Academic Study Program PHYSICS

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

Name of the course:	**Nuclear and Particle Physics**		
Study Programme	Doctorate studies in Physics		
Level of the course:	1rh year, 1th semester	**Number of ECTS credits:**	
Contact hours:	4 hours lectures per week, 40 hours in semester for consultations	**Total hours:**	150 hours in semester
Structure:	52 hours - lectures, 8 hours - exams, 40 hours - consultations, 50 hours – individual study.		
Language:	Montenegrin or English		
Prerequisites:	Nuclear Physics		
Aim:	This course is aimed to upgrade students' knowledge obtained at academic studies of Physics, and to make them acquainted with the unsolved questions of nuclear and particle physics.		
Contents:	Basic concepts (relativity and antiparticles, symmetries and conservation laws, interactions and Feynman diagrams, particle exchange – forces and potentials, observable quantities – cross sections and decay rates) Nuclear phenomenology (mass and binding energy, charge and matter distribution, nuclear instability, radioactive decay, nuclear reactions). Particle phenomenology (leptons – multiplets and numbers, neutrino masses and oscillations, universalne lepton interactions; quarks – generations and numbers; hadrons – charge multiplets, quark model spectroscopy, masses and magnetic moments). Experimental methods (accelerators and beams, particle interactions with matter, particle detectors). Strong interaction (quantum chromodynamics, bound states, strong coupling constant and asymptotic freedom, jets and gluons, deep inelastic scattering and nucleon structure). Electroweak interaction (symmetries of the weak interaction, spin structure of the weak interaction, $W^{\pm}$ i Z^0 bosons, semileptoic decays, neutrino scattering, neutral meson decays, neutral currents and the unified theory). Models and theories of nuclear physics (nucleon-nucleon potential, Fermi gas model, shell model, non-spherical nuclei, alpha decay, beta decay, gamma emision and internal conversion). Applications of nuclear physics (fission, fusion, biomedical applications). Unsolved questions of nuclear physics (structure of hadrons and nuclei, quark-gluon plasma, simmetries and standard model, nuclear medicine, nuclear energy, nuclear waste) Unsolved questions of particle physics (Higgs boson, grand unification, supersymmetry, particle astrophysics – neutrino astrophysics, dark matter, matter-antimatter assymetry).		
Main texts:	B.R. Martin: "Nuclear and Particle Physics", John Wiley & Sons, 2006.		
Further readings:	- Journals on nuclear and particle physics		
Competences to be developed:	- Capacity to learn; - Understanding of nuclear phenomena; - Literature search.		
Methods of teaching:	Lectures and consultations withh the active participation of students.		
Examination:	Two colloquia, estimation of individual activity on lectures and consultations, midterm examination, final exam.		
Methods of self-evaluation:	Results of exams, direct communications with the students.		