Academic Study Program PHYSICS

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

I semester (bachelor level)

	Course	Hours per week			ECTS credits
		Lect.	Vjež	Lab	
1.	Physical mechanics	4	4		9
2.	Mathematical analysis I	3	3		7
3.	Linear algebra and Analytical geometry	2	2		5
4.	Basics of physics experiment I	2	1		4
5.	Laboratory Practicum I (Mechanics)	0	0	3	3
6.	Computer practicum I	0	2		2
Total hours per week		11	12	3	30

II semester (bachelor level)

	Course	Hours per week			ECTS credits
		Lect.	Vjež	Lab	
1.	Molecular physics and Thermodynamics	4	4		10
2.	Mathematical analysis II	3	3		7
3.	Basics of physics experiment II	2	2		6
4.	Laboratory practicum I (Thermodynamics)	0	0	3	3
5.	Computer practicum II	0	2		2
6.	Foreign language I	2	0		2
Total hours per week		11	11	3	30

III semester (bachelor level)

	Course	Hours per week			ECTS credits
		Lect.	Vjež	Lab.	
1.	Mathematical analysis III	3	3		6
2.	Differential equations	2	2		4
3.	Electromagnetism	4	4		10
4	Basics of measurements in physics I	2	2		5
5.	Laboratory practicum II (Electromagnetism)	0	0	3	3
6.	Foreign language II	2	0		2
Total hours per week		13	11	3	30

IV semestar (bachelor level)

	Course	Hours per week			ECTS credits
		Lect.	Vjež	Lab.	
1.	Complex analysis	2	1		3
2.	Numerical methods	2	2		4
3.	Probability and Statistics	2	2		4
4.	Optics	4	4		9
5.	Basics of measurements in physics II	2	2		5
6.	Laboratory practicum II (Optics)	0	0	3	3
Total hours per week		12	11	3	30

V semestar (bachelor level)

	Course	Hours per week			ECTS credits
		Lect.	Vjež	Lab.	
1.	Atomic physics	4	2		6
2.	Mathematical methods in physics	3	2		6
3.	Theoretical physics I	2	2		6
4.	Quantum physics I	3	2		7
5.	Laboratory practicum III (Atomic physics)	0	0	3	3
6.	Foreign language III	2	0		2
Total hours per week		14	8	3	30

VI semestar (bachelor level)

		Hours per week			ECTS credits
		Lect.	Vjež	Lab.	
1.	Statistical physics	4	2		6
2.	Laboratory practicum III (Nuclear physics)	0	0	3	3
3.	Introduction to nuclear physics	4	2		6
4.	Theoretical physics II	2	2		6
5.	Quantum physics II	3	2		7
6.	History and philosophy of physics	2	0		2
Total hours per week		15	8	3	30

Name of the course:	**Introduction to Nuclear Physics**		
Programme of Studies:	Academic study programme Physics		
Level of the course:	Bachelor level, 3rd year, 6th semester	**Number of ECTS credits:**	6
Contact hours:	(4 hours lectures + 2 hours seminars) per week, 30 hours in semester for consultations = 120 contact hours in semester	**Total hours:**	6 x 30 = 180 hours in semester
Structure:	52 hours - lectures, 26 hours - seminars, 8 hours - exams, 30 hours - consultations, 30 hours – homework (individual solving of problems), 34 hours – individual study.		
Language:	Montenegrin or English		
Prerequisites:	Basic course of Quantum Physics		
Aim:	This course is aimed to introduce students with basic concepts of low energy nuclear physics, i.e. general properties of nuclei, characteristics of the nuclear force, principle models of the nucleus, radioactivity, nuclear reactions and to develop problem-solving skills in all these areas.		
Contents:	Properties of stable nuclei and nuclear forces: Mass number and electric charge of the atomic nucleus. Nuclear and nucleonic mass. Nuclear binding energy and nuclear stability. Weizsacker's semiempirical formula. Nuclear radius. Spin and magnetic moment of nucleons and nuclei. Quadrupole electric moment. Parity. Isotopic spin. Nucleon-nucleon interactions: forces and potentials (Yukava potential, fundamentals of meson theory). Models of atomic nucleus: Liquid drop model. Fermi gas model. Shell model – foundations, shemes, experimental consequences, drawbacks. Generalized model – single-particle states in a nonspherical well, rotational states, vibrational levels, applicability of the model. Radioactive nuclear transformations: Radioactivity - nuclear instabilities, laws of radioactive decay. General laws and types of nuclear reactions: classification of nuclear reactions, conserwation laws, nuclear fission, 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:	**Laboratory Practicum III - PRACTICUM IN NUCLEAR PHYSICS**		
Programme of Studies:	Academic study programme Physics		
Level of the course:	Bachelor level, 3rd year, 6th 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 II		
Aim:	Introducing students with simple 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:	- General theoretical introduction to the data analysis and nuclear instruments and methods that will be used in this practicum, as well as with interaction of radiation with matter. - Nine laboratory experiments: 1. Statistical fluctuation in nuclear processes. 2. Geiger-Muller counter and its characteristics. 3. Determination of of gamma-ray energy by absorption in Pb. 4. Determination of maximum energy of beta-rays by absorption in Al. 5. Determination of energies of alpha-particles with nuclear emulsion. 6. Measurements of natural background radiation with ionisation chamber. 7. Measurement of beta-activity of environmental samples. 8. Dosimetry, ALARA principle, decontamination of working table in the lab. 9. Angular distribution of radiation beam. - 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.		