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Basic description		
Course coordinator	Nenad Smokrović	
Course title	20th CENTURY CONTEMPORARY PHILOSOPHY	
Study programme	Graduate Study Programme Physics and Philosophy	
Course status	Compulsory	
Year	1. 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 course aims at promoting student's acquaintance with the dominant streams of the 20th century philosophy; their capacities to recognize and distinguish particular theories and schools of thinking; their capacity to associate them to the specific doctrines, arguments, concepts in philosophy that were considered in the course; ability to state in a concise, clear, and rigorous way the specific problem they aim to present and their main theses; ability to define or characterize philosophical problems and concepts in a concise, clear and rigorous ways and give appropriate examples, ability to present argument's structure, clarify their premises and their conclusion.

1.2. Course enrolment requirements

No specific enrolment requirements.

1.3. Expected course learning outcomes

Having successfully pass the exam, students will be able:
- to recognize and distinguish must important theories and school of thoight in 20th century philosophy,
- to comprehend Husserl's idea of phenomenology as one of the main sources of contemporary philosophy,
- to comprehend Merleau-Ponty's theory of phenomenology and compare it with Husserl's thoery,
- to understand the grounding ideas of Hermeneutics,
- to compare Gadamer's hermeneutic theory with those of his predecessors,
- to understand Habermas' ideas,
- to compare Frege's and Wittgenstein's understanding of the role of logic,
- to understand Russell's objections to Frege's theory,
- to compare and assess the differences between "continental" and "analytic" philosophy,

1.4. Course content

The must significant aspects of 20th century philosophical theories, both continental and analytic, including phenomenological theory in Husserl's and Merlou-Ponty's interpretation; traditional and contemporary hermeneutics theory exemplified by Gadamer's philosophy; new generation of the "Frankfurt school" (J. Habermas) ; main Frege's, Wittgenstein's and Russell's ideas and concepts. Particular attention will be paid to comparison between continental and analytic ways of doing philosophy and their philosophical styles.

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 regularly attend the lectures and seminars, to be active in seminar discussions, to present the essay, to admit to two colloquiums and the final examination.

1.8. Evaluation of student's work

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

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

Students activities will be assessed and evaluated throuhg their participation at seminars (students should prepare for the seminars by reading the required readings and be ready to answer a list of research question given the week before by the teacher), essay, colloquiums and final exam.

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

Husserl, E., (2003), Filozofija kao stroga znanost, Ljevak, Zagreb (Izabrana poglavlja).
Husserl, E., (1975), Ideja fenomenologije, BIGZ, Beograd.
Frege, G.,. (1995), Osnove aritmetike i drugi spisi, Kruzak, Zagreb.
Russell. B., On Denoting
Wittgenstein, L., (2003), Tractatus Logico-Philosophicus, Moderna vremena, Zagreb.
Wittgenstein, L., (1980), Filozofska istraživanja, Nolit, Beograd.

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

Landgrebe, L., (1976), Suvremena filozofija, Logos, Sarajevo
Čemu još filozofija? (izbor: J. Brkić), (1978), Znaci, Zagreb. (Izabrana poglavlja).
Marx, Werner, (2005), Fenomenologija Edmunda Husserla, Breza, Zgreb.
Merleau-Ponty, M., 1984, Struktura ponašanja, Nolit, Beograd.
Uvod u Heideggera, (1972), CDDO, Zagreb

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*
Husserl, E., (2003), Filozofija kao stroga znanost, Ljevak, Zagreb (Izabrana poglavlja).	2	10
Husserl, E., (1975), Ideja fenomenologije, BIGZ, Beograd.	2	10
Frege, G.,. (1995), Osnove aritmetike i drugi spisi, Kruzak, Zagreb.	2	10
Russell. B., On Denoting	1	10
Wittgenstein, L., (2003), Tractatus Logico-Philosophicus, Moderna vremena, Zagreb.	2	10

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

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Basic description		
Course coordinator	Nikola Petković	
Course title	AESTHETICS	
Study programme	Graduate Study Programme Physics and Philosophy	
Course status	Compulsory	
Year	1. 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 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 second diachronically and substantially links The Enlightenment to the Postmodernism. In the first part, which is more explicitly historical, students are 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.

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		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

Students will be evaluated and assessed both throughout during the course and a part of their grade will be based upon the 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 is to be found in the syllabus!

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, selection)
(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, selection)
Percy Bysshe Shelley (selection from 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 (ed. Peter Kivy)
Aesthetics and the philosophy of art : the analytic tradition : an anthology (ed. Peter Lamarque i Stein Haugom Olsen)
Aesthetics (ed. Susan L. Feagin and Patrick Maynard)

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

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

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

Roots of Postmodernism
Friedrich Nietzsche, Rođenje tragedije
Michel Foucault («Što je autor», Nadzor i kazna (selection),

Structuralism, Postmodenism
Roland Barthes, «Smrt autora» Jean-François Lyotard «Postmoderno stanje»

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

Deconstruction, Colonialism, Postcolonialism

Jacques Derrida Dissemination (selection),
Plato's Pharmacy
Pharmacia
The Father of Logos
The Pharmakon
The Pharmakeus

Psihoanaliza/Poststrukturalizam
Sigmund Freud, Tumačenje snova (selection)
Hélène Cixous Meduzin smijeh
Julia Kristeva Revolucija u pjesničkom jeziku (selection)
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 (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). Too, it will be aquired through the analyses of the realization of the expected outcomes of the course and by evaluations done at the Department or/and at the University level.

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Basic description		
Course coordinator	Dubravka Kotnik-Karuza	
Course title	ASTRONOMY AND ASTROPHYSICS	
Study programme	Graduate Study Programme Physics and Philosophy	
Course status	Elective	
Year	2. 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

Introduce the students to fundamentals of 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

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 the 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 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	1	Experimental work	
Written exam		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)

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 (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	Graduate Study Programme Physics and Philosophy	
Course status	Elective	
Year	1. year	
ECTS credits and teaching	***ECTS student 's workload coefficient***	4
	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

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	0.40	Activity/Participation	0.80	Seminar paper	1.00	Experimental work	
Written exam		Oral exam	1.00	Essay		Research	
Project		Sustained knowledge check	0.80	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	Dubravka Kotnik-Karuza	
Course title	ATOMIC PHYSICS LABORATORY	
Study programme	Graduate Study Programme Physics and Philosophy	
Course status	Elective	
Year	2. 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

To 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, to shed light on the microscopic scale of phenomena that are unavailable to usual everyday perception and to give insight in the scientific methodology of natural sciences based on active relationship between theory and experiment

1.2. Course enrolment requirements

Students must have passed the exam in Modern physics I.

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

The students are given a set of experiments to be carried out individually. They are dealing with subjects and phenomena of modern physics:

- Fine structure, one-electron spectra and two-electron spectra
- Rutherford experiment
- ß-spectroscopy
- Surface treatment / Plasma Physics
- Helium Neon Laser
- Stern-Gerlach experiment
- Radioactivity
- Maxwell Boltzmann distribution function
- Absorption of electromagnetic radiation
- Excitation of atoms and molecules

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

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,

1.8. Evaluation of student's work

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

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.
Haken H., Wolf H.C., *ATOMIC AND QUANTUM PHYSICS,* 2nd ed., Springer-Verlag, 1984
Thorne A., Litzén U., Johansson S., *SPECTROPHYSICS*, Springer-Verlag, 1999
K. Seeger: *SEMICONDUCTOR PHYSICS*, Springer 1991
M. Sarta Deković, D. Kotnik-Karuza: Fizički praktikum IV ((teaching material of the Dept. of Physics), Rijeka, 2009)

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

Krane K.S.: Modern Physics, John Wiley & Sons, Inc., New York, 1996.
Gettys W.E., Keller F.J., Skove M.J., *PHYSICS CLASSICAL AND MODERN*, McGraw-Hill, 1989
http://www.phywe.com/313
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*
M. Sarta Deković, D. Kotnik-Karuza: Fizički praktikum IV (Interni nastavni materijali na Odjelu za fiziku)	In agreement with the number of attending students	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	5
Thorne A., Litzén U., Johansson S., *SPECTROPHYSICS*, Springer-Verlag, 1999	1	5
K. Seeger: *SEMICONDUCTOR PHYSICS*, Springer 1991	1	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 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	Dubravka Kotnik-Karuza	
Course title	BASIC ELECTRONICS	
Study programme	Graduate Study Programme Physics and Philosophy	
Course status	Elective	
Year	1. 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

Starting from the basic knowledge of semiconductor physics to acquaint the students with electronic devices, models, circuits and systems through a step-by-step approach.

1.2. Course enrolment requirements

Students must have passed the exam in Modern physics.

1.3. Expected course learning outcomes

The student is expected to understand the structure and function of electronic elements based on physical characteristics of the material they are built from. Further, he should understand the function and structure of the basic electronic circuits as well as to be able to design more complex electronic circuits, devices and systems.

In particular, the student should be able to:

1. analyze the open-circuited and biased *pn* junction
2. describe the Zener diode, tunel diode and Schottky diode and their use in most common circuits
3. explain the structure and function of rectifiers (half-wave, full-wave, Graetz bridge circuit, voltage multiplier)
4. understand the structure and function of bipolar and unipolar transistors
5. describe the common-emitter, common-base and common-collector configuration and their practical applications
6. understand the structure and function of a DC power supply
7. understand the structure and function of a low-signal transistor amplifier and discuss the conditions of linearity
8. explain the transistor feedback amplifying circuits, focusing on the current amplifier
9. describe the cascade amplifiers
6. analyze the structure and function of operational amplifier and describe the inverting and noninverting circuit
7. distinguish pasive from active low-frequency and high-frequency filters and explain their function in electronic circuits
8. explain the use of operational amplifiers in analog electronic circuits
9. explain the basic operational amplifier operations (analog inverter, scale changer, adder, DC voltage follower)
10. understand the structure and function of a differential DC amplifier
11. analyze the analog computational circuits performing differentiation, integration, exponentiation, finding logarithms
12. explain the structure and function of basic digital circuits (OR, AND, NOT, NOR, NAND)

1.4. Course content

p-n diode. Special diodes (Zener,tunnel,Schotky). Rectifiers (half-wave, full-wave, Graetz, voltage multipliers). Bipolar and unipolar transistor. Transistor amplifiers, emitter follower, feedback amplifiers, differential amplifier, cascade amplifiers. Operational amplifier. Elektronic filters – pasiv and active. Digital circuits.

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 (lectures and exercises) attendance, passing the written and oral 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	1	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. 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)

N.W.Aschroft, N.D.Mermin: Solid state physics, Saunders College Publishing, Harcourt Brace College Publishers, 1996
D. Kotnik-Karuza: Osnove elektronike s laboratorijskim vježbama, Filozofski fakultet u Rijeci, 2000
P. Biljanović: Elektronički sklopovi, Školska knjiga, Zagreb, 2001
P. Biljanović: Mikroelektronika (Integrirani elektronički sklopovi), Školska knjiga, Zagreb, 2001
P. Biljanović, I. Zulim: Elektronički sklopovi (zbirka zadataka), Školska knjiga, Zagreb, 1994
DeMassa, Thomas A.: Digital Integrated Circuits, New York, John Wiley & Sons, 1996

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

D.V. Hall: Digital circuits and systems, Mc Graw-Hill, 1989
Millman-Halkias: Integrated electronics, Analog and digital circuits and systems, Mc Graw-Hill Kogakusha, 1972
D.L. Schilling, C.Belove: Electronic circuits, Mc Graw-Hill, 1989
K. Seeger: Semiconductor physics, Springer 1991
http://wnt.cc.utexas.edu/~wlh/index.cfm
http://viper.hep.princeton.edu/~mcdonald/examples/

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*
N.W.Aschroft, N.D.Mermin: Solid state physics, Saunders College Publishing, Harcourt Brace College Publishers, 1996	2	5
D. Kotnik-Karuza: Osnove elektronike s laboratorijskim vježbama, Filozofski fakultet u Rijeci, 2000	6	5
P. Biljanović: Elektronički sklopovi, Školska knjiga, Zagreb, 2001	4	5
P. Biljanović: Mikroelektronika (Integrirani elektronički sklopovi), Šk. knjiga, Zagreb, 2001	4	5
P. Biljanović, I. Zulim: Elektronički sklopovi (zbirka zadataka), Šk. knjiga, Zagreb, 1994	4	5
DeMassa, Thomas A.: Digital Integrated Circuits, New York, John Wiley & Sons, 1996	1	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). Basic knowledge of semiconductor electronics is assessed on the course exam (written and oral). 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	Marta Žuvić-Butorac	
Course title	BIOPHYSICS	
Study programme	Graduate Study Programme Physics and Philosophy	
Course status	Elective	
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

This course is designed to provide a base of knowledge of physical concepts and techniques used in explanation and problem solving in biology and medicine.

1.2. Course enrolment requirements

Courses: Physics I,II,III and IV. It is recommended to enrol elective courses Chemistry and Biology. The course program correlates with Physical Chemistry course, and in smaller amount with Fluid dynamics and Organic chemistry courses.

1.3. Expected course learning outcomes

This course will enable students to apply physical principles and concepts in biological systems, and to become acquainted with problems in molecular biophysics and human physiology, as well as techniques for their study. After this course students will be able to follow general trends in development of biophysical problem solving as well as diagnostic tools and corresponding technologies in medicine.

1.4. Course content

Molecular biophysics

- The structure of prokaryotic and eukaryotic cell. The structure of biomacromolecules: carbohydrates, lipids, proteins and nucleic acids. Macromolecular complexes: glycolipids, glycoproteins, lipoproteins, nucleoproteins, biological membrane. Forces that stabilize the structure of biomacromolecules and complexes: hydrogen bonding, disulfide bridges, hydrophobic effect. Correlation of structure and function.
- Thermodynamics of biological systems. Gibbs free energy (G), relation of free energy to enthalpy and entropy, dependence of G on pressure and temperature, chemical potential, chemical and electrochemical balance.
- Energetic of lipid bilayer and cell membrane. Transport of ions through the membrane. Ionic channels. Structure, selectivity and permeability. Voltage-gated, ligand-gated and mechanosensitive channels. Transport processes on the membrane. Diffusion, co-transport, active transport. Simporters and antiporters.
- Transmembrane potential – evolution and changes. Myelin. Action potential. Neural system cell types – neurons and glia. Signal transduction in neuronal system; action potential spread, synapse, neurotransmitters.
- Spectroscopy in biophysics: fluorescence spectroscopy, electron spin resonance (ESR), nuclear magnetic resonance (NMR).

Biomechanics

- Molecular and cell biomechanics: cell molecular motors, cytoskeleton, actin-myozin system, cilia, flagella.
- Biomechanics of locomotive system. Types of deformations present in locomotive system. Biomechanical properties of muscles and bones. Muscles and bones as leverages. Balance and stability of locomotive system.
- Biomechanics of cardiovascular system (closed hydro mechanical system). Pressure and resistance in cardiovascular system. Laminar and turbulent flow. Bernoulli equation in explaining stenosis and aneurysm. Real fluids. Poisseuille law and hypertension.

Medical physics
Imaging techniques medical diagnostics.

- Ultrasound imaging - sonography. Ultrasound transducer. Modes of medical sonography. Principles of Color Doppler imaging devices. 2D and 3D imaging.
- X-ray imaging – computerized tomography (CT). 2D and 3D imaging.
- Magnetic resonance imaging (MRI). Functional MRI.

Techniques to acquire and display the bioelectrical signals.

- Bioelectric potential of organs and organic systems. Methods for acquiring and recording: electroencephylography (EEG), electrocaridiography (ECG), electromyiography (EMG).

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 have corresponding e-course on University LMS MudRI. The e-course will present all course materials, home works and activities to be completed by students, including Forums for discussion. Individual assignments will be given in the form of homework to be completed and submitted via LMS. Seminars will be organized as goup work (research, preparation and presentation of seminar topics), which will be assesed by teacher and peers. Mentorship will be organized to help and follow up students in their seminar work, through LMS and if needed in person. Fieldwork will be organized as study visit to Radiology and Internistic departmetnt in Clinical Hospital Rijeka.	

1.7. Student's obligations

Students are obliged to actively participate in course, during the classroom hours as well as on e-course activities. Regular submission of homework is expected and required. Seminar paper and presentation in front of colleagues.

1.8. Evaluation of student's work

Course attendance		Activity/Participation	0.5	Seminar paper	1.0	Experimental work	
Written exam	1.5	Oral exam		Essay		Research	
Project		Sustained knowledge check	1.0	Report	1.0	Practice	
Portfolio							

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

Student's work will be assesed and evaluated during the course and on the filnal written exam. Student can gain 70 points durign the course by doing homeworks, writing seminar paper, presenting the seminar topic and hving positively graded periodical knowledge assesment tests, while the 30 points can be gained at final written exam after the course activities are over.

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

R. Glaser: Biophysics, Springer, Berlin, 2000.
D.Juretić: Bioenergetika – rad membranskih proteina, Informator 1997.
Jasminka Brnjas-Kraljević: Fizika za studente medicine – I dio, struktura materije i dijagnostičke metode, Medicinska naklada Zagreb, 2001.
Ante Šantić: Biomedicinska elektronika, Školska knjiga Zagreb, 1995.
Arthur C. Guyton i John E. Hall: Medicinska fiziologija, Medicinska naklada Zagreb, 2006.

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

M.Daune: Molecular Biophysics, Oxford University Press,1999.
R.B.Gennis: Biomembranes – molecular structure and function, Spriger 1999.
W.H.Elliot, D.C.Elliot: Biochemistry and Molecular Biology, Oxford University Press, 2001.
B.H. Brown, R.H. Smallwood, D.C: Barber, P.V. Lawford, D.R. Hose: Medical Physics and Biomedical Engineering, IOP Publishing Ltd 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*
R. Glaser: Biophysics, Springer, Berlin, 2000.	1	
D.Juretić: Bioenergetika – rad membranskih proteina, Informator 1997.	1	
Jasminka Brnjas-Kraljević: Fizika za studente medicine – I dio, struktura materije i dijagnostičke metode, Medicinska naklada Zagreb, 2001.	1	
Ante Šantić: Biomedicinska elektronika, Školska knjiga Zagreb, 1995.	1	
Arthur C. Guyton i John E. Hall: Medicinska fiziologija, Medicinska naklada Zagreb, 2006.	1	
* book chapters relevant for teaching and learninhg propcess will be digitalized in University Library and presented in e-course.		

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences
Questionairres: anonymous questionairre for students on their expectations (at the course beggining) and survey on T&L quality assesment and student's satisfaction (at the end). Student's Portfolio: individual follow up of student and his/hers progress (feedback provided for all activities). Seminar paper and presentation in digital form, with feedback in the form of teacher's and peer's review comments.

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Basic description		
Course coordinator	Dijana Dominis Prester	
Course title	COMPUTATIONAL PHYSICS	
Study programme	Graduate Study Programme Physics and Philosophy	
Course status	Elective	
Year	2. 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.

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	Velimir Labinac	
Course title	COMPUTERS IN PHYSICS TEACHING	
Study programme	Graduate Study Programme Physics and Philosophy	
Course status	Elective	
Year	2. year	
ECTS credits and teaching	***ECTS student 's workload coefficient***	2
	Number of hours (L+E+S)	15 + 15 + 0

1. COURSE DESCRIPTION

1.1. Course objectives

The course objective is to acquire knowledge and skills related to the use of ICT in various aspects of teaching physics: the collection of information, the use of multimedia elements in the development of educational materials (electronic publishing), various forms of on-line and self-checks of knowledge, communication and work in virtual workspace as a step towards e-learning, the adoption of pedagogical strategies supported information technology, computer as a tool for collecting and processing data.

1.2. Course enrolment requirements

It is assumed that the student possesses some basic skills in working with computers and has the basic knowledge and skills in the use of computer multimedia. The course is closely linked to the general physics courses (Physics I, II, III, IV, Modern Physics I, II) and Physics Laboratories I, II, III, IV. This program provides for acquisition of knowledge about different learning strategies supported by computer and is necessarily associated with the methods of teaching and learning (Methods and Strategies in Physics Teaching I, II, Demonstration Experiments for Physics Teacher Training and Laboratory Experiments for Physics Teacher Training).

1.3. Expected course learning outcomes

At a general level, the student should develop skills in using computers and other components of information and communication technologies. Specific competencies should be reflected in the ability to organize and conduct a computer assisted teaching (e-learning, electronic publishing, use of courseware tools).

1.4. Course content

Expected learning outcomes are:

1. At a general level, the student should develop skills in using computers and other components of ICT. Specific competencies should be reflected in the ability to organize and conduct a computer assisted teaching (e-learning, electronic publishing, use of courseware tools).
2. Data search. Specialized educational search engine. Repositories of educational content. Organization of data in repositories. Concepts: Learning Object, the fragmentation of educational content standards - Learning Object Metadata (LOM) standard. Student Activity: Exercise / Lab - search data in a repository (MERLOT), fragmentation of the educational content, using the description meta-data and storing in the database.
3. Tools for organizing and conducting classes in the virtual workspace (Courseware tools, LMS-Learning Management System). Student Activity: Exercise / Lab - exploring and working in one of LMS's (for example, open source software and commercial CLARLOINE WebCT)
4. Electronic publishing: the use of art in the development of educational content. Student Activity: Exercise / practicum / project task - creation of educational content, make the author's drawings.

5. Electronic publishing: the use of animation in the development of educational content. Student Activity: Exercise / practicum / project task - creation of educational content with the obligatory making authoring animations.
6. Electronic publishing: the use of photos and videos to creating educational content. Student Activity: Exercise / practicum / project task - creation of educational content, make the author's photographs and video.
7. Electronic publishing: the use of sound in the teaching process. Student Activity: Exercise / Lab - Working with sound generators, analysis of audio signals, processing the data obtained.
8. Interactive simulation in the teaching process, virtual and hybrid experiments. Student Activity: Exercise / practicum / project assignment - working with the interactive simulation. Creating educational content with interactive simulations.
9. Electronic and self-checks of knowledge, questionnaires, quizzes. Student Activity: Exercise / practicum / project assignment - working with different forms of on-line verification and self-checks of knowledge. Creating your own questionnaire with an accompanying educational content.
10. The computer as a measuring instrument, on-line data collection and processing. Student Activity: Exercise / Lab - measurement of time-dependent electrical signal using a USB oscilloscope. Processing and presentation of data.
11. The computer as a measuring instrument, on-line data collection and processing. Student Activity: Exercise / Lab - measurement of light signals through a USB spectrometer. Processing and presentation of data.
12. Computer assisted learning strategy (design classes, web-quest). Student Activity: Project task / assignment - making an on-line project, presentation of project results.

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 project and a seminar paper with the PowerPoint presentation;
- to pass the final oral exam.

1.8. Evaluation of student's work

Course attendance	0.1	Activity/Participation	0.2	Seminar paper	0.4	Experimental work	
Written exam		Oral exam	0.6	Essay		Research	
Project	0.5	Sustained knowledge check	0.2	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 (oral 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)

Christian W., Belloni M., *Physlets: Teaching Physics with Interactive Curricular Material*, Addison, Benjamin Cummings, San Francisco, 2000.
Clark R. C., Mayer E. R., *e-Learning and the Science of Instruction: Proven Guidelines for Consumers and Designers of Multimedia Learning*, 2nd ed., Pfeiffer; San Francisco, 2006.
Jurdana-Šepić R., Milotić B., *Metodički pokusi iz fizike*, Filozofski fakultet u Rijeci, Rijeka, 2001.

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

Physics textbooks for elementary and high schools.
Wilson J. D., *Physics Laboratory Experiments*, 5. izdanje, Houghton Mifflin Company, Boston, 1998.

WWW
https://lms.carnet.hr/
http://www.girep.org/
http://www.phy.ntnu.edu.tw/ntnujava/
http://scitation.aip.org/tpt
http://www.scienceinschool.org/
http://eskola.hfd.hr/
http://www.compadre.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*
Christian W., Belloni M., *Physlets: Teaching Physics with Interactive Curricular Material*, Addison, Benjamin Cummings, San Francisco, 2000.	1	5
Clark R. C., Mayer E. R., *e-Learning and the Science of Instruction: Proven Guidelines for Consumers and Designers of Multimedia Learning*, 2nd ed., Pfeiffer; San Francisco, 2006.	1	5
Jurdana-Šepić R., Milotić B., *Metodički pokusi iz fizike*, Filozofski fakultet u Rijeci, 2001	10	5

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	Branka Milotić	
Course title	CONCEPTUAL PHYSICS	
Study programme	Graduate Study Programme Physics and Philosophy	
Course status	Elective	
Year	2. year	
ECTS credits and teaching	***ECTS student 's workload coefficient***	2
	Number of hours (L+E+S)	15 + 0 + 15

1. COURSE DESCRIPTION

1.1. Course objectives

Developing ideas about physical phenomena and concepts, and understanding of physical principles in order to create concepts and design, organizing and linking knowledge into a coherent picture.

1.2. Course enrolment requirements

No conditions.

1.3. Expected course learning outcomes

The student will, after finishing the course, be able to:
- interpret the ideas associated with specific phenomena
- interpret the phenomena without the use of mathematical apparatus
- assess the level of conceptual understanding and expression during performance and interpretation of experiments
- apply conceptual knowledge to contextual problems
- to transfer knowledge in the new context with a conceptual understanding
- analyze the paper in a professional journal of physics in education

1.4. Course content

The structure of science and scientific methodology - from conceptual idea to a scientific theory. The movements and causes of motion - Newton's concept versus Aristotle. Energy: conversion and energy exchange. Conservation of energy. Force and force fields. Fundamental forces in nature. Unity of forces in nature. Relationship between structure and properties of matter (solid, liquid, gas, plasma). Thermal properties of the system - the heat, modes of transmission, the phase changes. Interaction of EM waves with matter. Interaction of EM waves with living matter. Models. A review of common misunderstandings and correcting the existing misunderstandings.

1.5. Teaching methods	☒ lectures ☒ seminars and workshops ☐ exercises ☐ long distance education ☐ fieldwork	☒ individual assignment ☒ multimedia and network ☐ laboratories ☐ mentorship ☒ consultative teaching
1.6. Comments	Seminars and workshops will be achieved through group work and individual tasks in the form of homework. During the seminar work a student can get help through consultations.	

1.7. Student's obligations

- regular attendance
- active participation in discussions about the conceptual content
- write a seminar work during the semester and present it in front of other students
- active participation in discussions after the presentation of seminar works of other students
- passing a written exam

1.8. Evaluation of student's work

Course attendance	0,3	Activity/Participation	0,4	Seminar paper	0,5	Experimental work	
Written exam	0,5	Oral exam		Essay		Research	
Project		Sustained knowledge check	0,3	Report		Practice	
Portfolio							

***Comments*:**
Classes will be interactive with the specific training of question-answer seeking conceptual understanding. Seminar hours will employ group work (solving the problems and disccusion on conceptual problems).

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

The student's work will be evaluated and assessed during the course activities and on written exam. The total number of credits a student can achieve during the course is 70 (assessed activities highlighted in the table) and on the written test 30 points.
Detailed elaboration of methodology for monitoring and evaluation of students' work will be presented in executive course plan.

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

Physics textbooks for primary and secondary schools
Krsnik, R., Suvremene ideje u metodici nastave fizike, Školska knjiga, Zagreb, 2008.
Jurdana-Šepić, R. , Milotić, B., Metodički pokusi iz fizike, Filozofski fakultet u Rijeci, Rijeka, 2001.
Demos of physics: www.wfu.edu/pshysics/demolabs/demos/avimov/)
Web:
http://conceptualphysics.com/pghewitt.shtml
http://www.drustvofizicara.com.ba/KONCEPTUALNA%20%20PREDAVANJA%20%20IZ%20FIZIKE%20-%20Zvuk.pdf

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

P.G.Hewitt: Conceptual physics, Addison Wesley 2001.
Web:
http://www.maa.org/cupm/crafty/Chapt13.pdf
http://www.fearofphysics.com/Atom/atom1.html
http://www.ba.infn.it/www/didattica.html
http://webphysics.davidson.edu/Applets/Applets.html
http://www.walter-fendt.de/ph11e/index.html
http://www.phy.ntnu.edu.tw/java/index.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*
Physics textbooks for primary and secondary schools	1	3
Krsnik, R., Suvremene ideje u metodici nastave fizike, Školska knjiga, Zagreb, 2008.	2	3
Jurdana-Šepić, R. , Milotić, B., Metodički pokusi iz fizike, Filozofski fakultet u Rijeci, Rijeka, 2001.	5	3

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences
There will be an introductory questionnaire on existing conceptual knowledge. During the course, the student's activities will be monitored and the feedback on performance and progress assured. There will be occasional knowledge assessment, with feedback provided. Atz the end of the course, an anonymous survey questionnaire on the quality of the course delivery and students' satisfaction will be offered to students.

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Basic description		
Course coordinator	Rajka Jurdana Šepić	
Course title	DEMONSTRATION EXPERIMENTS FOR PHYSICS TEACHERS TRAINING	
Study programme	Graduate Study Programme Physics and Philosophy	
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

After passing the exam student will be able to:
1. demonstrate an experiment in physics
2. describe and compare the types of demonstration experiments in physics
3. make a visual or multimedia exhibit on the default content from the teaching of physics
4. analyze the demonstration in physics teaching
5. analyze their own verbal expression during the performance of demonstration experiments
6. analyze the records supporting the demonstration experiments (layout boards, student notebooks)
7. describe and compare the styles of teachers of physics
8. describe and differentiate the objectives of teaching physics
9. compare the approaches of different textbooks and analyze the possibility of adapting the demonstration experiments in the teaching programs related to textbooks
10. analyse of articles in professional journals in physics teaching

1.2. Course enrolment requirements

/

1.3. Expected course learning outcomes

To develop competency for implementation of demo experiments in physics teaching, as well as to develop experiment performance skills.

1.4. Course content

Introduction lecture (the importance of experiments in teaching physics), followed by approximately 150 demo experiments (to be prepared, performed and evaluated) organized into 10 subject groups: Kinematics, Dynamics, Hydrostatics, Optics and acoustics, Electrostatics, Electrical circuits, Magnetism, Electromagnetic induction, Heat and intermolecular forces, physics experiment in e-environment

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

Written preparation is required for access to laboratory work. Evaluation of the laboratory work is to be submitted

regularly. All of the proposed laboratory work is obligatory as well as homework in the form of essay.. Students are to demonstrate one of the experiments in front of the peers during the semester. Active participation in discussions on colleague's demonstrational performance (peer reviewing). Preparation for final assessment (demo experimental performance and written paper on the subject)

1.8. Evaluation of student's work

Course attendance	1	Activity/Participation	1	Seminar paper		Experimental work	
Written exam	0,3	Oral exam	0,4	Essay	0,3	Research	
Project		Sustained knowledge check		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.. Activities during the course bring at least 70% of the total mark. Final assessment includes performance of the experiment and written paper on the subject.

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

Jurdana-Šepić R., Milotić B., *Metodički pokusi iz fizike*, Filozofski fakultet u Rijeci, 2001
e-škola fizike, e-radionice «Hokus pokus fizika»

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

Ehrlich R., Why Toast Lands Jelly-Side Down: Zen and the Art of Physics Demonstrations, Princeton University Press, New Jersey, 1997.
Ehrlich R., Turning the World Inside Out and 174 Other Simple Physics Demonstrations, Princeton University Press, New Jersey, 1990.
Textbooks on physics for elementary and hing school
Physics teacher http://scitation.aip.org/tpt/
Science in School Journal avaliable on line

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*
Jurdana-Šepić R., Milotić B., *Metodički pokusi iz fizike*, Filozofski fakultet u Rijeci, 2001	10	8

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

Student's Portfolio: Continuous follow up of the activities and personal dedication is provided. Feedback on all the materials submitted, as well as on the individual participation in laboratory work, considering personal progress and development. Individual consultations on preparation for the demo performance and final assignment. *Questionnaire*: At the end of course, anonymous questionnaire on the course quality.

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Basic description		
Course coordinator	Vesna Kovač	
Course title	DIDACTICS II	
Study programme	Graduate Study Programme Physics and Philosophy	
Course status	Compulsory	
Year	1. 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 objectives of this course are:
to get students acquainted with variety of didactical choices in teaching practice and their adequate use in teaching practice; to enhance students for continiouos educational development and development of their teaching practice, to motivate students for nurturing positive climate and team work in teaching; to encourage students for basic research skills and constant inovation of their teaching practice.

1.2. Course enrolment requirements

No requirements.

1.3. Expected course learning outcomes

In order to fulfill his/her student requirements, students are expected to develope several competencies:

- to interprete and analyse fundamental didactical concepts and theories;
- to give critical interpretation of various didactical theories, schools of thoughts and models;
- to analyse and use various didactical and methodological choices in actual educational and teaching practice;
- to analyse and use adequately various didactical knowledge and skills (curriculum design; micro and macro organisation of teaching; using educational technology; assessment procedures; professional staff development of teachers etc.);
- to carry out and interprete simple research projects in the field of didactics and to suggest possible improvements and innovations of teaching practice.

1.4. Course content

Planning and programing of the education process.
Artikulation of the education process.
Concept and clasification of teaching methods.
Forms of class activities.
Media in class and learning.
Making the materials for independetly learning.
Assessment and evaluation of student.
Constructively associate learning effects, class methods and assessment.
Quality classes.
Research work on the actual didactic problems.

1.5. Teaching methods	☒ lectures ☐ seminars and workshops ☒ exercises ☐ long distance education ☒ fieldwork	☒ individual assignment ☒ multimedia and network ☐ laboratories ☐ mentorship ☐ other
1.6. Comments	Class will be executed in a form of interactive lectures and excercises, mostly discussions. It is expected of a student to prepare for discussions by reading assigned literature, following media, network etc. Students have right to consultation with course coordinator (personaly and via e-mail)	

1.7. Student's obligations

Students are obligated to participate actively in all forms of class activities; seminar paper, practical excercise and final exam. Students will be awarded with points to follow actual discussions and research in didactics.
Students have to read titles from assigned literature and at least two titles from optional literature. Requirement for final exam is to fulfill all due exercises, tests and a proof that they read some research or discussion in the field of didactic in a form of seminar paper.

1.8. Evaluation of student's work

Course attendance	1	Activity/Participation	0,5	Seminar paper		Experimental work	
Written exam		Oral exam	1,0	Essay		Research	
Project		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

Students are required to fulfill all activities during the class to approach the final exam and they need to pass oral exam.
Percentage of each activity in the final grade:
- exercises – 40%
- sustained evaluation (test) - 30%
- final exam – 30%

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

Bognar, L. i Matijević, M. (2002). *Didaktika*. Zagreb: Školska knjiga.
Obavezna poglavlja: Teorijski pristupi i terminološka pitanja (13-34); Metodološka pitanja didaktike (71-97); Mediji u odgoju i obrazovanju (323-352); Odgojno-obrazovna komunikacija (357-372)
Grgin, T. (2001). *Školsko ocjenjivanje znanja*. Jastrebarsko: Naklada Slap
Lavrnja, I. (1998). *Poglavlja iz didaktike*. Rijeka: Pedagoški fakultet u Rijeci
Lavrnja, I. (2000). *Vježbe iz didaktike*. Rijeka: Pedagoški fakultet u Rijeci
Poljak, V. (1991). *Didaktika*. Zagreb: Školska knjiga

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

Bežan, A., Jelavić, F., Kujundžić, N. i Pletenac, V. (1991). *Osnove didaktike*. Zagreb: Školske novine
Blažić, M.; Ivanus-Grmek, M.; Kramar, M. i Strmčnik, F. (2003). *Didaktika*. Novo mesto: Institut za raziskovalno in razvojno delo.
Grgin, T. (1994). *Školska dokimologija*. Jastrebarsko: naklada Slap
Jelavić, F. (2003). *Didaktika*. Jastrebarsko: Naklada Slap
Jensen, E. (2003). *Super-nastava. Nastavne strategije za kvalitetnu školu i uspješno učenje*. Zagreb: Educa
Kippert, H. (2001). *Kako uspješno učiti u timu*. Zagreb: Educa
Kyriacu, C. (2001). *Temeljna nastavna umijeća*. Zagreb: Educa
Meyer, H. (2002). *Didaktika razredne kvake.Rasprave o didaktici, metodici i razvoju škole*. Zagreb: Educa
Stevanović, M. (2003). *Didaktika*. Rijeka: Digital Point
Terhat,E. (2001). *Metode poučavanja i učenja*. Zagreb: Educa
Vrcelj, S. (1996). *Kontinuitet u vrednovanju školskog uspjeha*. Rijeka: Pedagoški fakultet Rijeka.
Vrgoč, H. (ur.). (2002). *Evaluation i ocjenjivanje školskog uspjeha*. Zagreb: HPKZ

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*
Bognar, L. i Matijević, M. (2002). *Didaktika*. Zagreb: Školska knjiga.	10	120
Grgin, T. (2001). *Školsko ocjenjivanje znanja*. Jastrebarsko: Naklada Slap	10	120
Lavrnja, I. (1998). *Poglavlja iz didaktike*. Rijeka: Pedagoški fakultet u Rijeci	10	120
Poljak, V. (1991). *Didaktika*. Zagreb: Školska knjiga	10	120

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

Teaching portfolio.
Student evaluation.
Co-operation with alumni (questionnaire on knowledge earned during the study, need for continous professional development)

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Basic description		
Course coordinator	Predrag Dominis Prester	
Course title	ELECTRODYNAMICS	
Study programme	Graduate Study Programme Physics and Philosophy	
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

- 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

None.

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		

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	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. There will be a 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)

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	Dubravka Kotnik-Karuza	
Course title	ELECTRONICS LABORATORY	
Study programme	Graduate Study Programme Physics and Philosophy	
Course status	Elective	
Year	2. 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 solid state physics. By use of experimental approach consolidate basic knowledge of electronics.and improve student's understanding of the structure and function of the electronic elements in order to make him able to build step-by-step the basic analog and digital electronic circuits and systems.

1.2. Course enrolment requirements

Students must have passed the exam in Basic electronics.

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 perform individually and independently the following laboratory exercises:

1. Characteristics of a bipolar transistor
2. Low-signal transistor amplifier
3. Operational amplifier
4. Active electronic filters
5. Oscillator
6. Multivibrators
7. Digital circuits

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

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.

1.8. Evaluation of student's work

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

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

D. Kotnik-Karuza: Osnove elektronike s laboratorijskim vježbama, Filozofski fakultet u Rijeci, 2000
P. Biljanović: Elektronički sklopovi, Školska knjiga, Zagreb, 2001
P. Biljanović: Mikroelektronika (Integrirani elektronički sklopovi), Školska knjiga, Zagreb, 2001

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

D.V. Hall: Digital circuits and systems, Mc Graw-Hill, 1989
D.L. Schilling, C.Belove: Electronic circuits, Mc Graw-Hill, 1989
K. Seeger: Semiconductor physics, Springer 1991
B. Juzbašić: Elektronički elementi, Školska knjiga, Zagreb, 1980

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. Kotnik-Karuza: Osnove elektronike s laboratorijskim vježbama, Filozofski fakultet u Rijeci, 2000	6	5
P. Biljanović: Elektronički sklopovi, Školska knjiga, Zagreb, 2001	4	5
P. Biljanović: Mikroelektronika (Integrirani elektronički sklopovi), Školska knjiga, Zagreb, 2001	4	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 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	Predrag Dominis Prester	
Course title	ELEMENTARY PARTICLE PHYSICS	
Study programme	Graduate Study Programme Physics and Philosophy	
Course status	Elective	
Year	2. year	
ECTS credits and teaching	***ECTS student 's workload coefficient***	5
	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

Electrodynamics.

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.

1.8. Evaluation of student's work

Course attendance		Activity/Participation	0.5	Seminar paper	2	Experimental work	
Written exam		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

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	Ivo Orlić	
Course title	EXPERIMENTAL METHODS IN PHYSICS	
Study programme	Graduate Study Programme Physics and Philosophy	
Course status	Elective	
Year	2. 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

General competences: student should develop understanding of accelerator based analytical techniques, interaction of ions with matter, importance of related applications and its impact in modern society.
Specific competencies: students will acquire basic understanding of particle acceleration, specific applications of accelerator based analytical techniques, detecting, measuring and analysing related spectra. If time and conditions permits students will have a chance to perform hands on measurement and analysis of some real samples.

1.2. Course enrolment requirements

Prerequisites: Basic training in general physics.

1.3. Expected course learning outcomes

1.4. Course content

Statistical methods in experimental physics. Spectra and numerical methods of analysis. Particle accelerators, interaction of charged particles with matter, detection of charged particles and photons. Basic principles of accelerator based techniques PIXE, RBS, AMS and their applications in material, biomedical and environmental sciences, protection of cultural heritage. Synchrotron radiation, accelerators and their applications. Nuclear medicine and basic principles of nuclear magnetic resonance (NMR), Computer Tomography (CT), proton therapy, etc. Nondestructive techniques and their applications. Radioactivity, isotopes and basic principles of nuclear geochronology.

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

Forms of tuition: lectures (2 hours per week); independent work, tutorials, office hours (1 hour per week).
Manner of knowledge checking: class participation, written exam (2 midterm exams), oral exam.
Student is required to write and present a project in the field, usually some reading from a paper or a section in well-known book. The final exam is oral exam.

1.8. Evaluation of student's work

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

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 (the final presentation and demonstration of a school laboratory experiment). 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)

1. S. A. E. Johansson and J. L. Campbell, PIXE: A novel technique for elem. analysis, J. Wiley & Sons, 1988.
2. L.C. Feldman, J.W. Mayer, Fundamentals of Surface and Thin Film Analysis, Elsevier Sc Publ., NY 1986.
3. Melissinos, A. C., Napolitano, J., Experiments in Modern Physics, Academic Press,USA,2003.
4. Furić, M., Moderne eksperimentalne metode, tehnike i mjerenja u fizici, Školska knjiga, Zagreb, 1992.

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

1. Squires, G. L. Practical Physics, Cambrige University Press, Cambridge, 2001.
2. Leo, W. R. Techniques for Nuclear and Particle Physics Experiments, Springer-Verlag, Berlin, 1994.
3. Dunlap, R. A. Experimental Physics: Modern Methods, Oxford University Press, 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*
S. A. E. Johansson and J. L. Campbell, PIXE: A novel technique for elem. analysis, J. Wiley & Sons, 1988.	1	5
L.C. Feldman, J.W. Mayer, Fundamentals of Surface and Thin Film Analysis, Elsevier Sc Publ., NY 1986.	1	5
Melissinos, A. C., Napolitano, J., Experiments in Modern Physics, Academic Press,USA,2003.	1	5
Furić, M., Moderne eksperimentalne metode, tehnike i mjerenja u fizici, Školska knjiga, Zagreb, 1992.	1	5

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

Discussions with the students, questionnaires, achievements on the student projects and exams.

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Basic description		
Course coordinator	Zdravko Lenac	
Course title	FUNDAMENTALS OF QUANTUM MECHANICS	
Study programme	Graduate Study Programme Physics and Philosophy	
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

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 undergraduate study that includes the lectures from general physics and particularly 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

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	2.5	Oral exam	2.5	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

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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Basic description		
Course coordinator	Kornelija Mrnjaus	
Course title	GENERAL PEDAGOGY	
Study programme	Graduate Study Programme Physics and Philosophy	
Course status	Compulsory	
Year	1. 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

Course objective is to familiarise students with basic principles, concept, clasification of pedagogy and to form critical thinking about education in modern world.
The course is correspondent to other courses that have similar themes to history of pedagogy and pedagogy as a science.

1.2. Course enrolment requirements

No requirements.

1.3. Expected course learning outcomes

Upon finishing the course, students will be able to show general skills such as:

- speculative operations (induction, analisis, sintesis, comparation, evaluation…);
- analysing complexity of phenomenon of education;
- planing and organizing;
- applying ideas in analisis of practise work;
- conducting informations and presentation of informations.

Upon finishing the course, specific skill will provide students to be able to:

- describe, define and explain the phenomenon of education;
- analyse phenomenon of education on examples and cases;
- form and show ideas, actively engage in discussion

1.4. Course content

Pedagogy as a science (subject, methodology, pedagogy placement in the science system, pedagogy discipline system, pedagogy concept). Education and reproduction of human life. Education as social and humanistic phenomenon. Important features of human being – anthropological base of education. Education – constant of communion and culture (social, incultural, encultural, asimilated, individual). Relevant features of education. Education as a life need of a community (functionality, intentionality, instituationalization, fromalization of educational praxis). Education: effect of inheritance and social enviroment. Education as social function. Education as governing. Education as development. Educational goals, ideals and tasks. Educational enviroment: big social band, education family potencials, peers, school enviroment, mass media, free time enviroment, professional and working enviroment, enviroment for children with special needs.

1.5. Teaching methods	☒ lectures ☐ seminars and workshops ☒ exercises ☒ long distance education ☐ fieldwork	☒ individual assignment ☒ multimedia and network ☐ laboratories ☐ mentorship ☒ other; consultation
1.6. Comments	The course will be presented in hy*brid* form; combining long distance education (e-learning), class and individual and team work outside the class, using *Merlin*, system based on Moodle (Modular Object-Oriented Dynamic Learning Environment). Students will be instructed to use Merlin system. Active learning and teaching is recommended.	

1.7. Student's obligations

- active course attendance (when in class), preparation for class, active participating in class and planned activities on *Merlin*;
- presentation on paper;
- two tests during semester.

1.8. Evaluation of student's work

Course attendance	1.0	Activity/Participation	1.0	Seminar paper		Experimental work	
Written exam		Oral exam		Essay		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

Evaluation will take place without final exam. Student's work will be assessed during classes in the form of sustained assessments of activities on *Moodle*, two written tests and their exercises presentation.

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), General pedagogics (skripta). Rijeka: Filozofski fakultet u Rijeci

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

Bratanić, M. (1991) Mikro-pedagogija. Zagreb: Školska knjiga
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
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

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)	20	10
Katz, L. G., McClellan, E. (1999), Poticanje razvoja dječje socijalne kompetencije.	3	10

Zagreb: Educa, str.15-98.		
1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences		
Quality will be sustainly monitored during the course. Periodicaly will be used questionarries, assessment scale and discussions. Comments, suggestions and informations are used to improve lessons, lectures and other forms of work.		

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Basic description		
Course coordinator	Students are required to choose a Thesis Advisor.	
Course title	GRADUATE THESIS	
Study programme	Graduate Study Programme Physics and Philosophy	
Course status	Compulsory	
Year	2. year	
ECTS credits and teaching	***ECTS student 's workload coefficient***	5
	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 Graduate thesis.

1.2. Course enrolment requirements

Student is required to successfully pass all exams in the 1st year of the graduate study before applying for the Graduate thesis. The requirements for thesis defense are successfully and completely passed all exams on graduate 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 ☐ 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 choose a Thesis Advisor and find a thesis topic by consulting her/his Thesis Advisor;
- to independently prepare their thesis according to the Regulations on Writing the Graduate 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	4.5	Thesis Defence	0.5

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	Rajka Jurdana Šepić	
Course title	HISTORY OF PHYSICS	
Study programme	Graduate Study Programme Physics and Philosophy	
Course status	Compulsory	
Year	2. year	
ECTS credits and teaching	***ECTS student 's workload coefficient***	2
	Number of hours (L+E+S)	15+0+15

1. COURSE DESCRIPTION

1.1. Course objectives

To gain knowledge on development of physics scientific thought through history. To develop understanding of concepts and models creation in physics. To understand physics as part of philosophy of nature, to create awareness about importance of physical science in social context and about physics educational values.

1.2. Course enrolment requirements

/

1.3. Expected course learning outcomes

After passing the exam, the student will be able to
1.define methods of science
2. describe and analyze the circumstances from which arose the natural philosophy
3. define and describe the basic features of development of science thoughts and best-known scientists of great historical periods (Antiquity, Middle Ages, renesasna, the new century, 19th century, 20th century) and civilizations (Egyptian civilization, Maya civilization, the Arab civilization)
4. describe cosmological conceptions and models of celestial mechanics that occurred throughout history, name their authors, and concepts and models to distinguish and compare
5. analyse development optics (optical phenomena, the laws of geometrical optics, the nature of light) through history
6. describe and analyze the historical development of understanding the structure of matter
7. describe and analyze the historical development of concepts of heat and fluid
8. describe and analyze the historical development of concepts of electricity and magnetism and describe the construction of classical electrodynamics
9. describe Galilei and Newton's contribution to physics and to argue their importance
10th describe scientific contributions and historical significance of Croatian scientists Antun Marko De Dominis, Frane Petric, Hermann Dalmatin, Marin Getaldic, Ruder Boskovic, Nikola Tesla and Andrija Mohorovicic

1.4. Course content

Intuitive concepts on natural phenomena in pre-civilization. Mathematics, physics and astronomy in antic philosophy. Medieval understandings in philosophy of nature. Giordano Bruno. Johannes Kepler. Tycho Brache. Celestial mechanics and cosmogony. Physics of Galileo. Classical physics concepts development. Structure of matter and nature of light. Newton's natural philosophy. Mathematics and physics interaction. Ruđer Bošković. Mechanical understanding of Universe and determinism. Concepts of heat and fluids. Explanation of color and theory of light. Explanations of electricity, concept of field, electromagnetic field. M.Faraday. J.C. Maxwell. Concept of atom. Gas kinetic theory. Modern physics. Radiation laws. M.Planck. Quantum theory. Concept of ether and its fall. Einstein's theory of relativity. The influence of relativity and quantum theory on philosophy. Evolution of 20th century 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

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

1.8. Evaluation of student's work

Course attendance	0,2	Activity/Participation	0,3	Seminar paper		Experimental work	
Written exam		Oral exam	0,3	Essay		Research	
Project		Sustained knowledge check	0,4	Report	0,8	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. 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)

Web courseware Povijest fizike
I.Supek: Povijest fizike, ŠK, Zagreb 1980.
Ž.Dadić: Povijest ideja i metoda u matematici i fizici, ŠK, Zagreb, 1992
Faj, Z.: Pregled povijesti fizike, Sveučilište u Osijeku, Osijek, 1999

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

Bazala V, Pregled povijesti znanosti, ŠK, Zg, 1980
Balchin J., 100 znanstvenika koji su promijenili svijet, ŠK, Zg 2005
Dadić, Ž., Rudjer Bošković, Zg, 1987
Feynman R.: Osobitosti fizikalnih zakona, ŠK, Zagreb, 1986.
Gribbin, J. Vodič kroz znanost, Izvori, Zagreb, 2001.
Jeans, J., Fizika kroz vekove, Novo pokolenje, Beograd, 1952
Kalin, B., Povijest filozofije, ŠK, Zg, 2000.
Marković, Ž., Ruđe Bošković, Zg 1968-9
Skoko, D., Mokrović, J., Andrija Mohorovičić, ŠK, 1998
Supek, I., Filozofija znanosti i humanizam, Zg, 1979
Supek, I., Heisenbergov obrat u shvaćanju svijeta, Zg, 1986
Tauber (prir.): Einsteinova opća teorija relativnosti, Globus, Zagreb, 1979.
Vavilov, S.I., Newton, Zg, 1950

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: Povijest fizike, ŠK, Zagreb 1980.	5	10
Ž.Dadić: Povijest ideja i metoda u matematici i fizici, ŠK, Zagreb, 1992.	5	10
Faj, Z.: Pregled povijesti fizike, Sveučilište u Osijeku, Osijek, 1999.	5	10

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

Student's Portfolio: Continuous follow up of the activities, feedback on assignments and seminar work. Individual consultations for seminar work. *Questionnaire*: Introductory questionnaire on student's expectations. At the end of course, anonymous questionnaire on the course quality.

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Basic description		
Course coordinator	Rajka Jurdana Šepić	
Course title	INTERDISCIPLINARY SUBJECTS IN PHYSICS TEACHING	
Study programme	Graduate Study Programme Physics and Philosophy	
Course status	Elective	
Year	2. year	
ECTS credits and teaching	***ECTS student 's workload coefficient***	2
	Number of hours (L+E+S)	15 + 0 + 15

1. COURSE DESCRIPTION

1.1. Course objectives

To develop future teacher's ability to incorporate related subjects into physics course program, to gain insight about science as integrated human activity to envision natural processes and phenomena vs. the differentiation and specialization of scientific disciplines.

1.2. Course enrolment requirements

/

1.3. Expected course learning outcomes

After the course, students will be able to
1. define interdisciplinarity
2. describe the importance of interdisciplinary approaches to teaching and to physics teaching
3. analyze the content of physics, which offer the possibility of an interdisciplinary approach
4. shape didactically selected interdisciplinary content in the teaching of physics

1.4. Course content

Science and scientific methods. Differentiation of science through history as a from of social perception. The interdisciplinary concept of science.
Selected examples of physics teaching content with related school subjects.

- Mathematics: examples of related course content
- Biology: biopotential, animal nervous system, sensors as detectors, cardiac rhythm, gas laws and breathing, thermodynamics of open systems (cell and biological organism), interaction of electromagnetic waves with biological tissue, mechanic properties of biological tissues (bone strength, viscoelasticity of muscles), blood circulation as closed hydrodynamic system, stenosis, aneurism and Bernoulli's equation, diffusion on biomembranes.
- Anatomy: biomechanics of sports
- Technique: generators, plants, concepts of energy and power, electronics
- Technology in medicine: diagnostics (computer tomography, magnetic resonance and ultrasound) and therapy (EM wave therapies: lasers, diathermy, X-ray).
- Chemistry: structure of atom and periodic table of elements
- Geography: thermo dynamical aspect of climatology and meteorology
- History and Philosophy. History of science, influence of physics on philosophy.
- School textbook analysis. Methodological approach to incorporate interdisciplinary problems into primary school physics teaching. Methodological approach to incorporate interdisciplinary problems into secondary school and gymnasium physics teaching. Constructivist approach to incorporate interdisciplinary problems.

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.

1.8. Evaluation of student's work

Course attendance	0,5	Activity/Participation	0.5	Seminar paper	1	Experimental work	
Written exam		Oral exam		Essay		Research	
Project		Sustained knowledge check		Report		Practice	
Portfolio							

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 valued continuously 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)

Textbooks of biology, polytechnics, chemistry, mathematics for elementary and high school.

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

Physics teacher http://scitation.aip.org/tpt/
Science in School http://scienceinschool.org/
Paar, V., Šips, V.: *Gibanje i energija*, ŠK, Zagreb, 1987.
Šindler G., Mikuličić B., *Fizika 7*, udžbenik za 7. razred osnovne škole, ŠK, Zagreb, 1998.
Šindler G., Mikuličić B., *Fizika 8*, udžbenik za 8. razred osnovne škole, ŠK, Zagreb, 1999.
Krsnik, R.: *Fizika za prvi razred gimnazije*, ŠK, Zagreb, 1999.
Krsnik, R.: *Fizika za drugi razred gimnazije*, ŠK, Zagreb, 1999.
Krsnik, R., Mikuličić, B.: *Fizika: međudjelovanja, relativnost, titranje i zvuk*, priručnik za nastavnike u 3. razredu gimnazije, ŠK, 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*
/		
/		

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

Student's Portfolio: Continuous follow up of the activities, feedback on assignments and seminar work. Individual consultations for seminar work. *Questionnaire*: Introductory questionnaire on student's expectations. At the end of course, anonymous questionnaire on the course quality.

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Basic description		
Course coordinator	Velimir Labinac	
Course title	LABORATORY EXPERIMENTS FOR PHYSICS TEACHERS TRAINING	
Study programme	Graduate Study Programme Physics and Philosophy	
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

The main objectives are to develop future teacher's ability and sensibility for the use of experiment in physics teaching and active learning encouragement. Students will develop abilities for preparation and realization of laboratory experiments in physics teaching process.

1.2. Course enrolment requirements

The course assumes knowledge of general physics and requires that physics laboratories have been completed at an undergraduate level. It correlates with the course Methods and Strategies in Physics Teaching I, II.

1.3. Expected course learning outcomes

Students will be able:

1. to prepare, to present and to interpret elementary or high-school laboratory experiments;
2. to describe and compare the kinds of demonstration and laboratory experiments in physics;
3. to analyze and to correct their speech when performing the demonstration experiments;
4. to analyze the records supporting the demonstration experiments (chalkboard or whiteboard layout, student notebooks);
5. to describe and to compare different teaching styles and how do they relate to the performance of experiments;
6. to describe and to distinguish the objectives of physics teaching and how do they relate to the performance of demonstration and laboratory school experiments.

1.4. Course content

Exercises in implementation and interpretation of physics laboratory experiments for elementary and high-school. Several experiments are made from each of the following groups of exercises: Motion. Simple devices. Physical properties of bodies. Electrical circuits. Motion and forces. Heat. Electricity. Optics. Java applets in physics teaching. Final presentation and demonstration of a high-school laboratory experiment

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

- A written preparation is required for access to laboratory work.
- Evaluation of the laboratory work is to be submitted regularly.
- All of the proposed laboratory work is obligatory. Students are to demonstrate one of the experiments in front of the peers during the semester.
- Active participation in discussions on colleague's demonstrational performance (peer reviewing).
- Preparation for final assessment (final presentation and demonstration of a high-school laboratory experiment including a written paper on the subject).

1.8. Evaluation of student's work

Course attendance	0.2	Activity/Participation	0.2	Seminar paper	0.4	Experimental work	1.0
Written exam		Oral exam		Essay		Research	
Project		Sustained knowledge check	0.2	Report		Practice	
Final presentation and demonstration of a high-school laboratory experiment					1.0		

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 (the final presentation and demonstration of a school laboratory experiment). 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)

Ehrlich R., *Turning the World Inside Out and 174 Other Simple Physics Demonstrations*, Princeton University Press, New Jersey, 1990.
Ehrlich R., *Why Toast Lands Jelly-Side Down: Zen and the Art of Physics Demonstrations*, Princeton University Press, New Jersey, 1997.
Jurdana-Šepić R., Milotić B., *Metodički pokusi iz fizike*, Filozofski fakultet u Rijeci, 2001.
Sutton R. M., *Demonstration Experiments in Physics*, McGraw-Hill, New York, 1938. (the book is available in electronic format at http://physicslearning.colorado.edu/PiraHome/Sutton/Sutton.htm)

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

Bek, B., Marković B. i Tomaš L.: *Fizika 2*, Školska knjiga, Zagreb, 1981.
Edmonds D. S., *Cioffari's Experiments in College Physics*, 10. izdanje, Houghton Mifflin Company, Boston, 1997.
Krsnik, R, *Fizika za drugi razred gimnazije*, Školska knjiga, Zagreb, 1999.
Krsnik, R, *Fizika za prvi razred gimnazije*, Školska knjiga, Zagreb, 1999.
Krsnik, R., Mikuličić, B., *Fizika: međudjelovanja, relativnost, titranje i zvuk*, priručnik za nastavnike u 3. razredu gimnazije, Školska knjiga, Zagreb, 1992.
Meiners H. F., *Physics Demonstration Experiments*, vol. I, II, The Ronald Press Company, New York, 1970.
Mikuličić, B., *Fizika - Gibanje i energija*, Školska knjiga, Zagreb, 1990.
Mikuličić, B., *Fizika : Gibanje, električna energija i svjetlost*, sv.B, Školska knjiga, Zagreb, 1992.
Mikuličić, B., *Materija,čestice i međudjelovanja*, sv. B, Školska knjiga, Zagreb, 1988.
Paar, V., Šips, V., *Gibanje i energija*, Školska knjiga, Zagreb, 1987.
Šindler G., Mikuličić B., *Fizika 7*, udžbenik za 7. razred osnovne škole, Školska knjiga, Zagreb, 1998.
Šindler G., Mikuličić B., *Fizika 8*, udžbenik za 8. razred osnovne škole, Školska knjiga, Zagreb, 1999.
Šindler, G. i Valić, B., *Materija, gibanje, električna energija i svjetlost*, Školska knjiga, Zagreb, 1991.
Wilson J. D., *Physics Laboratory Experiments*, 5. izdanje, Houghton Mifflin Company, Boston, 1998.
Ostali udžbenici iz fizike za osnovne i srednje škole.

WWW
https://lms.carnet.hr/

http://www.fearofphysics.com/index.html
http://webphysics.davidson.edu/Applets/Applets.html
http://www.walter-fendt.de/ph14e/
http://www.phy.ntnu.edu.tw/java/index.html
http://www.surendranath.org/Applets.html
http://physicslearning.colorado.edu/PiraHome/index.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*
Jurdana-Šepić R., Milotić B., *Metodički pokusi iz fizike*, Filozofski fakultet u Rijeci, 2001.	10	10
Ehrlich R., *Why Toast Lands Jelly-Side Down: Zen and the Art of Physics Demonstrations*, Princeton University Press, New Jersey, 1997.	1	10
Ehrlich R., *Turning the World Inside Out and 174 Other Simple Physics Demonstrations*, Princeton University Press, New Jersey, 1990.	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	Zdravko Lenac	
Course title	MAGNETIC MATERIALS AND APPLICATIONS	
Study programme	Graduate Study Programme Physics and Philosophy	
Course status	Elective	
Year	2. 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

General competences: student should develop physical intuition and gain adequate knowledge of solving problems in materials science from the physicist point of view.
Specific competences: student should acquire basic knowledge about physical principles of magnetism and related phenomena, and should learn about applications of magnetic effects in the process of production and selection of different materials, and in the fabricating devices.

1.2. Course enrolment requirements

Prerequisites: Theoretical physics and applications I, II.
Related and recommended course: Spintronics.

1.3. Expected course learning outcomes

1.4. Course content

Definitions and units. Magnetization measurement methods. Magnetic properties of matter. Models of magnetism in insulators and metals. Magnetic anisotropy. Magnetoelasticity. Magnetization processes. Soft magnetic materials. Amorphous magnetic materials. Hard magnetic materials. Surface and thin-film magnetism. Magnetotransport. Magneto-optical materials. Nanomagnetic materials. Magnetic recording and memories. Investigating properties of materials by magnetic methods.

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 is required to write and present a project in the field, usually some reading from a paper or a section in well-known book. The exam consists of written part (or 2 midterm exams) and final (oral) exam.
Forms of tuition: lectures (2 hours per week); recitations (1 hour per week); independent work, tutorials, office hours (1 hour per week).
Manner of knowledge checking: class participation, written exam (2 midterm exams), 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	1.5	Essay		Research	
Project		Sustained knowledge check	0.5	Report		Practice	

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 (the final presentation and demonstration of a school laboratory experiment). 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)

O'Handley R. C., *Modern Magnetic Materials: Principles and Applications*, Wiley, New York, 2000.

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

Cullity B.D., Graham C.D.: *Introduction to Magnetic Materials*, 2nd ed., Wiley-IEEE Press, 2009.
Jiles D. C., *Introduction to Magnetism and Magnetic Materials*, 2nd ed., CRC Press, London, 1998.
Spaldin N. A., *Magnetic Materials: Fundamentals and Device Applications*, 2nd ed, Cambridge University Press, Cambridge, 2011.
Ashcroft N. W., Mermin N. D., *Solid State Physics*, Brooks Cole, New York, 1976.

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*
O'Handley R. C., *Modern Magnetic Materials: Principles and Applications*, Wiley, New York, 2000.	1	5

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

Discussions with the students, questionnaires, achievements on the student projects and exams.

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Basic description		
Course coordinator	Branka Milotić	
Course title	Methods and Strategies in Physics Teaching I	
Study programme	Graduate Study Programme Physics and Philosophy	
Course status	Compulsory	
Year	1. 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

To gain competence in teaching physics, to learn how to teach physics. To acquire principles of relating mathematical formalism to conceptual understanding of physical phenomena, to gain procedural knowledge on teaching and to develop critical thinking, to obtain positive but critical attitude towards teaching profession.

1.2. Course enrolment requirements

Finished course Demonstration Experiments for Teaching Physics

1.3. Expected course learning outcomes

After finishing the course, students will be able to:

1. define objectives and specific goals for teaching unit lesson and program
2. methodologically articulate class hour (in terms of content, time distribution, psychological and pedagogical aspects)
3. fill out preoperational form for class hour realization
4. use different teaching approaches
5. use scientifically-popular literature as a motivation for physics learning
6. actively teach using question-answer leading thinking and making conclusions
7. teach pupils how to critically think and how to learn
8. build physical concepts and models
9. develop conceptual understanding
10. apply contemporary educational conceptions
11. apply constructivist approach in teaching physics

1.4. Course content

Physics as scientific discipline and as a school subject. Physics and its relation and connection to other school subjects. Goals and outcomes of physics teaching. Preparation for a physics class. The influence of expected outcomes on the teaching methodology. Modern teaching perspectives. The importance of pupil's experience and pre-conceptions. Constructivism in teaching physics. Shaping the content methodologically. Methodology of teaching process. Construction of new concepts, structuring the conceptual net. Experiments in physics class. Development of concepts and models. Conceptual understanding in physics teaching. The role of educational films and animation in teaching physics.
Problem based teaching and problem based experiments. The role of mnemonics in teaching physics. Conditions and equipment to teach physics. Pupil's follow up and assessment of knowledge. Quality assurance.
The analysis of popular scientific literature on physics subjects. Methodological advices for teaching physics in primary and secondary school. Work on preoperational materials for classes. Student's class simulation and its analysis.

1.5. Teaching methods	☒ lectures ☒ seminars and workshops ☐ exercises ☐ long distance education ☐ fieldwork	☒ individual assignment ☒ multimedia and network ☐ laboratories ☒ mentorship ☒ consultative teaching
1.6. Comments	As an individual homework, students prepare one teaching unit and simulate one class hour in front of peers. Seminar work can be individually advised for corrections.	

1.7. Student's obligations

Class attendance and active participation are required, 15% of missed classes is allowed. An assay on popular scientific book or web page is to be presented to peers and submitted in written form. Completed preoperational form for one physics teaching class hour (primary or secondary school). Simulate one physics class hour in front of peers. Active participation in peer-reweaving and analysis of their performance.

1.8. Evaluation of student's work

Course attendance	0,5	Activity/Participation	1	Seminar paper	1	Experimental work	
Written exam		Oral exam	1	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 student's work is followed and assessed during the course and on the final exam. The total number of credits a student can achieve during the course is 70 (assessed activities highlighted in the table), and on the final exam 30 points.
Comment:
The work and progress of students is monitored continuously during the teaching process. The seminars specifically asses development of student's teaching competences. On final exam, teaching competences, attitudes towards physics curricula (as subject) and attitudes on teaching profession are assed.
Detailed elaboration of methodology for monitoring and evaluation of students' work will be presented in executive course plan.

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

Krsnik, R., Suvremene ideje u metodici nastave fizike, školska knjiga, Zagreb, 2008.
Jurdana-Šepić R., Milotić B., Metodički pokusi iz fizike, Čarolija eksperimentiranja, Filozofski fakultet u Rijeci, Rijeka, 2001.
Beck B., Modeli učenja u nastavi fizike, Školska knjiga, Zagreb, 1990.
Šindler G., Metodičke osnove oblikovanja početne nastave fizike, Školska knjiga, Zagreb, 1980.
Šindler G., Prilozi problemski usmjerenoj nastavi fizike, Školska knjiga, Zagreb, 1990.
Arar, Lj., Kolić-Vehovec, S., Milotić, B., Kako lakše učiti fiziku, MNEMOTEHNIKE – pomoć pri učenju, Školska knjiga, Zagreb, 2009.

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

Halliday D., Resnick R., Walker *FUNDAMENTALS OF PHYSICS II* , J.Willey and Sons, New York, 1997.
Wilson J. D., Physics Laboratory Experiments, 5th edition, Houghton Mifflin Company, Boston, 1998.
Milotić, B., Istinita čarolija BRANIMIR MARKOVIĆ Učenici o učitelju, Školska knjiga, Zagreb, 2009.
Buggle, F., Razvojna psihologija Jeana Piageta, Naklada Slap, Jastrebarsko, 2002.
Pijaže, Ž., Poreklo saznanja, Nolit, Beograd (prevedeno 6 značajnih Piagetovih radova publiciranih između 1964. i 1972.)
Krsnik R., Fizika I, Školska knjiga, Zagreb, 1994.
Physics Textbooks for Primary and Secondary Schools
Manuals for teachers
Dictionary Croatian Language,
Dictionary of Foreign Words

Goleman D., Emocionalna inteligencija, Mozaik knjiga, Zagreb, 1998.
Breene G., Nove paradigme za stvaranje kvalitetnih škola, Alinea, Zagreb, 1996.

Selected articles from journals in physics and the current educational periodicals:
Science in School, Physics Education, Physics Teacher, Metodički ogledi, Matematičko-fizički list, Svijet fizike, Obzornik za matematiko in fiziko, Napredak, Zrno, Školske novine, Drvo znanja …

Reading: Lederman I., Tenesi D., Božja čestica, Izvori, Zagreb, 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*
Krsnik, R., Suvremene ideje u metodici nastave fizike, školska knjiga, Zagreb, 2008.	3	6
Jurdana-Šepić R., Milotić B., Metodički pokusi iz fizike, Čarolija eksperimentiranja, Filozofski fakultet u Rijeci, Rijeka, 2001.	5	6
Beck B., Modeli učenja u nastavi fizike, Školska knjiga, Zagreb, 1990	5	6
Arar, Lj., Kolić-Vehovec, S., Milotić, B., Kako lakše učiti fiziku, MNEMOTEHNIKE – pomoć pri učenju, Školska knjiga, Zagreb, 2009.	3	6
Šindler G., Metodičke osnove oblikovanja početne nastave fizike, Školska knjiga, Zagreb, 1980.	3	6
Šindler G., Prilozi problemski usmjerenoj nastavi fizike, Školska knjiga, Zagreb, 1990.	3	6

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

Conversation with students on their expectations from the course. Introductory examination of the conceptual understanding of physics content for primary and secondary schools and analysis of incorrect preconceptions.
The feedback is provided for all student's activities, written papers and homework's.

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Basic description		
Course coordinator	Branka Milotić	
Course title	Methods and Strategies in Physics Teaching II	
Study programme	Graduate Study Programme Physics and Philosophy	
Course status	Compulsory	
Year	2. year	
ECTS credits and teaching	***ECTS student 's workload coefficient***	3
	Number of hours (L+E+S)	30 + 0 + 15

1. COURSE DESCRIPTION

1.1. Course objectives

To gain competence in teaching physics and assessing pupils in classroom, with respect to different aspects of acquired knowledge. Familiarization with the curriculum and syllabus for physics (as a elementary and secondary school subject) and corresponding textbooks. Gaining teaching skills in simulated conditions.

1.2. Course enrolment requirements

Finished courses Laboratory Experiments for Teaching Physics and Methods and Strategies in Physics Teaching I

1.3. Expected course learning outcomes

After finishing the course, students will be able to:

1. apply knowledge on physical phenomena to particular physics teaching units, according to elementary and secondary school curriculum
2. adapt the content to different pupils' age
3. be independent in creating physics teaching environment
4. use the experiment as central teaching unit element
5. prepare educational tools using everyday materials and objects
6. create, analyze and solve problems and problem based contextual situations
7. use correctly all metrological units of measurement
8. use mathematical apparatus and mathematical terminology
9. differentiate professional terminology and everyday language
10. use scientific language and be able to communicate in community of professionals
11. disclose cause-effect connections in physical phenomena taught in school
12. asses the level of pupils' knowledge
13. deliver a class hour in elementary and secondary school, professionally and methodologically right work on personal professional development

1.4. Course content

Analysis of Plan and Program. Physical entities and scientific terminology. The problem of standard and scientific language in physics teaching. Scientific communication. History of physics in physics as school subject. The role of mathematics and mathematical formalism in physics. Environment and equipment for teaching physics. E-learning. Monitoring of students, assessment of knowledge. Valuation of teaching performance. Teacher's personality.

1.5. Teaching methods	X lectures X seminars and workshops	X individual assignment X multimedia and network

	☐ exercises ☐ long distance education ☐ fieldwork	☐ laboratories X mentorship X consultative teaching
1.6. Comments	As an individual homework, students prepare one teaching unit and simulate one class hour in front of peers. Seminar work can be individually advised for corrections.	

1.7. Student's obligations

Students are required to regularly attend classes, 15% of missed classes are allowed. Students are required to actively participate in classroom activities, and are obliged to deliver a simulated lesson in front of all students (peers), and actively participate in the analysis of colleagues' delivery. Students need to write a seminar paper based on reading physics education journal papers and to present it to other students within the group.

1.8. Evaluation of student's work

Course attendance	0,5	Activity/Participation	0,5	Seminar paper	0,5	Experimental work	
Written exam		Oral exam	1	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 student's work is assessed during the course and on final exam. The total number of credits a student can achieve during the course is 70 (assessed activities highlighted in the table), while on final exam 30 points.
Comment:
The work and progress of students is monitored continuously during the teaching process, the seminars are used to test the student's teaching skills and readiness. The simulated delivery of class hours is analyzed and assed. Fill- out preoperational forms are cheeked for correctness on individual consultations. On final exam, teaching competences, attitudes towards physics curricula (as subject) and attitudes on teaching profession are assed.

Detailed elaboration of ways of monitoring and evaluation of students' work will appear in execution plan object.

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

Krsnik, R., Suvremene ideje u metodici nastave fizike, Školska knjiga, Zagreb, 2008.
Jurdana-Šepić R., Milotić B., Metodički pokusi iz fizike, Čarolija eksperimentiranja,
Filozofski fakultet u Rijeci, Rijeka, 2001.
Beck B., Modeli učenja u nastavi fizike, Školska knjiga, Zagreb, 1990.
Arar, Lj., Kolić-Vehovec, S., Milotić, B., Kako lakše učiti fiziku, MNEMOTEHNIKE – pomoć pri učenju, Školska knjiga, Zagreb, 2009.
Šindler G., Metodičke osnove oblikovanja početne nastave fizike, Školska knjiga,
Zagreb, 1980.
Šindler G., Prilozi problemski usmjerenoj nastavi fizike, Školska knjiga, Zagreb, 1990.

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

Milotić, B., Istinita čarolija BRANIMIR MARKOVIĆ Učenici o učitelju, Školska knjiga, Zagreb, 2009.
Wilson J. D., Physics Laboratory Experiments, 5th edition, Houghton Mifflin Company, Boston, 1998.
Halliday D., Resnick R., Walker *FUNDAMENTALS OF PHYSICS II* , J.Willey and Sons, New York, 1997.
Buggle, F., Razvojna psihologija Jeana Piageta, Naklada Slap, Jastrebarsko, 2002.
Pijaže, Ž., Poreklo saznanja, Nolit, Beograd (prevedeno 6 značajnih Piagetovih radova publiciranih između 1964. i 1972.)
Krsnik R., Fizika I, Školska knjiga, Zagreb, 1994.
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Dictionary Croatian Language,
Dictionary of Foreign Words

Goleman D., Emocionalna inteligencija, Mozaik knjiga, Zagreb, 1998.
Breene G., Nove paradigme za stvaranje kvalitetnih škola, Alinea, Zagreb, 1996.

Selected articles from journals in physics and the current educational periodicals:
Science in School, Physics Education, Physics Teacher, Metodički ogledi, Matematičko-fizički list, Svijet fizike, Obzornik za matematiko in fiziko, Napredak, Zrno, Školske novine, Drvo znanja …

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*
Krsnik, R., Suvremene ideje u metodici nastave fizike, školska knjiga, Zagreb, 2008.	3	6
Jurdana-Šepić R., Milotić B., Metodički pokusi iz fizike, Čarolija eksperimentiranja, Filozofski fakultet u Rijeci, Rijeka, 2001.	5	6
Beck B., Modeli učenja u nastavi fizike, Školska knjiga, Zagreb, 1990.	5	6
Arar, Lj., Kolić-Vehovec, S., Milotić, B., Kako lakše učiti fiziku, MNEMOTEHNIKE – pomoć pri učenju, Školska knjiga, Zagreb, 2009.	3	6
Šindler G., Metodičke osnove oblikovanja početne nastave fizike, Školska knjiga, Zagreb, 1980.	3	6
Šindler G., Prilozi problemski usmjerenoj nastavi fizike, Školska knjiga, Zagreb, 1990.	3	6

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

Students deliver a simulated class hour and analyse and discuss the instructional content, methodology and teaching strategies employed. Wile doing this they express their attitudes and personal criteria for good teaching. The feedback is provided for all student's activities, written papers and homework's.
Students attend extra class hours in elementary and secondary schools, where the progress is monitored. At the end of the course, students are surveyed about personal expectations and the level of quality in course delivery, as well as personal satisfaction with the course.

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Basic description		
Course coordinator	Dijana Dominis Prester	
Course title	MODERN PHYSICS II	
Study programme	Graduate Study Programme Physics and Philosophy	
Course status	Elective	
Year	1. year	
ECTS credits and teaching	***ECTS student 's workload coefficient***	4
	Number of hours (L+E+S)	60 + 15 + 0

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

None.

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.

1.8. Evaluation of student's work

Course attendance		Activity/Participation	0.5	Seminar		Experimental work	
Written exam	1	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

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	Petar Pervan	
Course title	NANOSCIENCE AND NANOTECHNOLOGIES	
Study programme	Graduate Study Programme Physics and Philosophy	
Course status	Elective	
Year	2. 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

General competences: students will learn the basic concepts relevant for nanotechnology.
Specific competences: students will learn about fundamental preparation and characterization techniques of nanosciences and nanotechnologies.

1.2. Course enrolment requirements

Prerequisites: Fundamentals of physics from undergraduate studies, *Solid State Physics*.

1.3. Expected course learning outcomes

1.4. Course content

Physical foundations of nanosciences. Surface science and ultrathin layers: experimental methods, photoelectron spectroscopies, low energy electron diffraction, thermal desorption, work function. Single atom and molecule manipulation techniques: STM, AFM, MFM. Nanostructures: from atomic and molecular clusters to macroscopic structures, carbon-based nanostructures (fullerenes, CNT, graphene). Preparation methods: self-assembly and litography. Selected cases of nano-based applications from current literature.

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

Student is required to write and present a seminar in the field, usually some reading from a paper or a section in well-known book. The exam consists of written part (or 2 midterm exams) and final exam.
Forms of tuition: lectures (2 hours per week); independent work, tutorials, Internet and multimedia (1 hour per week).
This will be a combination of face-to-face and distant (e-) learning. Each student will be asigned a seminar to expose publicly.
Two intermediate written exams and the final written exam will be used to check the overall progress of a student. When necessary an oral examination may take place.

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	1.5	Essay		Research	
Project		Sustained knowledge check	0.5	Report		Practice	

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 (the final presentation and demonstration of a school laboratory experiment). 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. L. Wolf, *Nanophysics and Nanotechnology: An Introduction to Modern Concepts in Nanoscience*, 2nd edition, Wiley, New York, 2006.

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

G. A. Mansoori, *Principles of Nanotechnology: Molecular-Based Study of Condensed Matter in Small Systems*, World Scientific, Singapore, 2005.
C. P. Poole, F. J. Owens, *Introduction to Nanotechnology*, Wiley-Interscience, New York, 2003.
M. Wilson, K. Kannangara, G. Smith, M. Simmon, B. Raguse, *Nanotechnology: Basic Science and Emerging Technologies*, CRC, London, 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. L. Wolf, *Nanophysics and Nanotechnology: An Introduction to Modern Concepts in Nanoscience*, 2nd edition, Wiley, New York, 2006.	1	5

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

Discussions with the students, questionnaires, achievements on the student projects and exams.

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Basic description		
Course coordinator	Elvio Baccarini	
Course title	PHILOSOPHY OF POLITICS	
Study programme	Graduate Study Programme Physics and Philosophy	
Course status	Compulsory	
Year	2. 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 *Philosophy of Politics*.

1.2. Course enrolment requirements

The course *Philosophy of Politics* corresponds to the similar philosophy courses held at other universities. It correlates, first of all, with the course *Ethics* held within the undergraduate program of philosophy, as well as other courses in the field of ethics, or various specific domains of philosophy of politics, offered as electives. The content of the course Philosophy of politics correlates with other related courses at Law School (for example, *The Theory of State and Law*), courses related to discussions on economic justice at Faculty of Economics, as well as courses that are concerned with social relations at Cultural Studies. Where the course deals with the question of multiculturalism and minorities or marginal groups, it correlates also with the Pedagogy studies that are directed towards the development of ability of education in a multicultural society (first of all, in contemporary European context). There are no special prerequisites, besides the course *Ethics* (this course can easily be made up by students from other undergraduate studies).

1.3. Expected course learning outcomes

After the completion of the requirements assigned in the course, it is expected:
- that the students understand the basic notions and theoretical doubts in the philosophical discussion about politics, and that they develop their own attitudes;
- that the students can creatively use the acquired knowledge. This will be achieved through autonomous understanding of ideas espoused by authors from the field of philosophical–political thought;
- that the students can relate discussions closely connected to philosophical–political issues, and insights from other areas (other parts of philosophy and, as far as it is possible regarding the nature of double-major study, with insights from other fields of humanistic and social sciences);
- that the students use the development of their methodological abilities in discussions about actual issues in the modern world (for instance, the problem of justice, equality, rights, multiculturalism).

1.4. Course content

The first part of the course is dedicated to the concepts that are crucial in current discussions in the field of philosophy of politics: liberalism, republicanism, democracy, communitarianism, totalitarianism. The special attention will be given to the question of how these concepts apply to the question of the system of government.
Secondly, relying on previously acquired knowledge, the question of formation of society will be considered and the answers to the questions: why and how is a society formed? The conflict between the atomistic approaches, according to which the society is arbitrary grouping of individuals (for example, the theory of social contracts), and holistic approaches, according to which the society is a precondition for determining of individual himself as a intellectual being with identity, for whom the choices are possible.
Furthermore, the theories of justice which are confronted in contemporary discussions will be presented and discussed

with the students:

- liberalism (with its anglophone meaning, as an approach which acknowledges the freedom of individuals, but does not exclude redistribution of goods);
- libertarianism (the theory which does not allow the redistribution of goods and which corresponds to the meaning of the notion "liberalism" on the continent.)
- communitarianism (the theory which affirms the primacy of society);
- utilitarianism (the theory according to which a well-organized state maximizes common good, preferences etc.);
- marxism and radical egalitarian theories. The contemporary issues from the philosophy of politics which are related to the field of international law will be analyzed as well.

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

The students are required to attend class and complete their assignments, as well as participate in the sustained knowledge check. 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	Activity/Participation	0,3	Seminar paper		Experimental work	
Written exam	1,5	Oral exam		Essay		Research	
Project		Sustained knowledge check	2,2	Report		Practice	
Portfolio							

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

Version 1. (final exam) The activities of the students will be evaluated and assessed in the form of sustained knowledge check, as well as with the final exam. The student can realize a maximum of 70 ECTS before the final exam (the activities indicated in the table are marked), while they can obtain 30 ECTS at the final exam.

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

MacIntyre, A., Za vrlinom, KruZak, Zagreb 2002.
Plant, R., Suvremena politička misao, Jesenski i Turk, Zagreb 2002.
Rawls, J., A Theory of Justice, Cambridge, Mass., Harvard University Press, 1971.

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

Arendt, H., Totalitarizam, Politička kultura, Zagreb 1996.
Aristotel, Politika, Sveučilišna naklada Liber, Zagreb 1988.
Bell, D., Komunitarizam i njegovi kritičari, Zagreb, KruZak, 2004.
Berlin, I., Četiri eseja o slobodi, Feral Tribune, Split 2000.
Hegel, G.W.F., Osnovne crte filozofije prava, Veselin Masleša, Sarajevo 1964.
Hobbes, T., Levijatan (str. 11-246), Jesenski i Turk, Zagreb 2004.
Mill, J.S., O slobodi, u Mill, Izabrani politički spisi, Informator, Zagreb 1988.
Nozick, R., Anarhija, država, utopija, Zagreb, Jesenski i Turk, 2003.
Rawls, J., Pravo naroda, KruZak, Zagreb 2004.
Rousseau, J.J., Društveni ugovor, Školska knjiga, Zagreb 1978.

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*
MacIntyre, A., Za vrlinom, KruZak, Zagreb 2002.	2	10
Plant, R., Suvremena politička misao, Jesenski i Turk, Zagreb 2002.	2	10
Rawls, J., A Theory of Justice, Cambridge, Mass., Harvard University Press, 1971.	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) as well. 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	Luca Malatesti	
Course title	PHILOSOPHY OF MIND	
Study programme	Graduate Study Programme Physics and Philosophy	
Course status	Compulsory	
Year	1. 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

Mental states have intentionality or the property to be about something. The course focuses on three fundamental issues in contemporary analytic philosophy of mind that are related to intentionality. The first question deals with the conditions that determine the intentional content of mental states. Two debates on the subject will be considered. First, there are different philosophical views on the role that factors outside the person should have in determining the intentional content of her mental states. Then, philosophers debate whether intentionality is strictly related to normativity.

Another issue concerns the position of intentionality in the natural world as described and explained by the natural sciences. In particular, we will examine the prospects of those theories that have attempted to analyse intentionality as a natural property.

Finally, philosophers have debated whether intentionality is a characterising feature of all mental states. Special attention will be devoted to a discussion that deals with the question of whether the qualitative properties of experience can be reduced to intentional properties.

1.2. Course enrolment requirements

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

Introduction to Intentionality
Naturalization intentionality
Intentionality and inference
Intentionality and normativity
Normativity
"Narrow" and "wide" mental content
Against the broad content
David Chalmers's two dimensions of content
Against Chalmers theory content
Non-conceptual Content
Against the non-conceptual content
Phenomenal character and intentional content
Non-intentional qualia
Recapitulation

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

1.8. Evaluation of student's work

Attendance **0.5**	Participation **0.5**	Seminar presentation **1**	Esej **2**
Final pismeni ispit **1**	Mid term exam 1		

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

AKTIVNOST KOJA SE OCJENJUJE	**MAX BROJ BODOVA**
1 essay of 2000 words and oral presentation in Croatian	40
EXAM - written in Croatian language	30
FINAL EXAM-written in Croatian language	30
Total	100

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

Brandom, R. 2002. "Reasoning and representing." In D. Chalmers, ed. *Philosophy of Mind: Classical and Contemporary Readings*. Oxford: Oxford University Press, 509-519.

Brentano, F. 2002. "The distinction between mental and physical phenomena." In D. Chalmers, ed. *Philosophy of Mind: Classical and Contemporary Readings*. Oxford: Oxford University Press, 479-484.

Chalmers, D. 2002. "The components of content." In D. Chalmers, ed. *Philosophy of Mind: Classical and Contemporary Readings*. Oxford: Oxford University Press, 608-633.

Dretske, F. 2002. "A recipe for thought." In D. Chalmers, ed. *Philosophy of Mind: Classical and Contemporary Readings*. Oxford: Oxford University Press, 491-499.

Heck, R. G. 2007. "Are there different kinds of content?" In B. P. McLaughlin and J. Cohen, eds. *Contemporary Debates in Philosophy of Mind*. Oxford: Blackwell, 117-138.

Millikan, R. 2002. "Biosemantics." In D. Chalmers, ed. *Philosophy of Mind: Classical and Contemporary Readings*. Oxford: Oxford University Press, 500-509.

Rey, G. 2007. "Resisting Normativism in Psychology." In B. P. McLaughlin and J. Cohen, eds. *Contemporary Debates in Philosophy of Mind*. Oxford: Blackwell, 69-84.

Sawyer, S. 2007. "There is no viable notion of narrow content." In B. P. McLaughlin and J. Cohen, eds. *Contemporary Debates in Philosophy of Mind*. Oxford: Blackwell, 20-34.

Segal, G. 2007. "Cognitive Content and Propositional Attitudes Attributions." In B. P. McLaughlin and J. Cohen, eds. *Contemporary Debates in Philosophy of Mind*. Oxford: Blackwell, 5-19.

Shoemaker, S. 2007. "A case for qualia." In B. P. McLaughlin and J. Cohen, eds. *Contemporary Debates in Philosophy of Mind*. Oxford: Blackwell, 318-332.

Tye, M. 2007. "New troubles for the qualia freak." In B. P. McLaughlin and J. Cohen, eds. *Contemporary Debates in Philosophy of Mind*. Oxford: Blackwell, 303-318.

Wedgwood, R. 2007. "Normativism defended." In B. P. McLaughlin and J. Cohen, eds. *Contemporary Debates in Philosophy of Mind* . Oxford: Blackwell, 85-101.

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

Braddon-Mitchell, D. and F. Jackson. 1996. *Philosophy of Mind and Cognition*. Oxford: Blackwell. (Selected chapters)

Byrne, A. and J. Pryor. 2006. "Bad intensions." In M. Garcia-Carpintero and J. Macia, eds. *Two-dimensional semantics*. Oxford: Oxford University Press.

Chalmers, D. ed. 2002. *Philosophy of Mind: Classical and Contemporary Readings*. New York, NY: Oxford University Press. (Further selected chapters)

Chisholm, R. M. 2002. "Intentional inexistence." In D. Chalmers, ed. *Philosophy of Mind: Classical and Contemporary Readings* . Oxford: Oxford University Press, 484-491.

Crane, T. 2001. The *Elements of Mind: An Introduction to the Philosophy of Mind*. Oxford: Oxford University Press. (Selected chapters: 2,3,4)

Fodor, J. 2007. "The revenge of the given." In B. P. McLaughlin and J. Cohen, eds. *Contemporary Debates in Philosophy of Mind*. Oxford: Blackwell, 105-116.

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. Chalmers, ed. *Philosophy of Mind: Classical and Contemporary Readings*. Oxford: Oxford University Press, 2002.	1	
P. McLaughlin and J. Cohen, eds. *Contemporary Debates in Philosophy of Mind*. Oxford: Blackwell, 2002.	1	

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	Majda Trobok	
Course title	PHILOSOPHY OF PHYSICS	
Study programme	Graduate Study Programme Physics and Philosophy	
Course status	Compulsory	
Year	2. 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 aim of the course is to acquire students with the basic problems of physics and with the philosophical interpretation and philosophical consequences of the problems in order to get insight into interdisciplinary and multidisciplinary solution of some problems.

1.2. Course enrolment requirements

Programme of the course correlates with some important topics and concepts of physics, philosophy of science, epistemology, ontology.

1.3. Expected course learning outcomes

It is expected better understanding of the relation of science, especially physics, and philosophy.

1.4. Course content

Philosophical problems of Physics in Antiquity and in the Middle Ages
Main currents of Greek philosophical thought about nature, Aristotles' physics, observational astronomy, Ptolemy's World-System, treatises on motion and of the structure of matter in the Middle ages,
Prenewtonean Physics
Copernican astronomy, Kepler's laws, Galileian mechanics and the problem of motion, corpuscular philosophy.
Newtonean science
Concepts of mass, development of concept of force, gravitation, space, time, motion, axiomatization of classical mechanics, causality and determinism of the classical science.
Concept of energy
Notion and kinds of energy, thermodynamics and its laws, entropy and probability, cosmological and philosophical consequences.
Electrodynamical world view
Models of aether, Maxwell's theory, Michelson.Morley's experiment, the Kaufmann experiments.
The theory of relativity
Essentials of special theory of relativity, general theory of relativity, philosophical consequences of the theory of relativity.
The end of causality and quantum theory
The wave-particle duality, Planc's hypothesis, the old quantum theory, Heisenberg uncertainly relations, Copenhagen interpretation of quantum mechanics, paradoxes of quantum mechanics, alternative interpretations of quantum mechanics, space, time, matter in contemporary cosmological theories.

1.5. Teaching methods	☒ 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

Obligation of attending lectures, held seminar work or write an essay, study requires literature.

1.8. Evaluation of student's work

Course attendance	0.5	Activity/Participation	0.5	Seminar paper	1.5	Experimental work	
Written exam	1.0	Oral exam	1.0	Essay	1.5	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)

Roberto Toretti, *The Philosophy of Physics*, Cambridge University Press, 1999.
James T. Cushing, *Philosophical Concepts in Physics*, Cambridge University Press, 1998.
Alan Lightman, *Great Ideas in Physics*, McGraw-Hill, Inc., 1992.

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

Ernst Cassirer, *Uz Einsteinovu teoriju relativnosti*, Demetra, Zagreb, 1998.
I. Bernard Cohen, *Revolution in Science*, The Belknap Press of Harvard University Press, 1985.
E. J. Dijksterhuis, *The Mechanization of the World Picture*, Princeton University Press, 1986.
Werner Heisenberg, *Fizika i filozofija*, KruZak, Zagreb, 1997.
Werner Heisenberg, *Promjene u osnovama prirodne znanosti*, KruZak, Zagreb, 1998.
Gerald Holton, *Thematic Origins of Scientific Thought,* Harvard University Press, 1988.
Max Jammer, *Concepts of Mass,* Harvard University Press, 1961.
Max Jammer, *Concepts of Space*, Harvard University Press, 1970.
Max Jammer, *Concepts of Force,* Dover Publications, Inc., 1999.
Alexandre Koyré*, From the Closed World to the Infinite Universe*, Baltimore, 1957.
Thomas S. Kuhn, *Struktura znanstvenih revolucija*, Jesenski-Turk, Zagreb, 1999.
Ilya Prigogine/Isabelle Stengers, *Novi savez. Metamorfoza znanosti*, Globus, Zagreb, s.a.
Natan Spielberg/Bryon D. Anderson, *Seven Ideas that Shook the Universe*, John Wiley & Sons, Inc., 1987.
Tihomir Vukelja, *Nesjedinljivo znanje. Bohrov doprinos filozofskoj teoriji spoznaje*, KruZak, Zagreb, 2004.
Nikola Zovko, *Prostor, vrijeme, tvar*, ArTresor, Zagreb, 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*
Roberto Toretti, *The Philosophy of Physics*, Cambridge University Press, 1999.	1	10
James T. Cushing, *Philosophical Concepts in Physics*, Cambridge University Press, 1998.	1	10
Alan Lightman, *Great Ideas in Physics*, McGraw-Hill, Inc., 1992.	1	10

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

Students shall write anonymously comments on the course.

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Basic description		
Course coordinator	Predrag Šustar	
Course title	PHILOSOPHY OF SCIENCE	
Study programme	Graduate Study Programme Physics and Philosophy	
Course status	Compulsory	
Year	1. 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 basic aim of this course is to bring out the details of the main issues, accounts, and schools of the contemporary philosophy of science. Furthermore, the course will try to show to the student the way in which science, and scientific discoveries are important for better understanding of classical philosophical problems, our descriptions of the world, and ourselves. Finally, some significant aspects of the so-called 'special sciences' will be considered.

1.2. Course enrolment requirements

The course program establishes correspondence, and correlation with the following philosophy courses: Introduction to Philosophy, Modern Philosophy from Descartes to Kant, Philosophy as a System. History of the Classical German Idealism, Epistemology, Contemporary Philosophy, Philosophy of Science: Darwinism, Molecular Biology, and Medicine, Philosophy of the Natural, and Social Sciences.

1.3. Expected course learning outcomes

1) improving the employment of a philosophical approach to natural sciences, and to their impact on other research fields; 2) raising up the level of acquaintance about scientific practice, as well as of a correct understanding of its importance for traditional philosophical topics; 3) raising up the quality of student's research in relation to her corresponding seminar paper; 4) helping out the student in carrying out her research project in the form of an essay; 5) improving of student's oral presentation of both her understanding of course content and her own research results.

1.4. Course content

1. Scientific and Common-Sensical Picture of the World
Are the aforementioned two pictures of the world compatible? If not, which one calls for the supremacy, and why? Can we maintain our traditional religious beliefs in the light of the modern scientific picture of the world and ourselves? Realism and anti-realism (e.g., instrumentalism) debate on these questions;
2. The Growth of Scientific Knowledge
Can we trace the line of progress in scientific knowledge? If there is some kind of progress, what exactly that progress consists of, and what is it its goal? Argument from the miracle – does the truth of scientific claims, or some kind of their approximation to the truth, represent the best account for their success? What patterns apply to the growth of scientific knowledge?
3. Theory and Observation
Are scientific theories 'incommensurable' or is there any common observational basis to which distinct theories can be confronted? Are there any 'theory-free' observational statements, and on what grounds can we endorse such a view?
4. The Issue of Scientific Rationality
Which theory should be accepted: one which is confirmed to a certain degree, or one which has not been refuted? What

types of reasons compete in accepting a certain theory within scientific community?

5. Scientific Explanation

Which features distinguish a valid explanatory argument? Is scientific explanation an argument in the strict sense? An overview of the main accounts in question: the covering-law models, causal-mechanical models, the pragmatical ones, and the unificationist accounts. Different structures of explanation in the contemporary sciences. How should we best go about functional and teleological ascriptions in some scientific domains?

6. The Issue of Justification of Inductive Inferences in Scientific Reasoning

Is induction really so important to scientific reasoning? What is exactly at stake in the philosophical problem of induction? Why is justification required in that regard? Deductive, inductive, and pragmatical justifications of inductive inferences. Can we really maintain that the inductive justification in question (the so-called 'meta-induction') is not valid? What kind of relationships binds the inductive arguments in the standard sense with the argument of 'inference to the best explanation'?

[NB: Depending on the student's interest, on new results in recent debates in the philosophy of science, the course content may change in giving priorities to particular aspects in the aforementioned list of topics, or even opening new ones.]

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

1.7. Student's obligations

The instructor expects from the student to attend regularly classes, to work out a seminar paper, which she will deliver orally at the end of the first half of semester 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	1	Activity/Participation	1	Seminar paper	2	Experimental work	
Written exam	1	Oral exam		Essay		Research	
Project		Sustained knowledge check	0.25	Report	0.75	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. 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 the largest extent, the overall score depends on the quality of the seminar paper.
Detailed elaboration of ways of monitoring and evaluation of students' work will be displayed in the Working Plan of the Philosophy of Science course.

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

Friedman, Michael (2001), *Dynamics of Reason, Stanford Kant Lectures*, CSLI, Stanford, CA;
Godfrey-Smith, Peter (2003), *An Introduction to the Philosophy of Science: Theory and Reality*, Chicago University Press, Chicago;
Kitcher, Philip (1993), *The Advancement of Science*, Oxford University Press, New York;
ID. (2001), *Science, Truth, and Democracy*, Oxford University Press, New York;
Klemke, E.D., Robert Hollinger, David W. Rudge with A.D. Kline (eds) (1998), *Introductory Readings in the Philosophy of Science*, Prometheus Books, Amherst, NY;
Psillos, Stathis and Martin Curd (eds) (2008), *The Routledge Companion to Philosophy of Science*, Routledge, London

and New York;
Salmon, Wesley C. (1989), *Four Decades of Scientific Explanation*, University of Minnesota Press, Minneapolis;

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

Armstrong, David M. (1983), *What is a Law of Nature*, Cambridge University Press, Cambridge;
Beebee, Helen, Christopher Hitchcock, and Peter Menzies (eds) (2010), *The Oxford Handbook of Causation*, OUP, Oxford and New York;
Berčić, Boran (1995), *Znanost i istina. Realizam i instrumentalizam u filozofiji znanosti*, Hrvatski kulturni dom, Rijeka;
Callebaut, Werner (ed.) (1993), *Taking the Naturalistic Turn, or, How Real Philosophy of Science is Done*, Chicago University Press, Chicago;
Goodman, Nelson (1955), *Fact, Fiction, and Forecast*, Harvard University Press, Cambridge, MA;
Hacking, Ian (1983), *Representing and Intervening: Introductory Topics in the Philosophy of Natural Science*, Cambridge University Press, Cambridge;
Hempel, Carl G. (1965), *Aspects of Scientific Explanation and Other Essays in the Philosophy of Science*, Free Press, New York;
ID. (1966), *Philosophy of Natural Science*, Prentice-Hall, Englewood Cliffs, NJ;
Kuhn, Thomas S. (1962), *The Structure of Scientific Revolutions*, Chicago University Press, Chicago;
Nagel, Ernst (1974), *Struktura nauke*, prev., Nolit, Beograd;
Popper, Karl R. (1963), *Conjectures and Refutations: The Growth of Scientific Knowledge*, Routledge and Kegan Paul, London;
Psillos, Stathis (1999), *Scientific Realism: How Science Tracks Truth*, Routledge, New York;
Quine, Willard v. (1953), *From a Logical Point of View*, Harvard University Press, Cambridge, MA;
Salmon, Wesley C. (1984), *Scientific Explanation and the Causal Structure of the World*, Princeton University Press, Princeton;
van Fraassen, Bas C. (1980), *The Scientific Image*, Oxford University Press, Oxford.

[NB: (1) the required literature for continuous written assessments, and final oral exam is agreed with the course instructor; (2) during classes, an additional references list will be distributed in order to make easier to the student her research leading to a seminar paper; the priority will be given to the most recent scholarship in the field, including the newest journal articles in the following leading journales in general philosophy of science research area: «Philosophy of Science», «The British Journal for the Philosophy of Science» etc.]

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*
Friedman, Michael (2001), *Dynamics of Reason, Stanford Kant Lectures*, CSLI, Stanford, CA;	1	10
Godfrey-Smith, Peter (2003), *An Introduction to the Philosophy of Science: Theory and Reality*, Chicago University Press, Chicago;	1	10
Kitcher, Philip (1993), *The Advancement of Science*, Oxford University Press, New York;	1	10
ID. (2001), *Science, Truth, and Democracy*, Oxford University Press, New York;	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	Nada Orlić	
Course title	PHYSICAL CHEMISTRY	
Study programme	Graduate Study Programme Physics and Philosophy	
Course status	Elective	
Year	2. 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

Objectives of this course are to:
- create more completely picture about atom, chemical connections and spectroscopic methods,
- applicate thermodynamics' lows and other ideas in chemical reactions as well as in predictions of equilibrium constants.

1.2. Course enrolment requirements

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

1.3. Expected course learning outcomes

After passing the examination students will be able to:
- analyze and distinguish chemical reactions,
- describe and distinguish phase's diagrams,
- describe and distinguish laws for gas, liquid and solid phases,
- explain fundamentals of quantum chemistry,
- describe and derive Schrödinger's equations,
- describe and explain translational, rotational and vibrational motions,
- explain the theory of molecular orbitals,
- analyze and explain rotational and vibrational spectra of molecule,
- define and explain basic of statistical thermodynamics,
- determine the constant of chemical reaction,
- describe and explain photophysical and photochemical processes.

1.4. Course content

Chemical equilibrium. Ideal and real gases. Liquid properties. Thermochemistry. Phase's diagrams. Equilibrium in electrochemistry. Quantum chemistry. Atomic structure and atomic spectra. Molecular structure. Molecular spectroscopy: rotational and vibrational spectra, electronic transitions, magnetic resonance. Applications of statistical thermodynamics. Molecular interactions. Macromolecules. Crystals. Kinetic's. Motions of molecules in gases and liquids. Diffusion. Dynamics of chemical reactions. Photochemical and photophysical processes.

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

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	1.00	Experimental work	
Written exam		Oral exam	1.50	Essay		Research	
Project		Sustained knowledge check	1.00	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)

Atkins, P., de Paula, J., *Atkins' Physical Chemistry*, 8th edition, W.H. Freeman & Company, 2006.
Cvitaš, T., *Fizikalna kemija*, Prirodoslovno-matematički fakultet, Sveučilište u Zagrebu, 2007.

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

Mekjavić, I., *Fizikalna kemija 1*, Školska knjiga, Zagreb, 1996.
Gratzel, M., Infelta, P., *The Bases of Chemical Thermodynamics*, Universal Publishers, 2000.
Simeon, V., *Termodinamika*, Školska knjiga, Zagreb, 1980.

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*
Atkins, P., de Paula, J., *Atkins' Physical Chemistry*, 8th edition, W.H. Freeman & Company, 2006.	1	5
Cvitaš, T., *Fizikalna kemija*, Prirodoslovno-matematički fakultet, Sveučilište u Zagrebu, 2007.	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	Aleksandra Golubović	
Course title	SCHOOL PRACTICE IN PHILOSOPHY I	
Study programme	Graduate Study Programme Physics and Philosophy	
Course status	Compulsory	
Year	2. year	
ECTS credits and teaching	***ECTS student 's workload coefficient***	2
	Number of hours (L+E+S)	0 + 45 + 0

1. COURSE DESCRIPTION

1.1. Course objectives

Students learn to follow and practical teaching of philosophy, logic and ethics in high school.

1.2. Course enrolment requirements

Methodological practices pertaining to the teaching of philosophy, logic and ethics in high school correspondence courses from the undergraduate study of philosophy, especially the introduction to philosophy, ancient philosophy, logic and ethics, and methods of teaching philosophy.

1.3. Expected course learning outcomes

After realizing the content and methodological practices in the high school student will be able to:

1. analyze and interpret the performance of classes in philosophy, logic and ethics;
2. evaluate and structure the lesson (in philosophy, logic and ethics);
3. organize and implement components of the previously written in the immediate preparation of teaching activities in high school in the subject field: philosophy, logic and ethics;
4. analyze and evaluate teaching performance.

1.4. Course content

A total of 15 working days per semester provides for a stay in schools training centers. Content provided methodological practices: introduction to the schools training centers and tutors, the number of hours of demonstration, two methodological exercise preparation and maintenance of lesson in philosophy, logic and ethics in high school.

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

1.7. Student's obligations

Students are expected to regularly and actively participate in the methodological exercises in schools training centers. Students, mostly during the semester, prepares and maintains its two methodological exercises and writing two comprehensive educational preparation.

1.8. Evaluation of student's work

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

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

Methodically evaluate the practical part of the basis of successfully prepared and held classes, and written successfully teaching preparation. It is necessary to regularly attend classes and student activities during all methodical exercise (participation in Perspectives held classes). Final grade in methodological practicum student expresses readiness to participate in the teaching of philosophy, logic and ethics.
Variant 2 (no exam) the student on the case will be evaluated and assessed during the course. Students can achieve a total of 100 points (evaluate the activities highlighted in the table).
Detailed elaboration of ways of monitoring and evaluation of students' work will be displayed in the Working Plan Item!

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

For methodological exercise, students use the current high school textbook literature and literature for the course Methods of teaching philosophy.

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

Students need to use all of the relevant literature listed in the list of mandatory and optional title for the course Methods of teaching philosophy.

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

Continuous monitoring and recording performance on a specially prepared form.

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Basic description		
Course coordinator	Aleksandra Golubović	
Course title	SCHOOL PRACTICE IN PHILOSOPHY II	
Study programme	Graduate Study Programme Physics and Philosophy	
Course status	Compulsory	
Year	2. year	
ECTS credits and teaching	***ECTS student 's workload coefficient***	2
	Number of hours (L+E+S)	0 + 45 + 0

1. COURSE DESCRIPTION

1.1. Course objectives

Students learn to follow and practical teaching of philosophy, logic and ethics in high school.

1.2. Course enrolment requirements

Methodological practices pertaining to the teaching of philosophy, logic and ethics in high school correspondence courses from the undergraduate study of philosophy, especially the introduction to philosophy, ancient philosophy, logic and ethics, and methods of teaching philosophy.

1.3. Expected course learning outcomes

After realizing the content and methodological practices in the high school student will be able to:

1. analyze and interpret the performance of classes in philosophy, logic and ethics;
2. evaluate and structure the lesson (in philosophy, logic and ethics);
3. organize and implement components of the previously written in the immediate preparation of teaching activities in high school in the subject field: philosophy, logic and ethics;
4. analyze and evaluate teaching performance.

1.4. Course content

A total of 15 working days per semester provides for a stay in schools training centers. Content provided methodological practices: introduction to the schools training centers and tutors, the number of hours of demonstration, two methodological exercise preparation and maintenance of lesson in philosophy, logic and ethics in high school.

1.5. Teaching methods	☐ 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

Students are expected to regularly and actively participate in the methodological exercises in schools training centers. Students, mostly during the semester, prepares and maintains its two methodological exercises and writing two comprehensive educational preparation.

1.8. Evaluation of student's work

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

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

Methodically evaluate the practical part of the basis of successfully prepared and held classes, and written successfully teaching preparation. It is necessary to regularly attend classes and student activities during all methodical exercise (participation in Perspectives held classes). Final grade in methodological practicum student expresses readiness to participate in the teaching of philosophy, logic and ethics.
Variant 2 (no exam) the student on the case will be evaluated and assessed during the course. Students can achieve a total of 100 points (evaluate the activities highlighted in the table).
Detailed elaboration of ways of monitoring and evaluation of students' work will be displayed in the Working Plan Item!

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

For methodological exercise, students use the current high school textbook literature and literature for the course Methods of teaching philosophy.

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

Students need to use all of the relevant literature listed in the list of mandatory and optional title for the course Methods of teaching philosophy.

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

Continuous monitoring and recording performance on a specially prepared form.

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Basic description		
Course coordinator	Rajka Jurdana Šepić	
Course title	SCIENCE POPULARIZATION	
Study programme	Graduate Study Programme Physics and Philosophy	
Course status	Elective	
Year	2. year	
ECTS credits and teaching	***ECTS student 's workload coefficient***	2
	Number of hours (L+E+S)	15+0+15

1. COURSE DESCRIPTION

1.1. Course objectives

Science popularization is integral part of teacher's and scientist's profession in any subject. The course objectives are to develop the consciousness on social context for the science, as well as on the need to popularize and communicate science, to develop the abilities to popularize science actively through public promotion of scientific subjects and scientific research results.

1.2. Course enrolment requirements

/

1.3. Expected course learning outcomes

During the course students will gain competence to
- describe and analyze the need and importance of the popularization of physics and science in general
- differentiate and analyze the channels of science popularization
- describe types of popularization activities and their extent, scope, advantages and disadvantages
- describe the influence of public media in the promotion of scientific activities
- describe and analyze the interaction between social structures and the promotion of science (local community, educational system, the strategy of the University)
- build a plan of their own popularization contributions and activities
- implement the plan within the field of teaching in organizing the Rijeka Science Festival

1.4. Course content

Social context of science. Concept and short history on science popularization and communication. The role of science promotion in knowledge based society.
Channels to popularize science. Methods to directly promote science (public lectures, presentations, workshops, science cafés, interactive exhibitions. Methods to promote science in media (public relations, press announcements, articles, radio and TV, multimedia materials suitable for Internet publication).
Particularity of physics popularization and promotion. Social context of physics. Physics popularization among kids. Physics in media. Popular books on physics. Physics and politics. Physics of devices in everyday use. Physics and margins of science. Unexplained phenomena

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 in discussion. Individual assignment on physics popularization.

1.8. Evaluation of student's work

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

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

The course has no final exam. The work of students in the subject will be evaluated and assessed during the semester. The detailed working out ways of monitoring and evaluation of students' work will appear in the performing level forms.

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

B.Jergović (ur.): Znanost i javnost, Izvori, Zagreb, 2002.
Znanstveno-popularne radio emisije «Baltazar», CD, Zlatni rez i Radio Rijeka, 2010, R.Jurdana-Šepić (eds)

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

A. Simonić, Znanost najveća avantura i izazov ljudskog roda, Vitagraf, Rijeka, 1999.
M. Alley : The Craft of Scientific Presentations: Critical Steps to Succeed and Critical Errors to Avoid. Springer-Verlag, 2002
T. Caulton: Hands-On Exhibitions: Managing Interactive Museums and Science Centres (The Heritage, Care-Preservation-Management). Routledge, 1998
S.M. Cutlip, A.H. Center, G.M. Broom: Odnosi s javnošću (prijevod 'Effective public relations'). Mate, Zagreb, 2003
A. Einstein: Moja teorija, Kronos, Zagreb, 1991.
A. Einstein: Moj pogled na svijet, Izvori, Zagreb, 1991.
Krauss M.L., Fizika zvjezdanih staza, Jesenski i Turk, Zagreb 2004.
R. Feynman: Osobitosti fizikalnih zakona, ŠK, Zagreb, 1986.
C.Sagan: Kosmos, Izvori, Zagreb 2004.
L.Lederman, D.Teresi: Božja čestica, Izvori, Zagreb, 2000.
J.Gribbin: U traganju za Schrodingerovom mačkom, Prosveta, Beograd, 1989.
J. Walker: The Flying Circus of Physics, J.Willey and Sons, New York, 1977.
W.R. Wood: FUNtastic Science activities for Kids, McGrow Hill, New York, 1997.
W.R. Wood: Physics for Kids, Mc Geaw-Hill, New York, 1997.
A. Wilson, J. Gregory, S. Miller; S. Earl: Handbook of science communication, Institute of Physics Publishing, 1998

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.Jergović (ur.): Znanost i javnost, Izvori, Zagreb, 2002.	2	4

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

Student's Portfolio: Continuous follow up of the activities, feedback on assignments and seminar work. Individual consultations for work on individual assignment and seminar paper.
Questionnaire: Introductory questionnaire on student's expectations. At the end of course, anonymous questionnaire on the course quality.

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Basic description		
Course coordinator	Mladen Petravić	
Course title	SEMICONDUCTORS: PRINCIPLES AND APPLICATIONS	
Study programme	Graduate Study Programme Physics and Philosophy	
Course status	Elective	
Year	2. year	
ECTS credits and teaching	***ECTS student 's workload coefficient***	6
	Number of hours (L+E+S)	30 + 15 + 15

1. COURSE DESCRIPTION

1.1. Course objectives

To gain knowledge and develp understanding of principles and application of semiconducting electronic materials. To understand fundamental properties of semiconducting materials and techniques for tailoring these properties for specific applications and design of electronic devices.

1.2. Course enrolment requirements

Prerequisites: Fundamentals of physics from undergraduate studies, *Solid State Physics*.

1.3. Expected course learning outcomes

1.4. Course content

This course outlines the physics, modeling, application and technology of semiconductor materials in electronic, optoelectronic, and photonic devices and integrated circuits. Topics, related to the technologically important semiconductors such as Si, GaAs, GaN or GaAsN, include basic physical models describing electronic structure, charge carriers, effective mass, p-n junction, transport and optical properties, intrinsic and extrinsic semiconductors and defects in semiconductors. This course also gives a survey of growth techniques, such as MBE and MOCVD, dopping (by diffusion, ion implantation etc.) and manufacturing of semiconductor devices, such as LEDs, transistors or metal-semiconductor devices, photodetectors or modulators. The physical background is given for basic electronic devices, from diodes and transistors to solar cells and lasers. New trends and hot topics in semiconductor theory and applications are illustrated by the modern heterostructures at low dimensions, including quantum wells, quantum wires, and quantum dots together with their applications and recent advances in semiconductor nanostructures.

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 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 (2 ECTS) as well as via written and oral presentations, partial and final exams (4 ECTS).

1.8. Evaluation of student's work

Course attendance	0.25	Activity/Participation	0.25	Seminar paper	1.8	Experimental work	
Written exam	1.65	Oral exam	1.2	Essay		Research	
Project		Sustained knowledge check	0.25	Report	0.6	Practice	

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 (the final presentation and demonstration of a school laboratory experiment). 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)

P. Y. Yu i M. Cardona, *Principles of Semiconductors*, Springer, Berlin, 2005.
S. O. Kasap, *Principles of Electronic Materials and Devices*, McGraw-Hill, New York, 2002.

For the seminar work, students shall be given references from textbooks or web sites.

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

J. W. Mayer i S. S. Lau, *Electronic Materials Science*, Macmillan, New York, 1990.

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. Y. Yu i M. Cardona, *Principles of Semiconductors*, Springer, Berlin, 2005.	1	5
S. O. Kasap, *Principles of Electronic Materials and Devices*, McGraw-Hill, New York, 2002.	1	5

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	Mladen Petravić	
Course title	SOLID STATE PHYSICS	
Study programme	Graduate Study Programme Physics and Philosophy	
Course status	Elective	
Year	2. 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

This course provides the basic knowledge of solid state physics by exploring the basic principles of crystal structure and chemical bonding, lattice dynamics, electrons in periodic potential, electrical, optical and thermal properties of materials, Fermi surfaces, and an introduction to magnetic properties of materials, semiconductors, superconductors, dielectrics and ferroelectrics and defects in crystal lattice. New trends in condensed matter theory and application are introduced by quantum structures, superlattices, nanostructures, amorphous semiconductors and magnets and liquid crystals and polimers.

1.2. Course enrolment requirements

Fundamentals of physics, Mathematical analysis and Linear Algebra

1.3. Expected course learning outcomes

Developing of basic knowledge of properties and application of materials
Understanding and differentiate different crystal structures and interatomic bonding in crystals
Understanding connection between properties of materials and dynamic of crystal lattice and electronic structure
Deriving basic principles of electrical and thermal conductivity and magnetic properties important for specific application of materials
Defining basic properties of metals, semiconductors and superconductors in connection with their applications in modern technologies
Understanding basic characteristics and physics of nanostructures and their applications in modern technologies

1.4. Course content

Crystal structure
Chemical bonding in crystals
Dynamics of crystal lattice
Electrical, thermal and magnetic properties of materials
Semiconductors, superconductors and nanostructures

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

1.7. Student's obligations

Regular attendance of classes
Deliver several written homeworks with solved problems
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

To be given in detailed programme

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

V. Šips, *Uvod u fiziku čvrstog stanja*, Školska knjiga, Zagreb, 2003.
C. Kittel, *Introduction to Solid State Physics*, Wiley, 8. izdanje, New York, 2005.

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

J.D.Patterson, B.C.Bailey, Solid State Physics, Springer, Berlin 2007.
Specific references to be given to students for seminars during the semester from a selection of books and web materials.

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*
V. Šips, *Uvod u fiziku čvrstog stanja*, Školska knjiga, Zagreb, 2003.	8	3
C. Kittel, *Introduction to Solid State Physics*, Wiley, 8. izdanje, New York, 2005.	2	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	Majda Trobok	
Course title	SYMBOLIC LOGIC	
Study programme	Graduate Study Programme Physics and Philosophy	
Course status	Compulsory	
Year	2. 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

On the level of first order logic: to upgrade the skills in logical analysis, in arguments' validity assessment and in construction of proofs, to appreciate logical issues in philosophy.

1.2. Course enrolment requirements

The course is an extension of course on Logic.

1.3. Expected course learning outcomes

On the level of first order logic (FOL) a successful student will master: translations between FOL language and natural language, use of different methods for assessing the validity of inferences, construction of (informal and formal) proofs using natural deduction rules as well as proofs by mathematical induction. S/he will deepen the understanding of the relation between semantic and syntactic characterization of logic and of limited expressive power of FOL language. S/he will have an adequate background to go on to learn and understand more sophisticated logics.

1.4. Course content

[FOL language] Atomic sentences. Identity. Well formed formulas. Quantification: logic of quantifiers, multiple quantifiers, definite descriptions, and the logic of generalized quantification. Discussion of selected issues in logical analysis of natural language and of communication (e.g. maxims of cooperative communication). [Deductive systems for FOL] Axiomatic method, natural deduction, tree method. Proof construction and proof strategies. Discussion on the relation between «logical rules» and «structural rules» of proof. [Axiomatic of set theory] Axioms of naive set theory and Russell's paradox. Modeling relations in set theory. Discussion: Russell's paradox. Discussion: intuitions behind different axiomatizations of set theory. [Introduction to formal semantics] First order structures. Truth and satisfaction. Discussion: modeling non-classical consequence relations (e.g. non-monotonic). [Metatheory] The soundness theorem. The completeness theorem for FOL natural deduction system (Henkin theory and Henkin construction). The Löwenheim-Skolem theorem. Skolem paradox. The compactness theorem. Discussion: the limitations in expressive power of FOL language and relations between language and cognition.

1.5. Teaching methods	☒ lectures ☒ seminars and workshops ☐ exercises ☒ long distance education ☐ fieldwork	☒ individual assignment ☒ multimedia and network ☐ laboratories ☐ mentorship ☐ consultations
1.6. Comments	Comments: In the course logic educational software is being extensively used.	

1.7. Student's obligations

Class attendance and participation, regular homework.

1.8. Evaluation of student's work

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

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

Barwise, Jon and Etchemendy, John (2000.) Language, Proof and Logic. (Text / Software Package) New York · London. CSLI Publications. Center for the Study of Language and Information Stanford University. Seven Bridges Press. New York · London. [chapters: 9–19]

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

Barwise, Jon and Etchemendy, John (2000.) Language, Proof and Logic. (Text / Software Package) New York · London. CSLI Publications. Center for the Study of Language and Information Stanford University. Seven Bridges Press. New York · London. [chapters: 9–19]

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

Jeffrey, Richard. *Formal Logic: its Scope and Limits*. (1989.) McGraw-Hill Book Company [chapters: 1-5]
Quine, Willard Van Orman. *Methods of Logic*. (1978.) London: Routledge & Kegan Paul [parts: 3 i 4]
Restall, Greg. *An Introduction to Substructural Logics*. (2000.) London: Routledge [chapters: 1-2]
[learning tools]
Žarnić, Berislav (2004.) *Interaktivna logika* [collection of logic interactivities, visualizations and other learning resources]. (http://www.vusst.hr/~logika/pilot)

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*
Barwise, Jon and Etchemendy, John (2000.) Language, Proof and Logic. (Text / Software Package) New York · London. CSLI Publications. Center for the Study of Language and Information Stanford University. Seven Bridges Press. New York · London. [chapters: 9–19]	1	10

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

Students' and colleagues' evaluation.

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Basic description		
Course coordinator	Aleksandra Golubović	
Course title	TEACHING METHODS IN PHILOSOPHY I	
Study programme	Graduate Study Programme Physics and Philosophy	
Course status	Compulsory	
Year	2. year	
ECTS credits and teaching	***ECTS student 's workload coefficient***	3
	Number of hours (L+E+S)	30 + 15 + 0

1. COURSE DESCRIPTION

1.1. Course objectives

Aim has continued teaching methods will become trained the student for all forms teaching and extracurricular educationally-educational work according to contemporary reaches pedagogic sciences, first of all for leading out classes philosophy, logic and ethics in gymnasiums and other secondary schools.

1.2. Course enrolment requirements

Object of Teaching methods in philosophies in the correlation is with courses from History of philosophy, Logic, Ethics and Esthetics. Next to the course from the study of philosophy course of Teaching methods continue philosophies in the correlation is with communicate-programmatically courses Psychology of education and instruction, General pedagogy and Didactics.

1.3. Expected course learning outcomes

After execution of study duties in the object expects that students:

- Know the lesson and teaching process;
- Know methods leading out continue social and humanistic objects;
- Can independently to determine teaching aims for cited teaching objects;
- Can independently to determine adequately teaching methods for teaching objects and teaching units;
- Can value and appraise student and teacher's work;
- Can independently to lead out the lesson from induced objects.

1.4. Course content

1. Kinds of classes
2. Problem and historical access in philosophy
3. Prepares the teacher for leading out teaching
4. Determining educationally-educational aims (teaching themes, units and entireties)
5. Didactics principles in the lesson
6. Methods teaching in philosophy and object of humanities
7. The principles in the teaching of philosophy in relation to teaching

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

1.6. Comments	Accent of work in the lesson will be on the interactive relation of teachers and students, this adapted mode to the interests of students for the teaching realization of philosophical themes, this theme from the ethics.

1.7. Student's obligations

For the perform of study duties necessary is that the student:
- Regularly attends the lesson,
- Executes the task of practical lesson
- Writes least two teaching preparations
- Orally displays least two teaching units
- Lays down the oral exam.

1.8. Evaluation of student's work

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

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 the final exam can achieve 30 points.
Detailed elaboration of ways of monitoring and evaluation of students' work will be displayed in the Working Plan Item!

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

Josip Marinković: Metodika nastave filozofije, Zagreb, 1982.
Boris Kalin: Logika i oblikovanje kritičkog mišljenja, Zagreb, 1983.
Boris Kalin. Povijest filozofije, Školska knjiga , Zagreb, različita izd.
Gajo Petrović: Logika, Školska knjiga, Zagreb, različita izd.

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

Josip Marinković: Filozofija kao nastava, Zagreb, 1990.
Josip Marinković: Ogledi iz filozofije odgoja, Zagreb, 1987.
Josip Marinković: Utemeljenost odgoja u filozofiji, Zagreb, 1981.
Milan Polić: Odgoj i svije(s)t, Zagreb, 1993.
Milan Polić: K filozofiji odgoja, Zagreb, 1993.
Pavao Vuk Pavlović: Ličnost i odgoj, Zagreb, 1932.
Časopis Metodički ogledi, Hrvatsko filozofsko društvo, Zagreb.

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*
Josip Marinković: Metodika nastave filozofije, Zagreb, 1982.	3	10
Boris Kalin: Logika i oblikovanje kritičkog mišljenja, Zagreb, 1983.	3	10
Boris Kalin. Povijest filozofije, Školska knjiga , Zagreb, različita izd.	10	10
Gajo Petrović: Logika, Školska knjiga, Zagreb, različita izd.	10	10

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

Qualities and performance of programs follow the anonymous poll about the quality organizations continue, contents of objects and relation of teacher towards students. Evaluate uses all segments continue aims, contents, methods leading out continue, clarity of teachers' presentation. Regularly will follow and presence student lesson and will calculate middle evaluations of objects after laid down oral exams.

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Basic description		
Course coordinator	Aleksandra Golubović	
Course title	TEACHING METHODS IN PHILOSOPHY II	
Study programme	Graduate Study Programme Physics and Philosophy	
Course status	Compulsory	
Year	2. year	
ECTS credits and teaching	***ECTS student 's workload coefficient***	3
	Number of hours (L+E+S)	30 + 15 + 0

1. COURSE DESCRIPTION

1.1. Course objectives

Aim has continued teaching methods will become trained the student for all forms teaching and extracurricular educationally-educational work according to contemporary reaches pedagogic sciences, first of all for leading out classes philosophy, logic and ethics in gymnasiums and other secondary schools.

1.2. Course enrolment requirements

Object of Teaching methods in philosophies in the correlation is with courses from History of philosophy, Logic, Ethics and Esthetics. Next to the course from the study of philosophy course of Teaching methods continue philosophies in the correlation is with communicate-programmatically courses Psychology of education and instruction, General pedagogy and Didactics.

1.3. Expected course learning outcomes

After execution of study duties in the object expects that students:

- Know the lesson and teaching process;
- Know methods leading out continue social and humanistic objects;
- Can independently to determine teaching aims for cited teaching objects;
- Can independently to determine adequately teaching methods for teaching objects and teaching units;
- Can value and appraise student and teacher's work;
- Can independently to lead out the lesson from induced objects.

1.4. Course content

1. Principles of teaching philosophy, in relation to students
2. Methods of introduction to philosophical thinking; skandalon, questioning and actualization
3. Philosophical texts in the teaching of philosophy
4. The process of communication in teaching philosophy
5. Evaluation and testing of students
6. The functions of school libraries in teaching
7. Teaching climate and teacher-student relationship

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

1.6. Comments	Accent of work in the lesson will be on the interactive relation of teachers and students, this adapted mode to the interests of students for the teaching realization of philosophical themes, this theme from the ethics.

1.7. Student's obligations

For the perform of study duties necessary is that the student:
- Regularly attends the lesson,
- Executes the task of practical lesson
- Writes least two teaching preparations
- Orally displays least two teaching units
- Lays down the oral exam.

1.8. Evaluation of student's work

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

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 the final exam can achieve 30 points.
Detailed elaboration of ways of monitoring and evaluation of students' work will be displayed in the Working Plan Item!

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

Josip Marinković: Metodika nastave filozofije, Zagreb, 1982.
Boris Kalin: Logika i oblikovanje kritičkog mišljenja, Zagreb, 1983.
Boris Kalin. Povijest filozofije, Školska knjiga , Zagreb, različita izd.
Gajo Petrović: Logika, Školska knjiga, Zagreb, različita izd.

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

Josip Marinković: Filozofija kao nastava, Zagreb, 1990.
Josip Marinković: Ogledi iz filozofije odgoja, Zagreb, 1987.
Josip Marinković: Utemeljenost odgoja u filozofiji, Zagreb, 1981.
Milan Polić: Odgoj i svije(s)t, Zagreb, 1993.
Milan Polić: K filozofiji odgoja, Zagreb, 1993.
Pavao Vuk Pavlović: Ličnost i odgoj, Zagreb, 1932.
Časopis Metodički ogledi, Hrvatsko filozofsko društvo, Zagreb.

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

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Boris Kalin: Logika i oblikovanje kritičkog mišljenja, Zagreb, 1983.	3	10
Boris Kalin. Povijest filozofije, Školska knjiga , Zagreb, različita izd.	10	10
Gajo Petrović: Logika, Školska knjiga, Zagreb, različita izd.	10	10

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

Qualities and performance of programs follow the anonymous poll about the quality organizations continue, contents of objects and relation of teacher towards students. Evaluate uses all segments continue aims, contents, methods leading out continue, clarity of teachers' presentation. Regularly will follow and presence student lesson and will calculate middle evaluations of objects after laid down oral exams.

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Basic description		
Course coordinator	Branka Milotić	
Course title	TEACHING PRACTICE IN PHYSICS	
Study programme	Graduate Study Programme Physics and Philosophy	
Course status	Compulsory	
Year	2. year	
ECTS credits and teaching	***ECTS student 's workload coefficient***	3
	Number of hours (L+E+S)	0 + 45 + 0

1. COURSE DESCRIPTION

1.1. Course objectives

Direct training of physics teaching, in active (as teacher) and passive (monitoring mentor's class hours) role. Gaining teaching skills in real conditions. Acquisition of procedural knowledge needed for teaching, gaining competence for teaching profession.

1.2. Course enrolment requirements

Finished course Methods and Strategies in Physics Teaching II

1.3. Expected course learning outcomes

Acquisition of procedural knowledge needed for teaching at different educational levels (primary, secondary), reaching a adequate level of critical-thinking skills and criteria and attitudes toward the profession and teaching competences.

1.4. Course content

Monitoring of physics class hours in elementary and secondary schools. Getting to know school documentation, pupil's records and familiarization with life in school from teacher's perspective. Delivery of one class hour in elementary and secondary school.

1.5. Teaching methods	☐ lectures ☐ seminars and workshops X exercises ☐ long distance education X fieldwork X practical teaching	X individual assignment X multimedia and network ☐ laboratories X mentorship X consultative teaching ☐ other
1.6. Comments	Elementary and secondary schools with assigned mentors (physics teachers) accept students, in order to get to know school life, to familiarize with school documents and to monitor class hours delivered by mentor. Students prepare individually the delivery of one physics class hour and make a trial delivery in real classroom. Students are individually consulted during the preparation. All students are obliged to prepare the delivery of one class hour both in elementary and secondary school.	

1.7. Student's obligations

Students are obliged to monitor and assess at least 10 class hours in elementary and 10 hours in secondary school, to attend two so-called exemplary teaching class hours delivered by mentors, and actively participate in analysis of delivered class hours. Students are obliged to individually prepare and deliver two class hours, the performance of which will be assessed. If one delivery is assessed negative, may repeat the delivery, but if both deliveries were negatively assessed, the course is to be entered again.

1.8. Evaluation of student's work

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

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

Student's work is monitored and assessed continuously during the course. The total number of credits a student can achieve during the course is 70 (assessed activities highlighted in the table), and the class hour delivery can be assessed with additional 30 points.
Comment:
Student's work progress is monitored continuously during the course and specifically during the trial class hour deliveries. Detailed elaboration of methodology for monitoring and evaluation of students' work will be presented in executive course plan.

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

Krsnik, R., Suvremene ideje u metodici nastave fizike, Školska knjiga, Zagreb, 2008.
Jurdana-Šepić R., Milotić B., Metodički pokusi iz fizike, Čarolija eksperimentiranja,
Filozofski fakultet u Rijeci, Rijeka, 2001.
Physics textbooks for a particular level of education.
Manuals for teachers

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

School Curriculum
Dictionary Croatian Language,
Dictionary of foreign words,
Popular and scientific literature,
Arar, Lj., Kolić-Vehovec, S., Milotić, B., Kako lakše učiti fiziku, MNEMOTEHNIKE – pomoć pri učenju, Školska knjiga, Zagreb, 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*
Krsnik, R., Suvremene ideje u metodici nastave fizike, Školska knjiga, Zagreb, 2008.	1	6
Jurdana-Šepić R., Milotić B., Metodički pokusi iz fizike, Čarolija eksperimentiranja, Filozofski fakultet u Rijeci, Rijeka, 2001.	5	6
Physics textbooks	1	6
Manuals for teachers	1	6

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

Students deliver a trial and model class hours, which are analyzed and discussed with school mentor, course coordinator and peers. They receive feedback on the successfulness and reception of delivery in class. Success and quality are directly reflected in the student's progress during the teaching practice. At the end of the course, students are offered an anonymous questionnaire on personal expectations and the level of met expectations, as well as on the quality of course delivery.