

GRADUATE STUDY

PHYSICS AND INFORMATICS

March 2005

1) INTRODUCTION

a) *Reasons for initiations of studies*

- The basic reason is the scientific study of physics as the basic science coupling with modern techniques and informatic technologies for teaching purposes as well as the permanent need of the professors (teachers) of physics and informatics in primary and secondary schools and various private informatics schools and companies.
- It should be emphasized that all-time more tumultuous development of new technologies and techniques based on physics creates the need for the most flexible education based on the fundamental, physical knowledge which is slower in becoming obsolete. This makes need for explanation and study of modern technologies and techniques through explanation of their physical bases as well as the doctrine of utilization of modern informatics technologies in physics.
- Such programme of studies is comparable to all universities in Europe where the basic sciences are studied. According to the instruction, we state two of them: in Uppsala and in Lille.

b) *Previous experiences of proposers in carrying out of equivalent or similar programmes*

The previous existence of two similar four-year studies of physics: Mathematics and Physics and Physics and Technical Culture realized by *Department of physics*, University J.J. Strossmayer guarantees this experience.

c) *Graduate studies*

It has already been mentioned that there is permanent need of these streamings (teachers, professors) in primary and secondary schools and in private informatics schools and companies.

d) *Openness of studies towards mobility of students*

The coordination of graduate programme with the programmes from European Union as well as the coordination of the corresponding undergraduate studies with the undergraduate studies of physics and corresponding technical studies in Croatia and European Union would make possible the significant openness of studies towards the mobility of students. There would be the vertical mobility towards doctoral studies of physics and/or informatics in educational streamings.

a) *Other components*

It should be mentioned that there are adequate laboratories, cabinets for practical courses realization and equipment on the Department of Physics premises, University J.J. Strossmayer in Osijek.

2. GENERAL PART

1) Title of studies

PHYSICS AND INFORMATICS

2) Implementation-bearer

J.J. STROSSMAYER UNIVERSITY OF, OSIJEK

Realization:

DEPARTMENT OF PHYSICS, UNIVERSITY J.J. STROSSMAYER, OSIJEK and
DEPARTMENT OF MATHEMATICS, UNIVERSITY J.J. STROSSMAYER, OSIJEK

3) Duration

Two years (4 semesters)

4) Admission requirements

Completed undergraduate studies of physics or mathematics

5) Undergraduate Studies

6) Graduate studies

After having finished the studies, the student is qualified to teach physics and informatics in primary and secondary schools and various private informatics schools and companies. To be able follow the studies, it is necessary to complete the undergraduate studies of physics or corresponding technical undergraduate studies programme (of Osijek or some other university in Croatia or European Union).

7) -----

8) Professional or academic title acquired after completing studies

PROFESSOR OF PHYSICS AND INFORMATICS

3. PROGRAMME DESCRIPTION

3.1. Programme structure with credits

1. YEAR

1 st Semester						
Course code	Course title	Course structure*				EC TS
		L	S	E	P	
Z109	Psychology of education 1	30	0	15	0	3
Z111	General pedagogy	30	0	30	0	4
F116	Quantum mechanics 2	30	15	15	0	5
F117	Demonstration Experiments Laboratory I	0	0	0	60	5
I112	Governing multimedia contents	30	0	0	30	5
Elective courses: student choose 8 credits						
F118	Advanced Physics Laboratory	0	0	0	60	5
I113	Computer-aided design (CAD)	0	0	0	30	3
F119	Fundamentals of the physical electronics	30	15	15	0	5
Total:						30
* L=Lectures, S=Seminars, E= exercises, , P=Practical (Laboratory)						

2 nd Semester						
Course code	Course title	Course structure*				EC TS
		L	S	E	P	
Z110	Psychology of education 2	30	0	15	0	3
Z112	Didactics	30	0	30	0	4
F122	Demonstration Experiments Laboratory II	0	0	0	60	5
I114	Information theory	30	0	0	15	4
Elective courses: student choose 14 credits						
I115	Information systems modeling	30	0	0	30	5
F125	Laboratory works from electronic	0	0	0	45	4

F130	Atomic physics and spectroscopy	30	15	15	0	5
Total:						30
* L=Lectures, S=Seminars, E= exercises, , P=Practical (Laboratory)						

2. YEAR

3 rd Semester						
Course code	Course title	Course structure*				EC TS
		L	S	E	P	
F127	Physics Education I	30	0	30	30	7
I117	Methodics of teaching informatics	30	30	0	15	5
I118	Project governing	30	0	0	30	5
Elective courses: student choose 13 credits						
I119	Data storage	30	0	0	30	5
I120	Data mining	30	0	0	30	5
I122	Basics of artificial intelligence	30	0	0	30	5
F128	History of physics	30	0	0	0	3
Total:						30
* L=Lectures, S=Seminars, E= exercises, , P=Practical (Laboratory)						

4 th Semester						
Course code	Course title	Course structure*				EC TS
		L	S	E	P	
F129	Physics Education II	30	0	30	30	7
I121	Methodics of teaching informatics - Practicum	0	30	0	60	6
I123	Diploma thesis	0	8	0	0	17
Total:						30
* L=Lectures, S=Seminars, E= exercises, , P=Practical (Laboratory)						

3.2. Description of every course of lectures

Course title	Psychology of personality and intellectual development 1		
Course code	Z109		
Type of course	Lectures and seminars		
Level of course	Elementary course of lectures		
Year of study	1st	Semester	1st
ECTS (Number of credits allocated)	3 ECTS 100 hours = 45 hours (lectures) + 15 hours (preparation for seminars) + 40 hours (recommended reading and preparation for the exam)		
Name of lecturer	dr.sc. Mirjana Duran		
Learning outcomes and competences	Students should be taught different aspects in the child's development, structure and personality development. The knowledge that can have an influence on understanding educational praxis.		
Prerequisites	None.		
Course contents	Origin and importance of psychology of personality and intellectual development; concept of personality and its structure; development and organization of intelligence; origin of individual differences; contribution of schools; intercultural researches of mathematical achievements; development of sensitive and motivative characteristics; temper; moral development; development of positive picture of oneself; specific characteristics of adolescence; subculture in adolescence; psychological background of addiction		
Recommended reading	<ol style="list-style-type: none"> 1. Michael J. A. Howe Psihologija učenja. Jastrebarsko: Naklada Slap. (Izabrana poglavlja) (2002) 2. V.Andrilović, M.Čudina-Obradović Psihologija učenja i nastave. Zagreb: Školska knjiga. (Izabrana poglavlja) (1996) 3. R.Vasta., M.Haith, S.A.Miller Dječja psihologija. Jastrebarsko: Naklada Slap. (Izabrana poglavlja) (2000) 		
Supplementary reading	<ol style="list-style-type: none"> 1. T.Grgin Edukacijska psihologija. Jastrebarsko: Naklada Slap. (1997) 2. B.Petz Uvod u psihologiju. Jastrebarsko: Naklada Slap. (2001) 3. P.Zarevski Psihologija učenja i pamćenja. Jastrebarsko: Naklada Slap. (1998) 4. H.Gardner, M.L.Kornhaber, K.Wake inteligencija - različita gledišta. Jastrebarsko: Naklada Slap (1999) 		
Teaching methods	Lectures and seminars are obligatory for all students.		
Assessment methods	After completion of lectures and seminars, the students may go in for the exam. The exam consists of written and oral parts.		
Language of instruction	Croatian		
Quality assurance methods	An anonymous questionnaire among students		

Course title	General pedagogy		
Course code	Z111		
Type of course	Lectures and seminars		
Level of course	Elementary course of lectures		
Year of study	1st	Semester	1st
ECTS (Number of credits allocated)	4 ECTS 120 hours = 30 hours (lectures) + 30 hours (preparation for seminars) + 60 hours (recommended reading and preparation for the exam)		
Name of lecturer	dr. sc. Emerik Munjiza		
Learning outcomes and competences	Students – future educators should be taught pedagogy, which is considered to be critical and creative science in education. This pedagogical system should enable students to be creative and educational in praxis and pedagogical theory.		
Prerequisites	None		
Course contents	<p>Men, education, society. The meaning of education and its determination. The power and the limits of education. Terminology. Theory of education. Education of cultures and personal characteristics.</p> <p>Pedagogy as critical and creative science. Pedagogy – science of education. Pedagogy in the scientific system. The system of pedagogical science; Pedagogical theory and praxis; Development of pedagogy – general and national history of pedagogy. Future of pedagogy.</p> <p>Pedagogical methodology. Researches in education. Types of researches. Hypothesis and variables. Instruments and approaches. Quantitative and quality analysis. Action researches.</p> <p>Analysis of the educational process. Educational goal, tasks and ideals. Models for making educational goals more concrete. Education in narrower and wider sense. Functional and intentional education. Education as value category. System of educational values.</p> <p>Areas of education. Specific characteristics and points in education. Educational factors and their effects. Principles, methods, approaches, instruments and forms.</p> <p>Schools, management and educational policy.</p> <p>Meaning and history of schools. Theory of school. School systems in the world and in Croatia. Teacher and his learning outcomes and competences. Meaning and importance of educational policy. Theories, models and approaches in management.</p>		
Recommended reading	<ol style="list-style-type: none"> 1. M.Cindri, Profesija učitelja u svijetu i u Hrvatskoj, Persona, V.Gorica, Zagreb, 1995 2. H.Giesecke, Uvod u pedagogiju, Educa, Zagreb, 1993. 3.H.Gudjons, Pedagogija temeljna znanja, Educa, Zagreb, 1994. 		
Supplementary reading	<ol style="list-style-type: none"> 1.M.Ajduković, N.Pečnik, Nenasilno rješavanje sukoba, Alinea, Zagreb, 1994. 2. D.Gossen, Restitucija preobrazba školske discipline, Alinea, Zagreb, 1994. 3. M.Matijević, Alternativne škole, Institut za pedagogijska istraživanja, Zagreb, 		

	1994. 4. R.Winkel, Djeca koju je teško odgajati, Educa, Zagreb, 1996.
Teaching methods	There are lectures and seminars. Students write one seminar work on agreed topic and perform two exercises.
Assessment methods	Written and oral exam at the end of the course
Language of instruction	Croatian
Quality assurance methods	An anonymous questionnaire among students

Course title	Psychology of personality and intellectual development 2		
Course code	Z110		
Type of course	Lectures and seminars		
Level of course	Elementary course of lectures		
Year of study	1st	Semester	2nd
ECTS (uz odgovarajuće obrazloženje)	3 ECTS 100 hours = 45 hours (lectures) + 15 hours (preparation for seminars) + 40 hours (recommended reading and preparation for the exam)		
Name of lecturer	dr.sc. Mirjana Duran		
Learning outcomes and competences	Students should be taught different aspects in the child's development, structure and personality development. The knowledge that can have an influence on understanding educational praxis.		
Prerequisites	None.		
Course contents	Origin and importance of psychology of personality and intellectual development; concept of personality and its structure; development and organization of intelligence; origin of individual differences; contribution of schools; intercultural researches of mathematical achievements; development of sensitive and motivative characteristics; temper; moral development; development of positive picture of oneself; specific characteristics of adolescence; subculture in adolescence; psychological background of addiction		
Recommended reading	1. Michael J. A. Howe Psihologija učenja. Jastrebarsko: Naklada Slap. (Izabrana poglavlja) (2002) 2. V.Andrilović, M.Čudina-Obradović Psihologija učenja i nastave. Zagreb: Školska knjiga. (Izabrana poglavlja) (1996) 3. R.Vasta., M.Haith, S.A.Miller Dječja psihologija. Jastrebarsko: Naklada Slap. (Izabrana poglavlja) (2000)		
Supplementary reading	1. T.Grgin Edukacijska psihologija. Jastrebarsko: Naklada Slap. (1997) 2. B.Petz Uvod u psihologiju. Jastrebarsko: Naklada Slap. (2001) 3. P.Zarevski Psihologija učenja i pamćenja. Jastrebarsko: Naklada Slap. (1998) 4. H.Gardner, M.L.Kornhaber, K.Wake inteligencija - različita gledišta. Jastrebarsko: Naklada Slap (1999)		
Teaching methods	Lectures and seminars are obligatory for all students.		

Assessment methods	After completion of lectures and seminars, the students may go in for the exam. The exam consists of written and oral parts.
Language of instruction	Croatian
Quality assurance methods	An anonymous questionnaire among students

Course title	Didactics		
Course code	Z112		
Type of course	Lectures and seminars		
Level of course	Elementary course of lectures		
Year of study	1st	Semester	2nd
ECTS (Number of credits allocated)	4 ECTS 120 hours = 30 hours (lectures) + 30 hours (preparation for seminars) + 60 hours (recommended reading and preparation for the exam)		
Name of lecturer	doc.dr.sc. Anđelka Peko		
Learning outcomes and competences	The program of didactics enables students to learn basic didactic theories dealing with the organisation of lessons in primary schools. To develop characteristics necessary for the application, realization and evaluation of lectures. To become familiar with the development of didactic thoughts. To learn basic didactical theories in educational processes. To learn methods of exploring didactical occurrences. To become familiar with the structure and meaning of the curriculum. To create critical approach towards methods, forms and ways of working in lectures. To understand the preparation, realization and evaluation of the lectures. To present and understand lessons as ways of communication. To become familiar with theoretical and practical systems in lectures. To enable students to use and to have critical approach towards educational technology. To become familiar with the didactic pluralism – alternative schools		
Prerequisites	Psychology of personality and intellectual development		
Course contents	<ul style="list-style-type: none"> - Didactics– theory of education and teaching. Basic notions of didactics. Modern didactic theories: “Berlin didactics” (P. Heimann), Critical-constructive (W. Klafki), Kurikilarna (Ch.Moeller), Kibernetical (F. von Cube), Critical-communicative didactics (R. Winkel) - Methodological problems of didactic researches. - Lesson plan and programme. Theoretical-methodological approaches in structure of lesson plans and programmes (kurikulum). Realization and adapted programmes. Evaluation of teaching programme.. - Structure and steps of teaching process. Teaching systems. Teaching methods. - Organization and articulation of lesson - Media in teaching: didactic functions, choosing classification of teaching media. Use of computers in teaching; simulation in teaching; Internet in teaching. Didactic shaping of programme. - Didactic solutions in some alternative schools (Montessori, Jenaplan,, Waldorf). - Lifelong education. Preparing student for lifelong learning. 		
Recommended reading	1. A.Bežen, F.Jelavić, N.Kujundžić, V.Pletenac, Osnove didaktike, NIRO Školske novine, Zagreb, 1991.		

	2. L.Bognar, M.Matijević, Didaktika, Školska knjiga, Zagreb, 1994. 3. A.Peko, A.Pintarić, Uvod u didaktiku (hrvatskoga jezika) Sveučilište J.J.Strossmayera, Osijek, 1999
Supplementary reading	1. W.Glasser, Kvalitetna škola, Educa, Zagreb, 1994. 2. H.Gudjons, R.Teske, R.Winkel(UR), Didaktičke teorije, Educa, Zagreb, 1994. 3. F.Jelavić, Didaktičke osnove nastave, Naklada Slap, Jastrebarsko, 1995. 4. L.Legrand, Obrazovne politike, Educa, Zagreb, 1993. 5. J.Lesourne, Obrazovanje i društvo, Educa, zagreb, 1993. 6. A.Madlain, Osloboditi školu, Educa, Zagreb, 1995. 7. M.Matijević, Alternativne škole, Institut za pedagojska istraživanja, Zagreb, 1994. 8. C.J.Marsh, Kurikulum: Temeljni pojmovi, Educa, Zagreb, 1994. 9. V.Mužić, A.Peko (Vr), Vrednovanje obrazovnog procesa programa, ostvarivanja, učinka, Pedagoški fakultet, Osijek, 1996.
Teaching methods	Program is to be realized through lectures, seminars and consultations.Seminars are organized as active students' workshops, in which there is a possibility to have a critical approach towards chosen didactical topics.
Assessment methods	After completion of lectures and seminars, the students may go in for the exam. The exam consists of written and oral parts.
Language of instruction	Croatian
Quality assurance methods	An anonymous questionnaire among students

Course title	Demonstration Experiments Laboratory II		
Course code	F122		
Type of course	Laboratory		
Level of course	Introductory		
Year of study	1 st	Semester	2 nd
ECTS (Number of credits allocated)	5 ECTS 40% hours allocated for this course is used in direct contact between teaching staff and students. The rest is devoted to student's preparation for demonstration experiments and writing reports.		
Name of lecturer	Vanja Radolić, PhD		
Learning outcomes and competences	Students will be able to do a large scale of demonstration experiments which they will be use as school teachers in primary and secondary schools.		
Prerequisites	Demonstration Experiments Laboratory I		
Course contents	Simple harmonic motion (harmonic oscillator, mathematical and physical pendulum). Standing waves. Sound. Electrostatics. Kirchoff`s laws. R-C, R-L and R-L-C circuits. Magnetic field of currents. The electromagnetic induction. Geometrical optics. Reflection and refraction of light. Mirrors and lens. Diffraction		

	and interference. Polarization and Brewster's law. Spectroscope with biprism.
Recommended reading	[1] Vernić-Mikuličić, Vježbe iz fizike, Školska knjiga, Zagreb 1990. [2] Experiment descriptions for Demonstration Experiments Laboratory I [3] R. Jurdana-Šepić i B. Milotić, Metodički pokusi iz fizike, Filozofski fakultet, Rijeka 2002 [4] Mikuličić-Varićak-Vernić, Zbirka zadataka za I. do IV. razred gimnazije, Školska knjiga, Zagreb, 1997.
Supplementary reading	[1] Croatian textbooks for secondary schools [2] Internet portal E-school of physics
Teaching methods	Experiential learning through cooperative work in team spirit (pairs). There are ten exercises with lots of demonstration experiments; many numerical physics problems are involved into these exercises.
Assessment methods	1. Written (30%): At least 70 % successfully solved numerical physics problems are condition for practical exam. 2. Practical (30%): Two or three demonstration experiments are performed with detailed analysis of results in written form. 3. Oral (40%): Physical background of used relations and the explanation of obtained results.
Language of instruction	Croatian
Quality assurance methods	Students interview Statistic reports on success in course

Course title	Governing multimedia contents		
Course code	I112		
Type of course	30+0+0+30		
Level of course	Basic		
Year of study	1.	Semestar	1.
ECTS (Number of credits allocated)	5		
Name of lecturer	doc.dr.sc. Branimir Dukić		
Learning outcomes and competences	Course goals: to develop students general and specific knowledge needed for governing multimedia contents (prijelom knjiga, novina. Planing e-books, e-newspapers and internet issues. Programing solutions of vector and pixel graphics, fractal graphics. Picture, video and movie manipulation in different formats and software tools)		
Prerequisites			
Course contents	Multimedia design. Integration of text, graphic, video and audio elements. Desktop publishing. Image processing. Audio processing. Video processing. XML		
Recommended	1. P.Gross, M. Gross: Macromedia Director 8.5 Shockwave Studio for 3D Training from the Source, Macromedia Press 2002, ISBN: 86-7555-205-X		

reading	2. Bonnie Blake: Adobe® Premiere® Virtual Classroom, Osborne/McGraw Hill 2001, ISBN: 86-7555-182-7 3. D. McClelland: Photoshop 7 Bible, Wiley 2003, ISBN 86-7555-215-7 David Karlins: Adobe Illustrator 10 Virtual Classroom, Osborne 2003, ISBN 86-7555-211-4
Supplementary reading	1. Lectures, seminars and laboratory exercises 1. Elliotte Rusty Harold, Elliotte Rusty, XML Bible, John Wiley & Sons, 2001, ISBN: 0764547607 2. Bhavani Thuraisingham, Bhavani Thuraisingha, XML Databases and the Semantic Web, CRC Press, 2002. ISBN: 0849310318
Teaching methods	Lectures and laboratory exercises
Assessment methods	Written and oral exam with colloquium requirement
Language of instruction	Croatian/English
Quality assurance methods	Student evaluation, teacher and field expert evaluation, exam scores, international supervision

Course title	Advanced Physics Laboratory		
Course code	F118		
Type of course	Laboratory exercises		
Level of course	Advanced		
Year of study	1 st	Semester	1 st
ECTS (Number of credits allocated)	5 ECTS <i>Description:</i> - making experiments: 60 h ~ 2 credit - learning theoretical background for experiments: around 30 h ~ 1 of the credit - data analysis and writing the experiment reports: around 30 h ~ 1 credit - exam preparation and exam: around 7 hours ~ 1 of the credit		
Name of lecturer	Dr. Branko Vuković, assistant professor		
Learning outcomes and competences	Skill of the independent running up experiments from the field of nuclear physics, data analysis and understanding of their physical background, as well as writing the experiment reports.		
Prerequisites	Competences acquired from the course “General Physics I-IV”.		
Course contents	Rutherford experiment, atomic spectroscopy, Photoelectric effect - Planck constant, Franck – Hertz experiment, alpha decay, beta decay, gamma decay, Am-241 spectar, determination of wavelength of light, Balmer series, radon measurements.		
Recommended reading	1. University Laboratory Experiments-Physics, (Phywe Systeme GMBH,Goettingen, 2003.) 2. B.Vuković: Viši fizikalni praktikum (u pripremi).		
Supplementary reading	1. K. Krane, Introductory Nuclear Physics, J. Wiley (1988)		
Teaching methods	Students within 3 hours perform experiments from chosen topics in nuclear physics.		

Assessment methods	While performing the experiment, student will be examined on it. On each experiment done, student is obliged to write an experiment report which will be graded. The exam is consisted of performing one of experiments. The final mark is formed on the basis of the knowledge shown on the exam, during the semester and the average experimental reports mark.
Language of instruction	Croatian.
Quality assurance methods	During the semester the progression in performing experiments, data analysis and their physical understanding, as well as the quality of experiment reports will be recorded. Student questionnaires about the didactical and suitability level of experiments, and the quality of the script, teacher and assistant as well.

Course title	COMPUTER-AIDED DESIGN (CAD)		
Course code	I113		
Type of course	Laboratory classes.		
Level of course	Intermediate		
Year of study	1 st	Semester	1 st
ECTS (Number of credits allocated)	3 ECTS credits <i>Description:</i> - making experiments: 1 credit - learning theoretical background for experiments: 1ETCS credit - exam preparation and exam: 1 ETCS credit		
Name of lecturer			
Learning outcomes and competences	Students will learn how create parametric and feature based part and assembly models using CAD systems.		
Prerequisites	Technical Documentation		
Course contents	Introduction to Computer-Aided Design (CAD) systems and computer models. Students will learn how create parametric and feature based part and assembly models using CAD systems.		
Recommended reading	1. Galeta, T.: Računalno modeliranje dijelova i sklopova, podloge za predavanja, Osijek, 2004.		
Supplementary reading	1. Lee, K.: Principles of CAD/CAM/CAE Systems, Addison-Wesley, Reading, Massachusetts, 1999. 1. Shah J. J.; Mäntylä, M.: Parametric and Feature-Based CAD/CAM, Wiley-Interscience Publication, New York, 1995.		
Teaching methods	Auditory and laboratory classes.		
Assessment methods	Design of parametric and feature based part model. Exam prerequisite: passed exam in subject Technical Documentation.		
Language of instruction	Croatian. English (optional)		

Quality assurance methods	Student questionnaires about the didactical and suitability level of experiments, and the quality of the script, teacher and assistant as well..
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Course title	Fundamentals of the physical electronics		
Course code	F119		
Type of course	Theoretical		
Level of course	Intermediate		
Year of study	1 st	Semester	1 st
ECTS (Number of credits allocated)	5 ECTS Teaching (lectures 30 hours, exercises 15 hours) \approx 1 ECTS Preparation for seminars, \approx 1 ECTS Student studying, about 90 hours \approx 3 ECTS		
Name of lecturer	Dr. Ramir Ristić, assistant professor		
Learning outcomes and competences	With lectures, discussion and exercises to introduce the students with basic electronic elements and circuits.		
Prerequisites			
Course contents	Emission and motion of the electrons in cathode tubes with electrostatic and magnetic deflection; properties and applications. Principles and technological realization of the semiconductor elements. Physical analysis and current-voltage characteristics of diodes, bipolar (BJT) and unipolar (JFET i MOSFET) transistors. Basic circuits of analog electronics. Some important voltage and current amplifiers. Exercises: an addition to the lectures with selected samples, detailed working out of the program with numerical calculus.		
Recommended reading	1. C.L.Hemenway, R.W.Henry, M.Caulton, Physical Electronics, John Wiley & Sons, In., New York 1967. (translation on Croatian in the library of Physics Department) 2. J.Cathey, Electronic Devices and Circuits, McGraw-Hill, 1988,		
Supplementary reading	1. G.Parker, Introductory Semiconductor Device Physics, Prentice Hall, 1994 2. P. Biljanović, Elektronički sklopovi, Školska knjiga, Zagreb 1989.		
Teaching methods	Lectures. Solving problems instructed by assistant. Uninfluenced solving of problems. Check of the solved problems and discussion of the tutorials.		
Assessment methods	Preliminary exams. Written exam. Oral exams which includes whole or part of teaching material.		
Language of instruction	Croatian		
Quality assurance methods	Student's opinion poll.		

Course title	Demonstration Experiments Laboratory I	
Course code	F117	
Type of course	Laboratory	
Level of course	Introductory	
Year of study	1 st	Semester 1 st
ECTS (Number of credits allocated)	5 ECTS 40% hours allocated for this course is used in direct contact between teaching staff and students. The rest is devoted to student's preparation for demonstration experiments and writing reports.	
Name of lecturer	Vanja Radolić, PhD	
Learning outcomes and competences	Students will be able to do a large scale of demonstration experiments which they will be use as school teachers in primary and secondary schools.	
Prerequisites	General Physics I-IV, General Physics Laboratory A, B	
Course contents	Elemental measurements of length and mass. Determination of densities of various rigid bodies and liquids. Kinematics (motion in one dimension, projectile motion). Dynamics (Laws of motion). Forces (Friction, Centripetal and Centrifugal). Work-Energy experiments, Energy conservation law. Temperature and Calorimetry. The gas laws. First law of thermodynamics.	
Recommended reading	[1] Vernić-Mikuličić, Vježbe iz fizike, Školska knjiga, Zagreb 1990. [2] Experiment descriptions for Demonstration Experiments Laboratory I [3] R. Jurdana-Šepić i B. Milotić, Metodčki pokusi iz fizike, Filozofski fakultet, Rijeka 2002 [4] Mikuličić-Varićak-Vernić, Zbirka zadataka za I. do IV. razred gimnazije, Školska knjiga, Zagreb, 1997.	
Supplementary reading	[1] Croatian textbooks for secondary schools [2] Internet portal E-school of physics	
Teaching methods	Experiential learning through cooperative work in team spirit (pairs). There are ten exercises with lots of demonstration experiments; many numerical physics problems are involved into these exercises.	
Assessment methods	1. Written (30%): At least 70 % successfully solved numerical physics problems are condition for practical exam. 2. Practical (30%): Two or three demonstration experiments are performed with detailed analysis of results in written form. 3. Oral (40%): Physical background of used relations and the explanation of obtained results.	
Language of instruction	Croatian	
Quality assurance methods	Students interview Statistic reports on success in course	

Course title	Information theory		
Course code	I114		
Type of course	30+0+0+15		
Level of course	Basic		
Year of study	1.	Semestar	2.
ECTS (Number of credits allocated)	4		
Name of lecturer	doc.dr.sc. Josip Mesarić		
Learning outcomes and competences	To gain fundamental knowledge from the field of information theory which, aside with knowledge, in the information society, represents the most important resources connected with science, economy and society proceses.		
Prerequisites	None		
Course contents	Basic definitions and classifications of theory of information. Entropy. Data compression. Communication models. Communication channels. Coding. Cryptography. Information management.		
Recommended reading	<ol style="list-style-type: none"> 1. Sinković, V., Informacija, simbolika i semantika, Školska knjiga, Zagreb, 1997. 2. Cover, T.M., J.A., Thomas, Elements of Information Theory, J. Wiley & Sons, N. York, 1991. 3. Lin, S., Costello, D. J., Error Control Coding: Fundamentals and Applications Prentice Hall Inc., Englewood, New York, 1983. 4. Pauše, Ž., Uvod u teoriju informacije, Školska knjiga, Zagreb, 1980. 5. Rožić, N., Informacije komunikacije kodiranje s primjenama, Alineja, Zagreb, 1992. 		
Supplementary reading	<ol style="list-style-type: none"> 1. Scientific journals (npr. IEEE transaction on Information Theory) 2. Internet. 		
Teaching methods	Lectures and laboratory exercises		
Assessment methods	Written and oral exam with coloquium requirement		
Language of instruction	Croatian/English		
Quality assurance methods	Student evaluation, teacher and field expert evaluation, exam scores, international supervision		

Course title	INFORMATION SYSTEMS MODELING
Course code	I115
Type of course	30+0+0+30

Level of course	Basic		
Year of study	1.	Semestar	2.
ECTS (Number of credits allocated)	5		
Name of lecturer	doc.dr.sc. Josip Mesarić		
Learning outcomes and competences	Gaining of general and specific knowledge which includes: access to information system projecting, ability to recognize and apply the methodology for system modeling and design, planing and following projects and applying design tools, data gathering, presenting and prevođenje, methodology for data and tool controlling for efficient use, ability to choose technological solutions: computer equipment, network infrastructure, software solutions for applying new bussines paradigmas. To develop organizational and using abilities for effitient IS resource using		
Prerequisites	None		
Course contents	System analysis and design; SDLC approach, project planning, CASE, process modeling, data management, object modeling, client-server model. IS functioning. IS maintains. IS reengineering. Business processes.		
Recommended reading	1. Majdandžić, Niko: Izgradnja informacijskih sustava proizvodnih poduzeća, Slavonski Brod : Strojarski fakultet, 2004. ISBN 953-6048-25-6 2. Čerić, Vlatko, Varga Mladen: Informacijska tehnologija u poslovanju, Element, Zagreb, 2004, ISBN 953-197-640-6		
Supplementary reading	1. Pavlić, Mile: Razvoj informacijskih sustava, Zagreb : Znak, 1996. ISBN 953-180:004.6 2. Davis, S. William, Yen C. David: The Information System Consultant's Handbook: Systems Analysis and Design CRC Press (December 28, 1998) ISBN: 0849370019		
Teaching methods	Lectures and laboratory exercises		
Assessment methods	Written and oral exam with colouqium requirement		
Language of instruction	Croatian/English		
Quality assurance methods	Quality and succesfulness of the course can be monitored through knowledge check systems, making of own practical homeworks according to given assignments, and students ability to apply knowledge and skills attained at this course at other courses		

Course title	Laboratory works from electronic		
Course code	F125		
Type of course	Laboratory exercises		
Level of course	Advanced		
Year of study	1 st	Semester	2 nd
ECTS (Number of credits allocated)	4 ECTS credits - making experiments: 45 h ~ 2 credit - learning theoretical background for experiments: around 30 h ~ 1 of the credit		

	- data analysis and writing the experiment reports: around 30 h ~ 1 credit - exam preparation and exam: around 7 hours ~ 1 of the credit
Name of lecturer	Dr. Ramir Ristić, assistant professor
Learning outcomes and competences	To introduce the students with work of some basic electronic elements and circuits.
Prerequisites	Fundamentals of the physical electronics
Course contents	Laboratory works are realized as an addition to the lectures from Foundations of physical electronics by composing and learning basic types of amplifiers and logic circuits (discret and integrated elements) and studying same simple equipment.
Recommended reading	1. P. Biljanović, Elektronički sklopovi, Školska knjiga, Zagreb 1989. 2. Printed hints for laboratory works (only for internal use).
Supplementary reading	1. J.Cathey, Electronic Devices and Circuits, McGraw-Hill, 1988,
Teaching methods	Students within 3 hours perform experiments from chosen topics in nuclear physics.
Assessment methods	While performing the experiment, student will be examined on it. On each experiment done, student is obliged to write an experiment report which will be graded. The exam is consisted of performing one of experiments. The final mark is formed on the basis of the knowledge shown on the exam, during the semester and the average experimental reports mark.
Language of instruction	Croatian.
Quality assurance methods	During the semester the progression in performing experiments, data analysis and their physical understanding, as well as the quality of experiment reports will be recorded. Student questionnaires about the didactical and suitability level of experiments, and the quality of the script, teacher and assistant as well.

Course title	Physics Education I		
Course code	F127		
Type of course	Lectures, seminars, field experience (school)		
Level of course	Introductory		
Year of study	2 nd	Semester	3 rd
ECTS (Number of credits allocated)	7 ECTS 40% hours allocated for this course is used in direct contact between teaching staff and students. The rest is devoted to student's preparation for seminars and field work (school teaching) as well as learning for final written exam.		
Name of lecturer	Vanja Radolić, PhD		
Learning outcomes and competences	Students will be able to implement the traditional as well as modern didactical strategies and methods in physics teaching in primary schools. Students will meet other educational activity in primary schools (pupils competitions, field trips, outreach activity, collaboration with physics and astronomy societies).		
Prerequisites	Demonstration Experiments Laboratory II		

Course contents	<p>Lectures: Aims and tasks of physics teaching in primary education. Transmission (traditional), behaviouristic (tutorials), exemplar (projects) and mentor (leading heuristics) teaching. Material conditions of physics teaching, lecture room, collection of laboratory tools. Didactical approaches: laboratory and demonstration experiment, arguing, reading physics text, arithmetic and graphics representation, computer simulation. Contemporary teaching technology in physics education (multimedia, web design, internet, java-applets, just-in-time teaching). Assessments methods in non-traditional physics teaching settings, Quality assurance methods (internal, external - PISA project). The methods of grading. Detailed didactical instruction on physics curriculum implementation in different primary school environment.</p> <p>Seminars and teaching experience in primary school: Habits of experiential learning and teaching are acquired in cooperative seminar exercises in faculty settings and during teaching in schools under the control of experienced teachers (mentors) and faculty staff.</p>
Recommended reading	<p>[1] Gustav Šindler, Prilozi problemski usmjerenoj nastavi fizike, Školska knjiga, Zagreb 1990.</p> <p>[2] Franjo Filipović, Metodika nastave fizike u osnovnoj školi, Pedagoško-književni zbor, Zagreb 1968.</p> <p>[3] Ministarstvo prosvjete i sporta, Kurikularni pristup promjenama u osnovnom školstvu, Zagreb, 2002.</p> <p>[4] Rajka Jurdana-Šepić i Branka Milotić, Metodički pokusi iz fizike, Filozofski fakultet, Rijeka 2002</p> <p>[5] Primary school textbooks</p>
Supplementary reading	<p>[1] Keith Gibbs, The Resourceful Physics Teacher – 600 ideas for creative teaching, IOP Publishing Ltd. 1999.</p> <p>[2] Selected articles from: Physics Education, Physics Teacher, Science Education, International J. of Science Education, J. of Research in Science Education itd.</p> <p>[3] Leading projects in physics education: PSSC Physics, Harvard Project Physics, Nuffield 0 Level Physics, Nuffield Advanced Physics.</p>
Teaching methods	<p>Experiential learning through cooperative work in academic settings (seminars) and real settings (school teaching):</p> <p>a) workshops experience in faculty class consisting of theoretical preparation for school teaching and discoursing after school teaching using techniques of action research and multimedia technology (analysis of video and audio materials)</p> <p>b) primary school teaching (students have to listen at least 5 lectures of school teacher before he/she lecture for grade)</p>
Assessment methods	<p>1. Practical (40%): Quality of students activity in seminars and school teaching is crucial measure of success in course.</p> <p>2. Written (40%): Final essay on 8-10 pages describing one theme from primary physics program (chosen among 5-6 suggested) which reflects knowledge of:</p> <ul style="list-style-type: none"> • theme (<i>level of general physics</i>) • textbooks for primary school (<i>didactical transformation of physics content</i>) • difficulties exposed by the pupils while learning particular physics concepts (<i>research in physics teaching</i>) • specific didactical approaches which help pupils acquire physics concepts, models and physics methods (<i>physics didactics</i>). <p>3. Oral (20%): Explanation of written essay.</p>
Language of instruction	Croatian

Quality assurance methods	Students interview Statistic reports on success in course
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Course title	METHODICS OF TEACHING INFORMATICS		
Course code	I117		
Type of course	30+30+0+15		
Level of course	Osnovna		
Year of study	2.	Semestar	3.
ECTS (Number of credits allocated)	5		
Name of lecturer	Doc.dr.sc. Margita Pavleković		
Learning outcomes and competences	Applying of didactical theories and teaching models in class, ability to analyze teaching plans and programs according to taxonomy of informational education		
Prerequisites			
Course contents	<p>The role of methodology in realising the appointed goals and tasks of teaching. Didactical theories (Klafki, Schulz, Winkel, Frank, Moller, Klingberg) and their implementation in the preparation, organization and analysis of classes. Models of teaching (constructive, generic, work-oriented, open, proficient, practical, revealing, parallel). School theories with overview of actual reforms of school system. Taxonomy of computer education according to ACM and IEEE. Principles of choice and schedule of educational frame with analysis of teaching plans and programmes for given level of education. Presentation tools. Impact of cognitive development on learning (Piaget, Vigotski and Moscow school, Bruner, Gagne, Klausmeier). Psychological types and education in Informatics. Difficulties in learning informatic contents and how to prevail them. Methods by which a level of attained knowledge is being examined and the improvement of pupils is followed-up. Instructions in certain field in Informatics in elementary and secondary school. Methodology of procedural and object programme languages. Methodology of programme packages. Principles of research in informatical education. Basic methods of applied statistics. Analysis of typical expert and scientific works in the field of methodology of teaching Informatics.</p>		
Recommended reading	<ol style="list-style-type: none"> 1. Gudjons, H., Teske, R., Winkel, R. (ed) Didaktičke teorije, Zagreb, Educa, 1992 2. Tucker, A. (Ed) A model curriculum for K-12 ,Computer Science: Report..., 2002 3, Udžbenička građa za osnovnu i srednju školu. 		
Supplementary reading	<ol style="list-style-type: none"> 1. Marsh, C. J., Kurikulum: temeljni pojmovi, Zagreb, Educa , 1994 2. Tillman, K. J. (ed) Teorije škole, Zagreb, Educa, 1994 		
Teaching methods	Lectures, seminars		
Assessment methods	Written and oral exam, intern exam lecture		
Language of	Croatian		

instruction	
Quality assurance methods	Student evaluation, teacher and field expert evaluation, exam scores

Course title	PROJECT GOVERNING		
Course code	I118		
Type of course	30+0+0+30		
Level of course	Basic		
Year of study	2.	Semestar	3.
ECTS (Number of credits allocated)	5		
Name of lecturer	Izv.prof.dr.sc. Ninoslav Novak		
Learning outcomes and competences	To train student for project approach to bussines activity solutions. To familirize with theoretical basics of project approach to information system creation and implementation and ICT consulting procedures throughout project duration. To achieve optimal operational results applying the good designing of machine, communicational, software and data components of the IS.		
Prerequisites	None		
Course contents	Basic definitions and classifications: Vision, mission, strategy, tactics, logistics. ICT project characteristics. ICT management. System analysis. Planning. Tools. Documentation. Standards. Team work. Optimization. Business integration. IT outsourcing. IT co-sourcing. XML standards. ICT performance. ICT lifecycle. ICT in education.		
Recommended reading	1. Novak, N.: Uspješno upravljanje ICT projektima. Osijek-Zagreb, 2007. 2. Grupa autora.: Komunikacijske tehnologije i norme u informatici, Opatija, 2002.		
Supplementary reading	1. Thomson, Y.:A guide for the Young Economist, London, 2001. 2. Certo, P.: Strategic Management – A Focus on Process. Illinois, 1993.		
Teaching methods	Lectures and laboratory exercises		
Assessment methods	Written and oral exam with colouqium requirement		
Language of instruction	Croatian/English		
Quality assurance methods	Student evaluation, teacher and field expert evaluation, exam scores, international supervision		

Course title	DATA STORING		
Course code	I119		
Type of course	30+0+0+30		

Level of course	Basic		
Year of study	2.	Semestar	3.
ECTS (Number of credits allocated)	5		
Name of lecturer	Doc.Dr.Sc Branimir Dukić		
Learning outcomes and competences	Course goals are: to develop students general and specific knowledge of data storing modeling in making bussines solutions and to overview the possibilities of analyzing datas in store. Besides the theory of data storing, students have to meet the methods of conceptual, logical and principles of physical modeling. Students also have to gain skills needed for pragmatic use of data storing systems		
Prerequisites	None		
Course contents	Data storage. Dimension modeling and data storing. Storage and access tools. QAPI. OLE DB. MDX. MS SQL. MYSQL.OLAP architecture and principals of data analysis. Data storage and Internet.		
Recommended reading	1. R.Kimball:The Data Warehouse Toolkit,Wiley,1996. 2. Varga M.: Baze podataka – konceptualno, logičko i fizičko modeliranje podataka, DRIP, Zagreb 1994		
Supplementary reading	1. R.Kimball,L.Reeves,M.Ross,W.Thorntwaite:The Data Warehouse Lifecycle Toolkit -Expert Methods for Designing, Developing and Deploying Data Warehouses,Wiley, 19983. C.J. Shepherd, Database Management: Theory and Application, Boston: IRWIN, 1990. 2. R. Kimball,R. Mertz: The Data Webhouse Toolkit - Building the Web-Enabled Data Warehouse, Wiley, 2000		
Teaching methods	Lectures and laboratory exercises		
Assessment methods	Written and oral exam with colouqium requirement		
Language of instruction	Croatian/English		
Quality assurance methods	Student evaluation, teacher and field expert evaluation, exam scores, international supervision		

Course title	DATA MINING		
Course code	I120		
Type of course	30+0+0+30		
Level of course	Basic		
Year of study	2.	Semestar	3.
ECTS (Number of credits allocated)	5		
Name of lecturer	Doc. Dr. Sc. Nataša Šarlija		
Learning outcomes and	The goal of the course is to train every participant to gain ability to apply the particular method of data mining. These methods, which will be thought, as theoretical as with the aplliment of software, are: regresion analisys, dessionion trees		

competences	and neuron networks.
Prerequisites	None
Course contents	Basic definitions and classifications. Introduction to Data mining. Data Modeling. Definition and problem methodology. Data preparing. Methods. Data Analysis. Results interpretation.
Recommended reading	1. Westphal, C., Blaxton, T.; Data Mining Solutions, John Wiley & Sons, Toronto, 1998. 2. Afifi, A.A., Clark, V., Computer-Aided Multivariate Analysis, Chapman&Hall, Washington, D.C., 2000.
Supplementary reading	1. Han, J., Kamber, M., Data Mining: Concepts and Techniques, Morgan Kaufman Publishers, San Francisco, 2001. 2. Trippi, R., Turban, E editori; Nerual Networks in Finance and Investing, Probus Publishing Company, Chicago, 1993.
Teaching methods	Lectures and laboratory exercises
Assessment methods	Written and oral exam with colouqium requirement
Language of instruction	Croatian/English
Quality assurance methods	Student evaluation, teacher and field expert evaluation, exam scores, international supervision

Course title	BASICS OF ARTIFICIAL INTELIGENCE		
Course code	I122		
Type of course	30+0+0+30		
Level of course	Basic		
Year of study	2.	Semestar	3.
ECTS (Number of credits allocated)	5		
Name of lecturer	Doc. Dr. Sc. Marijana Zekić-Sušac		
Learning outcomes and competences	The course goal is to familirize student with methods, techniques, achievements and appling of artificial intelignce.		
Prerequisites			
Course contents	Basic definitions and classifications of intelligence and artificial intelligence. Turing's test. Expert systems. Agents and multi agents of intelligence systems. Neural networks.		
Recommended reading	1. Russell S., Norvig P., Artificial Intelligence – A Modern Approach, 2nd Ed., Prentice Hall, 2003. 2. Haykin S., Neural Networks, Comprehensive Foundation, 2nd, Prentice Hall, 1999. 3. Zimmermann, H.J., Fuzzy Set Theory and Its Applications, 2nd. Ed., Kluwer Academic Publishers, 1991		

Supplementary reading	1. Klir G.J., Fogler T.A, Fuzzy Sets, Uncertainty and Information, Prentice Hall, Englewood Cliffs, New York, 1988. 2. Kaufmann A., Gupta M.M., Introduction to Fuzzy Arithmetic, Theory and Applications, Van Nostrand Reinhold, New York, 1991.
Teaching methods	Lectures and laboratory exercises
Assessment methods	Written and oral exam with colloquium requirement
Language of instruction	Croatian/English
Quality assurance methods	Student evaluation, teacher and field expert evaluation, exam scores, international supervision

Course title	History of physics		
Course code	F128		
Type of course	Lectures (30 hours)		
Level of course	Basic course		
Year of study	2 nd	Semester	3 rd
ECTS (Number of credits allocated)	3 ECTS: - 30 class units ~ 22 h of lectures = 0.75 ECTS - about 67 h independent student work~ 2.25 ECTS		
Name of lecturer	Dr Zdravko Faj, Professor		
Learning outcomes and competences	The knowledge of the historical evolution of many physical phenomena.		
Prerequisites	General physics I, II, III and IV, mathematics, classical mechanics and quantum physics I and II.		
Course contents	Beginning of physics. Physics in old Greece, The idea of atoms, Aristotel's natural philosophy. Physics in medieval Europe. New physics, Galilei, Kopernik, Kepler, Descartes, Leibniz. Newton's natural philosophy. Classical physics, mechanics, optics, thermodynamics, and electromagnetism. Modern physics, relativistic theory, quantum physics, atomic and nuclear physics, elementary particles.		
Recommended reading	Z. Faj, Pregled povijesti fizike, Osijek 1999.		
Supplementary reading	I. Supek, Povijest fizike, Zagreb, 1980. I. Supek, Heisenbergov obrat u shvaćanju svijeta, Zagreb, 1986. Ž. Marković, Rude Bošković, Zagreb, 1968/69. S. I. Vavilov, Isaac Newton, prijevod s ruskog, Zagreb, 1950.		
Teaching methods	The teaching of the course is carried out through lectures. Discussions on specific historical development are stimulated.		
Assessment methods	The exam is in oral form. It is held during regular examination period.		
Language of	Croatian language.		

instruction	
Quality assurance methods	On exams the candidate should show adequate knowledge of the material.

Course title	Physics Education II		
Course code	F129		
Type of course	Lectures, seminars, field experience (school)		
Level of course	Introductory		
Year of study	2 nd	Semester	4 th
ECTS (Number of credits allocated)	7 ECTS 40% hours allocated for this course is used in direct contact between teaching staff and students. The rest is devoted to student's preparation for seminars and field work (school teaching) as well as learning for final written exam.		
Name of lecturer	Vanja Radolić, PhD		
Learning outcomes and competences	Students will be able to implement the traditional as well as modern didactical strategies and methods in physics teaching in primary schools. Students will meet other educational activity in primary schools (pupils competitions, field trips, outreach activity, collaboration with physics and astronomy societies).		
Prerequisites	Physics Education I		
Course contents	<p>Lectures: Detailed didactical instruction on physics curriculum implementation in different secondary school environment. Methodology of working with talented pupils. Pupils competitions. Making presentations and different materials for visualisation and popularisation of physics.</p> <p>Seminars and teaching experience in primary school: Habits of experiential learning and teaching are acquired in cooperative seminar exercises in faculty settings and during teaching in schools under the control of experienced teachers (mentors) and faculty staff.</p>		
Recommended reading	<p>[1] Secondary school textbooks</p> <p>[2] Selected articles from: Physics Education, Physics Teacher, Science Education, International J. of Science Education, J. of Research in Science Education itd.</p> <p>[3] Selected articles from: Matematičko-fizički list, Čovjek i svemir, Priroda</p>		
Supplementary reading	<p>[1] Leading projects in physics education: PSSC Physics, Harvard Project Physics, Nuffield 0 Level Physics, Nuffield Advanced Physics.</p> <p>[2] Internet web sites about physics</p>		
Teaching methods	<p>Experimental learning through cooperative work in academic settings (seminars) and real settings (school teaching):</p> <p>a) workshops experience in faculty class consisting of theoretical preparation for school teaching and discoursing after school teaching using techniques of action research and multimedia technology (analysis of video and audio materials)</p> <p>b) primary school teaching (students have to listen at least 5 lectures of school teacher before he/she lecture for grade)</p>		
Assessment methods	<p>1. Practical (40%): Quality of students activity in seminars and school teaching is crucial measure of success in course.</p>		

	<p>2. Written (40%): Final essay on 8-10 pages describing one theme from primary physics program (chosen among 5-6 suggested) which reflects knowledge of:</p> <ul style="list-style-type: none"> • theme (<i>level of general physics</i>) • textbooks for primary school (<i>didactical transformation of physics content</i>) • difficulties exposed by the pupils while learning particular physics concepts (<i>research in physics teaching</i>) • specific didactical approaches which help pupils acquire physics concepts, models and physics methods (<i>physics didactics</i>). <p>3. Oral (20%): Explanation of written essay.</p>
Language of instruction	Croatian
Quality assurance methods	Students interview Statistic reports on success in course

Course title	Methodological informatics seminar with practice		
Course code	I121		
Type of course	Seminar		
Level of course	Main course		
Year of study	2 nd	Semestar	4 th
ECTS (Number of credits allocated)	6 ECTS school hours participation, trial lectures and lectures of students with analysis 3 ECTS Studying literature, especially about difficulties that pupils are having and ways how to prevail them 3 ECTS Preparations of lectures for elementary and secondary school 25 TOTAL 90 sati		
Name of lecturer	Doc.dr.sc. Margita Pavleković		
Learning outcomes and competences	Obtaining practical skills in teaching, mastering numerous and different methods of teaching and adequate use of media		
Prerequisites	Knowledge of didactics in theory, methods of teaching and basic informatics		
Course contents	Preparation for teaching – general model derived from theory of didactics and models of teaching as well as recommendations of leading teaching theories. With reference to this model preparations for key themes are compiled, such as procedure programming, object programming, structure of data, data base, operating systems, programme packages for text processing, calculation in tables, construction of web page etc.		
Recommended reading	Informatics manuals for elementary and secondary school		
Supplementary reading	Milat, J. <i>Preparation for teaching</i>		

Teaching methods	Seminars, internal lectures, participations in schoolwork as well as trial lectures, analysis of lectures held. Each student has to hold at least one examination lecture for elementary and secondary school
Assessment methods	Practical examination – lectures for elementary and secondary school
Language of instruction	Croatian
Quality assurance methods	Student evaluation, evaluation from educators and experts in this field

Course title	Quantum mechanics 2		
Course code	F116		
Type of course	Lectures (30), Seminars (15), Exercises (15)		
Level of course	Basic course		
Year of study	I.	Semestar	II.
ECTS (Number of credits allocated)	5 ECTS : - 60 class units ~ 45 h ~ 1 ECTS - about 120 h of independent student work with consultations ~ 4 ECTS		
Name of lecturer	Ph.D. Josip Brana, Assistant Professor		
Learning outcomes and competences	The understanding and knowledge of the physical phenomena of modern physics. Quantum mechanical problem solving skills, both analytical and computational		
Prerequisites	Examined: mathematics, general physics, classical mechanics, electrodynamics 1, quantum mechanics 1		
Course contents	Identical particles in QM and wave function symmetries. Pauli's principle. Atoms with more electrons- H atom model. Hartree-Fock equations. Molecules. Born-Openheimer approximation. H molecule. Vibration and rotation spectra. Relativistic wave equations. Klein-Gordon equation - interpretation. Dirac equation for a free electron, spin – interpretation of a negative energies – positrons. Dirac equation in an electromagnetic field – magnetic momentum of electron. Relativistic spectrum of H atom. Discrepancies with experiments – Lamb shift, spontaneous emission and anomalous magnetic momentum of electron. Basic ideas about quantized fields. Elements of Standard Model.		
Recommended reading	R. L. Liboff, Introductory Quantum Mechanics, Addison-Wesley, 2003. F. Schwabl, Quantum mechanics, Springer-Verlag, Berlin, 2002. L. I. Schiff, Quantum Mechanics, Mc-Graw Hill, New York 1968. and lectures annotation,		
Supplementary reading	F.S. Levin, An Introduction to Quantum Theory, Cambridge University Press, 2002. R. Ročak, M. Vrtar, Zbirka zadataka iz kvantne mehanike, Zagreb 1969. I. Supek, Teorijska fizika i struktura materije, Školska knjiga, Zagreb		
Teaching methods	The teaching of the course is carried out through lectures seminars and exercises. Seminars are devoted to deeper explanation of mathematical and physical concepts		

	and solving physical problems and exercises will carried out through computational and analytical solving of problems.
Assessment methods	The examination is in writing and oral form.
Language of instruction	Croatian/english
Quality assurance methods	The student polling and statistical analysis of exam results

Course title	Atomic physics and spectroscopy		
Course code	F130		
Type of course	Lectures(30), Seminars (15) Laboratory drill(15)		
Level of course	basic course		
Year of study	I	Semestar	II
ECTS (Number of credits allocated)	5 ECTS : - 60 class units ~ 45 h ~ 1 ECTS - about 120 h of independent student work with consultations ~ 4 ECTS		
Name of lecturer	Ph. D. Davor Kirin, Scientific consultant		
Learning outcomes and competences	Fundamental knowledges in the field of atomic physics and spectroscopy		
Prerequisites	General physics, mathematics, electrodynamics 1, quantum mechanics 1		
Course contents	Fundamentals of atomic physics. Line spectra and continuous spectra. Sources of light. Lasers. Detection of light. Men's eye, photography, photographic plate, photodetectors. Colour like a psychophysical quantity. Basic concepts of spectroscopy. Classification of spectroscopies. Atomic emission and absorption spectroscopy. Molecular spectroscopy, infrared and Raman spectroscopy, electronic spectroscopy. Spectroscopy like information source about a structure of matter.		
Recommended reading	C. Foot, Atomic Physics, Oxford U.P., 2004. W. T. Silfvast, Laser Fundamentals, Cambridge University Press, 2004. W.S.C. Chang, Principles of Lasers and Optics, Cambridge University Press, 2005.		
Supplementary reading	D. Budker, D. F. Kimball, D. P. DeMille, Atomic physics: An exploration through problems and solutions, Oxford U.P., 2004. L. Mandel, E. Wolf, Optical coherence and quantum optics, Cambridge U.P. 1995		
Teaching methods	Predavanja, seminarski radovi i odgovarajuća praksa u baratanju sa eksperimentalnim uređajima		
Assessment methods	Oral exam as well as observing of student's knowledge through laboratory drill continuously		
Language of instruction	Croatian/english		
Quality assurance	The student survey and statistical analysis of exam results		

methods	
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Course title	Diploma thesis		
Course code	I123		
Type of course	Seminar		
Level of course	Advanced		
Year of study	2 nd	Semester	4 th
ECTS (Number of credits allocated)	17 ECTS seminar 5 ECTS independent student work with consultations 12		
Name of lecturer	Diploma thesis advisor.		
Learning outcomes and competences	Competences in preparation of research and research itself, data acquiring and data analysis. Competences of writing the scientific report.		
Prerequisites	Acquired competences needed for the research specified by the thesis topic, defined by the topic advisor.		
Course contents	Defined by diploma thesis topic, choosing, search and study of literature. Activity preparation and conducting. Writing and presentation of the report .		
Recommended reading	Defined by diploma thesis topic.		
Supplementary reading	Defined by diploma thesis topic.		
Teaching methods	Student's advising through necessary activities by seminar- and consultation-instruction types.		
Assessment methods	Graduate thesis report inspection and diploma thesis examination in front of commission.		
Language of instruction	Croatian. English (possibility).		
Quality assurance methods	Student's questionnaires before, during and after finishing thesis activities.		