlag, 1984	1	7

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

The quality of the course will be permanently verified by the student's progress which is assessed through exams and other achievement records (solving problems during the course exercises and written tests).
Additional feedback on quality and efficiency of the course is gained by implementation of a students' questionnaire at the end of the course.

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Basic description		
Course coordinator	Snježana Prijić-Samaržija	
Course title	MODERN PHILOSOPHY FROM DESCARTES TO KANT	
Study programme	Undergraduate Study Programme Physics	
Course status	Compulsory	
Year	3. year	
ECTS credits and teaching	***ECTS student 's workload coefficient***	6
	Number of hours (L+E+S)	30 + 0 + 30

1. COURSE DESCRIPTION

1.1. Course objectives

- To introduce in the fundamental philosophical issues of modern philosophy (16-18 centuries)
- To develop the capacity to analyze and interpret classical philosophical papers
- To develop critical thinking through analysis of problems in ex cathedra lectures, seminars, debates and work in discussion groups
- To develop independent and creative application of acquired knowledge, and to develop the capacity of further research about the problems through individual tutorial work with interested students

1.2. Course enrolment requirements

The course correlates with the group of courses History of Philosophy, both with those which proceed like ancient and medieval and those which proceed like German idealism and contemporary philosophy. On the other side, course correlates with the several core courses such as Epistemology and Ontology, and the numerous elective courses (Perception, Emotion, Philosophy of religion, Moral anthropology, Philosophy of language, etc.).

1.3. Expected course learning outcomes

- to develop the skills of analytical and critical thinking about the traditional philosophical issues
- to obtain an appropriate level of knowledge about modern philosophy
- the acquiring of methodologies of scientific and philosophical reasoning
- to develop the skills of work on original philosophical literature
- to develop the capacity of confronting opposite approach and to defiance of their own
- to develop the awareness of the importance of argumentative discussion

1.4. Course content

1. ***Sources of knowledge, faculties of knowledge*** (from Descartes to Kant): innate and acquired knowledge; empiria vs. reason; British empiricism and continental rationalism, representationalism and phenomenalism (ideas, impressions); a priori vs. a posteriori; universal and self-evident truths (axioms of thought); Kant's critiques
2. ***Objectivity of knowledge*** (Locke, Berkeley, Hume, Spinoza, Reid, Kant): primary and secondary qualities – subjective and objective qualities; objectivity of dispositional qualities; epistemological realism and anti-realism; commonsense and scientific picture of the external world; Hume's scepticism and naturalism; Spinoza's degrees of knowledge;
3. ***Descartes: Methodical scepticism and evil demon:*** interrogative or negative scepticism, dream argument and other sceptical arguments; Evil Demon; Archimedean point – foundationalism; *Cogito, ergo sum*– theory of privileged access; introspection as a source of beliefs; intuitions; criteria of truth; representationalism

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4. ***Method*** (Bacon, Hume, Descartes, Spinoza, Wolff): induction and deduction; theory of idols, problem of induction; practical and clear rules; mathematical (geometrical) method; status of mathematics and logic on the one side and empirical sciences on other
5. ***Epistemology of testimony*** (Locke, Hume i Reid): social epistemology; transmission of knowledge as the source of knowledge; Hume about miracles; reductivism and anti-reductivism; a priory justification of trust (credulity) as necessary condition for reason functioning and contra universal scepticism; justified trust based of reduction to perception and generalization from perception.
6. ***Substance*** (Descartes, Spinoza, Leibniz, Locke, Hume i Berkeley): the notion of substance, *causa sui*, *natura naturata* and *natura naturans*, finite and infinite substance, *res cogitans* and *res extensa*; attributes and infinite modes of substance; monism, dualism, pluralism; simple substances or monads; monadology and dynamism; mind-body problem; Descartes' interactionism and Spinoza's parallelism; Leibniz and the idea of pre-established harmony; Berkeley's refutation of materialism; ontological realism and idealism etc.
7. ***The legitimacy of metaphysics;*** (Leibniz, Locke and Hume): necessary and contingent truths; truths of fact and truths of reason; causality; determinism; freedom of will; Hume's relations of ideas and matters of fact
8. ***The arguments to God's existence*** (Descartes, Spinoza, Pascal, Leibniz, Hume, Berkeley): Ontological argument, wager argument (Pascal); the problem of evil; The arguments to God's existence from eternal truths; the argument from truths of fact; the argument from the pre-established harmony; Hume's critique of the arguments to God's existence; Berkeley's argument to God's
9. ***Social Contract*** (Hobbes, Locke, Rousseau): the origins of political society the state of nature and the natural moral law; natural state of war, rational egoism and the state as *modus vivendi*; Hobbes political theory vs. Locke's political theory; Sovereignty and government; the liberty of subjects; the dissolution of government; civil government, etc.
10. ***Tolerance*** (Locke i Spinoza): the notion of tolerance; tolerance and freedom; religious tolerance, arguments for tolerance
11. ***Special problems:*** personal identity (Descartes, Locke, Hume); space and time (Newton, Leibniz); nominalism and realism (Leibniz and Locke); the critique of the theory of ideas, coherentism and foundationalism (Reid); Hume about emotions; judgments and preference (Pascal and Locke) etc.

1.5. Teaching methods	☒ lectures ☒ seminars and workshops ☐ exercises ☒ long distance education ☐ fieldwork	☒ individual assignment ☒ multimedia and network ☐ laboratories ☐ mentorship ☒ consultations
1.6. Comments	• Teaching strategies depend on the number of students who choose the course and on the previous knowledge about the issue. • Methodically complex approach, which unifies individual and group work, is preferred. • Successful work reacquires computer skills (Internet) and English language competence. • Evaluation is based on the continuous assessment of the students' work. • Consultations and successful participation in the discussion groups are the aspects of active participation. • In a case of tutorial work, student's work on the published articles or participation on the (international) conferences is of the highest respect	

1.7. Student's obligations

- Regular and active participation on lecture's class and discussion groups (including consultations)
- An essay (5-15 pages)
- Consultations during the work on the seminar papers
- Written and oral exam at the end of course (written exam could be substituted by several seminar papers, essays or short written tests during the semester)
- To the most interested students, additional individual work with the supervisor is offered.

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1.8. Evaluation of student's work

Course attendance	1.0	Activity/Participation	1.0	Seminar paper		Experimental work	
Written exam	1.0	Oral exam		Essay	1.0	Research	
Project		Sustained knowledge check	2.0	Report		Practice	
Portfolio							

1.9. Assessment and evaluation of student's work during classes and on final exam

Student will be evaluated and assessed during the course and final exam. Maximum total percentage which student can achieve during the lessons is 70%, while the final exam provides 30% at best.
Detailed elaboration of ways of monitoring and evaluation of students' work will be displayed in the Working Plan!

1.10. Assigned reading (at the time of the submission of study programme proposal)

Rene Descartes: Meditacije o prvoj filozofiji, u E. Husserl, Kartezijanske meditacije, Zagreb, SSO, 1975.
John Locke: Ogled o ljudskom razumu I i II, Beograd, Kultura,1962.
George Berkeley: Odabrane filozofske rasprave (Rasprava o načelima ljudske spoznaje, Tri dijaloga između Hylasa i Philonousa), Zagreb, KruZak,1999.
David Hume: Istraživanje o ljudskom razumu, Zagreb, Naprijed,1988.
Gottfried Wilhelm Leibniz: Novi ogled o ljudskom razumu, Sarajevo, Veselin Masleša, 1986.
Immanuel Kant: Kritika čistog uma, Zagreb, Matica hrvatska, 1987.

1.11. Optional / additional reading (at the time of proposing study programme)

Thomas Hobbes: Levijatan, Zagreb, Jesenski iTurk, 2004.
Rene Descartes: Rasprava o metodi, Zagreb, Matica Hrvatska,1951.
Baruch Spinoza: Etika, Beograd, BIGZ, 1959;
Baruch Spinoza: Rasprava o poboljšanju razuma, Beograd, Kultura,1957;
Gottfried Wilhelm Leibniz: Izabrani filozofski spisi, Zagreb, 1980
Francis Bacon: Novi organon, Zagreb, 1986.

Frederik Copleston: A History of Philosophy, Vol.5: Hobbes to Hume, New York, 1959.
Frederik Copleston: A History of Philosophy, Vol.4: Hobbes to Hume, New York, 1959.
Johnatan Bennett: Locke, Barkeley, Hume - Central Themes, Oxford, 1991.
Bernard Williams: Descartes - the Project of Pure Enquiry, Pelican Books, 1978.
Margaret.D. Wilson: Descartes, London, Rautledge, 1978
Michael Ayers: Locke (Epistemology & Ontology), London, 1991.
J.L. Mackie: Problems from Locke, Oxford, Claredon Press, 1976.
Vere Chappell (ur.), Locke, Oxford, Oxford University Press, 1998.
Barry Stroud: Hume, London, 1977.
George S. Pappas, Berkeley's Thought, Ithaca, Cornell University Press, 2000
Robert, J. Fogelin, Berkeley, London, Rautledge, 2001.
Roger Scruton, Spinoza, Oxford, Oxford University Press,1986.
Roger Scruton, Kant, Oxford, Oxford University Press,1982.
Anthony Savile, Leibniz and the Monadology, London, Rautledge, 2000.
Vanda Božičević (ur.), Filozofija britanskog empirizma; Svezak 4, Hrestomatija filozofije, urednik hrestomatije Damir Barbarić; Zagreb, 1997.

(obvezna i dopunska literatura će se nadopunjavati obzirom na nova izdanja i prijevode)

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
Rene Descartes: Meditacije o prvoj filozofiji, u E. Husserl, Kartezijanske meditacije, Zagreb, SSO, 1975.	2	10

John Locke: Ogled o ljudskom razumu I i II, Beograd, Kultura,1962.	2	10
George Berkeley: Odabrane filozofske rasprave (Rasprava o načelima ljudske spoznaje, Tri dijaloga između Hylasa i Philonousa), Zagreb, KruZak,1999.	2	10
David Hume: Istraživanje o ljudskom razumu, Zagreb, Naprijed,1988	2	10

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

- Lecturer self-evaluation
- The results in attaining the course objectives
- Official and anonymous evaluation that is accomplished by Philosophy Department and Faculty of Philosophy

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Basic description		
Course coordinator	Dijana Dominis Prester	
Course title	MODERN PHYSICS II	
Study programme	Undergraduate Study Programme Physics	
Course status	Compulsory	
Year	2. year 3. year	
ECTS credits and teaching	***ECTS student 's workload coefficient***	6
	Number of hours (L+E+S)	60 + 15 + 15

1. COURSE DESCRIPTION

1.1. Course objectives

This course is designed to give the fundamental knowledge in some parts of modern physics.
Development of analytical, logical and abstract opinions, indispensable in physical considerations, are important as well, and understanding of experimental techniques of modern physics.

1.2. Course enrolment requirements

Physics I and II.

1.3. Expected course learning outcomes

The following outcomes are expected :
Realization of the previously quoted objectives.
Adoption of the course program and possibility to use the knowledge in the other parts of physics and interdisciplinary fields.

1.4. Course content

Photons. Blackbody radiation. Molecular structure. Molecular energy states and transitions (electronic, rotation, vibration). Raman effect.
Structure of atomic nuclei. Nuclear forces. Radioactivity. Nuclear models. Nuclear reactions. Mössbauer effect.
Elementary particles. Conservation laws. Classification of elementary particles. Mechanism of interaction between elementary particles.
Plasma. Basics of stellar evolution, pulsars and black holes. Standard Model and the Big Bang Theory.

1.5. Teaching methods	☒ lectures ☒ seminars and workshops ☒ exercises ☐ long distance education ☒ fieldwork	☒ individual assignment ☒ multimedia and network ☐ laboratories ☐ mentorship ☐ other
1.6. Comments	During the course students will be taken for a visit to Croatian or foreign laboratories active in the fields covered through this course, according to the current financial situation.	

1.7. Student's obligations

Attendance at all classes and active participation is expected ; tests and homeworks during the semester. Written and oral exams.

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1.8. Evaluation of student's work

Course attendance	0.5	Activity/Participation	0.5	Seminar	1	Experimental work	
Written exam	1	Oral exam	2	Essay		Research	
Project		Sustained knowledge check	1	Report		Practice	
Portfolio							

1.9. Assessment and evaluation of student's work during classes and on final exam

During the classes students can obtain up to 70% of the final grade through activity and sustained knowledge check. At the final exam they can achieve up to 30%.

1.10. Assigned reading (at the time of the submission of study programme proposal)

Krane, K. S. *Modern physics*, John Wiley& Sons, New York, 1995.
Eisberg, R., Resnick, R. *Quantum Physics of Atoms, Molecules, Solids, Nuclei and Particles*, John Wiley& Sons, New York, 1985.

1.11. Optional / additional reading (at the time of proposing study programme)

Gautreau, R. *Schaum's Outline of Modern Physics*, McGraw-Hill, New York, 1999.
Bransden, B.H., Joachain, C. J. *Physics of Atom and Molecules*, Prentice Hall, 2002.
Serway, R. A., Moses, C. J., Moyer, C. A. *Modern Physics*, Brooks Cole, 2004.
Llewellyn, R., Tipler, P. A. *Modern Physics*, W. H. Freeman & Co., 2002.
Vršnak, B.: *Temelji fizike plazme*, Školska knjiga Zagreb, 1996.
Furić, M., *Moderne eksperimentalne metode, tehnike i mjerenja u fizici*, Školska knjiga, Zagreb, 1992.
Vujnović, V.: Astronomija I i II, Školska knjiga Zagreb, 2005.

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

Discussions with students about difficulties, origining eventually in course objectives realization.
Anonimous questionnaire about students' expectation at the beginning of the course.
Anonimous questionnaire designed to evaluate quality of course program, lectures and lecture materials, teaching methods and interaction with students at the end of the course.

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Basic description		
Course coordinator	Nataša Hoić-Božić	
Course title	MULTIMEDIA SYSTEMS	
Study programme	Undergraduate Study Programme Physics	
Course status	Compulsory	
Year	3. year	
ECTS credits and teaching	***ECTS student 's workload coefficient***	5
	Number of hours (L+E+S)	30 + 30 + 0

1. COURSE DESCRIPTION

1.1. Course objectives

In the context of the course the students acquire the fundamental knowledge about the digitalization of single media (graphics, text, sound, animation, and video) and integration of these media into multimedia project.

1.2. Course enrolment requirements

The course program correlates with the courses Computer Networks. The course is a prerequisite for the course Hypermedia Systems in Education.

1.3. Expected course learning outcomes

Upon completion of course, students will be able to do the following:

- define and compare the concepts of multimedia, hypermedia and hypertext
- outline and explain advantages and disadvantages of multimedia and hypermedia
- describe software and hardware components of multimedia computer system
- outline, describe and compare digital media elements: graphics, text, sound, animation, and video
- develop and design simple digital multimedia files: graphics, sound, animation, and video clips
- organizing multimedia elements into web presentation by WWW standards and according to the phases for multimedia project development

1.4. Course content

Definition of multimedia, historical overview, usage of multimedia and hypermedia, multimedia hardware and software. Multimedia computer networks.
Using text in multimedia. Computers and text: producing text, fonts and character sets. Hypertext and elements of hypertextual user interfaces. Text for the Web.
Images: types, the process of digitalization, colour schemas, image file formats, image compression. Graphics for the Web.
Sound: MIDI and digital audio, preparing digital audio sound (music and speech), audio file formats, sound compression. Sound for the Web.
Animation: types, basic principles and techniques of animation, animation file formats, creating animations. Animation for the Web.
Video: analog and digital video standards, video and computers, video file formats and compression. Video for the Web, streaming video.
WWW multimedia standards (SMIL - Synchronized Multimedia Integration Language). Relation between HTML, XML and SMIL.

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1.5. Teaching methods	☒ lectures ☐ seminars and workshops ☒ exercises ☒ long distance education ☐ fieldwork	☒ individual assignment ☒ multimedia and network ☐ laboratories ☐ mentorship ☐ other
1.6. Comments		

1.7. Student's obligations

Students should actively participate in all forms of works, perform practical exercises and produce seminar papers. They should pass the final exam consisting of practical part (the exercises by using computer) and written part.

1.8. Evaluation of student's work

Course attendance	0.50	Activity/Participation	0.50	Seminar paper	2.00	Experimental work	
Written exam	1.00	Oral exam		Essay		Research	
Project		Sustained knowledge check	1.00	Report		Practice	
Portfolio							

1.9. Assessment and evaluation of student's work during classes and on final exam

Version 1 with final exam: Student's work is evaluated during the semester and on the final exam. Total number of points during the semester is 70 and on the final exam 30.
The detailed scheme for student's evaluation and assessing will be presented in the implementation plan for the course.

1.10. Assigned reading (at the time of the submission of study programme proposal)

1. Vaughan, T. (2001). Multimedia : Making It Work, Berkeley: McGraw-Hill Osborne Media.
2. Online learning materials for the course

1.11. Optional / additional reading (at the time of proposing study programme)

1. Rosenborg, Green, Hester, Knowles, & Wirsching, (1993). A Guide To Multimedia. Carmel, Indiana: New Riders Publishing.
2. Ružić, F. (1994). Multimedija. Zagreb: Klik.
3. Cox N., Manley, C.T., & Chea F. (1995). LAN Times Guide to Multimedia Networking. Berkeley: Osborne McGraw-Hill.
4. Niederst, J. (2001). Learning Web Design: A Beginner's Guide to HTML, Graphics, and Beyond. O'Reilly.
5. Application programes' tutorilas

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
Vaughan, T. (2001). Multimedia : Making It Work, Berkeley: McGraw-Hill Osborne Media.	1	10

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

During the last week of classes, a poll will be conducted, where students would evaluate the quality of classes. Students' achievements will be analyzed.

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Basic description		
Course coordinator	Velimir Topolovec	
Course title	OBJECT ORIENTED MODELING	
Study programme	Undergraduate Study Programme Physics	
Course status	Elective	
Year	2. year	
ECTS credits and teaching	***ECTS student 's workload coefficient***	5
	Number of hours (L+E+S)	30 + 30 + 0

1. COURSE DESCRIPTION

1.1. Course objectives

The main aim of this course is that students adopt concepts of object-oriented technology. Capacitate students for individual modeling, program and use object-oriented approach and methods in solving problems by using modeling language (UML).

1.2. Course enrolment requirements

1.3. Expected course learning outcomes

Students are expected to acquire:
adopt concepts of object-oriented technology,
using UML in modeling complex problems solutions based on object-oriented approach.

1.4. Course content

Object-oriented languages and methods for modeling. Role of UML. Introducing structure and UML component. Work with relations. Understanding aggregations, compositions, interface and realisations. Functional view: diagram of way of use. Work with static structure diagram: class diagrams and object diagrams. Description of dinamic behaviour, interaction: flow diagram and cooperations. Description of object's state change: state diagrams and activity diagram. Work with implementation diagrams: component diagram and disposition. Implementation of UML in development process. Connecting UML with C++.

1.5. Teaching methods	☒ lectures ☒ seminars and workshops ☒ exercises ☐ long distance education ☐ fieldwork	☒ individual assignment ☐ multimedia and network ☐ laboratories ☐ mentorship ☐ other
1.6. Comments		

1.7. Student's obligations

It is compulsory for students to attend exercises. To present seminar work. A student has to pass the written (practical) part of the examination which regards the exercises, as the precondition to take the oral part of examination where the complete knowledge of the student is examined and evaluated.

1.8. Evaluation of student's work

Course attendance	0.20	Activity/Participation	0.30	Seminar paper	0.50	Experimental work	
Written exam	1.00	Oral exam	1.00	Essay		Research	
Project		Sustained knowledge check	1.50	Report		Practice	0.50
Portfolio							

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1.9. Assessment and evaluation of student's work during classes and on final exam

Version 1 with final exam: Student's work is evaluated during the semester and on the final exam. Total number of points during the semester is 70 and on the final exam 30.
The detailed scheme for student's evaluation and assessing will be presented in the implementation plan for the course.

1.10. Assigned reading (at the time of the submission of study programme proposal)

1. B. Grady, J. Rumbaugh, I. Jacobson: The Unified Modeling Language User Guide, Addison-Wesley, 2004. (2nd ed.)
2. J. Schmuller: Teach Yourself UML in 24 Hours, Third Edition, Sams Publishing, Indianapolis, 2004

1.11. Optional / additional reading (at the time of proposing study programme)

1. Rumbaugh, J., Jacobson, I., Booch, G.: The Unified Modeling Language Reference Manual. Addison-Wesley, 2004. (2nd ed.)
2. H.E Eriksson, M. Penker: UML Toolkit, Wiley Computer Publishing, NY, 1998.
3. www.omg.org/uml/

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
B. Grady, J. Rumbaugh, I. Jacobson: The Unified Modeling Language User Guide, Addison-Wesley, 2004. (2nd ed.)	1	10
J. Schmuller: Teach Yourself UML in 24 Hours, Third Edition, Sams Publishing, Indianapolis, 2004.	1	10

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

During the last week of classes, a poll will be conducted, where students would evaluate the quality of classes. Students' achievements will be analyzed.

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Basic description		
Course coordinator	Velimir Topolovec	
Course title	OBJECT ORIENTED PROGRAMMING	
Study programme	Undergraduate Study Programme Physics	
Course status	Elective	
Year	2. year	
ECTS credits and teaching	***ECTS student 's workload coefficient***	5
	Number of hours (L+E+S)	30 + 30 + 0

1. COURSE DESCRIPTION

1.1. Course objectives

The main aim of this course is that students adopt concepts of object-oriented technology. Capacitate students for individual modeling, program and use object-oriented approach and methods in solving problems.

1.2. Course enrolment requirements

The content of this course draws on those informatics courses that deal with information systems and programming (Programming 1, Programming 2).

1.3. Expected course learning outcomes

Students are expected to acquire:
basic operations of programming interface
logical expressions, type of variable and their memory storage
use of hiearhical design by function use
make program documentation
develop program with one or more memory storage field
develop program for storage and finding data in files

1.4. Course content

Object-oriented systems and development of programming support. Introduction to object-oriented programming with programming language C++. Definition and use of class. Constructor and destructor. Global and static object. Using of basic system class and function. Function overcome. Overload of operators. Inheritance: type and use of inheritance. Class hierarchy. Object fields. Function and class templates. Exception and exception management.

1.5. Teaching methods	☒ lectures ☒ seminars and workshops ☒ exercises ☐ long distance education ☐ fieldwork	☒ individual assignment ☐ multimedia and network ☐ laboratories ☐ mentorship ☐ other
1.6. Comments		

1.7. Student's obligations

It is compulsory for students to attend exercises. A student has to pass the written (practical) part of the examination which regards the exercises, as the precondition to take the oral part of examination where the complete knowledge of the student is examined and evaluated.

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1.8. Evaluation of student's work

Course attendance	0.20	Activity/Participation	0.30	Seminar paper	0.50	Experimental work	
Written exam	1.00	Oral exam	1.00	Essay		Research	
Project		Sustained knowledge check	1.50	Report		Practice	0.50
Portfolio							

1.9. Assessment and evaluation of student's work during classes and on final exam

Version 1 with final exam: Student's work is evaluated during the semester and on the final exam. Total number of points during the semester is 70 and on the final exam 30.
The detailed scheme for student's evaluation and assessing will be presented in the implementation plan for the course.

1.10. Assigned reading (at the time of the submission of study programme proposal)

1. Liberty,J., C++ Unleashed, Sams Publishing, Indianapolis, 2000.
2. Liberty,J., Teach Yourself C++ in 21 Days, Third Edition, Sams Publishing, Indianapolis, 1999.

1.11. Optional / additional reading (at the time of proposing study programme)

1. Motik, B., Šribar, J., Demistificirani C++, Element, Zagreb, 2001.
2. Stroustrup, B. : The C++ Programming Language, Addison-Wesley, 2000.
3. Coad, P., North, D., Mayfield, M., Object models, Strategies, Patterns and Applications, Prentice Hall, Upper Sadle River, NJ, 1997.

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
Liberty,J., C++ Unleashed, Sams Publishing, Indianapolis, 2000.	1	10
Liberty,J., Teach Yourself C++ in 21 Days, Third Edition, Sams Publishing, Indianapolis, 1999.	1	10

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

During the last week of classes, a poll will be conducted, where students would evaluate the quality of classes. Students' achievements will be analyzed.

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Basic description		
Course coordinator	Božidar Kovačić	
Course title	OPERATING SYSTEMS I	
Study programme	Undergraduate Study Programme Physics	
Course status	Compulsory	
Year	3. year	
ECTS credits and teaching	***ECTS student 's workload coefficient***	4
	Number of hours (L+E+S)	30 + 30 + 0

1. COURSE DESCRIPTION

1.1. Course objectives

- introduce students with basic concept in Operating systems
- acceptance knowledge about basic concept of Operating system: processes, communication,
- data management, memory management,
- preparing for advance using of Operating systems

1.2. Course enrolment requirements

Students have to pass the course correlates with computer architecture courses.

1.3. Expected course learning outcomes

After completing the course and meeting requirements, students are expected to be capable of:

- define and distinguish operating systems' structure
- define concept of process and apply adopted knowledge at the problems related to concurrency, synchronization, scheduling and deadlock of processes.
- define memory management and distinguish difference in implementation of memory management
- define concept of directory and distinguish implementation of allocation of external memory
- describe concepts of security and protection and explain it's implementation

1.4. Course content

- Introduction in Operating system: development, structure
- Process management: concurrency, synchronization, delays, process scheduling
- Memory management: virtual memory, paging, segmentation
- Input/output: principles of Input/output software and hardware
- File systems: files, directories, file system implementation
- Security

1.5. Teaching methods	☒ lectures ☐ seminars and workshops ☒ exercises ☐ long distance education ☐ fieldwork	☐ individual assignment ☐ multimedia and network ☐ laboratories ☒ mentorship ☐ other
1.6. Comments	During the semester, a student obtains required number of ECTS credits through regular attendance and active participation in all forms of lectures, completion of tasks assigned and elaboration of particular topic.	

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1.7. Student's obligations

Regular class attendance and active participation in learning process. Student is supposed to pass written exam in respect to exercises as a precondition for taking the oral exam, where students' complete knowledge is evaluated and assessed.

1.8. Evaluation of student's work

Course attendance	1.00	Activity/Participation	2.00	Seminar paper		Experimental work	
Written exam	0.50	Oral exam	0.50	Essay		Research	
Project		Sustained knowledge check		Report		Practice	
Portfolio							

1.9. Assessment and evaluation of student's work during classes and on final exam

Student is supposed to pass two written exam related to lectures and two exams related to exercises (practical work with some operating systems) as a precondition for taking the final exam. Students' complete knowledge is evaluated and assessed by written final exam.
Maximal number of points during semester is 70, and 30 points for final exam.

1.10. Assigned reading (at the time of the submission of study programme proposal)

Tanenbaum A., Modern Operating systems, Prentice Hall, 2004.
Tanenbaum A., Woodhull A., Operating systems, Design & Implementation, Prentice Hall, 1997.

1.11. Optional / additional reading (at the time of proposing study programme)

Silberschatz A., Galvin P. B., Gagne G.,, Operating system concepts, John Wiley & Sons, 2009.

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
Tanenbaum A., Modern Operating systems, Prentice Hall, 2004	1	10
Tanenbaum A., Woodhull A., Operating systems, Design & Implementation, Prentice Hall,1997.	1	10

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

Periodical evaluation and assessment of students and teachers is foreseen in order to provide continuous improvement of teaching quality. During the last week of classes, a poll will be conducted, where students would evaluate the quality of classes. Students' achievements will be analyzed.

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Basic description		
Lecturer	Jasminka Giacometti	
Course title	ORGANIC CHEMISTRY	
Study programme	Undergraduate Study Programme Physics	
Course status	Compulsory	
Academic year	3. year	
Course grading and contact hours	***ECTS student 's workload coefficient***	7
	Number of hours (L+E+S)	20+30+10

1. COURSE DESCRIPTION

1.1. Course objectives

The goal is to link the basic knowledge of the structure and properties of organic molecules with the potential contamination of the environment.

1.2. Conditions for enrollment

Exam in the subject General Chemistry, Inorganic Chemistry and Analytical Chemistry.

1.3. Expected learning outcomes for the course

Evolving knowledge about the chemical changes and properties of organic environmental pollutants.

1.4. Course description

Classification of organic compounds
Organic contaminants of water, air and soil
Halogenated hydrocarbons and aromatic hydrocarbons. Polycyclic aromatic hydrocarbons (PAH)
Petroleum and petroleum products
Detergents and organic cleaning products
Synthetic polymers
Drugs
Food
Organic compounds present in the environment
CFCs (chlorofluorocarbons-freons)

1.5. Teaching methods	☒ Lectures ☐ Seminars and workshops ☒ Practical ☒ E-learning ☒ Fieldwork	☒ Case study ☐ Multimedia, internet ☐ Laboratory ☐ Tutorial ☐ Others _____
1.6. Comments	This course organic chemistry, students will go on field work in the DINA petrochemicals, Inc. Omišalj and INA Refinery Rijeka.	

1.7. Student obligations

Attending lectures, seminars, exercises, and writing seminar and exam.

1.8. Grading assesment

Class attendance	X	Activity	X	Seminar paper	X	Experimental work	
Test	X	Oral exam	X	Essay		Research	
Project		Coninuous evaluation	X	Report		Practical work	
Portfolio							

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1.9. Assessment and evaluation of students' work during the semester and final exam

Feedback from the subject of Organic Chemistry provides complete information about the candidate's success, and includes evaluation of the results conducted through continuous education and the final exam.
Continuing education consists of assessment of the results obtained on laboratory exercises (20 points), continuous assessment, which consists of 4 test consisted of 10 questions (30 points), seminar (15 points) and regular attendance (5 points), for a total continuous teaching contributes to 4.9 ECTS.
The final examination contributes 30 points and consists of a written and / or oral part, or 2.1 ECTS.
Criteria for evaluation complies with the criteria of undergraduate study: A (5) - 80-100%, B (4) - 70-79,99%, C (3) - 60 to 69.99%, D (2) - 50-59 , 99%, E (2) - 40 to 49.99%, F and FX - (1). On the final exam students must solve 50% of exam.

1.10. Required texts (at the time of registration of a program proposal)

1. S.H. Pine: Organska kemija, Školska knjiga, Zagreb, 1994.

1.11. Additional reading (when receiving the proposal of a program)

1. McMurry, John: Organic Chemistry: 6th Edition, Thomson Brooks/Cole, 2004.

1.12. Number of copies required literature in relation to the number of students who currently attend classes in the subject

Title	*Number of copies*	*Number of students*

1.13. Quality assurance

Quality performance is monitored by student evaluation, which include monitoring of teaching and curriculum, students passing the exams, individual performance appraisals of teachers (each student) conducted by student polls.

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Basic description		
Course coordinator	Boran Berčić	
Course title	PARADOXES	
Study programme	Undergraduate Study Programme Physics	
Course status	Optional	
Year	2. year	
ECTS credits and teaching	***ECTS student 's workload coefficient***	3
	Number of hours (L+E+S)	15 + 0 + 15

1. COURSE DESCRIPTION

1.1. Course objectives

To acquaint student with most known paradoxes in philosophy and their solutions.

1.2. Course enrolment requirements

This course is correlated with several other courses in philosophy; Logic, Epistemology, Philosophy of Language, Metaphysics, etc.

1.3. Expected course learning outcomes

To increase student's capacity of recognition of paradoxical consequences of certain views in philosophy, to increase the capacity of recognition of logical fallacies.

1.4. Course content

Semantic Paradoxes: liar paradox, barber paradox and other related semantic paradoxes.
Paradoxes in Inductive Reasoning: Hempel's or ravens paradox, Goodman's new riddle of induction or grue paradox, "Kripkestein".
Paradoxes in Deductive Reasoning: Caroll's paradox of Achilles and the Tortoise, selection task and the paradoxes of material implication.
Paradoxes in Rational Decision: prisoner's dilemma, Newcomb's paradox, Buridan's ass.
Pragmatic Paradoxes: unexpected exam or hangman's paradox, Moore's paradox.
Paradoxes of Motion: Zeno's paradoxes.
Paradoxes of Time: time travel and McTaggart's paradox.
Paradoxes of Divine Attributes: omniscience and omnipotence.

1.5. Teaching methods	☒ lectures ☒ seminars and workshops ☐ exercises ☐ long distance education ☐ fieldwork	☐ individual assignment ☐ multimedia and network ☐ laboratories ☐ mentorship ☐ other
1.6. Comments		

1.7. Student's obligations

Student should attain classes and seminars, write a paper and present it.

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1.8. Evaluation of student's work

Course attendance	1.0	Activity/Participation		Seminar paper	1.0	Experimental work	
Written exam		Oral exam		Essay		Research	
Project		Sustained knowledge check	1.0	Report		Practice	
Portfolio							

1.9. Assessment and evaluation of student's work during classes and on final exam

Student will be evaluated and assessed during the course. No final exam. Maximum total percentage which student can achieve during the lessons is 100%.
Detailed elaboration of ways of monitoring and evaluation of students' work will be displayed in the Working Plan!

1.10. Assigned reading (at the time of the submission of study programme proposal)

Sainsbury R.M: *Paradoxes*, Cambridge University Press, 1995.

1.11. Optional / additional reading (at the time of proposing study programme)

Robert M. Martin: *There Are Two Errors In The The Title Of This Book*, a sourcebook of philosophical puzzles, paradoxes and problems, Ontario, Canada, 1992.
Michael Clark: *Paradoxes From a to z*, Routledge, 2002.

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
Sainsbury R.M: *Paradoxes*, Cambridge University Press, 1995.	1	10

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

At the end of the course students shall anonymously write their comments on the course.

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Basic description		
Course coordinator	Predrag Šustar	
Course title	PHILOSOPHY AS A SYSTEM. HISTORY OF THE CLASSICAL GERMAN IDEALISM	
Study programme	Undergraduate Study Programme Physics	
Course status	Compulsory	
Year	3. year	
ECTS credits and teaching	***ECTS student 's workload coefficient***	5
	Number of hours (L+E+S)	30 + 0 + 30

1. COURSE DESCRIPTION

1.1. Course objectives

The basic aim of this course is to provide for undergraduate students an introduction to Kant's philosophy, to the post-Kantian period, as well as to the main features, and significance of resulting philosophical systems, such as one represented specifically by Hegel's idealism. Furthermore, the course will point out issues, and arguments that have had a major impact on more recent philosophical debates, and research traditions.

1.2. Course enrolment requirements

The course program establishes correspondence, and correlation with the following philosophy courses: Epistemology, Philosophy of the Natural and Social Sciences, Introduction to the History of Philosophy, Modern Philosophy from Descartes to Kant, Moral Philosophy.

1.3. Expected course learning outcomes

1) improving the ability to read classical works stemming from Modern Philosophy; 2) raising up the quality of student's research leading to her seminar paper.

1.4. Course content

Kant: pre-critical, and critical phases of Kant's philosophy; Hume's account of causal relations, and Kant's 'awakening from his dogmatic slumbers'; the 'Copernican revolution', and Kant's philosophical system. The main transcendental questions: how are synthetic *a priori* judgments possible in mathematics? How are synthetic *a priori* judgments possible in the natural sciences? Object of cognition as an «appearance», and the problem of epistemic status of the so-called «thing in itself» within Kant's philosophical system. The 'preeminence of the practical reason' over the speculative, and the critical foundation of moral philosophy: distinction between moral and legal domains; roles of different formulations of the categorical imperative. Kant's idea of freedom.

Hegel: objections to Kant's 'formal' idealism. Hegel's science of logic: the doctrine of being, doctrine of essence, and the doctrine of concept (subjective concept, object, idea). Philosophy of nature, in particular, the organism concept. History of philosophy, and Hegel's system approach.

1.5. Teaching methods		
	☒ lectures	☒ individual assignment
	☒ seminars and workshops	☒ multimedia and network
	☐ exercises	☐ laboratories
	☐ long distance education	☐ mentorship
	☐ fieldwork	☒ consultations

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1.6. Comments	The classes are thought by an instructor at the level of assistant professor, or higher, in the humanities, the research field of philosophy. Apart from the score obtained at the final oral exam, the overall exam score depends on the results obtained during continuous written assessments. Nevertheless, to a largest extent, the overall score depends on the quality of the seminar paper.

1.7. Student's obligations

It is expected from the student to attend regularly the classes, to work out a seminar paper, which will be delivered orally and, after that, submitted to the instructor. At the end, the student has a final, oral exam.

1.8. Evaluation of student's work

Course attendance	0.83	Activity/Participation	0.83	Seminar paper	2.1	Experimental work	
Written exam	0.83	Oral exam		Essay		Research	
Project		Sustained knowledge check	0.41	Report		Practice	
Portfolio							

1.9. Assessment and evaluation of student's work during classes and on final exam

Student will be evaluated and assessed during the course and final exam. Maximum total percentage which student can achieve during the lessons is 70%, while the final exam provides 30% at best.
Detailed elaboration of ways of monitoring and evaluation of students' work will be displayed in the Working Plan!

1.10. Assigned reading (at the time of the submission of study programme proposal)

Hegel, Georg W.F. (1987), Enciklopedija filozofijskih znanosti, prev., Veselin Masleša-Svjetlost, Sarajevo;
Kant, Immanuel (1953), Dvije rasprave (Prolegomena za svaku buduću metafiziku; Osnov metafizike ćudoređa), prev., Matica hrvatska, Zagreb;

1.11. Optional / additional reading (at the time of proposing study programme)

Barbarić, Damir (ur.) (1998), Filozofija njemačkog idealizma, Hrestomatija filozofije sv.6, Zagreb;
Beiser, Frederick C. (ed.) (1993), The Cambridge Companion to Hegel, Cambridge University Press, Cambridge;
Bonsiepen, Wolfgang (1997), Die Begrundung einer Naturphilosophie bei Kant, Schelling, Fries und Hegel: Mathematische versus spekulative Naturphilosophie, V. Klostermann, Frankfurt am Main;
Fichte, Johann G. (1956), Odabrane filozofske rasprave, prev., Kultura, Zagreb;
Guyer, Paul (ed.) (1992), The Cambridge Companion to Kant, Cambridge University Press, Cambridge;
Hegel, Georg W.F. (1955), Fenomenologija duha, prev., Kultura, Zagreb;
Kant, Immanuel (1984), Kritika čistoga uma, prev., Nakladni zavod Matice hrvatske, Zagreb;
ID. (1976), Kritika moći suđenja, prev., Naprijed, Zagreb;
Kitcher, Patricia (ed.) (1998), Kant's Critique of Pure Reason. Critical Essays, Rowman and Littlefield, Lanham;
Löw, Reinhard (1980), Philosophie des Lebendigen: Der Begriff des Organischen bei Kant, sein Grund und seine Aktualität, Suhrkamp, Frankfurt am Main;
Longuenesse, Beatrice and Robert B. Pippin (eds) (2006), Hegel's Critique of Metaphysics, Cambridge University Press, New York;
Schelling, Friedrich W.J. (1965), Sistem transcendentalnog idealizma, prev., Naprijed, Zagreb.

[Napomena: tijekom nastave, za potrebe studentskih seminarskih radova, bit će navedena dodatna literatura, s naglaskom na recentnijim radovima na ovom području.]

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
Hegel, Georg W.F. (1987), Enciklopedija filozofijskih znanosti, prev., Veselin Masleša-Svjetlost, Sarajevo	1	10

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Kant, Immanuel (1953), Dvije rasprave (Prolegomena za svaku buduću metafiziku; Osnov metafizike ćudoređa), prev., Matica hrvatska, Zagreb	1	10

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

In the first part of the course, and at the end, the student's opinion on the quality of information obtained will be assessed by anonymous surveys.

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Basic description		
Course coordinator	Ivo Orlić	
Course title	PHYSICS I: MECHANICS	
Study programme	Undergraduate Study Programme Physics	
Course status	Compulsory	
Year	1. year	
ECTS credits and teaching	***ECTS student 's workload coefficient***	9
	Number of hours (L+E+S)	45+45+0

1. COURSE DESCRIPTION

1.1. Course objectives

Objectives of this course are to introduce fundamental knowledge of the physics required for continuing of physics programme.

1.2. Course enrolment requirements

It is presumed the knowledge of Basic mathematics. Course is in correlation with other physics courses from 1st and 2nd year of study programme (Physics II to IV) and it is basis for the performance of Physics laboratory I, II, III, IV and of all subsequent physics courses.

1.3. Expected course learning outcomes

After passing the examination students will be able to:

- compare basic and deduced magnitudes in physics as well as scalar and vector quantities,
- compare coordinate systems and distinguish linear from nonlinear motion of particles,
- define Newton's laws of mechanics,
- apply Hook's law, derive and describe harmonic and anharmonic motions,
- describe and derive magnitudes in dynamics,
- describe and derive Newton's law of gravity,
- compare inertial and noninertial systems,
- describe and apply consequences of Lorentz transformation equations,
- describe activity of forces in rigid body mechanics,
- define, derive, describe and apply force's momentum, angular momentum and moments of inertia,
- describe on appearance of surface tightness and capillarity,
- distinguish statics from fluid dynamics.

1.4. Course content

Introduction. Intuition and measurements. Basic and deduced magnitudes in physics and measurement's units. Mechanics of particles. Linear and nonlinear motions. Newton's laws of mechanics. Newton's law of gravity. The gravitational field and gravitational potential. Conservation of energy, conservation of linear momentum and their applications. Inertial and noninertial systems. Consequences of special relativity and relativistic mechanics. Rigid body mechanics. Harmonic and anharmonic motions. Fluid mechanics.

1.5. Teaching methods	☒ lectures ☐ seminars and workshops ☒ exercises ☐ long distance education ☐ fieldwork	☒ individual assignment ☒ multimedia and network ☐ laboratories ☐ mentorship ☐ other

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1.6. Comments	The course consists from lectures, seminars and exercises adopted to attain outcomes specified before.

1.7. Student's obligations

Student's obligations consist in attendance at all classes in accordance to regulation of study. Active participation is expected. Final written and oral exam is obliged.

1.8. Evaluation of student's work

Course attendance	0.50	Activity/Participation	1.00	Seminar paper		Experimental work	
Written exam	2.00	Oral exam	2.50	Essay		Research	
Project		Sustained knowledge check	2.00	Report		Practice	
Portfolio		Substantive work	1.00				

1.9. Assessment and evaluation of student's work during classes and on final exam

Students work will be evaluated and assessed during the semester and final exam. Total number of credits a student can achieve during the semester is 70 (to assess the activities listed in the table), while during the final examination can achieve 30 points. The detailed working out ways of monitoring and evaluation of student's work will appear in the performing level courses.

1.10. Assigned reading (at the time of the submission of study programme proposal)

Udžbenik fizike Sveučilišta u Berkeleyu, 1, Tehnička knjiga, Zagreb, 1982.
Halliday, D., Resnick, R., Walker, J, *Fundamentals of Physics*, 6th ed, J. Wiley and Sons Inc., New York, 2003.

1.11. Optional / additional reading (at the time of proposing study programme)

Kulišić, P., Mehanika i toplina, Školska knjiga, Zagreb, 1987.
The Feynman Lectures on Physics, 1, California Institute of Technology, 1975.

WWW
http://www.physics.harvard.edu/problems.htm

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
Udžbenik fizike Sveučilišta u Berkeleyu, 1, Tehnička knjiga, Zagreb, 1982.	2	12
Halliday, D., Resnick, R., Walker, J, *Fundamentals of Physics*, 6th ed, J. Wiley and Sons Inc., New York, 2003.	3	

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

Student's portfolio: Continuous assessment of student's work.
Questionnaires: Questionnaire on student's expectations at the beginning of the course. Questionnaire at the end of the course designed to evaluate quality of course programme, lectures and lecture materials, teaching methods and interaction with students. After oral exam student is asked to comment course programme and to give suggestions about lecture materials, teaching methods and possible individual difficulties met during process of learning.

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Basic description		
Course coordinator	Mladen Petravić	
Course title	PHYSICS II: ELECTRICITY AND MAGNETISM	
Study programme	Undergraduate Study Programme Physics	
Course status	Compulsory	
Year	1. year	
ECTS credits and teaching	***ECTS student 's workload coefficient***	9
	Number of hours (L+E+S)	45+45+0

1. COURSE DESCRIPTION

1.1. Course objectives

Objectives of this course are to introduce fundamental knowledge of electricity and magnetism required for continuing of physics program.

1.2. Course enrolment requirements

/

1.3. Expected course learning outcomes

General: understanding of basic concepts and features of electricity and magnetism, development of physical way of thinking as well as skills for solving numerical and conceptual problems of electricity and magnetism.
Particular, student will be able to
1. define and distinguish basic concepts and laws of electrostaitcs and apply them on the calculus of forces and fields in electrostatics
2. define capacity, describe capacitors, apply definition of capacity on the numerical determination of capacity of the capacitors
3. define and distinguish basic concepts and laws concerning direct current and apply them to solve numerical problems with capacity, resistance and physical parameterst of current circuits
4. define and distinguish basic concepts and laws of conductivity of gases, fluids and metals
5. define and distinguish basic concepts and laws of magnetism and geomagnetism and apply them to solve numerical problems concerning magnetic induction
6. define and distinguish basic concepts and laws concerning alternating current and apply them
7. describe magnetic properties of materials
8. describe and distinguish Maxwells equations
9. derive equation of electromagnetic wave from Maxwell equation
10. describe and analyse fundamental experiments of electricity and magnetism

1.4. Course content

Electric charge. Coulomb's law. Electric field. Gauss's law. Electric potential. Electric dipole. Capacitance and capacitors. Direct current. Ohm's law. Resistance. Electric current loops.
Current in gases. Electrical conductivity of electrolytes. Electrical conduction in solids. Magnetism. Geomagnetism. Lorenz's force. Magnetic induction. Magnetic materials. Faraday's law of electromagnetic induction. Ampere's law. Maxwell's equations. Alternating current. Electromagnetic waves.

1.5. Teaching methods	☒ lectures ☐ seminars and workshops ☒ exercises ☒ e- learning (long distance education)	☐ individual assignment ☒ multimedia and network ☐ laboratories ☐ mentorship

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	☐ fieldwork	☒other
1.6. Comments	/	

1.7. Student's obligations

Attendance at all classes and active participation is expected. Final written and oral exam.
The Physics I course is required to enroll this course.

1.8. Evaluation of student's work

Course attendance	1	Activity/Participation	1	Seminar paper		Experimental work	
Written exam	3	Oral exam	2	Essay		Research	
Project		Sustained knowledge check	2	Report		Practice	
Portfolio							

1.9. Assessment and evaluation of student's work during classes and on final exam

Students work will be evaluated and assessed during the semester and final exam. Total number of credits a student can achieve during the semester is 70 (to assess the activities listed in the table), while during the final examination can achieve 30 points.
The detailed working out ways of monitoring and evaluation of students' work will appear in the performing level courses.

1.10. Assigned reading (at the time of the submission of study programme proposal)

Halliday D., Resnick R., Walker J., FUNDAMENTALS OF PHYSICS, 6th ed., J.Wiley and Sons Inc., New York, 2003.
Kulišić P., Lopac V. ELEKTROMAGNETSKE POJAVE I STRUKTURA TVARI, ŠK, Zagreb, 1991.

1.11. Optional / additional reading (at the time of proposing study programme)

Cindro N. *FIZIKA 2*, ŠK, Zagreb, 1985.
Purcell E. M. *ELECTRICITY AND MAGNETISM*, Berkeley Physics Course, Vol 2., Mc Graw Hill, New York, 1965.
Yavorski B. and Pinsky A. *FUNDAMENTALS OF PHYSICS* Vol.1., MIR Pub., Moscow, 1975

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
Halliday D., Resnick R., Walker J., FUNDAMENTALS OF PHYSICS, 6th ed., J.Wiley and Sons Inc., New York, 2003.	1	15-20
Kulišić P., Lopac V. ELEKTROMAGNETSKE POJAVE I STRUKTURA TVARI, ŠK, Zagreb, 1991.	5	15-20

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

Students' portfolio: Continuous assessment of students' work.
Questionnaires: Questionnaire on student's expectations at the beginning of the course.
Questionnaire at the end of the course designed to evaluate quality of course program, lectures and lecture materials, teaching methods and interaction with students.
After oral exam student is asked to comment course program and to give suggestions about lectures and lecture materials, teaching methods and possible individual difficulties met during process of learning

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Basic description		
Course coordinator	Rajka Jurdana Šepić	
Course title	PHYSICS III: WAVES AND OPTICS	
Study programme	Undergraduate Study Programme Physics	
Course status	Compulsory	
Year	2. year	
ECTS credits and teaching	***ECTS student 's workload coefficient***	7
	Number of hours (L+E+S)	45+30+0

1. COURSE DESCRIPTION

1.1. Course objectives

Objectives of this course are to introduce fundamental knowledge of the physics of waves and optics required for continuing of physics program.

1.2. Course enrolment requirements

/

1.3. Expected course learning outcomes

General: understanding of basic concepts and features of the physics of waves and optics, development of physical way of thinking as well as skills for solving numerical and conceptual problems of the physics of waves and optics.
Particular, student will be able to
1. define and distinguish basic concepts of vibration, periodic motion and waves and apply them on solving of numerical problems of wave motion
2. define and describe standing wave, wave equation and apply them on numerical problems solving
3. define and describe superposition of waves and wave energy
4. define and describe Doppler effect and apply the relation on numerical problems solving
5. define and distinguish basic concepts and laws of acustics and apply them to solve numerical problems
6. define and distinguish basic concepts of optics; refraction, reflection and formationa of images
7. describe mirror, describe and draw formation of images by the plane and spherical mirrors, derive mirror and magnification equation
8. describe lenses, describe and draw formation of images by the lenses, derive thin-lens and magnification equation, apply them on solving of numerical problems concerning lenses
9. describe basic humen eye anatomy, image formation by the eye and emetropies
10 . describe and distinguish fundamental optical instruments
11. describe wave nature of the light, dispersion and colour formation
12. describe concept of interference and formation of interferention pattern, apply the facts on solving of numerical problems concerning interference
13. describe concept of diffraction, diffraction on the slit and apply the facts on solving of numerical problems concerning diffraction
14. describe basic concept of light polarisation and define Brewsters angle

1.4. Course content

Nature of waves. The speed of the wave. The mathematical description of the wave. Wave equation. Superposition of waves. Standing waves. Energy of wave. The nature of sound. Speed of sound. The Doppler effect. Reflection and refraction of light. Images. Mirrors. Lenses. Human Eye. Optical instruments. Light as electromagnetic wave. Dispersion. Colours. Interference. Diffraction. Resolving power. Fotometry.. Speed of light. Polarization.

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1.5. Teaching methods	☒ lectures ☐ seminars and workshops ☒ exercises ☒ e- learning (long distance education) ☐ fieldwork	☐ individual assignment ☒ multimedia and network ☐ laboratories ☐ mentorship ☒ other
1.6. Comments	/	

1.7. Student's obligations

Attendance at all classes and active participation is expected. Final written and oral exam.
The Physics I course is required to enroll this course.

1.8. Evaluation of student's work

Course attendance	1	Activity/Participation	1	Seminar paper		Experimental work	
Written exam	2	Oral exam	1	Essay		Research	
Project		Sustained knowledge check	2	Report		Practice	
Portfolio							

1.9. Assessment and evaluation of student's work during classes and on final exam

Students work will be evaluated and assessed during the semester and final exam. Total number of credits a student can achieve during the semester is 70 (to assess the activities listed in the table), while during the final examination can achieve 30 points.
The detailed working out ways of monitoring and evaluation of students' work will appear in the performing level courses.

1.10. Assigned reading (at the time of the submission of study programme proposal)

Halliday D., Resnick R., Walker J., FUNDAMENTALS OF PHYSICS, 6th ed., J.Wiley and Sons Inc., New York, 2003.
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1.11. Optional / additional reading (at the time of proposing study programme)

Cutnell, Johnson, Essentials of Physics, Wiley and Sons, 2006
Yavorski B. and Pinsky A. *FUNDAMENTALS OF PHYSICS* Vol.1., MIR Pub., Moscow, 1975

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
Halliday D., Resnick R., Walker J., FUNDAMENTALS OF PHYSICS, 6th ed., J.Wiley and Sons Inc., New York, 2003.	1	15-20

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

Students' portfolio: Continuous assessment of students' work.
Questionnaires: Questionnaire on student's expectations at the beginning of the course.
Questionnaire at the end of the course designed to evaluate quality of course program, lectures and lecture materials, teaching methods and interaction with students.
After oral exam student is asked to comment course program and to give suggestions about lectures and lecture materials, teaching methods and possible individual difficulties met during process of learning

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Basic description		
Course coordinator	Nada Orlić	
Course title	PHYSICS IV: THERMODYNAMICS AND BASIC STATISTICAL PHYSICS	
Study programme	Undergraduate Study Programme Physics	
Course status	Compulsory	
Year	2. year	
ECTS credits and teaching	***ECTS student 's workload coefficient***	8
	Number of hours (L+E+S)	60+30+0

1. COURSE DESCRIPTION

1.1. Course objectives

Objectives of this course are to introduce fundamental knowledge of heat phenomena and statistical physics required to continuing of physics programme.

1.2. Course enrolment requirements

It is presumed the knowledge of Basic mathematics, Mathematical Analysis, Physics I, II and III. This course is basis for the performance of Physics laboratory I, II, III, IV and of all subsequent physics courses.

1.3. Expected course learning outcomes

After passing the examination students will be able to:

- define and compare basic concepts of heat phenomena,
- derive and describe laws of gases as well as gas state equation,
- describe, analyze and apply different forms of heat transfer,
- analyze and distinguish concept of kinetics theory of matter and thermodynamics,
- define laws of thermodynamics and describe the necessity to introduce the concept of entropy,
- define and distinguish functions of state from functions of process,
- derive the basic thermodynamics relation and equation of energy,
- apply to determine other useful relationships among thermodynamics magnitudes,
- describe and distinguish equilibrium and nonequilibrium states as well as reversible and irreversible processes,
- describe the phase crossing and derive the Clausius-Clapeyron equation,
- describe and distinguish heat capacities and derive relation among them,
- define basic concepts in probability calculations,
- describe the phase space and distinguish elementary presumptions in statistical mechanics,
- derive the Maxwell's law of velocity distribution and analyze three characteristic velocities,
- derive the Boltzmann's distribution,
- describe the quantization of energetic spectra,
- derive the Bose-Einstein and Fermi-Dirac distributions.

1.4. Course content

Basic concepts of heat phenomena. Gas laws. Heat transfer. Concepts of molecular-kinetics theory of matter. Laws of thermodynamics. Concept of entropy. Basic and general thermodynamics relations. Heat capacity. Thermodynamic's potentials. Phase equilibrium. Probability calculations. Elementary presumptions of statistical mechanics. Differentiation and nondifferentiation of particles. The Maxwell-Boltzmann distribution. Partition function. Quantization of energetic spectra. Bose-Einstein and Fermi-Dirac distributions.

1.5. Teaching methods		
	☒ lectures	☒ individual assignment
	☐ seminars and workshops	☒ multimedia and network

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	☒ exercises ☐ long distance education ☐ fieldwork	☐ laboratories ☒ mentorship ☐ other
1.6. Comments	The course consists from lectures, seminars and exercises adopted to attain outcomes specified before.	

1.7. Student's obligations

Student's obligations consist in attendance at all classes in accordance to regulation of study. Active participation is expected. Final written and oral exam is obliged.

1.8. Evaluation of student's work

Course attendance	0.50	Activity/Participation	1.00	Seminar paper		Experimental work	
Written exam	2.00	Oral exam	2.50	Essay		Research	
Project		Sustained knowledge check	2.00	Report		Practice	
Portfolio		Substantive work					

1.9. Assessment and evaluation of student's work during classes and on final exam

Students work will be evaluated and assessed during the semester and final exam. Total number of credits a student can achieve during the semester is 70 (to assess the activities listed in the table), while during the final examination can achieve 30 points. The detailed working out ways of monitoring and evaluation of student's work will appear in the performing level courses.

1.10. Assigned reading (at the time of the submission of study programme proposal)

Paić, M., *Toplina i termodinamika*, Školska knjiga, Zagreb, 1994.
Šips, V., *Uvod u statističku fiziku,* Školska knjiga, Zagreb, 1990.
Halliday, D., Resnick, R., Walker, J., *Fundamentals of Physics*, 6th ed, J. Wiley and Sons Inc., New York, 2003.

1.11. Optional / additional reading (at the time of proposing study programme)

Kulišić, P., *Mehanika i toplina*, Školska knjiga, Zagreb, 1987.
The Feynman Lectures on Physics, 1, California Institute of Technology, 1975.
Roy, B.N., *Fundamentals of Classical and Statistical Thermodynamics*, John Wiley & Sons, 1982.

WWW
http://www.physics.harvard.edu/problems.htm
http://scienceworld.wolfram.com/physics/
http://physics.weber.edu/thermal/

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
Paić, *Toplina i termodinamika*,	5	10
Šips, V., *Uvod u statističku fiziku*, Školska knjiga, Zagreb, 1990.	5	
Halliday, D., Resnick, R., Walker, J, *Fundamentals of Physics*, 6th ed, J. Wiley and Sons Inc., New York, 2003.	3	

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

Student's portfolio: Continuous assessment of student's work.
Questionnaires: Questionnaire on student's expectations at the beginning of the course. Questionnaire at the end of the course designed to evaluate quality of course programme, lectures and lecture materials, teaching methods and interaction with students. After oral exam student is asked to comment course programme and to give suggestions about lecture materials, teaching methods and possible individual difficulties met during process of learning.

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Basic description		
Course coordinator	Branka Milotić	
Course title	PHYSICS LABORATORY I	
Study programme	Undergraduate Study Programme Physics	
Course status	Compulsory	
Year	1. year	
ECTS credits and teaching	***ECTS student 's workload coefficient***	3
	Number of hours (L+E+S)	0 + 0 + 45

1. COURSE DESCRIPTION

1.1. Course objectives

Introducing the student to the skills in measurement, statistical analysis of results, display and interpretation of measurement results, establishing a connection of experimental to theoretical approach to the subject, developing an conceptual understanding.

1.2. Course enrolment requirements

Passed the examination in Physics I (Mechanics)

1.3. Expected course learning outcomes

Developing specific skills in experimental measurement, gaining competence in statistical analysis, display and interpretation of experimental results, as well as developing ability to connect theory to experimental measurement.

1.4. Course content

Introduction to measurement and correct display of experimental results. Calculation of experimental errors and statistical analysis of experimental results. Direct measurement of length. Indirect measurement of distances and radii of spherical surfaces. Measurement of weight and inertia. Density of solid bodies and liquids. Uniformly accelerated motion (Atwood's free fall device). Checking the 2nd Newton's law. Harmonic oscillation. Torsion. Rotational motion of objects. Measurement of rotational inertia for different objects. Measurement of gravitational acceleration by pendulum. Surface tension of liquids. Viscosity. Fluid flow. Aerodynamic buoyancy.

1.5. Teaching methods	☐ lectures ☒ seminars and workshops ☐ exercises ☐ long distance education ☐ fieldwork	☒ individual assignment ☐ multimedia and network ☒ laboratory work ☐ mentorship ☒ consultations
1.6. Comments	Students are obliged to write a lab preparation in advance. Measurements and statistical evaluation of results is done in laboratory. A completed measurement evaluation and discussion is submitted in the form of seminar paper. The corrections and assessment of work on consultation hours.	

1.7. Student's obligations

Written preparation for every lab work is needed. Measurement results need to be within expected experimental errors, evaluation and calculation done precisely, discussion and conclusions drawn correctly. Finished previous and prepared next lab exercise is required for access to measurement. Obligatory consultations for correction of negatively assessed papers. Students are obliged to attend laboratory classes regularly; missing the class possible twice in semester, but all the measurements should be done during the semester. All seminar papers should be approved and signed in order to access the final course exam.

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1.8. Evaluation of student's work

Course attendance	0,3	Activity/Participation	0,5	Seminar paper	0,2	Experimental work	0,5
Written exam		Oral exam	0,5	Essay		Research	
Project		Sustained knowledge check	0,5	Report	0,5	Practice	
Portfolio							

1.9. Assessment and evaluation of student's work during classes and on final exam

Student's work and progress is followed continuously: the knowledge is assessed colloquially during the laboratory measurements, written preparations and evaluations are assessed regularly. Organized and connected knowledge, as well as conceptual understanding on subject is assessed on final course exam.

1.10. Assigned reading (at the time of the submission of study programme proposal)

Laboratory I working materials.
Marković B., Miler D., Rubčić A., Račun pogrešaka i statistika, Liber, Zagreb, 1987.

1.11. Optional / additional reading (at the time of proposing study programme)

Required literature for Physics I course.
Wilson J. D., Physics Laboratory Experiments, 5th edition, Houghton Mifflin Company, Boston, 1998.
Gymnasium textbooks in physics.

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
Laboratory I working materials.	8	8
Marković B., Miler D., Rubčić A., Račun pogrešaka i statistika, Liber, Zagreb, 1987.	1	8

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

Feedback on course quality and achievements is obtained from permanent communication to students in lab and on consultation hours. Student's progress and adopted level of integrated thinking is being followed during the course

Activity that is evaluated	SHARE ACTIVITY IN ECTS POINTS MAX.	NUMBER OF POINTS
Course attendance	0.3	-
Activity/Participation	0.5	10
Seminar paper	0.2	10
Experimental work (measurements)	0.5	10
Continuous assessment	0.5	10
Report (processing exercises)	0,5	30
Final Exam	0,5	30
TOTAL	3	100

SCHEDULE - the scoring of each activity under review:

Activity/Participation - estimated to be:
- Collaborative relationships with other students (1 - 5 credits)
- Asking questions and seeking answers (1 - 5 points)

Seminar - estimated to be:
- Production of preparations for Exercise (1 - 5 points)
- Correctness of preparation (1 - 5 points)

Experimental work - it is estimated:
- Skills in the measurement and correctness of tabled results of measurement (1-5 points)
- Precision and accuracy of measurement (1 - 5 points)

Continuous assessment - estimated to be:

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- Application of the physical content to a specific exercise (1 - 10)

Report - estimated to be:
- Numerical data analysis (1- 10 points)
- The quality of interpretation of the results (1 - 10 points)
- Correctness of answers to assigned tasks and questions (1 - 10 points)

The final exam consists of three problems that the candidate is to answer orally. The quality of responses to each question is assessed with a 1 - 10 score.

1 (2) points - meets the minimum criteria (level of recognition)
2 (4) points - satisfactory, but with significant shortcomings (level reproduction)
3 (6) point (s) and - average, with noticeable errors (reproduction comprehension)
4 (8) point (s) and - above average, with the occasional error (the application and effectiveness)
5 (10) points - an exceptional response (level of creativity)

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Basic description		
Course coordinator	Branka Milotić	
Course title	PHYSICS LABORATORY II	
Study programme	Undergraduate Study Programme Physics	
Course status	Compulsory	
Year	2. year	
ECTS credits and teaching	***ECTS student 's workload coefficient***	3
	Number of hours (L+E+S)	0 + 0 + 45

1. COURSE DESCRIPTION

1.1. Course objectives

The objectives of this course are to familiarize students with the skills of doing experimental measurements and statistical data analysis, presentation and interpretation of experimental results and of linking experimental with theoretical approach and developing physical concepts in mechanics.

1.2. Course enrolment requirements

Passed the examination in Physics II (Electricity and Magnetism, Waves and Optics)

1.3. Expected course learning outcomes

Developing specific skills in experimental measurement, gaining competence in statistical analysis, display and interpretation of experimental results, as well as developing ability to connect theory to experimental measurement.

1.4. Course content

Simple electric circuits. Complex electric circuits. Internal electrical resistance of voltage sources. Ampermeter and voltmeter measurement range extension. Measurement of electrical resistance, coil inductivity and capacitor capacity. Reflection of light on plane mirror. Refraction of light on prism and half sphere. Refraction of light on lenses. Plane and spherical mirrors on optical bench. Lenses on optical bench. Microscope.

1.5. Teaching methods	☐ lectures ☒ seminars and workshops ☐ exercises ☐ long distance education ☐ fieldwork	☒ individual assignment ☐ multimedia and network ☒ laboratory work ☐ mentorship ☒ consultations
1.6. Comments	Prior to experimental work, students will have to make written preparation for every lab exercise. After finishing the lab exercise, the students are obliged to submit lab report, which consists of tabled results of measurement and complete statistical data analysis, together with conclusions. In order to gain all reports graded positively, students will have the opportunity to consult with course coordinator to correct the reports.	

1.7. Student's obligations

Written preparation for every lab work is needed. Measurement results need to be within expected experimental errors, evaluation and calculation done precisely, discussion and conclusions drawn correctly. Finished previous and prepared next lab exercise is required for access to measurement. Obligatory consultations for correction of negatively assessed papers. Students are obliged to attend laboratory classes regularly; missing the class possible twice in semester, but all the measurements should be done during the semester. All seminar papers should be approved and signed in order to access the final course exam.

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1.8. Evaluation of student's work

Course attendance	0,3	Activity/Participation	0,5	Seminar paper	0,2	Experimental work	0,5
Written exam		Oral exam	0,5	Essay		Research	
Project		Sustained knowledge check	0,5	Report	0,5	Practice	
Portfolio							

1.9. Assessment and evaluation of student's work during classes and on final exam

The work and progress of students is monitored continuously, in a way that students preparation for the lab is assessed colloquially and the lab reports regularly. The final exam checks the ability to connect content and level of conceptual understanding.

1.10. Assigned reading (at the time of the submission of study programme proposal)

Laboratory II working materials.
Marković B., Miler D., Rubčić A., Račun pogrešaka i statistika, Liber, Zagreb, 1987.

1.11. Optional / additional reading (at the time of proposing study programme)

Required literature for Physics II course.
Wilson J. D., Physics Laboratory Experiments, 5th edition, Houghton Mifflin Company, Boston, 1998.
Gymnasium textbooks in physics.

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
Laboratory II working materials	8	8
Marković B., Miler D., Rubčić A., Račun pogrešaka i statistika, Liber, Zagreb, 1987.	1	8

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

The course quality control is performed in permanent communication with students in laboratory over the course time period. Individual consultations provide the information on the students' progress and on the level of integrated thinking and integrated approach to topics previously elaborated in College Physics I .

Activity that is evaluated	SHARE ACTIVITY IN ECTS POINTS MAX.	NUMBER OF POINTS
Course attendance	0.3	-
Activity/Participation	0.5	10
Seminar paper	0.2	10
Experimental work (measurements)	0.5	10
Continuous assessment	0.5	10
Report (processing exercises)	0,5	30
Final Exam	0,5	30
TOTAL	3	100

SCHEDULE - the scoring of each activity under review:

Activity/Participation - estimated to be:
- Collaborative relationships with other students (1 - 5 credits)
- Asking questions and seeking answers (1 - 5 points)

Seminar - estimated to be:
- Production of preparations for Exercise (1 - 5 points)
- Correctness of preparation (1 - 5 points)

Experimental work - it is estimated:
- Skills in the measurement and correctness of tabled results of measurement (1-5 points)
- Precision and accuracy of measurement (1 - 5 points)

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Continuous assessment - estimated to be:
- Application of the physical content to a specific exercise (1 - 10)

Report - estimated to be:
- Numerical data analysis (1- 10 points)
- The quality of interpretation of the results (1 - 10 points)
- Correctness of answers to assigned tasks and questions (1 - 10 points)

The final exam consists of three problems that the candidate is to answer orally. The quality of responses to each question is assessed with a 1 - 10 score.

1 (2) points - meets the minimum criteria (level of recognition)
2 (4) points - satisfactory, but with significant shortcomings (level reproduction)
3 (6) point (s) and - average, with noticeable errors (reproduction comprehension)
4 (8) point (s) and - above average, with the occasional error (the application and effectiveness)
5 (10) points - an exceptional response (level of creativity)

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Basic description		
Course coordinator	Branka Milotić	
Course title	PHYSICS LABORATORY III	
Study programme	Undergraduate Study Programme Physics	
Course status	Compulsory	
Year	2. year	
ECTS credits and teaching	***ECTS student 's workload coefficient***	3
	Number of hours (L+E+S)	0 + 0 + 45

1. COURSE DESCRIPTION

1.1. Course objectives

Introducing the student to the skills in measurement, statistical analysis of results, display and interpretation of measurement results, establishing a connection of experimental to theoretical approach to the subject, developing an conceptual understanding.

1.2. Course enrolment requirements

Passed the examination in Physics III courses (Warmth)

1.3. Expected course learning outcomes

Introducing the student to the skills in measurement, statistical analysis of results, display and interpretation of measurement results, establishing a connection of experimental to theoretical approach to the subject, developing an conceptual understanding.

1.4. Course content

Mechanical waves and sound waves. Colorimetric measurements (absorption of light). Diffraction of light on slit, optical grid and fiber. Polarimeter. Determination of coil magnetic field. Determination of electron mass. Photoelectric effect. Determination of specific heat capacity. Specific heat of water vaporization and ice melting. Checking the gas laws. Checking the gas laws in terms of gas kinetic theory. Measurement of air humidity.

1.5. Teaching methods	☐ lectures ☒ seminars and workshops ☐ exercises ☐ long distance education ☐ fieldwork	☒ individual assignment ☐ multimedia and network ☐ laboratory work ☐ mentorship ☒ consultations
1.6. Comments	Students are obliged to write a lab preparation in advance. Measurements and statistical evaluation of results is done in laboratory. A completed measurement evaluation and discussion is submitted in the form of seminar paper. The corrections and assessment of work on consultation hours.	

1.7. Student's obligations

Written preparation for every lab work is needed. Measurement results need to be within expected experimental errors, evaluation and calculation done precisely, discussion and conclusions drawn correctly. Finished previous and prepared next lab exercise is required for access to measurement. Obligatory consultations for correction of negatively assessed papers. Students are obliged to attend laboratory classes regularly; missing the class possible twice in semester, but all the measurements should be done during the semester. All seminar papers should be approved and signed in order to access the final course exam.

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1.8. Evaluation of student's work

Course attendance	0,3	Activity/Participation	0,5	Seminar paper	0,2	Experimental work	0,5
Written exam		Oral exam	0,5	Essay		Research	
Project		Sustained knowledge check	0,5	Report	0,5	Practice	
Portfolio							

1.9. Assessment and evaluation of student's work during classes and on final exam

Student's work and progress is followed continuously: the knowledge is assessed colloquially during the laboratory measurements, written preparations and evaluations are assessed regularly. Organized and connected knowledge, as well as conceptual understanding on subject is assessed on final course exam.

1.10. Assigned reading (at the time of the submission of study programme proposal)

Laboratory II working materials.
Marković B., Miler D., Rubčić A., Račun pogrešaka i statistika, Liber, Zagreb, 1987.

1.11. Optional / additional reading (at the time of proposing study programme)

Required literature for Physics III course.
Wilson J. D., Physics Laboratory Experiments, 5th edition, Houghton Mifflin Company, Boston, 1998.
Gymnasium textbooks in physics.

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
Laboratory III working materials.	8	8
Marković B., Miler D., Rubčić A., Račun pogrešaka i statistika, Liber, Zagreb, 1987.	1	1

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

Feedback on course quality and achievements is obtained from permanent communication to students in lab and on consultation hours. Student's progress and adopted level of integrated thinking is being followed during the course.

Activity that is evaluated	SHARE ACTIVITY IN ECTS POINTS MAX.	NUMBER OF POINTS
Course attendance	0.3	-
Activity/Participation	0.5	10
Seminar paper	0.2	10
Experimental work (measurements)	0.5	10
Continuous assessment	0.5	10
Report (processing exercises)	0,5	30
Final Exam	0,5	30
TOTAL	3	100

SCHEDULE - the scoring of each activity under review:

Activity/Participation - estimated to be:
- Collaborative relationships with other students (1 - 5 credits)
- Asking questions and seeking answers (1 - 5 points)

Seminar - estimated to be:
- Production of preparations for Exercise (1 - 5 points)
- Correctness of preparation (1 - 5 points)

Experimental work - it is estimated:
- Skills in the measurement and correctness of tabled results of measurement (1-5 points)
- Precision and accuracy of measurement (1 - 5 points)

Continuous assessment - estimated to be:

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- Application of the physical content to a specific exercise (1 - 10)

Report - estimated to be:
- Numerical data analysis (1- 10 points)
- The quality of interpretation of the results (1 - 10 points)
- Correctness of answers to assigned tasks and questions (1 - 10 points)

The final exam consists of three problems that the candidate is to answer orally. The quality of responses to each question is assessed with a 1 - 10 score.

1 (2) points - meets the minimum criteria (level of recognition)
2 (4) points - satisfactory, but with significant shortcomings (level reproduction)
3 (6) point (s) and - average, with noticeable errors (reproduction comprehension)
4 (8) point (s) and - above average, with the occasional error (the application and effectiveness)
5 (10) points - an exceptional response (level of creativity)

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Basic description		
Course coordinator	Dubravka Kotnik Karuza	
Course title	PHYSICS LABORATORY IV	
Study programme	Undergraduate Study Programme Physics	
Course status	Compulsory	
Year	3. year	
ECTS credits and teaching	***ECTS student 's workload coefficient***	4
	Number of hours (L+E+S)	0+0+60

1. COURSE DESCRIPTION

1.1. Course objectives

Provide a better understanding of the theory, develop creativity through active learning, consolidate basic knowledge of physics, assist the construction of physical models with a simple mathematical formalism, introduce the scientific methodology of natural science based on the active connection of theory and experiment.

1.2. Course enrolment requirements

No formal prerequisites. Knowledge of general physics is assumed.

1.3. Expected course learning outcomes

Developing specific skills in carrying out experiment, gaining competence in statistical analysis, display and interpretation of experimental results. Develop the ability to solve independently new problems based on previously adopted knowledge and to connect theory with experiment thus getting insight in the scientific methodology of natural sciences.

1.4. Course content

Students individually and independently perform the following laboratory exercises :

- Electronic tubes (vacuum, gas-filled)
- Semiconductor devices (diodes)
- Rectifier circuits (half-wave, full-wave)
- Electronic RC filters
- Shaping of electronic signals
- Hall effect
- Franck-Hertz experiment
- Zeeman effect
- Compton effect
- X-ray fluorescence and Moseley law

1.5. Teaching methods	☐ lectures ☐ seminars and workshops ☒ exercises ☐ long distance education ☐ fieldwork	☒ individual assignment ☐ multimedia and network ☒ laboratories ☒ mentorship ☐ other
1.6. Comments	The student receives a feedback on each accomplished exercise. He is obliged to make the required corrections either by repeating the part of the experiment or by re-evaluating the results.	

1.7. Student's obligations

To go through all experimental units one by one: by preparing the basic theory, carrying out the required observations and measurements, writing a report on the results and their discussion. Each of these steps is verified by the teacher, including the final examination.

1.8. Evaluation of student's work

Course attendance		Activity/Participation		Seminar paper		Experimental work	0.4
Written exam		Oral exam	1.2	Essay		Research	
Project		Sustained knowledge check	1.2	Report	1.2	Practice	
Portfolio							

1.9. Assessment and evaluation of student's work during classes and on final exam

The students' work is being permanently followed by assessment of their written preparations and evaluations and by checking their knowledge colloquially during the laboratory exercises The total number of credits a student can achieve during the course (reviewed activities specified in the table), refer to the points earned on the final exam as 70:30.

1.10. Assigned reading (at the time of the submission of study programme proposal)

M. Sarta Deković, D. Kotnik-Karuza: Fizički praktikum IV (teaching material for internal use, Department of Physics, Rijeka, 2009)
D. Kotnik-Karuza: Osnove elektronike s laboratorijskim vježbama, Filozofski fakultet u Rijeci, 2000
Thorne A., Litzén U. , Johansson S., *SPECTROPHYSICS*, Springer-Verlag, 1999
K. Seeger: *SEMICONDUCTOR PHYSICS*, Springer 1991
P. Biljanović: Elektronički sklopovi, Školska knjiga, Zagreb, 2001
Halliday D., Resnick R., Walker J., *FUNDAMENTALS OF PHYSICS* , 6th ed., J.Wiley and Sons Inc., New York , 2003.
Haken H., Wolf H.C., *ATOMIC AND QUANTUM PHYSICS,* 2nd ed., Springer-Verlag, 1984

1.11. Optional / additional reading (at the time of proposing study programme)

Millman-Halkias: Integrated electronics, Analog and digital circuits and systems, Mc Graw-Hill Kogakusha, 1972
Nuffield Advanced Science PHYSICS: Teacher's Guide 1,2, Longman Group Ltd, Hong Kong 1988
Nuffield Advanced Science PHYSICS: Sudent's Guide 1,2, Longman Group Ltd, Hong Kong 1988
University Laboratory Experiments PHYSICS 1-5, PHYWE AG, Göttingen, 1995
http://www.fearofphysics.com/Atom/atom1.html
http://www.ba.infn.it/www/didattica.html

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
M. Sarta Deković, D. Kotnik-Karuza: Fizički praktikum IV (interni nastavni materijal Odjela za fiziku)	5	5
D. Kotnik-Karuza: Osnove elektronike s laboratorijskim vježbama, Filozofski fakultet u Rijeci, 2000	6	5
Thorne A., Litzén U. , Johansson S., *SPECTROPHYSICS*, Springer-Verlag, 1999	1	5
K. Seeger: *SEMICONDUCTOR PHYSICS*, Springer 1991	1	5
Halliday D., Resnick R., Walker J., *FUNDAMENTALS OF PHYSICS* , 6th ed., J.Wiley and Sons Inc., New York , 2003.	2	5
Haken H., Wolf H.C., *ATOMIC AND QUANTUM PHYSICS,* 2nd ed., Springer-Verlag, 1984	1	
P. Biljanović: Elektronički sklopovi, Školska knjiga, Zagreb, 2001	3	5

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

Permanent monitoring of students' laboratory work is carried out in continuous interaction with the teacher, thus developing their creativity through active learning, as well as their experimental skills. Their work and progress is being permanently followed by assessment of their written preparations and evaluations and by checking their knowledge colloquially during the laboratory exercises At the final exam an evidence of conceptual understanding and ability to

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establish relationship between experiment and theory is expected.
Additional feedback on quality and efficiency of the course is gained by implementation of a students' questionnaire at the end of the course.

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Basic description		
Course coordinator	Velimir Labinac	
Course title	PHYSICS SEMINARS	
Study programme	Undergraduate Study Programme Physics	
Course status	Elective	
Year	2. year 3. year	
ECTS credits and teaching	***ECTS student 's workload coefficient***	2
	Number of hours (L+E+S)	0 + 0 + 30

1. COURSE DESCRIPTION

1.1. Course objectives

The main objectives of the course Physics Seminars are to extend comprehension of the concepts of general physics, and to introduce students with the content of physics beyond the standard university curricula.

1.2. Course enrolment requirements

It is assumed that student has basic knowledge of general physics, but there are no courses that are prerequisites for entry.

1.3. Expected course learning outcomes

After passing the exam, student will be able:

1. to read and translate papers in English containing topics from elementary physics;
2. to independently prepare and write a short seminar in the field of general physics (and perhaps a level beyond);
3. to present a seminar before the audience and answer questions from the audience;
4. to actively participate in discussions and ask questions after the presentation of their colleagues.

1.4. Course content

Topics for the seminars will be selected from leading educational journals in physics: American Journal of Physics, The Physics Teacher, Physics Today, Science in Computing and Engineering, European Journal of Physics, Physics Education.

1.5. Teaching methods	☐ lectures ☒ seminars and workshops ☐ exercises ☒ long distance education ☐ fieldwork	☒ individual assignment ☒ multimedia and network ☐ laboratories ☐ mentorship ☐ other
1.6. Comments		

1.7. Student's obligations

- students are required to write and submit two seminars: first, elaborating paper from The Physics Teacher or Physics Education, and second, elaborating paper from American Journal of Physics with more advanced topic. The seminar must be written according to the rules that will be given and explained at the beginning of the course;
- students are required to prepare a poster containing physics from one of the seminars;

- students are required to present her/his seminar with PowerPoint presentation (Microsoft Office or OpenOffice). The duration of the presentation is limited to 15 minutes;
- students are to be present at the presentations of their colleagues, and are required to actively participate in discussions following the presentations

1.8. Evaluation of student's work

Course attendance	0.2	Activity/Participation	0.3	Seminar paper	1.2	Experimental work	
Written exam		Oral exam		Essay		Research	
Project		Sustained knowledge check		Report	0.3	Practice	
Portfolio		Poster					

1.9. Assessment and evaluation of student's work during classes and on final exam

There is no final exam. Students will be evaluated and assessed during the semester.
Detailed elaboration of ways of monitoring and evaluation of students' work will be displayed in the Working Plan!

1.10. Assigned reading (at the time of the submission of study programme proposal)

JOURNALS:
American Journal of Physics (http://scitation.aip.org/ajp);
Computing in Scinece and Engineering (http://scitation.aip.org/cse);
European Journal of Physics (http://www.iop.org/EJ/journal/EJP)
Physics Education (http://www.iop.org/EJ/journal/0031-9120)
Physics Today (http://www.physicstoday.org/);
The Physics Teacher (http://scitation.aip.org/tpt).

1.11. Optional / additional reading (at the time of proposing study programme)

Feynman R. P., Leighton R. B., Sands M., *The Feynman Lectures on Physics*, vol. 1-3, Addison-Weseley, Reading, 1963.
Berkeley Physics Course, vol. 1-5, McGraw-Hill
Walker J, *Fundamentals of Physics*, 8th ed., Wiley, New York, 2008.
Young H. D., Freedman R. A., *University Physics with Modern Physics*, 11th ed., Pearson, San Francisco, 2004.

WWW
http://academicearth.org/
http://e-knjiznica.carnet.hr/
http://ocw.mit.edu/OcwWeb/web/home/home/index.htm

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
American Journal of Physics	subscription	10-15
The Physics Teacher	subscription	
Physics Today	subscription	
Computing in Scinece and Engineering	subscription	
European Journal of Physics	-	
Physics Education	-	

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1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences
Regular monitoring of the student's activity and attitude towards work. In the last week of classes, anonymous surveys will be conducted in which students will evaluate the quality of teaching. At the end of each semester (1 March and 30 September of the current academic year) student' success in examinations will be analyzed.

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Basic description		
Course coordinator	Velimir Labinac	
Course title	PHYSICS SEMINARS	
Study programme	Undergraduate Study Programme Physics	
Course status	Elective	
Year	3. year	
ECTS credits and teaching	***ECTS student 's workload coefficient***	3
	Number of hours (L+E+S)	0 + 0 + 30

1. COURSE DESCRIPTION

1.1. Course objectives

The main objectives of the course Physics Seminars are to extend comprehension of the concepts of general physics, and to introduce students with the content of physics beyond the standard university curricula.

1.2. Course enrolment requirements

It is assumed that student has basic knowledge of general physics, but there are no courses that are prerequisites for entry.

1.3. Expected course learning outcomes

After passing the exam, student will be able:

1. to read and translate papers in English containing topics from elementary physics;
2. to independently prepare and write a short seminar in the field of general physics (and perhaps a level beyond);
3. to prepare a poster in one of the software packages (Microsoft Office PowerPoint or CorelDraw);
4. to present a seminar before the audience and answer questions from the audience;
5. to actively participate in discussions and ask questions after the presentation of their colleagues.

1.4. Course content

Topics for the seminars will be selected from leading educational journals in physics: American Journal of Physics, The Physics Teacher, Physics Today, Science in Computing and Engineering, European Journal of Physics, Physics Education.

1.5. Teaching methods	☐ lectures ☒ seminars and workshops ☐ exercises ☒ long distance education ☐ fieldwork	☒ individual assignment ☒ multimedia and network ☐ laboratories ☐ mentorship ☐ other
1.6. Comments		

1.7. Student's obligations

- students are required to write and submit two seminars: first, elaborating paper from The Physics Teacher or Physics Education, and second, elaborating paper from American Journal of Physics with more advanced topic. The seminar must be written according to the rules that will be given and explained at the beginning of the course
- students are required to prepare a poster containing physics from one of the seminars

- students are required to present her/his seminar with PowerPoint presentation (Microsoft Office or OpenOffice). The duration of the presentation is limited to 15 minutes
- students are to be present at the presentations of their colleagues, and are required to actively participate in discussions following the presentations

1.8. Evaluation of student's work

Course attendance	0.2	Activity/Participation	0.3	Seminar paper	1.2	Experimental work	
Written exam		Oral exam		Essay		Research	
Project		Sustained knowledge check		Report	0.3	Practice	
Portfolio		Poster	1.0				

1.9. Assessment and evaluation of student's work during classes and on final exam

There is no final exam. Students will be evaluated and assessed during the semester.
Detailed elaboration of ways of monitoring and evaluation of students' work will be displayed in the Working Plan!

1.10. Assigned reading (at the time of the submission of study programme proposal)

JOURNALS:
American Journal of Physics (http://scitation.aip.org/ajp);
Computing in Scinece and Engineering (http://scitation.aip.org/cse);
European Journal of Physics (http://www.iop.org/EJ/journal/EJP)
Physics Education (http://www.iop.org/EJ/journal/0031-9120)
Physics Today (http://www.physicstoday.org/);
The Physics Teacher (http://scitation.aip.org/tpt).

1.11. Optional / additional reading (at the time of proposing study programme)

Feynman R. P., Leighton R. B., Sands M., *The Feynman Lectures on Physics*, vol. 1-3, Addison-Weseley, Reading, 1963.
Berkeley Physics Course, vol. 1-5, McGraw-Hill
Walker J, *Fundamentals of Physics*, 8th ed., Wiley, New York, 2008.
Young H. D., Freedman R. A., *University Physics with Modern Physics*, 11th ed., Pearson, San Francisco, 2004.

WWW
http://academicearth.org/
http://e-knjiznica.carnet.hr/
http://ocw.mit.edu/OcwWeb/web/home/home/index.htm

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
American Journal of Physics	subscription	10-15
The Physics Teacher	subscription	
Physics Today	subscription	
Computing in Scinece and Engineering	subscription	
European Journal of Physics	-	
Physics Education	-	

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1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences
Regular monitoring of the student's activity and attitude towards work. In the last week of classes, anonymous surveys will be conducted in which students will evaluate the quality of teaching. At the end of each semester (1 March and 30 September of the current academic year) student' success in examinations will be analyzed.

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Basic description		
Course coordinator	Maja Matetić	
Course title	PROGRAMMING	
Study programme	Undergraduate Study Programme Physics	
Course status	Compulsory	
Year	1. year	
ECTS credits and teaching	***ECTS student 's workload coefficient***	5
	Number of hours (L+E+S)	30 + 30 + 0

1. COURSE DESCRIPTION

1.1. Course objectives

This course provides basic comprehension of approaches, concepts and methods in procedural programming and gives an introduction to modular program construction. The course covers topics including methods of algorithm development and implementation, using of language constructs in simple program coding and methods for code debugging. Further, the course covers topics regarding advanced programming techniques including separate compilation, interface/implementation design and coding, dynamic memory allocation, pointer manipulation, and recursion. The course familiarises the student with commonly used algorithms, using the C++ programming language.

1.2. Course enrolment requirements

1.3. Expected course learning outcomes

The student should become familiar with the:
- basic operation of the programming environment and computer literacy.
- Boolean expressions, variable types and memory storage.

The student should learn:
- how to develop an algorithm and implementation to compute a mathematical function.
- to convert a set of Mathematical statements into a C++ Boolean expression.
- to develop an algorithm using programming language selection constructs.
- to develop an algorithm and implementation that repeatedly executes a sequence of steps.
- to debug a simple program and remove all syntax errors and all logic errors.
- to use preprogrammed functions to implement an algorithm.
- to implement a hierarchical design using methods/functions.
- to properly document code to a given standard.
- to develop and write a program that uses one or more array structures to store information.
- to develop and write a program that uses simple data files to store and retrieve information.
- advanced programming techniques including dynamic memory allocation, pointer manipulation, and recursion.

1.4. Course content

Historical survey of programming languages. Procedural and object-oriented languages. General or multipurpose languages. Special-purpose languages. The software development process. Developing programs interactively. Concepts of imperative, structured programming. The notion of the algorithm. Syntax and semantix of C++. Types, values and declarations: Names. Declarations. Type definitions. Numeric data types. Logical types. Character types. Enumeration types. Expressions and statements: Expressions. Statements. Sequencing and control. Iterative statements. Program structure: Procedural architecture. Alternative program architectures. Simple algorithms for search and sort. Parameters. Functions. Structured data: Arrays. Records. Strings. Files. Dinamic memory allocation, pointer manipulation. Recursion.

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1.5. Teaching methods	☒ lectures ☐ seminars and workshops ☐ exercises ☐ long distance education ☐ fieldwork	☒ individual assignment ☐ multimedia and network ☒ laboratories ☐ mentorship ☐ other
1.6. Comments		

1.7. Student's obligations

Students are expected to:
attend classes regularly
make necessary preparations for classes
do practical work
pass two midterm exams and a final exam.

1.8. Evaluation of student's work

Course attendance	0.50	Activity/Participation	0.50	Seminar paper		Experimental work	
Written exam	1.50	Oral exam	1.50	Essay		Research	
Project		Sustained knowledge check		Report		Practice	1.00
Portfolio							

1.9. Assessment and evaluation of student's work during classes and on final exam

1.10. Assigned reading (at the time of the submission of study programme proposal)

1. Julijan Šribar, Boris Motik:
Demistificirani C++, Dobro upoznajte protivnika da biste njime ovladali, Element, Zagreb, 2001.

1.11. Optional / additional reading (at the time of proposing study programme)

1. Jesse Liberty, Teach Yourself C++ in 24 Hours, SAMS, 1999.
2. Leslie B.Wilson and Robert G.Clark: Comparative Programming Languages, Third Edition, Addison-Wesley, 2001.

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

Quality of the course will be monitored and measured through the success of examinations and through the anonymous inquiry reflecting students' opinions regarding the course.

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Basic description		
Course coordinator	Zdravko Lenac	
Course title	QUANTUM MECHANICS	
Study programme	Undergraduate Study Programme Physics	
Course status	Compulsory	
Year	3. year	
ECTS credits and teaching	***ECTS student 's workload coefficient***	11
	Number of hours (L+E+S)	60 + 45 + 0

1. COURSE DESCRIPTION

1.1. Course objectives

Basic knowledge of fundaments of quantum physics and understanding of new concepts and principles embedded in quantum physics. Developing the cognizance how simple fundamental equations can explain complex physical phenomenon and lead to concrete applications. Developing the cognizance of the complex connection between the experiment and the theory and the specific way of explanation of the processes that cannot be directly measured.

1.2. Course enrolment requirements

Completed the courses: Physics I – mechanics, Physics II – electricity and magnetism, Mathematical method of physics I, II, and the course Classical mechanics I

1.3. Expected course learning outcomes

1. Understanding of fundaments of quantum mechanics and its relation with classical physics
2. Understanding of behaviour of particles in the bound and in the scattering states
3. Understanding of periodic system of elements
4. Understanding of functioning of instruments based on the principles of quantum mechanics (Laser, STM, NMR...)

1.4. Course content

Inadequacy of classical physics, uncertainty and complementarity principle, Schrodinger equation. Operators and eigenvalues. Measurements. Potential step and potential valley. Harmonic oscillator. Energy, momentum and angular momentum operators. Rotational invariance. Hydrogen atom. Spin. Zeeman effect. Helium. Periodic system of elements. Approximation methods. Stark effect. Collision theory. Scattering cross section. Time-dependent perturbation theory. Transition probabilities. Absorption and emission. Applications. Photo-effect. Laser. STM. NMR.

1.5. Teaching methods	☒ lectures ☒ seminars and workshops ☒ exercises ☒ long distance education ☐ fieldwork	☒ individual assignment ☒ multimedia and network ☐ laboratories ☐ mentorship ☐ practicum
1.6. Comments		

1.7. Student's obligations

Students are obligated:

- to attend regularly and to participate actively in lectures and exercises;

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- to do their homework independently;
- to pass two midterms and final oral exam.

1.8. Evaluation of student's work

Course attendance	1.0	Activity/Participation	1.0	Seminar paper		Experimental work	
Written exam	4.0	Oral exam	4.0	Essay		Research	
Project		Sustained knowledge check	1.0	Report		Practice	
Portfolio							

1.9. Assessment and evaluation of student's work during classes and on final exam

Student will be evaluated and assessed during the course and final exam. Maximum total percentage which student can achieve during the lessons is 70%, while the final exam (oral) provides 30% at best.
Detailed elaboration of ways of monitoring and evaluation of students' work will be displayed in the Working Plan!

1.10. Assigned reading (at the time of the submission of study programme proposal)

I. Supek, *Teorijska fizika i struktura materije*, 1. i 2. dio, Školska knjiga, Zagreb, 1977.
D. J. Griffiths, *Introduction to Quantum Mechanics*, 2nd ed., Prentice-Hall, New Jersey, 2005.
W. A. Harrison, *Applied quantum mechanics*, World Scientific, Singapore, 2001.

1.11. Optional / additional reading (at the time of proposing study programme)

L. I. Schiff, *Quantum Mechanics*, 3. izdanje, McGraw-Hill, New York, 1968.
J. J. Sakurai, *Modern Quantum Mechanics*, 2. izdanje, Addison-Wesley, Reading, 1994.
A. F. J. Levi, *Applied Quantum Mechanics*, 2. izdanje, Cambridge University Press, Cambridge, 2006.
A. Messiah, *Quantum Mechanics*, North-Holland, Amsterdam, 1970.

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
I. Supek, *Teorijska fizika i struktura materije*, 1. i 2. dio, Školska knjiga, Zagreb, 1977.	10	15-20
D. J. Griffiths, *Introduction to Quantum Mechanics*, 2nd ed., Prentice-Hall, New Jersey, 2005.	2	15-20
W. A. Harrison, *Applied quantum mechanics*, World Scientific, Singapore, 2001.	1	15-20

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

Regular monitoring of the student's activity and attitude towards work. In the last week of classes, anonymous surveys will be conducted in which students will evaluate the quality of teaching. At the end of each semester student' success in examinations will be analyzed.

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Basic description		
Course coordinator	Zdravko Lenac	
Course title	QUANTUM PHYSICS AND APPLICATIONS	
Study programme	Undergraduate Study Programme Physics	
Course status	Compulsory[1] Elective	
Year	3. year	
ECTS credits and teaching	***ECTS student 's workload coefficient***	8
	Number of hours (L+E+S)	45 + 30 + 0

1. COURSE DESCRIPTION

1.1. Course objectives

Basic knowledge of fundaments of quantum physics and understanding of new concepts and principles embedded in quantum physics. Developing the cognizance how simple fundamental equations can explain complex physical phenomenon and lead to concrete applications. Developing the cognizance of the complex connection between the experiment and the theory and the specific way of explanation of the processes that cannot be directly measured.

1.2. Course enrolment requirements

Completed the courses: Physics I – mechanics, Physics II – electricity and magnetism, Mathematical method of physics I, II, and the course Classical mechanics

1.3. Expected course learning outcomes

1. Understanding of fundaments of quantum mechanics and its relation with classical physics
2. Understanding of behaviour of particles in the bound and in the scattering states
3. Understanding of periodic system of elements
4. Understanding of functioning of instruments based on the principles of quantum mechanics (Laser, STM, NMR...)

1.4. Course content

Inadequacy of classical physics, uncertainty and complementarity principle, Schrodinger equation. Operators and eigenvalues. Measurements. Potential step and potential valley. Harmonic oscillator. Energy, momentum and angular momentum operators. Rotational invariance. Hydrogen atom. Spin. Zeeman effect. Helium. Periodic system of elements. Approximation methods. Stark effect. Collision theory. Scattering cross section. Applications. Photo-effect. Laser. STM. NMR.

1.5. Teaching methods	☒ lectures ☒ seminars and workshops ☒ exercises ☒ long distance education ☐ fieldwork	☒ individual assignment ☒ multimedia and network ☐ laboratories ☐ mentorship ☐ practicum
1.6. Comments	Student's active participation to classes and exercises. Partial exams: written. Final exam: oral.	
1.7. Student's obligations		

[1] Course is compulsory for optional subject Ecology and elective for optional subjects Mathematics and Computer Science.

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Students are obligated:

- to attend regularly and to participate actively in lectures and exercises;
- to do their homework independently;
- to pass two midterms and final oral exam.

1.8. Evaluation of student's work

Course attendance	0.5	Activity/Participation	0.5	Seminar paper		Experimental work	
Written exam	3.0	Oral exam	3.0	Essay		Research	
Project		Sustained knowledge check	1.0	Report		Practice	
Portfolio							

1.9. Assessment and evaluation of student's work during classes and on final exam

Student will be evaluated and assessed during the course and final exam. Maximum total percentage which student can achieve during the lessons is 70%, while the final exam (oral) provides 30% at best.
Detailed elaboration of ways of monitoring and evaluation of students' work will be displayed in the Working Plan!

1.10. Assigned reading (at the time of the submission of study programme proposal)

I. Supek, *Teorijska fizika i struktura materije*, 1. i 2. dio, Školska knjiga, Zagreb, 1977.
D. J. Griffiths, *Introduction to Quantum Mechanics*, 2nd ed., Prentice-Hall, New Jersey, 2005.
W. A. Harrison, *Applied quantum mechanics*, World Scientific, Singapore, 2001.

1.11. Optional / additional reading (at the time of proposing study programme)

L. I. Schiff, *Quantum Mechanics*, 3. izdanje, McGraw-Hill, New York, 1968.
J. J. Sakurai, *Modern Quantum Mechanics*, 2. izdanje, Addison-Wesley, Reading, 1994.
A. F. J. Levi, *Applied Quantum Mechanics*, 2. izdanje, Cambridge University Press, Cambridge, 2006.

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
I. Supek, *Teorijska fizika i struktura materije*, 1. i 2. dio, Školska knjiga, Zagreb, 1977.	10	15-20
D. J. Griffiths, *Introduction to Quantum Mechanics*, 2nd ed., Prentice-Hall, New Jersey, 2005.	2	15-20
W. A. Harrison, *Applied quantum mechanics*, World Scientific, Singapore, 2001.	1	15-20

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

Regular monitoring of the student's activity and attitude towards work. In the last week of classes, anonymous surveys will be conducted in which students will evaluate the quality of teaching. At the end of each semester student' success in examinations will be analyzed.

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T: (051) 406-500 • F: (051) 216-671; 216-091
W: www.uniri.hr • E: ured@uniri.hr

Basic description		
Course coordinator	Rene Sušanj	
Course title	SET THEORY	
Study programme	Undergraduate Study Programme Physics	
Course status	Elective	
Year	3. year	
ECTS credits and teaching	***ECTS student 's workload coefficient***	5
	Number of hours (L+E+S)	30 + 30 + 0

1. COURSE DESCRIPTION

1.1. Course objectives

- to acquaint students with basic notions of set theory
- to acquaint students with basics of cardinal and ordinal arithmetic

1.2. Course enrolment requirements

The programme of the course Set theory is in correlation with the other mathematical courses, especially Elementary Mathematics I, Elementary Mathematics II and Algebra.

1.3. Expected course learning outcomes

After completing this course students will be able to understand and apply basic notions of set theory.

1.4. Course content

Introduction. Intuitive notion of set. Sets and classes. Algebra of sets. Set operations of union and intersection. Complement and DeMorgan laws. Relations and functions. Finite Cartesian product and n-ary relation. Function. Infinite Cartesian product. Equivalence relation. Partial order relation. Natural numbers. Definition of the set of natural numbers. Peano axioms. Recursion. Arithmetic of natural numbers. Real numbers. Integers. Rational numbers. Cardinal numbers. Equivalent sets. finite sets. Denumerable and non-denumerable sets. Order of cardinal numbers. Cardinal arithmetic. Ordinal and cardinal numbers. Well-ordered sets and order types. Transfinite recursion and definition of ordinal numbers. Ordinal arithmetic. Set theory axiomatization. Axiom of choice and its equivalents. Paradoxes in set theory.

1.5. Teaching methods	☒ lectures ☐ seminars and workshops ☒ exercises ☒ long distance education ☐ fieldwork	☒ individual assignment ☒ multimedia and network ☐ laboratories ☐ mentorship ☐ other
1.6. Comments	Student's activities are continuously being monitored. Quality of student's active participation during classes and exercises is a component of the monitoring and evaluation. Complete knowledge of the student is evaluated at the exam.	

1.7. Student's obligations

Students must attend the lectures and participate in all activities required for the course. Exam: written and oral.

1.8. Evaluation of student's work

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Course attendance	0.35	Activity/Participation	0.35	Seminar paper		Experimental work	
Written exam	2.0	Oral exam	1.3	Essay		Research	
Project		Sustained knowledge check	1.0	Report		Practice	
Portfolio							

1.9. Assessment and evaluation of student's work during classes and on final exam

Student will be evaluated and assessed during the course and final exam. Maximum total percentage which student can achieve during the lessons is 70%, while the final exam provides 30% at the best.
Detailed elaboration of ways of monitoring and evaluation of students' work will be displayed in the Working Plan.

1.10. Assigned reading (at the time of the submission of study programme proposal)

1. P.Papić: Uvod u teoriju skupova, HMD, Zgb, 2000.
2. S.Lipschutz: Set Theory and Related Topics, McGraw Hill, New York, 1964.

1.11. Optional / additional reading (at the time of proposing study programme)

1. H.B.Enderton: Elements of Set Theory, Academic press, New York, 1977.
2. J.D.Monk: Introduction to Set Theory, McGraw Hill, New York, 1969.
3. A.Levy: Basic Set Theory, Springer 1979.

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
P.Papić: Uvod u teoriju skupova, HMD, Zgb, 2000.	5	10
S.Lipschutz: Set Theory and Related Topics, McGraw Hill, New York, 1964.	3	10

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

After the last lecture of the course students will be asked to fulfill a questionnaire about the quality of the lectures. At the end of each semester results of the exams will be analyzed.

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Basic description		
Course coordinator	Students are required to choose a Thesis Advisor.	
Course title	UNDERGRADUATE THESIS	
Study programme	Undergraduate Study Programme Physics	
Course status	Compulsory	
Year	3. year	
ECTS credits and teaching	***ECTS student 's workload coefficient***	3
	Number of hours (L+E+S)	-

1. COURSE DESCRIPTION

1.1. Course objectives

The main objectives are to use the knowledge gained during undergraduate studies and demonstrate independence and initiative in the organization and development of professional work such as undergraduate thesis.

1.2. Course enrolment requirements

Student is required to successfully pass all exams in the 1st and 2nd year of the undergraduate study before applying for the final thesis. The requirements for thesis defense are successfully and completely passed all exams on undergraduate studies.

1.3. Expected course learning outcomes

Students will be able to:

1. independently write a professional paper;
2. search and use the mother tongue and foreign language literature and other sources of knowledge independently;
3. correctly use mathematical apparatus and mathematical terminology;
4. use metrology of legally prescribed units;
5. professionally and methodically articulate the selected topic;
6. simply and concisely express thoughts, style, grammatically and spelling correctly write any text;
7. properly cite references;
8. orally present the work.

1.4. Course content

1.5. Teaching methods

☐ lectures	☐ individual assignment
☐ seminars and workshops	☒ multimedia and network
☐ exercises	☒ laboratories
☐ long distance education	☒ mentorship
☐ fieldwork	☐ other

1.6. Comments

1.7. Student's obligations

- to choose a Thesis Advisor and find a thesis topic by consulting her/his Thesis Advisor;

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- to independently prepare their thesis according to the Regulations on Writing the Undergraduate Thesis of the Department of Physics University of Rijeka and instructions given by Thesis Advisor;
- to present publicly their work and defend it before the Thesis Committee.

1.8. Evaluation of student's work

Course attendance		Activity/Participation		Seminar paper		Experimental work	
Written exam		Oral exam		Essay		Research	
Project		Sustained knowledge check		Report		Practice	
Portfolio				Thesis Preparation	1.5	Thesis Defence	1.5

1.9. Assessment and evaluation of student's work during classes and on final exam

Student will be evaluated and assessed during preparation of thesis and thesis defence. Thesis Advisor gives the final grades for the written part of thesis, and the three-member Thesis Committee is responsible for an overall assessment of the thesis defence.

1.10. Assigned reading (at the time of the submission of study programme proposal)

Student selects references according to the subject of the thesis and in consultation with the Thesis Advisor.

1.11. Optional / additional reading (at the time of proposing study programme)

Student selects additional references according to the subject of the thesis and in consultation with the Thesis Advisor.

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

Regular monitoring of the student's activity and attitude towards work. In the last week of classes, anonymous surveys will be conducted in which students will evaluate the quality of teaching. At the end of each semester (1 March and 30 September of the current academic year) student' success in examinations will be analyzed.

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Basic description		
Course coordinator	Students are required to choose a Thesis Advisor.	
Course title	UNDERGRADUATE THESIS	
Study programme	Undergraduate Study Programme Physics	
Course status	Compulsory	
Year	3. year	
ECTS credits and teaching	***ECTS student 's workload coefficient***	6
	Number of hours (L+E+S)	-

1. COURSE DESCRIPTION

1.1. Course objectives

The main objectives are to use the knowledge gained during undergraduate studies and demonstrate independence and initiative in the organization and development of professional work such as undergraduate thesis.

1.2. Course enrolment requirements

Student is required to successfully pass all exams in the 1st and 2nd year of the undergraduate study before applying for the final thesis. The requirements for thesis defense are successfully and completely passed all exams on undergraduate studies.

1.3. Expected course learning outcomes

Students will be able to:

1. independently write a professional paper;
2. search and use the mother tongue and foreign language literature and other sources of knowledge independently;
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7. properly cite references;
8. orally present the work.

1.4. Course content

1.5. Teaching methods	☐ lectures ☐ seminars and workshops ☐ exercises ☐ long distance education ☐ fieldwork	☐ individual assignment ☒ multimedia and network ☒ laboratories ☒ mentorship ☐ other

1.6. Comments

1.7. Student's obligations

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- to independently prepare their thesis according to the Regulations on Writing the Undergraduate Thesis of the Department of Physics University of Rijeka and instructions given by Thesis Advisor;
- to present publicly their work and defend it before the Thesis Committee.

1.8. Evaluation of student's work

Course attendance		Activity/Participation		Seminar paper		Experimental work	
Written exam		Oral exam		Essay		Research	
Project		Sustained knowledge check		Report		Practice	
Portfolio				Thesis Preparation	3.0	Thesis Defence	3.0

1.9. Assessment and evaluation of student's work during classes and on final exam

Student will be evaluated and assessed during preparation of thesis and thesis defence. Thesis Advisor gives the final grades for the written part of thesis, and the three-member Thesis Committee is responsible for an overall assessment of the thesis defence.

1.10. Assigned reading (at the time of the submission of study programme proposal)

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1.11. Optional / additional reading (at the time of proposing study programme)

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Title	*Number of copies*	*Number of students*

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Regular monitoring of the student's activity and attitude towards work. In the last week of classes, anonymous surveys will be conducted in which students will evaluate the quality of teaching. At the end of each semester (1 March and 30 September of the current academic year) student' success in examinations will be analyzed.