Academic Study Program PHYSICS

University of Montenegro, Faculty of Sciences and Mathematics, Depart. of Physics

VII semestar (specialist level)

	Course	Hours per week			ECTS credits
		Lect.	Vjež	Lab.	
1.	Particle physics	3	2		6
2.	Physics of ionized gases	4	2		7
3.	Pedagogy	4	0		2
4.	Nuclear physics	3	2		6
5.	School laboratory practice I	0	2		2
6.	Physics teaching methods I	2	0		3
7.	Computers in physics teaching I	2	2		4
Total hours per week		19	10		30

VIII semestar (specialist level)

	Course	Hours per week			ECTS credits
		Lect.	Vjež	Lab.	
1.	Solid state physics	4	3		7
2.	Psychology	4	0		2
3.	Foreign language IV	0	2		2
4.	School laboratory practice II	0	2		2
	Computers in physics teaching II	2	2		4
5.	Physics teaching methods II	2	0		3
6.	Laboratory Practicum IV	0	0	3	3
7.	Specialist work				7
Total hours per week		13	9	3	30

Name of the course:	**Nuclear Physics**		
Programme of Studies:	Academic study programme Physics		
Level of the course:	Specialist level, 4th year, 7th semester	**Number of ECTS credits:**	6
Contact hours:	(3 hours lectures + 2 hours seminars) per week, 30 hours in semester for consultations = 120 contact hours in semester	**Total hours:**	160 hours in semester
Structure:	39 hours - lectures, 26 hours - seminars, 8 hours - exams, 30 hours - consultations, 27 hours – homework (individual solving of problems), 30 hours – individual study.		
Language:	Montenegrin or English		
Prerequisites:	Introduction to Nuclear Physics		
Aim:	This course is aimed to complete general education of physicists, making students acquainted radioactive nuclear transformations and nuclear reactions, developing students' research abilities and skills to apply their knowledge in practice.		
Contents:	Radioactive nuclear transformations: Alpha decay - energy of alpha decay, theory. Beta decay – theory, parity nonconservation. Gamma decay – gama transition probability and selection rules, internal conversion, nuclear isomerism. General laws governing nuclear reactions: classification of nuclear reactions, conserwation laws, cross section. Interaction of neutrons with nuclei: Tipes of interaction, slowing down of neutrons, Bohr's theory of nuclear reaction. Nuclear fission: Elementary theory, utilization of fission energy, fission cross section, chain reaction, natural nuclear reactor, fission asymmetry. Nuclear reactions induced by light charged particles. Direct interaction reactions. Nuclear reactions induced by gamma-quanta, Thermonuclear reactions.		
Main texts:	K.N. Mukhin: Experimental Nuclear Physics. Vol I, Mir Publishers, Moscow 1987. W.E. Burcham: Nuclear and Particle Physics, Naučna knjiga Publisher, Belgrade, 1974 (in Serbian). D. Krpic, I. Anicin: Problems in Nuclear Physics. University of Belgrade Publisher, Belgrade, 1996 (in Serbian).		
Further readings:	B.R.Martin: Nuclear and Particle Physics – an introduction, John Wiley & Sons Ltd, 2006.		
Competences to be developed:	- Capacity to learn; - Basic knowledge and understanding of nuclear phenomena; - Problem solving skills in nuclear physics tasks; - Literature search.		
Methods of teaching:	Lectures and seminars with the active participation of students, individual home tasks, group and individual consultations.		
Examination:	Three colloquia, problem solving - home tasks, estimation of individual activity on lectures and seminars, midterm examination, final exam.		
Methods of self-evaluation:	Students pools, results of exams, direct communications with the students.		

Name of the course:	**Particle Physics**		
Programme of Studies:	Academic study programme Physics		
Level of the course:	Specialist level, 4^{th} year, 7^{th} semester	**Number of ECTS credits:**	6
Contact hours:	(3 hours lectures + 2 hours seminars) per week, 30 hours in semester for consultations = 120 contact hours in semester	**Total hours:**	160 hours in semester
Structure:	39 hours - lectures, 26 hours - seminars, 8 hours - exams, 30 hours - consultations, 27 hours – homework (individual solving of problems), 30 hours – individual study.		
Language:	Montenegrin or English		
Prerequisites:	Introduction to Nuclear Physics		
Aim:	This course is aimed to introduce students with fundamental structure of matter and make them understand physical background of fundamental interactions among elementary particles.		
Contents:	Classification of elementary particles and interactions. Basic notions in particle physics, units and dimensions. Kinematics of elementary particles. Interactions and fields. Yukawa's theory of particle exchange. Interaction rate. Cross section. Electromagnetic interaction. Feynman diagrams. Strong interaction of quarks and gluons – introduction. Properties of strong interaction. Electromagnetic interaction of quarks. Experimental evidence for colour states. Weak interaction. Fermi's theory. Carriers of weak interaction – production, decays, interactions. Phenomenology of electroweak interaction. Continuous space-time symmetries. Orbital and spin angular momentum of particles. Isospin. Parity. Charge conjugation. Parity and C-parity violation in weak interactions. Time inversion. CP symmetry. Quark model of hadrons. Hadron masses and hyperfine interactions. Baryon magnetic moments. Quarkonium states and spectroscopy of heavy mesons. Scattering of leptons and quarks. Form factors. Structural functions. Experimental evidence for quarks and gluons. Accelerators. Particle interactions with matter. Paricle detectors. Identification of particles. Unsolved questions and perspectives of particle physics.		
Main texts:	B. R. Martin and G. Shaw, Particle Physics, John Wiley & Sons 1992 D. Griffiths, Introduction to Elementary Particles, Harper & Row Publishers, New York 1987 D. H. Perkins, Introduction to High Energy Physics – 4th Edition, Cambridge University Press 2000		
Competences to be developed:	- Capacity to learn; - Basic knowledge and understanding of paricle physics phenomena; - Problem solving skills in particle physics tasks; - Literature search.		
Methods of teaching:	Lectures and seminars with the active participation of students, individual home tasks, group and individual consultations.		
Examination:	Three colloquia, problem solving - home tasks, estimation of individual activity on lectures and seminars, midterm examination, final exam.		
Methods of self-evaluation:	Students pools, results of exams, direct communications with the students.		

Name of the course:	**Laboratory Practicum IV - PRACTICUM IN NUCLEAR PHYSICS**		
Programme of Studies:	Academic study programme Physics		
Level of the course:	Specialist level, 4^{th} year, 8^{th} semester	**Number of ECTS credits:**	3
Contact hours:	3 hours in the lab per week, 15 hours in semester for consultations = 60 contact hours in semester	**Total hours:**	3 x 30 = 90 hours in semester
Structure:	39 hours – laboratory exercises, 8 hours - exams, 15 hours - consultations, 12 hours – homework, 16 hours – individual study.		
Language:	Montenegrin or English		
Prerequisites:	Laboratory Practicum III		
Aim:	Introducing students with instruments and methods in nuclear physics (particularly in spectroscopy and dosimetry of nuclear radiation) and analysis of raw data, the laboratory program will stress the development of their skills in designing and conducting experiments as well as in undertaking radiation protection measures.		
Contents:	- Theoretical introduction to the nuclear instruments and methods that will be used in this practicum. - Eight laboratory experiments: 1. Determination of NaI(Tl) detector spectral characteristics. 2. Monte Carlo simulation of radiation interaction with matter. 3. Determination of the HPGe detector characteristics. 4. Radioactivity analysis of a sample by HPGe gamma spectrometry. 5. Calibration of TL dosimeters. 6. Determination of Cs and K activities by the integral mode at the multidetector gamma-coincidence spectrometer. 7. Determination of Ra detection efficiency in non-coincidence mode and in double-coincidence mode at the gamma-coincidence spectrometer. 8. Th measurements in non-coincidence mode and in double-coincidence mode at the gamma-coincidence spectrometer. - Written seminar work. - Examination of the final report on laboratory experiments.		
Main texts:	P. Vukotic, S. Dapcevic: Practicum in Nuclear Physics. Faculty of Natural Sciences and Mathematics, Podgorica, 1998. I. Anicin, J. Puzovic: Practicum in Nuclear Physics. Faculty of Physics, Belgrade.		
Further readings:	I. Draganic, ed. : Radioactive Isotopes and Radiations – Books I, II. III. University of Belgrade and Institute Vinca, Belgrade, 1981 (in Serbian).		
Competences to be developed:	- Basic capacity to measure characteristics of some nuclear phenomena; - Ability to apply principles of radiation protection; - Usage of nuclear data bases.		
Methods of teaching:	Supervised laboratory exercises, colloquia, written seminar work, group and individual consultations.		
Examination:	Two colloquia, estimation of individua final report on laboratory experiments and of written seminar work.		
Methods of self-evaluation:	Students pools, results of exams, direct communications with the students.		