CONTENT

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚFV/ AJF1/08	**Course name:** Applied Nuclear Physics
Course type, scope and the method: **Course type:** Lecture **Recommended course-load (hours):** **Per week:** 2 **Per study period:** 28 **Course method:** present	
Number of ECTS credits: 4	
Recommended semester/trimester of the course: 3.	
Course level: II.	
Prerequisities:	
Conditions for course completion: Semestral project, its presentation, 2x elaboration of tasks, test, exam. Credit evaluation of the course: direct teaching and consultations (1credit), self-study (1credit), practical activities - project, tasks (1credit), evaluation (1credit), total 4credits. Minimum limit for completion of the course is to obtain at least 51% of the total evaluation.	
Learning outcomes: Overview of applications of nuclear radiation.	
Brief outline of the course: 1. -2. Properties of radioactive radiation. Artificial radioactivity. Interaction of radiation with matter. Production of radionuclides. Methods of using nuclear radiation and radioactivity. 3.-4. Influence of ionizing radiation on humans. Effects of ionizing radiation on the cell. Factors influencing the radiobiological effect of radiation. Irradiation disease. 5.-6. Dosimetry and radiation protection. System of dosimetric quantities. Methods of measuring dosimetric quantities. Radiation protection, limits and standards. 7. Activation analysis, principles of the method. Absolute and relative method. Determining the quantity of an element. Preparation of samples and standards. Interfering processes. Applications. 8. Radioactive indicators, basic characteristics. principles of the method. Selection and properties of isotope indicators. Requirements for radioactive indicators. Examples of applications. Overview of the most important radionuclides. 9.-10. Radioactive dating methods. Radiocarbon and tritium dating. Applications. Other methods. 11.-12. Radiobiological effects of ionizing radiation, new trends, hadron therapy.	
Recommended literature: 1. Cooper J.R, Randle K., Sokhi R.S.: Radioactive releases in the environment, J.Wiley &Sons, Ltd. 2003 2. R. L. Murray, Nuclear Energy, An Introduction to th Concepts, Systems, and Applications of Nuclear Processes, 6th edition,Elsevier, 2009 3. Ahmed S.N., Physics & Engineering of Radiation Detection, Elsevier, 2015 4. Dosanjh M.: From Particle Physics to Medical Applications, IOP Publishing, 2017 5. Powsner R.A.: Essential Nuclear Medicine Physics, Blackwell Publishing, 2006	

Course language:
slovak and english

Notes:

Course assessment
Total number of assessed students: 11

A	B	C	D	E	FX
63.64	27.27	9.09	0.0	0.0	0.0

Provides: doc. RNDr. Janka Vrláková, PhD.

Date of last modification: 19.11.2021

Approved: prof. RNDr. Milan Žukovič, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: KPPaPZ/KK/07	**Course name:** Communication and Cooperation
Course type, scope and the method: **Course type:** Practice **Recommended course-load (hours):** **Per week:** 2 **Per study period:** 28 **Course method:** present	
Number of ECTS credits: 2	
Recommended semester/trimester of the course: 3.	
Course level: II.	
Prerequisities:	
Conditions for course completion: Evaluation: A condition for student evaluation is his active participation in the seminar. It is expected that the student will actively participate in the discussions and will express their positions and possible solutions. The output for evaluation will be the development of a project in the form of a Power Point presentation or a video on a selected communication topic.	
Learning outcomes: The goal of the subject Communication, cooperation is the formation and development of students' language and communication skills through experiential activities. The student can demonstrate an understanding of individual behavior in various communication contexts. The student can describe, explain and evaluate communication techniques (cooperation, assertiveness, empathy, negotiation, persuasion) in practical contexts. The student can apply these techniques in common communication schemes.	
Brief outline of the course: Communication Communication theory Non-verbal communication and its means Verbal communication (basic components of communication, language means of communication) about active listening Empathy Short conversation and effective communication (principles and principles of effective communication) Cooperation About the basics of cooperation About types, signs, types and factors of cooperation Characteristics of the team (positions in the team) Small social group (structure, development, characteristics of a small social group, position of the individual in the group)	

About leadership (characteristics of the leader, management, leadership styles)

Recommended literature:

Course language:

Notes:

Course assessment
Total number of assessed students: 281

abs	n	z
98.22	1.78	0.0

Provides: Mgr. Ondrej Kalina, PhD., Mgr. Lucia Barbierik, PhD.

Date of last modification: 31.07.2022

Approved: prof. RNDr. Milan Žukovič, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚFV/ POF1b/99	**Course name:** Computational Physics II
Course type, scope and the method: **Course type:** Lecture / Practice **Recommended course-load (hours):** **Per week:** 2 / 1 **Per study period:** 28 / 14 **Course method:** present	
Number of ECTS credits: 4	
Recommended semester/trimester of the course: 1.	
Course level: I., II.	
Prerequisities:	

Conditions for course completion:

To successfully complete the course, the student must demonstrate a sufficient understanding of the basic methods of computer simulations of multiparticle systems. The basis of continuous assessment is participation and activity in exercises and work on assignments. The course ends with a final oral exam, the completion of which is conditional on the submission of all four assignments (projects) electronically and with the attached computer program. Credit rating of the course takes into account the following student workload: direct teaching (2 credits) and individual work on projects (2 credits). The minimum threshold for completing the course is to obtain at least 50% of the total score, using the following rating scale: A (90-100%), B (80-89%), C (70-79%), D (60-69%), E (50-59%), F (0-49%).

Learning outcomes:

To teach students to create simulation projects to help to solve various physical problems. To acquaint students with basic simulation methods of multiparticle systems by Monte Carlo and molecular dynamics and verify their practical implementation by preparing a computer program and analyzing the obtained results.

Brief outline of the course:

1. Methods of Monte Carlo (MC) simulations of lattice spin systems.
2. Local and cluster perturbation algorithms.
3. Errors and histogram analysis of MC data.
4. Reweighting by simple and histogram methods.
5. Universality and finite-size scaling.
6. Determination of order of phase transitions and calculation of critical exponents.
7. Basics of quantum MC simulations.
8. MC simulations of stochastic processes.
9. Diffusion equation.
10. Stochastic processes in financial analysis.
11.Basics of molecular dynamics method.
12. Discretization schemes of molecular dynamics.

Recommended literature:

Basic study literature:

LANDAU, D.P., BINDER, K.: A Guide to Monte Carlo Simulations in Statistical Physics, Cambridge Univ. Press, 5-th edition, 2021.
BOTTCHER, L., HERRMANN, H.J., Computational Statistical Physics, Cambridge Univ. Press, 2021.
Other study literature:
BERG, B.A.: Introduction to Markov Chain Monte Carlo Simulations and Their Statistical Analysis (http://www.worldscibooks.com/etextbook/5904/5904_intro.pdf)
JANKE, W.: Monte Carlo Simulations of Spin Systems (http://www.physik.uni-leipzig.de/~janke/Paper/spinmc.pdf)

Course language:

Notes:

Course assessment
Total number of assessed students: 55

A	B	C	D	E	FX
54.55	16.36	16.36	9.09	1.82	1.82

Provides: prof. RNDr. Milan Žukovič, PhD.

Date of last modification: 14.09.2021

Approved: prof. RNDr. Milan Žukovič, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚFV/ KZI1/03	**Course name:** Cosmic Rays
Course type, scope and the method: **Course type:** Lecture **Recommended course-load (hours):** **Per week:** 2 **Per study period:** 28 **Course method:** present	
Number of ECTS credits: 4	
Recommended semester/trimester of the course: 3.	
Course level: II.	
Prerequisities:	
Conditions for course completion: 1. Participation in course in accordance with the study regulations and instructions of the teacher. 2. Elaboration of a recherche work according to a selected article from the field of cosmic ray particle physics. Final written or oral exam Conditions for course succesfull completion: 1. Participation in course in accordance with the study regulations and according to the instructions of the teacher; 2. Mastering the conditions of the interim and final evaluation in the overall expression at the level of at least 80%. The credit evaluation of the course takes into account the following student workload: direct teaching (2 credits), self-study (1 credit) and evaluation (1 credit).	
Learning outcomes: During the continuous and final evaluation, the student will demonstrate adequate mastery and understanding of the content of the subject. Understands the ways and techniques of numerical solution of two basic physical problems from lectures, the motion of cosmic ray particles in the Earth's magnetosphere (Lorentz equation) and modulation of cosmic rays in the heliosphere (Fokker-Planck equation). They will learn how to determine the shape of the diffusion tensor for different shapes of the magnetic field. Gain a basic overview of the acceleration of cosmic radiation on shock waves, the geomagnetic field and the characteristics of cosmic radiation.	
Brief outline of the course: 1. Overview of the history of cosmic ray research. 2. Basic characteristics of cosmic rays. Energy spectrum and chemical composition. 3. Possible sources of cosmic rays. Changes in composition and energies from source to detector. 4. Overview of significant experiments. Space, atmospheric-balloon, ground, underground experiments. 5. Production of secondary cosmic radiation in the atmosphere. Hard, soft and electromagnetic component. Change in flux in the atmosphere with altitude. 6. Geomagnetic field of the Earth. Internal and exterbnal current systems.	

7. Motion of cosmic rays in the Earth's magnetosphere. Cut-off rigidity and magnetospheric optics. Backward solution of the Lorenz equation.
8. Distribution of cosmic rays in the heliosphere. Fokker-Planck equation and ways to solve it.
9. Parker field, diffusion tensor derived for Parker field
10. Solution of Fokker-Planck equation for supernova explosion. Basic characteristics of a supernova explosion.
11. Acceleration of cosmic rays on shock waves.

Recommended literature:

1. Marius S. Potgieter, Solar Modulation of Cosmic Rays, Living Reviews in Solar Physics volume 10, Article number: 3 (2013)
2. A Smart, D. F.; Shea, M. A.; Flückiger, E. O., Magnetospheric Models and Trajectory Computation, Space Science Reviews, 93, 2000
3. T. K. Gaisser. Cosmic Rays and Particle Physics. Cambridge, 1990.
4. L.I. Dorman: Cosmic Rays in the Earth's Atmosphere and Underground, Springer, 2004.
5. K. Kudela: On energetic particles in space, acta physica slovaca vol. 59 No. 5, 537 – 652, oct. 2009.
6. Precision Measurement of the Proton Flux in Primary Cosmic Rays from Rigidity 1 GV to 1.8 TV with the Alpha Magnetic Spectrometer on the International Space Station, Physical Review Letters, 114, 17, id.171103, 2015

Course language:

Notes:

Course assessment

Total number of assessed students: 38

A	B	C	D	E	FX
97.37	2.63	0.0	0.0	0.0	0.0

Provides: RNDr. Pavol Bobik, PhD.

Date of last modification: 19.11.2021

Approved: prof. RNDr. Milan Žukovič, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚFV/ KOZM/13	**Course name:** Cosmology
Course type, scope and the method: **Course type:** Lecture **Recommended course-load (hours):** **Per week:** 2 **Per study period:** 28 **Course method:** present	
Number of ECTS credits: 4	
Recommended semester/trimester of the course: 3.	
Course level: II.	
Prerequisities:	
Conditions for course completion: To successfully complete the course, the student must demonstrate sufficient understanding of the basic knowledge of the structure and evolution of the universe. Knowledge of the distribution of matter in the universe, expansion and other properties of the universe, application of the equations of the General Theory of Relativity in the construction of cosmological models, the origin and evolution of the universe are required. The condition for obtaining credits is passing a written or oral exam, preparation, and presentation of a semester essay. The credit evaluation of the course considers the following student workload: direct teaching (1 credit), self-study (2 credit) and assessment (1 credits). The minimum threshold for completing the course is to obtain at least 50% of the total score, using the following rating scale: A (90-100%), B (80-89%), C (70-79%), D (60-69%), E (50-59%), Fx (0-49%).	
Learning outcomes: After completing the lectures, the student will master the basic knowledge about the distribution of matter in the universe, expansion and other properties of the universe, the origin and evolution of the universe. He will also be able to apply the equations of the General Theory of Relativity in the construction of cosmological models and will have sufficient physical knowledge and mathematical apparatus to independently solve a wide range of tasks related to cosmological research.	
Brief outline of the course: 1. Introduction to cosmology: historical development of views on the universe, Olbers' paradox, gravitational paradox, cosmological principle. 2. Distribution of matter in the universe: Milky Way, its structure, dynamics and evolution, types of galaxies, quasars, intergalactic matter. 3. Groups, clusters and superclusters of galaxies, large-scale structure of the universe, dark matter, and dark energy. 4. Properties of the universe: isotropy and homogeneity of the universe, cosmic background radiation, expansion of the universe. 5. General theory of relativity: Einstein's gravitational equations. 6. Experimental tests of General theory of relativity, black holes, gravitational waves. 7. Relativistic cosmology: static solutions of Einstein's equations for homogeneous and isotropic universes, cosmological constant.	

8. Dynamic solutions of Einstein's equations for homogeneous and isotropic universes, FLWR metric.
9. Fridman's equations, models of the universe and their properties.
10. Standard cosmological model: the theory of the expanding universe, the Big Bang, the age of the universe.
11. The origin of the universe: the initial stages of the expansion of the universe, inflationary expansion, nucleogenesis, the formation of galaxies and galaxy clusters.
12. Physics of the universe, cosmological problems: the steady state theory and other cosmological theories, arrow of time, future of the universe, anthropic principle.

Recommended literature:

1. Narlikar, J.V., An Introduction to Cosmology, Cambridge University Press, Cambridge, 2002;
2. Contopoulos, D. Kotsakis, Cosmology, the structure and evolution of the Universe, Springer, 1984;
3. Weinberg, S., Gravitation and Cosmology, Wiley, New York, 1971;
4. Horský, J., Novotný, J., Štefánik, M., Úvod do fyzikální kosmologie, Academia, Praha, 2004;
5. Ullman, V., Gravitace, černé díry a fyzika prostoročasu, Československá astronomická společnost ČSAV, Ostrava, 1986;

Course language:
Slovak, English

Notes:

Course assessment
Total number of assessed students: 31

A	B	C	D	E	FX
74.19	19.35	6.45	0.0	0.0	0.0

Provides: doc. RNDr. Rudolf Gális, PhD.

Date of last modification: 20.09.2021

Approved: prof. RNDr. Milan Žukovič, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚFV/ DAD/21	**Course name:** Detection and dosimetry of cosmic rays at Earth
Course type, scope and the method: **Course type:** Lecture **Recommended course-load (hours):** **Per week:** 2 **Per study period:** 28 **Course method:** present	
Number of ECTS credits: 4	
Recommended semester/trimester of the course: 2.	
Course level: II.	
Prerequisities:	
Conditions for course completion: Final written or oral exam. The credit evaluation of the course takes into account the following student workload: direct teaching (2 credits), self-study (1 credit) and evaluation (1 credit).	
Learning outcomes: Students will acquire basic knowledge in the field of dosimetry of ionizing radiation and radiation protection. Course is focused on application of obtained knowledge in the field of dosimetry of mixed radiation fields including the cosmic radiation fields. The course describes, which methods are used to measure cosmic rays at Earth, how is the radiation situation at low Earth orbit, at the International Space Station and how to protect a man in an environment with increased levels of ionizing radiation including the cosmic radiation. Course attendees will obtain not only basic knowledge about the radiation protection from cosmic rays but also in the radiation protection in general. Hence, acquired knowledge can be used also in other branches of human activities where ionizing radiation is used like e.g. in medicine or industry.	
Brief outline of the course: 1. Introductory lecture: Revision of basic terms and quantities from experimental and nuclear physics: radioactivity, ionizing radiation, survey of elementary particles, sources of ionizing radiation, interactions of ionizing radiation with matter, directly and non-directly ionizing radiation. (PB) 2. Basics of ionizing radiation dosimetry: Definition of basic ionizing radiation dosimetry quantities - exposition, kerma and absorbed dose. Electron equilibrium. A Theory of Cavity Ionization. Conversion of quantities. (JK) 3. Biologic effects of ionizing radiation and radiation protection: Linear energy transfer, dose equivalent, personal dose equivalent, equivalent dose, effective dose, cumulative effective dose. (PB) 4. Metrology of dosimetric quantities: Detection of photon radiation. Measurement of exposition, kerma and absorbed dose in photon radiation field. (JK) 5. Metrology of dosimetric quantities: Detection of charged particles. Measurement of linear energy transfer in electron and proton radiation field. (JK)	

6. Metrology of dosimetric quantities: Detection of neutron radiation. Measurement of kerma and absorbed dose in the neutron radiation field. (JK)
7. Dosimetry of mixed ionizing radiation fields: Measurement of dosimetric quantitites in mixed radiation fields. Multiple detectors systems. (PB)
8. Shielding of ionizing radiation: Designing the radiation shielding. Equation for determination of thickness of shielding materials. Monte Carlo calculations. Multi-layer shielding of mixed radiation fields. Examples of shielding for common ionizing radiation sources. (JK)
9. Cosmic radiation sources at the Earth and in its vicinity: Galactic cosmic rays. Van Allen radiation belts. Secondary cosmic radiation. (PB)
10. Monitoring of cosmic radiation at the Earth: Basic methods and principles. Multiple detectors systems for cosmic rays showers detection. Neutron monitors. (PB)
11. Cosmic radiation detectors at the Lomnický štít observatory: NM64 type neutron monitor and the SEVAN instrument. Description of construction. Electronics. Detection units. (PB)
12. NM64 neutron monitor and SEVAN instrument at the Lomnický štít observatory: Visit of the workplace. Presentation of instruments on site. Data evaluation and processing. (PB)
13. Cosmic radiation and spaceflights: Risks that possess cosmic radiation for spaceflights. Shielding and radiation protection from cosmic rays. Radiation exposure of International Space Station (ISS) crew. Survey of experiments focused on radiation protection of ISS crew. (PB)

Recommended literature:
1. Jacob Shapiro - Radiation protection: a guide for scientists, regulators and physicians, Harvard University Press, 2002, ISBN: 0-674-00740-9
2. Glenn F. Knoll - Radiation Detection and Measurement, John Wiley & Sons, Inc., 2010, ISBN: 978-0-470-13148-0
3. P.K.F. Grieder - Cosmic Rays at Earth, Elsevier, 2001, ISBN: 978-0-444-50710-5

Course language:

Notes:

Course assessment
Total number of assessed students: 2

A	B	C	D	E	FX
100.0	0.0	0.0	0.0	0.0	0.0

Provides: RNDr. Pavol Bobik, PhD., Ing. Ján Kubančák, PhD.

Date of last modification: 19.11.2021

Approved: prof. RNDr. Milan Žukovič, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚFV/ DPO/14	**Course name:** Diploma Thesis and its Defence

Course type, scope and the method:
Course type:
Recommended course-load (hours):
Per week: **Per study period:**
Course method: present

Number of ECTS credits: 16

Recommended semester/trimester of the course:

Course level: II.

Prerequisities:

Conditions for course completion:

Learning outcomes:

Brief outline of the course:

Recommended literature:

Course language:

Notes:

Course assessment
Total number of assessed students: 65

A	B	C	D	E	FX
70.77	18.46	6.15	1.54	3.08	0.0

Provides:

Date of last modification: 07.12.2021

Approved: prof. RNDr. Milan Žukovič, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚFV/ FEC1/04	**Course name:** Elementary Particle Physics
Course type, scope and the method: **Course type:** Lecture / Practice **Recommended course-load (hours):** **Per week:** 4 / 2 **Per study period:** 56 / 28 **Course method:** present	
Number of ECTS credits: 8	
Recommended semester/trimester of the course: 1.	
Course level: II.	
Prerequisities:	
Conditions for course completion: Conditions for a successful course completion: 1. condition: successful passing of the written test with selected exercises from relativistic kinematics, dynamical conservation laws, Feynman diagrams and spin and isospin formalism 2. condition follows after successful 1. one: written or oral exam from the whole subject Credit distribution: lectures+exercises: 72 hours - 3 credits preparation for exercises + study: 50 hours - 2 credits preparation for final test with exercises: 25 hours - 1 credit preparation for the final exam: 50 hours - 2 credits	
Learning outcomes: Successful candidate will know how to solve standard exercises from relativistic kinematics connected with accelerator and detector, he/she will judge if the decay or interaction is allowed and to draw them using Feynman diagrams, he/she will know how to solve problems involving (iso)spin formalism. Successful candidate will have knowledge about basic discoveries in elementary particle physics, about kinematic and dynamic conservation laws and abut Standard Model of particle physics in general.	
Brief outline of the course: I. part: Introduction (1. week): Elementary particles - definition and properties, sources of elementary particles, detection of elementary particles, units in elementary particle physics II. part: Relativistic kinematics (2. week): Lorentz transformations - Four-vectors - Energy and momentum - Classical and relativistic collisions - Lifetime - Cross section III. part: Historical introduction (3.-7. week): The classical era (1897-1932): discovery of electron, proton and neutron - Photon (1900-1924): photoelectric effect, Compton scattering - Leptons and mesons (1934-1947): Yukawa meson, discovery of muon and pion in cosmic rays - Antiparticles (1930-1956): discovery of positron in cosmic rays, discovery of antiproton – experiment at Bevatron in Berkeley - Neutrinos (1930-1962):	

neutrino discovery, Reines-Cowan experiment, - Strange particles (1947-1960): discovery of K-mesons a Lambda hyperons in cosmic rays, strangeness - a new quantum number - Eightfold way (1961-1964): baryon and meson multiplets, discovery of Omega- in BNL - Quark model (1964): flavour and colour, isospin, resonances - November revolution revolution and its aftermath (1974-1983,1995): discovery of c quark in BNL and in SLAC, discoveries of b and t quarks in Fermilab, tau lepton discovery - Intermediate bosons (1983): discovery of W+- and Z0 at CERN, Higgs boson (2012) - Standard model (1978-?)
IV. part: Particle dynamics (8.-9. week):
The four forces - Quantum electrodynamics: examples of processes - Quantum chromodynamics: asymptotic freedom, examples of processes - Weak interactions: neutral and charged currents, interactions a decays of leptons and quarks, CKM matrix - Decays and conservation laws: charge, colour, lepton and baryon number, flavour - Unification scheme: electroweak theory, GUT theory
V. part: Symmetries (10.-11. week):
Symmetries and conservation laws - Spin, Isospin - Parity: parity violation in weak interactions, madam Wu experiment, Goldhaber experiment - Combined parity: neutral K-mesons, violation of combined parity, Cronin-Fitch experiment - CPT theorem
VI. part: Beyond Standard Model Physics (12. week):
Neutrino oscillations - Grand Unified Theories - Supersymmetry

Recommended literature:

1. D. Griffiths: Introduction to Elementary Particles, Wiley-VCH, 2008, ISBN 978-3-527-40601-2
2. A. Bettini: Introduction to Elementary Particle Physics, Cambridge University Press, 2008, ISBN 978-0-521-88021-3
3. B. Martin and G. Shaw: Particle Physcis, Wiley, 2008, ISBN 978-0-470-03293-0
4. D. Perkins: Introduction to High Energy Physics, Cambridge University Press, 2000, ISBN 978-0521621960

Course language:

Notes:

Course assessment
Total number of assessed students: 32

A	B	C	D	E	FX
40.63	37.5	9.38	6.25	6.25	0.0

Provides: doc. RNDr. Marek Bombara, PhD.

Date of last modification: 28.09.2021

Approved: prof. RNDr. Milan Žukovič, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚFV/ EJF1a/04	**Course name:** Experimental Methods of Nuclear Physics

Course type, scope and the method:
Course type: Lecture / Practice
Recommended course-load (hours):
Per week: 4 / 2 **Per study period:** 56 / 28
Course method: present

Number of ECTS credits: 8

Recommended semester/trimester of the course: 3.

Course level: II.

Prerequisities:

Conditions for course completion:
1. Active participation in lectures and excersises
2. Elaboration of a written report
3. Passing the oral exam
Detailed conditions are updated annually on the electronic notice board of the subject in AiS2 or within the repository for digital support materials (LMS UPJŠ, MS Teams UPJŠ, etc.)
Credit evaluation of the course takes into account the following student workload: direct teaching (3 credits), individual consultations (1 credit), self-study (2 credits), rating (2 credits). The minimum threshold for completing the course is to obtain at least 51% of the total score, using the following rating scale: A (91-100%), B (81-90%), C (71-80%), D (61- 70%), E (51-60%), F (0-50%).

Learning outcomes:
Acquire basic knowledges of the principles of particle detectors, construction of large detectors complex and basis of electronics in subnuclear physics.

Brief outline of the course:
1. week: Charged particle accelerators and their types. A brief history of accelerators and their use. Movement of charged particles in electric and magnetic fields, physical principles of acceleration, basic parts of accelerators, classification of accelerators.
2. week: Linear accelerators - electrostatic linear accelerators, cascade and Van de Graff generator, resonant linear accelerators, phase stability principle, beam focusing. Cyclic accelerators - the principle of operation of a cyclic accelerator, cyclotron and relativistic effect, stability of circular orbits, microtron and betatron, phasotron, electron synchrotron, synchrophasotron, colliding beams.
3. Principles and construction of particle detectors: quantities characterizing detectors.
4. Interaction of particles with matter.
5. Gaseous detectors: operation and construction - electrons and ions in gases: gas amplification, ion mobility, diffusion of ions in gas, recombination and capture of electrons, drift of electrons in an electric and magnetic field, diffusion of electrons in an electric and magnetic field.
6. Special types of gas detectors: Proportional chambers, MWPC. Drift chambers, TPC.
7. Silicon detectors (pixels/strips).
8. Scintilators and photodetectors.

9. Methods of physical quantities measurement: Vertex detectors. Track detectors (measurement of coordinates, paths, angles, momenta). Charged particle identification (ionisation losses, time of flight ...).
10. Calorimetry, electromagnetic and hadron calorimeters.
11. Large detector systems, fixed target and collider experiments.
12. Basis of electronics used in subnuclear physics (fundamental concepts, principles, requirements, specialness).

Recommended literature:

Fernow R.: Introduction to experimental particle physics, Cambridge, 1986.
Kleinknecht K.: Detectors for particle radiation, Cambridge, 1986.
Leo W.R., Techniques for Nuclear and Particle Physics Experiments, Springer Verlag, New York Berlin Heidelberg, 1994.
Bartke J.: Introduction to Relativistic Heavy Ion Physics, World Scientific Publishing, Singapore, 2009.
Grupen C.: Particle detectors, Cambridge, 2011.
Ahmed S. N.: Physics & Engineering of Radiation Detection, Elsevier, Amsterdam, 2015.

Course language:

slovak and english

Notes:

Course assessment

Total number of assessed students: 24

A	B	C	D	E	FX
62.5	29.17	4.17	4.17	0.0	0.0

Provides: doc. RNDr. Adela Kravčáková, PhD.

Date of last modification: 23.08.2022

Approved: prof. RNDr. Milan Žukovič, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚFV/ DEJ1/99	**Course name:** History of Physics
Course type, scope and the method: **Course type:** Lecture **Recommended course-load (hours):** **Per week:** 2 **Per study period:** 28 **Course method:** present	
Number of ECTS credits: 2	
Recommended semester/trimester of the course: 2., 4.	
Course level: I., II.	
Prerequisities:	
Conditions for course completion: Term project and its defense (60b), exam (40b). Credit evaluation of the subject: direct teaching and consultations (1credit), self-study, practical activities - project and evaluation (1credit). The minimum for completing the course is to obtain at least 51% of the total evaluation.	
Learning outcomes: Basic facts in the history of physics.	
Brief outline of the course: 1.-2. Evolution of knowledge before Galileo. 3.-4. Evolution of physics within the mechanical picture of the world. 5.-6. Evolution and limits of classical physics, phase of breakthrough in physics. 7.-8. Origin and evolution of the theory of relativity. Quantum physics and prospects of further evolution of physics and their application. 9.-10. Atomic and nuclear physics. 11.-12. Subnuclear physics. Contemporary state of physical research and its application in technology, natural sciences and philosophy. Position of physics in our society.	
Recommended literature: 1. R.Zajac, J.Chrapan: Dejiny fyziky, skriptá, MFF UK, Bratislava, 1982. 2. V.Malíšek: Co víte o dějinách fyziky, Horizont, Praha, 1986. 3. I.Kraus, Fyzika v kulturních dějinách Evropy, Starověk a středověk, Nakladatelství ČVUT, Praha, 2006. 4. A.I.Abramov: Istoria jadernoj fiziky, KomKniga, Moskva, 2006. 5. L.I.Ponomarev: Pod znakom kvanta, Fizmatlit, Moskva, 2006. 6. I.Kraus, Fyzika v kulturních dějinách Evropy, Od Leonarda ke Goethovi, Nakladatelství ČVUT, Praha, 2007. 7. I.Kraus, Fyzika od Thaléta k Newtonovi, Academia, Praha, 2007. 8. I.Štoll, Dějiny fyziky, Prometheus, Praha, 2009. 9. www-pages. 10.Brandt S., The harvest of a century, Discoveries of modern physics in 100 episodes, Oxford, 2009.	

Course language:
slovak and english

Notes:
The course is realized in the form of attendance, if necessary by distance learning in the environment of MS Teams or bbb.science.upjs.sk.

Course assessment
Total number of assessed students: 35

A	B	C	D	E	FX
82.86	8.57	8.57	0.0	0.0	0.0

Provides: doc. RNDr. Janka Vrláková, PhD.

Date of last modification: 19.11.2021

Approved: prof. RNDr. Milan Žukovič, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚFV/ ZMSE/07	**Course name:** Introduction to Simulations and Modeling of Experiments
Course type, scope and the method: **Course type:** Lecture / Practice **Recommended course-load (hours):** **Per week:** 2 / 1 **Per study period:** 28 / 14 **Course method:** present	
Number of ECTS credits: 4	
Recommended semester/trimester of the course: 2.	
Course level: II.	
Prerequisities:	
Conditions for course completion: exam - analysis of given task with algorithm	
Learning outcomes: Introduce the basics of Monte-Carlo methods and the applications in the simulation of high energy physics processes.	
Brief outline of the course: Mathematical foundations of Monte-Carlo methods. Buffon`s needle and basic MC methods. Comparisons of Monte-Carlo integrations with numerical quadrature. Random number generators (random numbers, random numbers generation, tests of random number generators). Monte-Carlo simulations of high energy physics processes.	
Recommended literature: James F.: Monte-Carlo theory and practice, Rep. Prog. Phys. 43, 1980, s. 1145-1189; Cern preprint DD/80/6, February 1980. http://placzek.home.cern.ch/placzek/lectures, http://en.wikipedia.org/wiki/Monte_Carlo_method	
Course language:	
Notes:	
Course assessment Total number of assessed students: 12	

A	B	C	D	E	FX
66.67	8.33	8.33	0.0	16.67	0.0

Provides: RNDr. Martin Vaľa, PhD.	
Date of last modification: 18.11.2021	
Approved: prof. RNDr. Milan Žukovič, PhD.	

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚFV/ PSD/14	**Course name:** Introduction to distributed data processing

Course type, scope and the method:
Course type: Lecture
Recommended course-load (hours):
Per week: 2 **Per study period:** 28
Course method: present

Number of ECTS credits: 4

Recommended semester/trimester of the course: 2.

Course level: II.

Prerequisities:

Conditions for course completion:
semestral project, presentation, evaluation

Learning outcomes:
Introductory lectures to basics of parallel data processing on analysis farms.

Brief outline of the course:
Basics of scripting languages under various operating systems.
Scripting in Unix/Linux.
Simple parametrization of jobs on analyses farms.
Basic principles of batch farm organizations.
Basic principles of interactive farm organizations.
Implementation and realization of job paralelization.

Recommended literature:
https://www.gnu.org/software/bash/
http://www.adaptivecomputing.com/products/open-source/torque/
http://root.cern.ch/drupal/
http://xrootd.org/
https://eos.readthedocs.org/en/latest/

Course language:
English

Notes:

Course assessment
Total number of assessed students: 5

A	B	C	D	E	FX
100.0	0.0	0.0	0.0	0.0	0.0

Provides: RNDr. Martin Vaľa, PhD.

Date of last modification: 18.11.2021

Approved: prof. RNDr. Milan Žukovič, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚFV/ ZDC/14	**Course name:** Introduction to particle detection by calorimetric methods
Course type, scope and the method: **Course type:** Lecture **Recommended course-load (hours):** **Per week:** 2 **Per study period:** 28 **Course method:** present	
Number of ECTS credits: 4	
Recommended semester/trimester of the course: 2.	
Course level: II.	
Prerequisities:	
Conditions for course completion: Knowledge of the issue at a sufficient level, exam. The credit evaluation of the course takes into account the following student workload: direct teaching (2k), self-study (1k) and assessment (1k). The minimum limit for completing the course is to obtain at least 51% of the total score.	
Learning outcomes: Special lectures as intoduction to partcle calorimetry.	
Brief outline of the course: PASSAGE OF PARTICLES THROUGH MATTER: Electronic energy loss by heavy particles, momenta and cross sections, maximum energy transfer in a single collision. Stopping power at intermediate energies. Mean excitation energy, density effect, energy loss at low energies. Energetic knock-on electrons (δ rays). Restricted energy loss rates for relativistic ionizing particles. Fluctuations in energy loss, energy loss in mixtures and compounds, ionization yields. Multiple scattering through small angles. Photon and electron interactions in matter. Collision energy losses by e±, Radiation length, Bremsstrahlung energy loss by e±. Critical energy, energy loss by photons, bremsstrahlung and pair production at very high energies. Photonuclear and electronuclear interactions at still higher energies , muon energy loss at high energy. Cherenkov and transition radiation. Optical Cherenkov radiation. Coherent Cherenkov radiation. CALORIMETERS: Principles of Calorimetry. Electromagnetic and Hadronic Showers. Shower Profiles and Containment . Electromagnetic calorimeters. Hadronic calorimeters.	

Signal Detection.
Energy and position resolution in calorimetry.

Recommended literature:
J. Beringer et al. (Particle Data Group), Phys. Rev. D86, 010001 (2012)
and 2013 partial update for the 2014 edition.
http://indico.cern.ch/getFile.py/access?contribId=24&resId=0&materialId=slides&confId=44587
http://www.slidefinder.net/c/
calorimetry_energy_measurements_prof_robin/252b_lecture8/27257380
http://www-ppd.fnal.gov/EPPOffice-w/Academic_Lectures/DGreen.pd
phttp://www-group.slac.stanford.edu/sluo/lectures/detector_lecture_files/detectorlectures_13.pd
http://indico.cern.ch/getFile.py/access?contribId=24&resId=0&materialId=slides&confId=44587
http://www.kip.uni-heidelberg.de/atlas/seminars/WS2009_JC/compensation1
R.Wigmans, Calorimetry, Energy measurement in Particle Physics,Oxford Univ.Press, 2017

Course language:
English

Notes:

Course assessment
Total number of assessed students: 4

A	B	C	D	E	FX
75.0	0.0	0.0	0.0	25.0	0.0

Provides: RNDr. Pavol Stríženec, CSc.

Date of last modification: 18.11.2021

Approved: prof. RNDr. Milan Žukovič, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚFV/ UKF/22	**Course name:** Introductory Medical Physics
Course type, scope and the method: **Course type:** Lecture **Recommended course-load (hours):** **Per week:** 2 **Per study period:** 28 **Course method:** present	
Number of ECTS credits: 4	
Recommended semester/trimester of the course: 1.	
Course level: II.	
Prerequisities:	
Conditions for course completion: 1. Attendance at seminars (also applies to the online form of Teaching). A student's excused absence for a maximum of two seminars will be excused without the need for an alternative term. In the case of long-term justified absence (e.g. due to sick leave), the teacher will assign the student a substitute form of mastering the missed content. 2. Successful completion of the exam.	
Learning outcomes: The course provides students with the theoretical basis for the work of a medical physicist. The student should know the physical principles of application of ionizing radiation in medicine - in radiodiagnostics, nuclear medicine, radiotherapy and the principles of radiation protection.	
Brief outline of the course: 1. Competencies of medical physicists in radiation oncology, nuclear medicine and radiodiagnostics. 2. Ionizing radiation sources used in medicine - radionuclides and generators. 3. Interactions of photon, electron, proton and heavy ions with matter. Interaction of ionizing radiation with organisms. 4. Ionizing radiation detection and measurement of the absorbed dose in medicine. Quantities and units used in medical dosimetry. 5. Radiofrequency linear accelerators. Proton accelerators and heavy ion accelerators for radiotherapy. 6. Overview of radiation treatment techniques (3D CRT, IMRT, SRS, SABR, TBI, RMM, gating). Imaging methods in radiotherapy. 7. Linear accelerator quality control systems. 8. Physical principles of brachytherapy application. 9. Treatment planning systems for radiotherapy. Information and verification systems in radiation oncology. 10. Imaging methods in radiodiagnostics and nuclear medicine. 11. Radiobiological models for predicting the effect of ionizing radiation. 12. Principles of radiation protection and current legislation.	
Recommended literature:	

1. Podorsak E.B..et al.: Radiation Oncology Physics , IAEA, 2005
2. Khan F. M.: The Physics of Radiation Therapy, Lippincott Williams & Wilkins, 2009
3. Šlampa P., Petera J.: Radiační onkológie, Galen Karolinum Praha 2007
4. Hirohiko T., et al.: Carbon-Ion Radiotherapy, Springer, 2014
5. Bushberg J. T., et al.: The Essential Physics of Medical Imaging, Wolters Kluwer, 2020
6. Lancaster J.L., Hasegawa B.1: Fundamental Mathematics And Physics Of Medical Imaging, CRC Press, 2016
7. Platná legislatíva SR (Zák.č. 87/2018 Z.z., vyhláška MZ SR č. 99/2018 Z.z., vyhláška MZ SR č. 101/2018 Z.z.)

Course language:

Notes:

Course assessment
Total number of assessed students: 0

A	B	C	D	E	FX
0.0	0.0	0.0	0.0	0.0	0.0

Provides: RNDr. Martin Jasenčak, PhD.

Date of last modification: 18.11.2021

Approved: prof. RNDr. Milan Žukovič, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: KF/ FMPV/22	**Course name:** Methodology of Science 1
Course type, scope and the method: **Course type:** Lecture / Practice **Recommended course-load (hours):** **Per week:** 1 / 1 **Per study period:** 14 / 14 **Course method:** present	
Number of ECTS credits: 2	
Recommended semester/trimester of the course:	
Course level: II.	
Prerequisities:	
Conditions for course completion: Attendance: A student may have one unexcused absence in seminar at the most. Absence in more than one seminar must be reasoned and substituted by consultations. Conditions of continuous and final control: during the semester a student is continuously checked and assessed according to his/her activity. To be awarded the credits, a student must pass a test from knowledge obtained in the lectures and seminars. Results of the test will make up the final grade.	
Learning outcomes: The course is aimed at getting familiar with the basic issues of methodology and philosophy of science. Significant part will be devoted to presenting the main concepts of the philosophy of science in the 20th century and this aim will be achieved by reading the source and interpretive texts.	
Brief outline of the course: • Falsificationism and critical realism by K. R. Popper. • Development and critique of the Popper's concept. • Understanding the science development in the work by T. S. Kuhn. • Methodology of scientific research programmes of I. Lakatos. • Methodological anarchism of P. Feyerabend. • W.V.O. Quine – the issue of relation between theory and empiricism.	
Recommended literature: BILASOVÁ, V. – ANDREANSKÝ, E.: Epistemológia a metodológia vedy. Prešov: FF PU 2007. FAJKUS, B.: Filosofie a metodologie vědy. Praha: Academia 2005. BEDNÁRIKOVÁ, M. Úvod do metodológie vied. Trnavská univerzita: Trnava 2013. DÉMUTH, A. Filozofické aspekty dejín vedy. Trnavská univerzita: Trnava 2013. FEYERABEND, P.: Proti metodě. Prel. J. Fiala. Praha: Aurora 2001. KUHN, T. S.: Štruktúra vedeckých revolúcií. Prel. Ľ. Valentová. Bratislava 1982.	
Course language: Slovak	
Notes:	

Course assessment
Total number of assessed students: 0

A	B	C	D	E	FX
0.0	0.0	0.0	0.0	0.0	0.0

Provides: prof. PhDr. Eugen Andreanský, PhD.

Date of last modification: 01.02.2022

Approved: prof. RNDr. Milan Žukovič, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚFV/ KDO1/22	**Course name:** Methods of Clinical Dosimetry
Course type, scope and the method: **Course type:** Lecture **Recommended course-load (hours):** **Per week:** 2 **Per study period:** 28 **Course method:** present	
Number of ECTS credits: 4	
Recommended semester/trimester of the course: 2.	
Course level: II.	
Prerequisities:	
Conditions for course completion: 1. Attendance at seminars (also applies to the online form of Teaching). A student's excused absence for a maximum of two seminars will be excused without the need for an alternative term. In the case of long-term justified absence (e.g. due to sick leave), the teacher will assign the student a substitute form of mastering the missed content. 2. Successful completion of the exam.	
Learning outcomes: The course provides students with the theoretical basis for the work of a medical physicist. The student should know the methods of detection of ionizing radiation used in medicine, know the basic characteristics of detectors and dosimeters, be able to independently select the correct type of detector, and perform dosimetric measurements. The student should know the principles of radiation protection.	
Brief outline of the course: 1. Physical characteristics and types of detectors and dosimeters in radiotherapy. 2. System of Standard Dosimetry Laboratories and calibration of dosimeters. Standards for measuring absorbed dose to water. Correction factors. 3. Standard of measurement of absorbed dose to water for photon beams. Measurements under reference conditions in the user beam. Uncertainty estimation. 4. Standard of measurement of absorbed dose to water for electron beams. Measurements under reference conditions in the user beam. Uncertainty estimation. 5. Acceptance tests and commissioning of the linear accelerator. 6. Daily and monthly stability checks and long-term stability tests of linear accelerators in radiotherapy. 7. Phantoms in dosimetry - anthropomorphic, geometric, tissue-equivalent, and dynamic. 8. Dosimetry methods in brachytherapy. 9. Dosimetry audits for treatment planning systems. Dose Calculation Algorithms 10. Verification of treatment plans - dosimetry "in vitro" and "in vivo". 11. Dosimetry of low- and intermediate-energy photon beams in radiotherapy and radiodiagnostics (X-ray therapy, CT, mammography) 12. Dosimetry and radiation protection in the nuclear medicine facility.	

Recommended literature:
1. Podorsak E.B..et al.: Radiation Oncology Physics , IAEA, 2005
2. Khan F. M.: The Physics of Radiation Therapy, Lippincott Williams & Wilkins, 2009
3. Platná legislatíva SR (Zák.č. 87/2018 Z.z., vyhláška MZ SR č. 99/2018 Z.z., vyhláška MZ SR č. 101/2018 Z.z.)
4. Andreo, P. et al.: Absorbed Dose Determination in External Beam Radiotherapy: An International Code of Practice for Dosimetry based on Standards of Absorbed Dose to Water, IAEA TRS-398, 2006

Course language:

Notes:

Course assessment
Total number of assessed students: 2

A	B	C	D	E	FX
100.0	0.0	0.0	0.0	0.0	0.0

Provides: RNDr. Martin Jasenčak, PhD.

Date of last modification: 18.11.2021

Approved: prof. RNDr. Milan Žukovič, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚFV/ NSF/10	**Course name:** Non-Equilibrium Statistical Physics
Course type, scope and the method: **Course type:** Lecture / Practice **Recommended course-load (hours):** **Per week:** 2 / 1 **Per study period:** 28 / 14 **Course method:** present	
Number of ECTS credits: 5	
Recommended semester/trimester of the course: 3.	
Course level: II.	
Prerequisities:	
Conditions for course completion:	
Learning outcomes: To give basic knowledges about modern trends and theoretical methods in description of non-equlibrium phenomena in physics.	
Brief outline of the course: Problems of kinetic theory - formulations of basic tasks. Distribution function. Liouville theorem. Liouville operator. Kinetic Boltzman equation. H-theorem. Maxwell distribution. Transport phenomena. Conservation laws. Derivation of the macroscopic eduqtions in leading and next-to-leading approximation. Hydrodynamic approximation. Set of equations for density, mean velocity and temperature. Derivation of continuity equation, Navier-Stokes equation, heat conductivity equation. Derivation of vicosity and diffusivity coefficients from microscopic description. Stokes laws. Reynolds number. Dynamical derivation of kinetic equation. Liouville (master) equation for N-particle distribution function. Bogolyubov set of equations for distribution functions. Principle of weakening of statistical correlations. Equation for one-particle distribution function. Brown motion. Langevin equation. Fokker-Planck equation and specific tasks.	
Recommended literature: 1. Landau L.D., Lifshitz E.M.: Teoreticheskaja fizika X: Lifshitz E.M., Pitaevskij L.P.: Fizicheskaja kinetika, Moskva, Fizmatlit 2002 2. K. Huang: Statistical mechanics, John Wiley and Sons, Inc., New York-London, 1963. D.N.Zubarev: Neravnovesnaja statisticheskaja termodinamika, Moskva, Nauka, 1971. A.N.Vasiliev Kvantovopolevaja renormgruppa v teorii kriticeskogo povedenija i stochasticeskoj dinamike, Sankt-Peterburg, Izd. Peters. Inst. Of. Nuclear physics (1998) 773 (The Field Theoretic Renormalization Group in Critical Behavior Theory and Stochastic Dynamics, Chapman & Hall CRS Press Company New York, 2004)	
Course language: slovak and english	
Notes:	

Course assessment
Total number of assessed students: 25

A	B	C	D	E	FX
64.0	8.0	16.0	12.0	0.0	0.0

Provides: prof. RNDr. Michal Hnatič, DrSc., RNDr. Tomáš Lučivjanský, PhD.

Date of last modification: 18.11.2021

Approved: prof. RNDr. Milan Žukovič, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚFV/ JADF/14	**Course name:** Nuclear Physics
Course type, scope and the method: **Course type:** **Recommended course-load (hours):** **Per week:** **Per study period:** **Course method:** present	
Number of ECTS credits: 4	
Recommended semester/trimester of the course:	
Course level: II.	
Prerequisities: ÚFV/FEC1/04 and ÚFV/EJF1a/04 and ÚFV/FJA1/14 and ÚFV/KTP1a/03 and ÚFV/KTP1b/03	
Conditions for course completion:	
Learning outcomes:	
Brief outline of the course:	
Recommended literature:	
Course language:	
Notes:	

Course assessment
Total number of assessed students: 11

A	B	C	D	E	FX
72.73	9.09	9.09	9.09	0.0	0.0

Provides:	
Date of last modification: 19.11.2021	
Approved: prof. RNDr. Milan Žukovič, PhD.	

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚFV/ JRE1/14	**Course name:** Nuclear Reactions
Course type, scope and the method: **Course type:** Lecture **Recommended course-load (hours):** **Per week:** 2 **Per study period:** 28 **Course method:** present	
Number of ECTS credits: 4	
Recommended semester/trimester of the course: 2.	
Course level: II.	
Prerequisities:	
Conditions for course completion: Semestral project, its presentation, 2x elaboration of tasks, test, exam. Credit evaluation of the course: direct teaching and consultations (1credit), self-study (1credit), practical activities - project, tasks (1credit), evaluation (1credit), total 4credits. Minimum limit for completion of the course is to obtain at least 51% of the total evaluation.	
Learning outcomes: Introduction to nuclear reactions.	
Brief outline of the course: 1.-2. Introduction to nuclear reactions. Conservation laws, kinematics, cross section, scattering theory. 3.-5. Mechanism of nuclear reactions. Direct nuclear reactions. Resonance reactions. Bohr model of nuclear reactions, compound nucleus. Plane wave Born approximation. Distorted wave Born approximation. Pre-compound model of nuclear reactions: cassade model, exciton model, fireball. 6.-8.Neutron physics. Neutron induced reactions. 9. Heavy ion reactions. 10.Gamma reactions. 11. Nuclear synthesis. Fusion in the Sun and Stars, carbon cycle, proton cycle. 12. Application - nuclear medicine physics.	
Recommended literature: 1. Bertulani C.A., Danielewicz P.: Introduction to nuclear reaction, IOP Publish. Ltd., 2004. 2. G. McCracken, P. Stott: Fusion, The Energy of the Universe, Elsevier 2005 3. P.A.Tipler, R.A.Llewellyn: Modern Physics, 6th Edition,W.H.Freeman and Company, 2012 4. Cahn R., Goldhaber G., The experimental Foundations of Particle Physics, Cambridge Univ. Press, 2011 5. Iliadis Ch., Nuclear Physics of Stars, Wiley -VCH Verlag, 2015 6. Heyde K., Basic Ideas and Concepts in Nuclear Physics, IoP Publ., 2004	
Course language: slovak and english	
Notes:	

Course assessment
Total number of assessed students: 18

A	B	C	D	E	FX
72.22	22.22	0.0	5.56	0.0	0.0

Provides: doc. RNDr. Janka Vrláková, PhD.

Date of last modification: 22.11.2021

Approved: prof. RNDr. Milan Žukovič, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚFV/ FPK1/07	**Course name:** Phase Transitions and Critical Phenomena

Course type, scope and the method:
Course type: Lecture
Recommended course-load (hours):
Per week: 3 **Per study period:** 42
Course method: present

Number of ECTS credits: 4

Recommended semester/trimester of the course: 2.

Course level: II.

Prerequisities:

Conditions for course completion:
To successfully complete the course, the student is required to understand the concept of phase transitions and critical phenomena based on thermodynamics and statistical physics. The successful graduate will be able to apply this apparatus to simpler models of magnetic systems using exact or approximate methods. The condition for obtaining credits is successful completion of the final oral exam. The credit evaluation of the course takes into account the following student workload: direct teaching (2 credits), self-study (1 credit), and assessment (1 credit). The minimum limit for completing the course is to obtain at least 50% of the total score, using the following rating scale: A (90-100%), B (80-89%), C (70-79%), D (60- 69%), E (50-59%), F (0-49%).

Learning outcomes:
To acquaint students with the basic problems of the theory of phase transitions and critical phenomena and their solutions using the methods of thermodynamics and statistical physics. Emphasis is placed on the study of phase transitions in magnetic systems, through several theoretical models, but the course also covers other areas such as phase transitions in nuclear matter.

Brief outline of the course:
1. Thermodynamics and phase transitions.
2. Conditions of stability of the equilibrium state of the magnetic system.
3. Phase equilibrium, phase transitions. Clausius-Clapeyron equation.
4. Classical (Ehrenfest) classification of phase transitions: phase transitions of the first and second kind.
5. Landau's description of phase transitions of the second kind.
6. Critical indices, universality. Definition of critical indices for the magnetic system. Thermodynamic relations between critical indices.
7. Basic microscopic models of magnetic phase transitions. Heisenberg and Ising model.
8. Exact solutions of microscopic models: one-dimensional and two-dimensional Ising model.
9. Thermodynamic functions for a one-dimensional Ising model.
10. Some approximate methods of solving the Ising model.
11. Landau's theory of phase transitions.
12. Phases of nuclear matter.

Recommended literature:

Basic literature:
BOBÁK, A., Phase Transitions and Critical Phenomena, Project 2005/NP1-051 11230100466, European Social Fund, Košice 2007.
STANLEY, H.G.: Introduction to Phase Transitions and Critical Phenomena, Clarendon Press Oxford, 1971.
Other literature:
REICHL, L.E.: A Modern Course in Statistical Physics, University of Texas Press, Austin, 1980.
PLISCHKE, M., BERGERSEN, B.: Equilibrium Statistical Physics, World Scientific, 1994.
KADANOFF, L.P.: Statistical Physics, Statistics, Dynamics and Renormalization, World Scientific, 2000.

Course language:
1. Slovak,
2. English

Notes:
The course is realized in the presence form, if necessary remotely in the MS Teams environment.

Course assessment
Total number of assessed students: 131

A	B	C	D	E	FX
56.49	11.45	11.45	14.5	6.11	0.0

Provides: prof. RNDr. Milan Žukovič, PhD.

Date of last modification: 19.11.2021

Approved: prof. RNDr. Milan Žukovič, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: KF/ FILA/22	**Course name:** Philosophical Antropology
Course type, scope and the method: **Course type:** Practice **Recommended course-load (hours):** **Per week:** 2 **Per study period:** 28 **Course method:** present	
Number of ECTS credits: 2	
Recommended semester/trimester of the course:	
Course level: II.	
Prerequisities:	
Conditions for course completion:	
Learning outcomes:	
Brief outline of the course:	
Recommended literature:	
Course language:	
Notes:	
Course assessment Total number of assessed students: 0	

A	B	C	D	E	FX
0.0	0.0	0.0	0.0	0.0	0.0

Provides: doc. PhDr. Kristína Bosáková, PhD.	
Date of last modification: 01.02.2022	
Approved: prof. RNDr. Milan Žukovič, PhD.	

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚFV/ LEK1/02	**Course name:** Physical Principles of Medical Diagnostics and Therapy
Course type, scope and the method: **Course type:** Lecture **Recommended course-load (hours):** **Per week:** 2 **Per study period:** 28 **Course method:** present	
Number of ECTS credits: 2	
Recommended semester/trimester of the course: 1., 3.	
Course level: II.	
Prerequisities:	

Conditions for course completion:

To complete successfully the course, the student has to demonstrate the understanding of the basic notions and the physical principles of medical technology, especially of the diagnostic (imaging). In addition to attending classes, it is necessary for the student to study some specifics (details) of the discussed issues within self-study. The conditions for obtaining credits is, in addition to participation in teaching and passing the final exam, a successful completion of a written test. The minimum limit for passing the exam is to obtain 51% of the total score, which takes into account all required activities. The credit evaluation takes into account the following student workload: direct teaching - 1 credit, self-study of recommended literature - 1 credit, continuous study for the test and evaluation - 1 credit.

Rating scales: A - 91% -100% points, B - 81% -90% points, C - 71% -80% points, D - 61% -70% points, E - 51% -60% points.

Learning outcomes:

After completing the lectures, the student will have the knowledge to understand the principles and operation of modern medical devices, such as e.g. ultrasound diagnostics, computed transmission tomography, computed emission (positron) tomography, magnetic (resonance) tomography, radiotherapy and lasers, and to be able to explain the principles and use of the facilities to others. The acquired knowledge should also be a good prerequisite for a possible employment of the student in companies producing or operating modern medical technology.

Brief outline of the course:

1. Division of medical technology into diagnostic and therapeutic. A brief history of medical technology.
2. Ultrasound diagnostics (USG). Basic terms - used frequencies, wave intensities, acoustic impedance, ultrasound generation, absorption of ultrasonic waves, reflection and refraction of waves, space resolution, focusing of waves. Types of ultrasound imaging: type A and B imaging, creation of a dynamic (real time) image, time imaging (time motion). Some methods of signal processing: digitization, time-dependent signal balancing, etc.
3. Ultrasound diagnostics based on Doppler effect. Systems with unmodulated and modulated carrier waves, examination of blood flow in the organism. Possibilities of ultrasound diagnostics and

its advantages. Interaction of ultrasound with tissues (active and passive), principles of ultrasound therapy.
4. Transmission computed tomography (CT). Absorption of X-rays in tissues, evaluation of relationships between the intensity of incident and the intensity of penetrated radiation, image constructions.
5. Construction of a CT equipment, X-ray source, detection system, evaluation and processing of results. Types (generations) of CT devices. Implementation of CT examination and image evaluation. 6. Emission computed tomography (ET). Single-photon emission tomography - selection of suitable radionuclides and evaluation of the distribution of radionuclides in the body.
7. Construction of emission tomograph, benefits and use of emission tomography. Positron emission tomography (PET). Positron emitters, positron - electron annihilation, coincident photon detection. Construction of PET equipment, benefits and use of PET.
8. Thermography - basic concepts. Contact thermography - properties of liquid crystals, detection of changes in surface temperature of an organism. Contactless thermography. Radiation of bodies, detection of infrared radiation, distribution and properties of detectors. Thermograph design, use of thermography in medicine and other areas.
9. Magnetic (resonance) tomography (MR/MT). Principles of nuclear magnetic resonance - magnetic moment of the nucleus, movement (precession) of magnetic moments in magnetic field. Longitudinal and transverse relaxation times, causes of their change. Methods of measuring relaxation times.
10. Acquisition of image information - use of magnetic field gradients, methods of their creation. Design of magnetic tomographs - basic magnet, high frequency coils, shielded rooms, evaluation systems. Possibilities and use of MT, the use of contrast agents.
11. Lasers in medical technology. Principle of laser operation, spontaneous and induced emission, three-level lasers (solid, gas), construction of lasers. Properties of laser radiation and the effect of laser beam on biological objects (tissues). Use of lasers in various fields of medicine.
12. Principles of radiotherapy. Interaction of various ionizing particles (photons, electrons, neutrons, protons) with the environment. Biological effects of ionizing radiation, applied doses, survival curves. New methods of irradiation, the use of Bragg maximum in hadron irradiation therapy, neutron capture therapy. Possibilities of ionizing radiation beam modification.

Recommended literature:

- Režňák I. et al., Modern imaging methods in medical diagnostics, Vyd. Osveta, Martin, 1992.
- Jurga Ľ. et al., Basics of Medical Radiology, Script of LF UPJŠ, Košice, 1990.
- Mc Ainsh T.F., Physics in Medicine and Biology, Pergamon Press, Oxford, 1987.
- Huda W., Slone R.M., Review of Radiologic Physics, Lippincot, London, 1995
- Bushberg J.T, et al., The essential physics of imaging, Lippincott Williams, Philadelphia, 2002.

Course language:

Slovak, English

Notes:

Recommended range of lessons (in hours): Weekly: 2/0
For the period of study: 26/0
Method of study: Teaching is carried out in person, if necessary remotely, in the environment of MS Teams.
Number of ECTS credits: 3
Degree of studz: I. resp. II.
Prerequisites: none

Course assessment
Total number of assessed students: 37

A	B	C	D	E	FX
86.49	10.81	2.7	0.0	0.0	0.0

Provides: doc. RNDr. Karol Flachbart, DrSc.

Date of last modification: 06.10.2021

Approved: prof. RNDr. Milan Žukovič, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚFV/ FJA1/14	**Course name:** Physics of the Nucleus

Course type, scope and the method:
Course type: Lecture
Recommended course-load (hours):
Per week: 2 **Per study period:** 28
Course method: present

Number of ECTS credits: 4

Recommended semester/trimester of the course: 1.

Course level: II.

Prerequisities:

Conditions for course completion:
Active participation in lectures.
Passing the oral exam.
Detailed conditions are updated annually on the electronic notice board of the subject in AiS2 or within the repository for digital support materials (LMS UPJŠ, MS Teams UPJŠ, etc.)
The teacher excuses the justified absence of the student (incapacity for work, family reasons, etc.) for a maximum of two lectures during the semester without the need for substitute performance.
In the case of a longer-term justified absence (for example due to incapacity for work), the student will be assigned an alternative form of mastering the missed study matter.
Credit evaluation of the course takes into account the following student workload: direct teaching and individual consultations (2 credits), self-study (1 credit), rating (1 credit). The minimum threshold for completing the course is to obtain at least 51% of the total score, using the following rating scale: A (91-100%), B (81-90%), C (71-80%), D (61- 70%), E (51-60%), F (0-50%).

Learning outcomes:
Extension of basic knowledge of nuclear physics on a better theoretical basis:
Theory of scattering.
Properties of nucleus. Nuclear masses, binding energy. Nuclear radius, density distribution of nuclear matter.
Nuclear momentum and parity. Spin and magnetic momentum of nuclei. Quadrupole electric momentum.
Theory of deuteron. Nuclear spin and isospin.
Nuclear forces. Models of atomic nucleus.
Alpha, beta, gamma radioactive decay.

Brief outline of the course:
1. Introduction. Theoretical and experimental methods.
2. Sources of particles, accelerators and accumulation rings, colliding beams,
3. Particle scattering problem.
4. Properties of stable atomic nuclei: basic elements of atom, antiparticles.
5. Nuclear composition, isotopes, isobars, nuclides, mass and binding energy, spin and parity.
6. Nuclear moments and nucleus shape: dipole moment, magnetic moment, quadrupole moment,

7. Magnetic moments, measurement of nuclear moments.
8. Shape, dimensions and structure of atomic nuclei.
9. Models of atomic nuclei and nuclear forces: one-particle, droplet, layer and generalized model.
10. Properties of nuclear forces, meson and field theory of nuclear forces.
11. Decay of unstable nuclei, radioactivity and its laws.
12. Decays of α, β, γ and their applications.

Recommended literature:

Preston M.A. , Physics of the Nucleus, Addison-Wesley Publishing Company, 1962.
Bertulani C., Danielewicz P., Introduction to Nuclear Reactions, IoP, 2004.
Suhonen J., From Nucleons to Nucleus, Springer, 2007.

Course language:

slovak and english

Notes:

Course assessment

Total number of assessed students: 49

A	B	C	D	E	FX
63.27	14.29	10.2	8.16	4.08	0.0

Provides: doc. RNDr. Adela Kravčáková, PhD.

Date of last modification: 16.09.2021

Approved: prof. RNDr. Milan Žukovič, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚFV/PFJ1/13	**Course name:** Programming and Data Processing in Nuclear Physics I
Course type, scope and the method: **Course type:** Lecture / Practice **Recommended course-load (hours):** **Per week:** 2 / 2 **Per study period:** 28 / 28 **Course method:** present	
Number of ECTS credits: 5	
Recommended semester/trimester of the course: 1.	
Course level: II.	
Prerequisities:	
Conditions for course completion: semestral project, presentation, evaluation	
Learning outcomes: To teach the students python language and how to analyse data using the ROOT framework and help them to gain practical skills.	
Brief outline of the course: Introduction to Python. Implementation of own histogram object and display it via tcl library.Basic description of ROOT environment, work with the basic tools for data processing: histograms and graphs, their creation and fitting, data storing into the structure suitable for analysis in ROOT - trees, working with trees.	
Recommended literature: 1. https://www.python.org/ 2. https://docs.python.org/3/tutorial/ 3. https://root.cern.ch/	
Course language:	
Notes:	
Course assessment Total number of assessed students: 14	

A	B	C	D	E	FX
85.71	0.0	14.29	0.0	0.0	0.0

Provides: RNDr. Martin Vaľa, PhD.	
Date of last modification: 19.11.2021	
Approved: prof. RNDr. Milan Žukovič, PhD.	

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚFV/ PJF2/13	**Course name:** Programming and Data Processing in Nuclear Physics II

Course type, scope and the method:
Course type: Lecture / Practice
Recommended course-load (hours):
Per week: 2 / 2 **Per study period:** 28 / 28
Course method: present

Number of ECTS credits: 5

Recommended semester/trimester of the course: 2.

Course level: II.

Prerequisities:

Conditions for course completion:
semestral project, presentation, evaluation

Learning outcomes:
To provide practical cookbook of the object oriented programming in C++

Brief outline of the course:
Introduction to C++.
Create own project using cmake and configure it using ROOT libraries.
Basic description of ROOT environment, work with the basic tools for data processing: histograms and graphs, creation and fitting.
Data storing into the structure suitable for analysis in ROOT - trees, working with trees.

Recommended literature:
1. J.J. Barton, L.R. Nackman, Scientific and Engineering C++, Addison Wesley, 1994
2. B. Kernigham, D. Ritchie, ANSI C 3. Stephen Prata, Mistrovství v C++ (3. aktualizované vydání), Computer Press, 2007
4. http://www.cplusplus.com/doc/tutorial/
5. http://www-root.fnal.gov/root/CPlusPlus/index.html
6. B. Eckel: Thinking in C++, 2d ed,, 2000

Course language:

Notes:

Course assessment
Total number of assessed students: 14

A	B	C	D	E	FX
92.86	0.0	0.0	0.0	7.14	0.0

Provides: RNDr. Martin Vaľa, PhD.

Date of last modification: 18.11.2021

Approved: prof. RNDr. Milan Žukovič, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚFV/ KTP1a/03 | **Course name:** Quantum Field Theory I

Course type, scope and the method:
Course type: Lecture / Practice
Recommended course-load (hours):
Per week: 3 / 1 **Per study period:** 42 / 14
Course method: present

Number of ECTS credits: 6

Recommended semester/trimester of the course: 1.

Course level: II.

Prerequisities:

Conditions for course completion:

Learning outcomes:

Brief outline of the course:

Recommended literature:

Course language:

Notes:

Course assessment
Total number of assessed students: 74

A	B	C	D	E	FX
47.3	18.92	9.46	8.11	14.86	1.35

Provides: RNDr. Tomáš Lučivjanský, PhD.

Date of last modification: 16.11.2021

Approved: prof. RNDr. Milan Žukovič, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚFV/ KTP1b/03	**Course name:** Quantum Field Theory II
Course type, scope and the method: **Course type:** Lecture / Practice **Recommended course-load (hours):** **Per week:** 3 / 1 **Per study period:** 42 / 14 **Course method:** present	
Number of ECTS credits: 6	
Recommended semester/trimester of the course: 2.	
Course level: II.	
Prerequisities: ÚFV/KTP1a/03	
Conditions for course completion: Assignment processing; their presentation at exercises, joint analysis of the issue; an exam. Conditions for successful completion of the course - demonstration of knowledge of the issue at sufficient level, active participation in teaching through the presentation of assignment solutions. Course credit evaluation: direct teaching (3 credits), self-study (1credit), practical activities - assignments (1credit) and evaluation (1 credit). The minimum threshold for completing the course is to obtain at least 51% of the total score.	
Learning outcomes: To offer basic knowledges about modern trends and theoretical methods in description of microword and phenomena in physical systems with infinite degrees of freedom.	
Brief outline of the course: Interacting fields. The principle of symmetry and the form of interactions of quantum fields. Lagrange operator in QED. S – matrix. Wick theorems and Feynman diagrams. Perturbative calculation of S - matrix. S - matrix and cross section of the processes. Compton scattering of the proton on electron cross section calculation in QCD frame. Radiation corrections and the divergences of the Feynman graphs. Running coupling constant.	
Recommended literature: Bogoljubov N.N., Širkov D.V.: Vvedenie v teoriu kvantovannych polej, Moskva, 1957 (prvé vydanie); Moskva, Nauka 1984 (4. Vydanie) Itzykon C., Zuber J.B.: Quantum field theory,McGraw-Hill, New York, 1986; ruský preklad: Icikon K., Zjuber Z.B.: Kvantovaja teoria polja, Mir, Moskva, 1984. Ryder L.H.: Quantum field theory, Cambridge University Press, 1985; ruský preklad: Rajder L.: Kvantovaja teoria polja, Mir, Moskva, 1987.	
Course language: slovak and english	
Notes:	

Course assessment
Total number of assessed students: 63

A	B	C	D	E	FX
53.97	26.98	9.52	4.76	4.76	0.0

Provides: prof. RNDr. Michal Hnatič, DrSc., RNDr. Tomáš Lučivjanský, PhD.

Date of last modification: 15.12.2021

Approved: prof. RNDr. Milan Žukovič, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚFV/ RJF1/14	**Course name:** Relativistic Nuclear Physics
Course type, scope and the method: **Course type:** Lecture **Recommended course-load (hours):** **Per week:** 2 **Per study period:** 28 **Course method:** present	
Number of ECTS credits: 4	
Recommended semester/trimester of the course: 2.	
Course level: II.	
Prerequisities:	
Conditions for course completion: exam + elaboration of one of the key publications in relativistic heavy ions in a form of a paper draft Credit distributiuon: lectures: 28 hours - 1 credit home study: 25 hours - 1 credit paper draaft study: 25 hours - 1 credit preparation for the final exam: 25 hours - 1 credit	
Learning outcomes: Students will obtain basic information about physics of relativistic nuclear collisions and they will have a knowledge of experimental methods used for these collisions as well as experimental signatures of quark-gluon plasma which is created in these collisions. At the end of the course, the student should be able to understand a baseline in publications in corresponding physics area.	
Brief outline of the course: 1. week: relativistic kinematics for nuclear collisions, transverse momentum, rapidity and pseudorapidity, measurement results: transverse momentum spectrum and integrated yield 2. week: introduction to quark-gluon plasma physics, Bjorken collision evolution, nuclear matter phase diagram, quark-gluon plasma in early Universe and in neutron stars 3. week: experimental methods of studying the quark-gluon plasma: accelerators with heavy ions (AGS, SPS, RHIC and LHC) and experiments (NA57, STAR and ALICE), overview of experimental signatures of quark-gluon plasma 4. week: particle production in heavy ion collisions, production scaling with number of participants and with number of binary collisions, Glauber model, centrality and multiplicity, Lund model for particle production 5. week: strange particle production in heavy ion collisions and in proton-proton collisions, statistical model, production of deuterons and lighter nuclei 6. week: J/Psi production suppression, production of states with heavy quark as a function of environment temperature 7. week: high momentum transfer processes, jets, nuclear modification factor R_AA, jet quenching in central nucleus-nucleus collisions, dead cone effect	

8. week: angular two-particle correlations of particles with high transverse momentum, angular correlations with strange particles, I_AA variable
9. week: collective flow of partons and hadrons in nucleus-nucleus collision, spatial and momentum anisotropy of the collision system, elliptic and triangular flow
10. week: HBT correlations, femtoscopy of like and not like particle pairs, source size and interaction intensity
11. week: hadron resonances and possible changes of their properties in quark-gluon plasma environment, regeneration and rescattering in hadron phase
12. week: baryon production to meson prouction ratio as a signature of the quark-gluon plasma, production of direct photons and dileptons in quark-gluon plasma environment
13. week: indications of quark-gluon plasma production in small collisional systems, e.g. proton-proton or proton-lead collisions
14. week: summary of the experimental signatures of the quark-gluon plasma, outlook to the future - new accelerators and experiments

Recommended literature:
Chenk-Yin Wong: Introduction to High-Energy Heavy Ion Collisions, World Scientific, 1994.
Jerzy Bartke: Introduction to Relativistic Heavy Ion Physics, World Scientific, 2008
Sarkar, Sourav, Satz, Helmut, Sinha, Bikash (Eds.): The Physics of the Quark-Gluon Plasma, Lecture notes in Physics, Springer, 2010
Recent publications

Course language:

Notes:

Course assessment
Total number of assessed students: 28

A	B	C	D	E	FX
60.71	14.29	14.29	0.0	10.71	0.0

Provides: doc. RNDr. Marek Bombara, PhD.

Date of last modification: 28.09.2021

Approved: prof. RNDr. Milan Žukovič, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚTVŠ/ ÚTVŠ/CM/13	**Course name:** Seaside Aerobic Exercise
Course type, scope and the method: **Course type:** Practice **Recommended course-load (hours):** **Per week:** **Per study period:** 36s **Course method:** present	
Number of ECTS credits: 2	
Recommended semester/trimester of the course:	
Course level: I., II.	
Prerequisities:	
Conditions for course completion: Completion: passed Condition for successful course completion: - active participation in line with the study rule of procedure and course guidelines - effective performance of all tasks- aerobics, water exercise, yoga, Pilates and others	
Learning outcomes: Content standard: The student demonstrates relevant knowledge and skills in the field, which content is defined in the course syllabus and recommended literature. Performance standard: Upon completion of the course students are able to meet the performance standard and: - perform basic aerobics steps and basics of health exercises, - conduct verbal and non-verbal communication with clients during exercise, - organise and manage the process of physical recreation in leisure time	
Brief outline of the course: Brief outline of the course: 1. Basic aerobics – low impact aerobics, high impact aerobics, basic steps and cuing 2. Basics of aqua fitness 3. Basics of Pilates 4. Health exercises 5. Bodyweight exercises 6. Swimming 7. Relaxing yoga exercises 8. Power yoga 9. Yoga relaxation 10. Final assessment Students can engage in different sport activities offered by the sea resort – swimming, rafting, volleyball, football, table tennis, tennis and other water sports in particular.	
Recommended literature: 1. BUZKOVÁ, K. 2006. Fitness jóga. Praha: Grada. 167 s.	

2. ČECHOVSKÁ, I., MILEROVÁ, H., NOVOTNÁ, V. Aqua-fitness. Praha: Grada. 136 s.
3. EVANS, M ., HUDSON, J., TUCKER, P. 2001. Umění harmonie: meditace, jóga, tai-či, strečink. 192 s.
4. JARKOVSKÁ, H., JARKOVSKÁ, M. 2005. Posilováni s vlastním tělem 417 krát jinak. Praha: Grada. 209 s.
5. KOVAŘÍKOVÁ, K. 2017. Aerobik a fitness. Karolium, 130 s.

Course language:
Slovak language

Notes:

Course assessment
Total number of assessed students: 41

abs	n
12.2	87.8

Provides: Mgr. Agata Horbacz, PhD.

Date of last modification: 29.03.2022

Approved: prof. RNDr. Milan Žukovič, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚFV/ PFC1/03	**Course name:** Selected Topics from Elementary Particle Physics

Course type, scope and the method:
Course type: Lecture
Recommended course-load (hours):
Per week: 2 **Per study period:** 28
Course method: present

Number of ECTS credits: 4

Recommended semester/trimester of the course: 3.

Course level: II.

Prerequisities: ÚFV/FEC1/04

Conditions for course completion:
Active participation in lectures and seminars
2. Elaboration of a written report
3. Passing the oral exam
Detailed conditions are updated annually on the electronic notice board of the subject in AiS2 or within the repository for digital support materials (LMS UPJŠ, MS Teams UPJŠ, etc.)
The teacher excuses the justified absence of the student (incapacity for work, family reasons, etc.) for a maximum of two lectures during the semester without the need for substitute performance.
In the case of a longer-term justified absence (for example due to incapacity for work), the student will be assigned an alternative form of mastering the missed study matter.
Credit evaluation of the course takes into account the following student workload: direct teaching and individual consultations (2 credit), self-study (1 credits), rating (1 credits). The minimum threshold for completing the course is to obtain at least 51% of the total score, using the following rating scale: A (91-100%), B (81-90%), C (71-80%), D (61- 70%), E (51-60%), F (0-50%).

Learning outcomes:
Unified description of processes in nuclear and particle physics and selected experiments that lead to nuclear and nucleon substructures - to the quarks.

Brief outline of the course:
1. Basic building blocks of matter, interactions, symmetries and conservation laws, experiments and units.
2. Scattering processes: elastic and inelastic scattering, Cross section, Fermis „Golden Rule", Feynman diagrams.
3. Geometric shapes of nuclei: Kinematics of electron scattering, The Rutherford cross section.
4. Mott cross section, Nuclear form factors.
5. Elastic scattering off nucleons: form factor of the nucleons.
6. Quasi-elastic scattering.
7. Deep-inelastic scattering: excited states of nucleons, structure functions, Callan-Gross relation, scale invariance.
8. Parton model, interpretation of structure functions in the Parton model.

9. Quarks, gluons and strong interaction: the quark structure of nucleons, quarks in hadrons, quark-gluon interaction, Scaling violation of the structure functions.
10. Particle production in electron - positron collisions: production of lepton pairs, resonances, non-resonant hadron production, gluon emission.
11. The Mesons: mesonic multiplets, meson masses, decay channels, neutral kaon decay.
12. The Baryons: Production and detection of baryons, baryon multiplets, masses, magnetic moments, decay channels.

Recommended literature:

Perkins D.H.: Introduction to high energy physics, Cambridge, 2000.
Martin B., Shaw G.: Particle Physics, Wiley, 2008.
Martin B.R.: Nuclear and Particle Physics, Wiley, 2006.
Povh, Rith, Scholz, Zetsche: Particles and Nuclei, An Introduction to the Physical Concepts, Berlin, 1993.
Ryder L.H.: Elementary particles and symmetries, Routledge, 1975.

Course language:
slovak and english

Notes:

Course assessment
Total number of assessed students: 19

A	B	C	D	E	FX
57.89	21.05	10.53	5.26	5.26	0.0

Provides: doc. RNDr. Adela Kravčáková, PhD.

Date of last modification: 16.09.2021

Approved: prof. RNDr. Milan Žukovič, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: KF/ FIVYC/22	**Course name:** Selected Topics in Philosophy of Education (General Introduction)
Course type, scope and the method: **Course type:** Lecture / Practice **Recommended course-load (hours):** **Per week:** 1 / 1 **Per study period:** 14 / 14 **Course method:** present	
Number of ECTS credits: 2	
Recommended semester/trimester of the course:	
Course level: II.	
Prerequisities:	
Conditions for course completion:	
Learning outcomes:	
Brief outline of the course:	
Recommended literature:	
Course language:	
Notes:	
Course assessment Total number of assessed students: 0	

A	B	C	D	E	FX
0.0	0.0	0.0	0.0	0.0	0.0

Provides: PhDr. Dušan Hruška, PhD.	
Date of last modification: 27.04.2022	
Approved: prof. RNDr. Milan Žukovič, PhD.	

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚFV/ SPJFa/14	**Course name:** Semestral project I

Course type, scope and the method:
Course type:
Recommended course-load (hours):
Per week: **Per study period:**
Course method: present

Number of ECTS credits: 2

Recommended semester/trimester of the course: 1.

Course level: II.

Prerequisities:

Conditions for course completion:
Successful solution of tasks given by the supervisor and presentation of the achieved results orally or in written form.

Learning outcomes:
Diploma thesis serves as a confirmation of theory and terminology understanding, application of standard scientific methods and the gained knowledge and skills level. It is a proof of independent work in the field.

Brief outline of the course:
The subject is usually realised via individual consultations of student with his/her supervisor. The contents of the consultations depends on the diploma thesis subject.

Recommended literature:
KATUŠČÁK, Dušan: Ako písať vysokoškolské a kvalifikačné práce : Ako písať seminárne a ročníkové práce, práce študentskej vedeckej a odbornej činnosti, diplomové, záverečné a atestačné práce a dizertácie. 2. doplnené vyd. Bratislava: Stimul, 1998.
ČMEJRKOVÁ, Světla - DANEŠ, František - SVĚTLÁ, Jindra: Jak napsat odborný text. Praha : Leda, 1999.
BARTOŠ, Josef: Metodika diplomové práce. Olomouc : FF Univerzity Palackého, 1991.
MEŠKO, Dušan - KATUŠČÁK, Dušan a kol.: Akademická príručka. Martin : Osveta, 2004.
ŠANDEROVÁ, Jadwiga: Jak číst a psát odborný text ve společenských vědách : Několik zásad pro začátečníky. Praha : Slon, 2005.

Course language:
slovak and english

Notes:

Course assessment
Total number of assessed students: 12

A	B	C	D	E	FX
91.67	0.0	0.0	0.0	8.33	0.0

Provides:
Date of last modification: 15.12.2021
Approved: prof. RNDr. Milan Žukovič, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚFV/SPJFb/14	**Course name:** Semestral project II

Course type, scope and the method:
Course type:
Recommended course-load (hours):
Per week: Per study period:
Course method: present

Number of ECTS credits: 6

Recommended semester/trimester of the course: 2.

Course level: II.

Prerequisities:

Conditions for course completion:
Successful solution of tasks given by the supervisor and presentation of the achieved results orally or in written form.

Learning outcomes:
Diploma thesis serves as a confirmation of theory and terminology understanding, application of standard scientific methods and the gained knowledge and skills level. It is a proof of independent work in the field.

Brief outline of the course:
The subject is usually realised via individual consultations of student with his/her supervisor. The contents of the consultations depends on the diploma thesis subject.

Recommended literature:
KATUŠČÁK, Dušan: Ako písať vysokoškolské a kvalifikačné práce : Ako písať seminárne a ročníkové práce, práce študentskej vedeckej a odbornej činnosti, diplomové, záverečné a atestačné práce a dizertácie. 2. doplnené vyd. Bratislava: Stimul, 1998. ČMEJRKOVÁ, Světla - DANEŠ, František - SVĚTLÁ, Jindra: Jak napsat odborný text. Praha : Leda, 1999. BARTOŠ, Josef: Metodika diplomové práce. Olomouc : FF Univerzity Palackého, 1991. MEŠKO, Dušan - KATUŠČÁK, Dušan a kol.: Akademická príručka. Martin : Osveta, 2004. ŠANDEROVÁ, Jadwiga: Jak číst a psát odborný text ve společenských vědách : Několik zásad pro začátečníky. Praha : Slon, 2005.

Course language:
slovak and english

Notes:

Course assessment
Total number of assessed students: 12

A	B	C	D	E	FX
83.33	0.0	8.33	0.0	8.33	0.0

Provides:

Date of last modification: 15.12.2021
Approved: prof. RNDr. Milan Žukovič, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚFV/ SPJFc/14	**Course name:** Semestral project III

Course type, scope and the method:
Course type:
Recommended course-load (hours):
Per week: Per study period:
Course method: present

Number of ECTS credits: 6

Recommended semester/trimester of the course: 3.

Course level: II.

Prerequisities:

Conditions for course completion:
Successful solution of tasks given by the supervisor and presentation of the achieved results orally or in written form.

Learning outcomes:
To learn the basic problems and methods of data processing and data analysis in the nuclear and subnuclear physics.

Brief outline of the course:
To solve selected problems from nuclear and subnuclear physics.

Recommended literature:
As recommended by the supervisor.

Course language:
slovak and english

Notes:

Course assessment
Total number of assessed students: 12

A	B	C	D	E	FX
66.67	16.67	8.33	0.0	8.33	0.0

Provides:

Date of last modification: 03.05.2015

Approved: prof. RNDr. Milan Žukovič, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚFV/ SEB1/04	**Course name:** Seminar from Nuclear Physics

Course type, scope and the method:
Course type: Practice
Recommended course-load (hours):
Per week: 1 **Per study period:** 14
Course method: present

Number of ECTS credits: 1

Recommended semester/trimester of the course: 1.

Course level: II.

Prerequisities:

Conditions for course completion:

Learning outcomes:
To bring the topical problems, methodics and tools of high energy physics to the students.

Brief outline of the course:
Department seminar - selected topical problems of the nuclear and subnuclear physics.

Recommended literature:

Course language:
Slovak and English

Notes:

Course assessment
Total number of assessed students: 18

A	B	C	D	E	FX
100.0	0.0	0.0	0.0	0.0	0.0

Provides: doc. RNDr. Janka Vrláková, PhD.

Date of last modification: 22.11.2021

Approved: prof. RNDr. Milan Žukovič, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚFV/SEC1/04	**Course name:** Seminar from Nuclear Physics

Course type, scope and the method:
Course type: Practice
Recommended course-load (hours):
Per week: 1 **Per study period:** 14
Course method: present

Number of ECTS credits: 1

Recommended semester/trimester of the course: 2.

Course level: II.

Prerequisities:

Conditions for course completion:
Active participation in seminars, presentation at a seminar. The credit evaluation of the course takes into account the following student workload: practical activity - preparation of the contribution and its presentation in English (1credit).

Learning outcomes:
To bring the topical problems, methodics and tools of high energy physics to the students.

Brief outline of the course:
Department seminar - selected topical problems of the nuclear and subnuclear physics.

Recommended literature:

Course language:
Slovak and English

Notes:

Course assessment
Total number of assessed students: 17

A	B	C	D	E	FX
100.0	0.0	0.0	0.0	0.0	0.0

Provides: doc. RNDr. Janka Vrláková, PhD.

Date of last modification: 22.11.2021

Approved: prof. RNDr. Milan Žukovič, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚFV/SED1/04	Course name: Seminar from Nuclear Physics

Course type, scope and the method:
Course type: Practice
Recommended course-load (hours):
Per week: 1 **Per study period:** 14
Course method: present

Number of ECTS credits: 1

Recommended semester/trimester of the course: 3.

Course level: II.

Prerequisities:

Conditions for course completion:

Learning outcomes:
To bring the topical problems, methodics and tools of high energy physics to the students.

Brief outline of the course:
Department seminar - selected topical problems of the nuclear and subnuclear physics.

Recommended literature:

Course language:
Slovak and English

Notes:

Course assessment
Total number of assessed students: 15

A	B	C	D	E	FX
86.67	6.67	6.67	0.0	0.0	0.0

Provides: doc. RNDr. Janka Vrláková, PhD.

Date of last modification: 22.11.2021

Approved: prof. RNDr. Milan Žukovič, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚFV/ SPJ1/99	**Course name:** Special Practice from Nuclear Physics

Course type, scope and the method:
Course type: Practice
Recommended course-load (hours):
Per week: 3 **Per study period:** 42
Course method: present

Number of ECTS credits: 3

Recommended semester/trimester of the course: 2.

Course level: II.

Prerequisities:

Conditions for course completion:
Written tests, measurements of experimental tasks, written reports of tasks.
Credit evaluation of the course: practical activities - measurements of experimental task, reports (2credits), evaluation (1credit), total 3credits. Minimum limit for completion of the course is to obtain at least 51% of the total evaluation.

Learning outcomes:
Practice in nuclear physics – quantitative and qualitative analysis, selected detector methods and tasks.

Brief outline of the course:
1. Introduction to practice.
2. MEDIPIX - study of alpha and beta particles.
3. MEDIPIX - visualization of particle tracks.
4. MEDIPIX - detection of cosmic ray muons.
5. MEDIPIX - radiography.
6. Identification of an unknown gamma emitter, determination of activity.
7. Identification of an unknown beta emitter.
8. Short-lived radioisiotopes.
9.-10. Atom structure, atomic spectra, Frank-Hertz experiment.
11. Study of gamma radiation.
12. Study of beta radiation.
13. Study of alpha spectra.

Recommended literature:
1. J.Vrláková, S.Vokál: Základné fyzikálne praktikum, skriptá PF UPJŠ, Košice, 2012, dostupné na : http://www.upjs.sk/public/media/5596/Zakladne-fyzikalne-praktikum-III.pdf
2. W.R.Leo: Techniques for Nuclear and Particles Physics Experiments, Springer-Verlag,1994
3. V.Vícha: Experimenty s pixelovým detektorem pro výuku jaderné a částicové fyziky, ČVUT, Praha, 2016

Course language:
slovak

Notes:

Course assessment
Total number of assessed students: 16

A	B	C	D	E	FX
87.5	12.5	0.0	0.0	0.0	0.0

Provides: doc. RNDr. Janka Vrláková, PhD.

Date of last modification: 22.11.2021

Approved: prof. RNDr. Milan Žukovič, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚFV/ TRS/03	**Course name:** Special Theory of Relativity

Course type, scope and the method:
Course type: Lecture
Recommended course-load (hours):
Per week: 2 **Per study period:** 28
Course method: present

Number of ECTS credits: 3

Recommended semester/trimester of the course: 1.

Course level: I., II.

Prerequisities: ÚFV/TEP1/03

Conditions for course completion:

Learning outcomes:

Brief outline of the course:

Recommended literature:

Course language:

Notes:

Course assessment
Total number of assessed students: 179

A	B	C	D	E	FX
51.4	21.79	13.97	7.82	5.03	0.0

Provides: RNDr. Tomáš Lučivjanský, PhD.

Date of last modification: 16.11.2021

Approved: prof. RNDr. Milan Žukovič, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚTVŠ/ TVa/11	**Course name:** Sports Activities I.
Course type, scope and the method: **Course type:** Practice **Recommended course-load (hours):** **Per week:** 2 **Per study period:** 28 **Course method:** present	
Number of ECTS credits: 2	
Recommended semester/trimester of the course: 1.	
Course level: I., II.	
Prerequisities:	
Conditions for course completion: Min. 80% of active participation in classes.	
Learning outcomes: Sports activities in all their forms prepare university students for their professional and personal life. They have a great impact on physical fitness and performance. Specialization in sports activities enables students to strengthen their relationship towards the selected sport in which they also improve.	
Brief outline of the course: Brief outline of the course: Within the optional subject, the Institute of Physical Education and Sports of Pavol Jozef Šafárik University provides for students the following sports activities: aerobics, aikido, basketball, badminton, body form, bouldering, floorball, yoga, power yoga, pilates, swimming, body-building, indoor football, S-M systems, step aerobics, table tennis, tennis, volleyball and chess. In the first two semesters of the first level of education students will master basic characteristics and particularities of individual sports, motor skills, game activities, they will improve level of their physical condition, coordination abilities, physical performance, and motor performance fitness. Last but not least, the important role of sports activities is to eliminate swimming illiteracy and by means of a special program of medical physical education to influence and mitigate unfitness. In addition to these sports, the Institute offers for those who are interested winter and summer physical education trainings with an attractive program and organises various competitions, either at the premises of the faculty or University or competitions with national or international participation.	
Recommended literature: BENCE,#M.#et al.#2005. Plávanie.#Banská#Bystrica:#FHV#UMB.#198s. ISBN 80-8083-140-8. [online] Dostupné na: https://www.ff.umb.sk/app/cmsFile.php?disposition=a&ID=571 BUZKOVÁ, K. 2006. Fitness jóga, harmonické cvičení těla I duše. Praha: Grada. ISBN 8024715252. JARKOVSKÁ, H, JARKOVSKÁ, M. 2005. Posilování s vlastním tělem 417 krát jinak. Praha: Grada. ISBN 9788024757308. KAČÁNI, L. 2002. Futbal:Tréning hrou. Bratislava: Peter Mačura – PEEM. 278s. ISBN 8089197027.	

KRESTA, J. 2009. Futsal.Praha: Grada Publishing, a.s. 112s. ISBN 9788024725345.
LAWRENCE, G. 2019. Power jóga nejen pro sportovce. Brno: CPress. ISBN 9788026427902.
SNER, Wolfgang. 2004. Posilování ve fitness. České Budějovice: Kopp. ISBN 8072322141.
STACKEOVÁ, D. 2014. Fitness programy z pohledu kinantropologie. Praha: Galén. ISBN 9788074921155.
VOMÁČKO, S. BOŠTÍKOVÁ, S. 2003. Lezení na umělých stěnách. Praha: Grada. 129s. ISBN 8024721743.

Course language:
Slovak language

Notes:

Course assessment
Total number of assessed students: 14040

abs	abs-A	abs-B	abs-C	abs-D	abs-E	n	neabs
86.76	0.07	0.0	0.0	0.0	0.05	8.16	4.96

Provides: Mgr. Patrik Berta, Mgr. Agata Horbacz, PhD., Mgr. Dávid Kaško, PhD., Mgr. Ladislav Kručanica, PhD., Mgr. Richard Melichar, Mgr. Petra Tomková, PhD., Mgr. Marcel Čurgali, Mgr. Alena Buková, PhD.

Date of last modification: 29.03.2022

Approved: prof. RNDr. Milan Žukovič, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚTVŠ/ TVb/11	**Course name:** Sports Activities II.
Course type, scope and the method: **Course type:** Practice **Recommended course-load (hours):** **Per week:** 2 **Per study period:** 28 **Course method:** present	
Number of ECTS credits: 2	
Recommended semester/trimester of the course: 2.	
Course level: I., II.	
Prerequisities:	
Conditions for course completion: active participation in classes - min. 80%.	
Learning outcomes: Sports activities in all their forms prepare university students for their professional and personal life. They have a great impact on physical fitness and performance. Specialization in sports activities enables students to strengthen their relationship towards the selected sport in which they also improve.	
Brief outline of the course: Within the optional subject, the Institute of Physical Education and Sports of Pavol Jozef Šafárik University provides for students the following sports activities: aerobics, aikido, basketball, badminton, body form, bouldering, floorball, yoga, power yoga, pilates, swimming, body-building, indoor football, S-M systems, step aerobics, table tennis, tennis, volleyball and chess. In the first two semesters of the first level of education students will master basic characteristics and particularities of individual sports, motor skills, game activities, they will improve level of their physical condition, coordination abilities, physical performance, and motor performance fitness. Last but not least, the important role of sports activities is to eliminate swimming illiteracy and by means of a special program of medical physical education to influence and mitigate unfitness. In addition to these sports, the Institute offers for those who are interested winter and summer physical education trainings with an attractive program and organises various competitions, either at the premises of the faculty or University or competitions with national or international participation.	
Recommended literature: BENCE,#M.#et al.#2005. Plávanie.#Banská#Bystrica:#FHV#UMB.#198s. ISBN 80-8083-140-8. [online] Dostupné na: https://www.ff.umb.sk/app/cmsFile.php?disposition=a&ID=571 BUZKOVÁ, K. 2006. Fitness jóga, harmonické cvičení těla I duše. Praha: Grada. ISBN 8024715252. JARKOVSKÁ, H, JARKOVSKÁ, M. 2005. Posilování s vlastním tělem 417 krát jinak. Praha: Grada. ISBN 9788024757308. KAČÁNI, L. 2002. Futbal:Tréning hrou. Bratislava: Peter Mačura – PEEM. 278s. ISBN 8089197027. KRESTA, J. 2009. Futsal.Praha: Grada Publishing, a.s. 112s. ISBN 9788024725345.	

LAWRENCE, G. 2019. Power jóga nejen pro sportovce. Brno: CPress. ISBN 9788026427902.
SNER, Wolfgang. 2004. Posilování ve fitness. České Budějovice: Kopp. ISBN 8072322141.
STACKEOVÁ, D. 2014. Fitness programy z pohledu kinantropologie. Praha: Galén. ISBN 9788074921155.
VOMÁČKO, S. BOŠTÍKOVÁ, S. 2003. Lezení na umělých stěnách. Praha: Grada. 129s. ISBN 8024721743.

Course language:
Slovak language

Notes:

Course assessment
Total number of assessed students: 12731

abs	abs-A	abs-B	abs-C	abs-D	abs-E	n	neabs
84.8	0.53	0.02	0.0	0.0	0.05	10.45	4.15

Provides: Mgr. Agata Horbacz, PhD., Mgr. Dávid Kaško, PhD., Mgr. Marcel Čurgali, Mgr. Patrik Berta, Mgr. Ladislav Kručanica, PhD., Mgr. Richard Melichar, Mgr. Petra Tomková, PhD., Mgr. Alena Buková, PhD.

Date of last modification: 29.03.2022

Approved: prof. RNDr. Milan Žukovič, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice
Faculty: Faculty of Science
Course ID: ÚTVŠ/TVc/11 — **Course name:** Sports Activities III.
Course type, scope and the method: **Course type:** Practice **Recommended course-load (hours):** **Per week:** 2 **Per study period:** 28 **Course method:** present
Number of ECTS credits: 2
Recommended semester/trimester of the course: 3.
Course level: I., II.
Prerequisities:
Conditions for course completion: min. 80% of active participation in classes
Learning outcomes: Sports activities in all their forms prepare university students for their professional and personal life. They have a great impact on physical fitness and performance. Specialization in sports activities enables students to strengthen their relationship towards the selected sport in which they also improve.
Brief outline of the course: Within the optional subject, the Institute of Physical Education and Sports of Pavol Jozef Šafárik University provides for students the following sports activities: aerobics, aikido, basketball, badminton, body form, bouldering, floorball, yoga, power yoga, pilates, swimming, body-building, indoor football, S-M systems, step aerobics, table tennis, tennis, volleyball and chess. In the first two semesters of the first level of education students will master basic characteristics and particularities of individual sports, motor skills, game activities, they will improve level of their physical condition, coordination abilities, physical performance, and motor performance fitness. Last but not least, the important role of sports activities is to eliminate swimming illiteracy and by means of a special program of medical physical education to influence and mitigate unfitness. In addition to these sports, the Institute offers for those who are interested winter and summer physical education trainings with an attractive program and organises various competitions, either at the premises of the faculty or University or competitions with national or international participation.
Recommended literature: BENCE,#M.#et al.#2005. Plávanie.#Banská#Bystrica:#FHV#UMB.#198s. ISBN 80-8083-140-8. [online] Dostupné na: https://www.ff.umb.sk/app/cmsFile.php?disposition=a&ID=571 BUZKOVÁ, K. 2006. Fitness jóga, harmonické cvičení těla I duše. Praha: Grada. ISBN 8024715252. JARKOVSKÁ, H, JARKOVSKÁ, M. 2005. Posilování s vlastním tělem 417 krát jinak. Praha: Grada. ISBN 9788024757308. KAČÁNI, L. 2002. Futbal:Tréning hrou. Bratislava: Peter Mačura – PEEM. 278s. ISBN 8089197027. KRESTA, J. 2009. Futsal.Praha: Grada Publishing, a.s. 112s. ISBN 9788024725345.

LAWRENCE, G. 2019. Power jóga nejen pro sportovce. Brno: CPress. ISBN 9788026427902.
SNER, Wolfgang. 2004. Posilování ve fitness. České Budějovice: Kopp. ISBN 8072322141.
STACKEOVÁ, D. 2014. Fitness programy z pohledu kinantropologie. Praha: Galén. ISBN 9788074921155.
VOMÁČKO, S. BOŠTÍKOVÁ, S. 2003. Lezení na umělých stěnách. Praha: Grada. 129s. ISBN 8024721743.

Course language:
Slovak language

Notes:

Course assessment
Total number of assessed students: 8722

abs	abs-A	abs-B	abs-C	abs-D	abs-E	n	neabs
88.79	0.07	0.01	0.0	0.0	0.02	4.05	7.06

Provides: Mgr. Marcel Čurgali, Mgr. Agata Horbacz, PhD., Mgr. Dávid Kaško, PhD., Mgr. Patrik Berta, Mgr. Ladislav Kručanica, PhD., Mgr. Richard Melichar, Mgr. Petra Tomková, PhD., Mgr. Alena Buková, PhD.

Date of last modification: 29.03.2022

Approved: prof. RNDr. Milan Žukovič, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚTVŠ/TVd/11	**Course name:** Sports Activities IV.
Course type, scope and the method: **Course type:** Practice **Recommended course-load (hours):** **Per week:** 2 **Per study period:** 28 **Course method:** present	
Number of ECTS credits: 2	
Recommended semester/trimester of the course: 4.	
Course level: I., II.	
Prerequisities:	
Conditions for course completion: min. 80% of active participation in classes	
Learning outcomes: Sports activities in all their forms prepare university students for their professional and personal life. They have a great impact on physical fitness and performance. Specialization in sports activities enables students to strengthen their relationship towards the selected sport in which they also improve.	
Brief outline of the course: Within the optional subject, the Institute of Physical Education and Sports of Pavol Jozef Šafárik University provides for students the following sports activities: aerobics, aikido, basketball, badminton, body form, bouldering, floorball, yoga, power yoga, pilates, swimming, body-building, indoor football, S-M systems, step aerobics, table tennis, tennis, volleyball and chess. In the first two semesters of the first level of education students will master basic characteristics and particularities of individual sports, motor skills, game activities, they will improve level of their physical condition, coordination abilities, physical performance, and motor performance fitness. Last but not least, the important role of sports activities is to eliminate swimming illiteracy and by means of a special program of medical physical education to influence and mitigate unfitness. In addition to these sports, the Institute offers for those who are interested winter and summer physical education trainings with an attractive program and organises various competitions, either at the premises of the faculty or University or competitions with national or international participation.	
Recommended literature: BENCE,#M.#et al.#2005. Plávanie.#Banská#Bystrica:#FHV#UMB.#198s. ISBN 80-8083-140-8. [online] Dostupné na: https://www.ff.umb.sk/app/cmsFile.php?disposition=a&ID=571 BUZKOVÁ, K. 2006. Fitness jóga, harmonické cvičení těla I duše. Praha: Grada. ISBN 8024715252. JARKOVSKÁ, H, JARKOVSKÁ, M. 2005. Posilování s vlastním tělem 417 krát jinak. Praha: Grada. ISBN 9788024757308. KAČÁNI, L. 2002. Futbal:Tréning hrou. Bratislava: Peter Mačura – PEEM. 278s. ISBN 8089197027. KRESTA, J. 2009. Futsal.Praha: Grada Publishing, a.s. 112s. ISBN 9788024725345.	

LAWRENCE, G. 2019. Power jóga nejen pro sportovce. Brno: CPress. ISBN 9788026427902.
SNER, Wolfgang. 2004. Posilování ve fitness. České Budějovice: Kopp. ISBN 8072322141.
STACKEOVÁ, D. 2014. Fitness programy z pohledu kinantropologie. Praha: Galén. ISBN 9788074921155.
VOMÁČKO, S. BOŠTÍKOVÁ, S. 2003. Lezení na umělých stěnách. Praha: Grada. 129s. ISBN 8024721743.

Course language:
Slovak language

Notes:

Course assessment
Total number of assessed students: 5505

abs	abs-A	abs-B	abs-C	abs-D	abs-E	n	neabs
82.8	0.29	0.04	0.0	0.0	0.0	7.92	8.96

Provides: Mgr. Marcel Čurgali, Mgr. Agata Horbacz, PhD., Mgr. Dávid Kaško, PhD., Mgr. Patrik Berta, Mgr. Ladislav Kručanica, PhD., Mgr. Richard Melichar, Mgr. Petra Tomková, PhD., Mgr. Alena Buková, PhD.

Date of last modification: 29.03.2022

Approved: prof. RNDr. Milan Žukovič, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚFV/ SVKJ/99	**Course name:** Student Scientific Conference
Course type, scope and the method: **Course type:** **Recommended course-load (hours):** **Per week: Per study period:** **Course method:** present	
Number of ECTS credits: 4	
Recommended semester/trimester of the course: 2., 4.	
Course level: II.	
Prerequisities:	
Conditions for course completion: Contribution to Student Scientific Conference	
Learning outcomes:	
Brief outline of the course:	
Recommended literature:	
Course language:	
Notes:	
Course assessment Total number of assessed students: 0	
abs	n
0.0	0.0
Provides:	
Date of last modification: 01.12.2021	
Approved: prof. RNDr. Milan Žukovič, PhD.	

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚTVŠ/ LKSp/13	**Course name:** Summer Course-Rafting of TISA River
Course type, scope and the method: **Course type:** Practice **Recommended course-load (hours):** **Per week: Per study period:** 36s **Course method:** present	
Number of ECTS credits: 2	
Recommended semester/trimester of the course:	
Course level: I., II.	
Prerequisities:	
Conditions for course completion: Completion: passed Condition for successful course completion: - active participation in line with the study rule of procedure and course guidelines - effective performance of all tasks: carrying a canoe, entering and exiting a canoe, righting a canoe, paddling	
Learning outcomes: Content standard: The student demonstrates relevant knowledge and skills in the field, which content is defined in the course syllabus and recommended literature. Performance standard: Upon completion of the course students are able to meet the performance standard and: - implement the acquired knowledge in different situations and practice, - implement basic skills to manipulate a canoe on a waterway, - determine the right spot for camping, - prepare a suitable material and equipment for camping.	
Brief outline of the course: Brief outline of the course: 1. Assessment of difficulty of waterways 2. Safety rules for rafting 3. Setting up a crew 4. Practical skills training using an empty canoe 5. Canoe lifting and carrying 6. Putting the canoe in the water without a shore contact 7. Getting in the canoe 8. Exiting the canoe 9. Taking the canoe out of the water 10. Steering a) The pry stroke (on fast waterways) b) The draw stroke	

11. Capsizing
12. Commands

Recommended literature:

1. JUNGER, J. et al. Turistika a športy v prírode. Prešov: FHPV PU v Prešove. 2002. ISBN 8080680973.

Internetové zdroje:

1. STEJSKAL, T. Vodná turistika. Prešov: PU v Prešove. 1999.
Dostupné na: https://ulozto.sk/tamhle/UkyxQ2lYF8qh/name/Nahrane-7-5-2021-v-14-46-39#!ZGDjBGR2AQtkAzVkAzLkLJWuLwWxZ2ukBRLjnGqSomICMmOyZN==

Course language:
Slovak language

Notes:

Course assessment
Total number of assessed students: 183

abs	n
39.89	60.11

Provides: Mgr. Dávid Kaško, PhD.

Date of last modification: 29.03.2022

Approved: prof. RNDr. Milan Žukovič, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚFV/ CUVE/13	**Course name:** Ultra High Energy Particles

Course type, scope and the method:
Course type: Lecture
Recommended course-load (hours):
Per week: 2 **Per study period:** 28
Course method: present

Number of ECTS credits: 3

Recommended semester/trimester of the course: 1.

Course level: II.

Prerequisities:

Conditions for course completion:
1. Participation in course in accordance with the study regulations and instructions of the teacher.
2. Elaboration of a recherche work according to a selected article from the field of ultra high energy cosmic ray particle physics.
Final written or oral exam.
Conditions for course succesful completion:
1. Participation in course in accordance with the study regulations and according to the instructions of the teacher;
2. Mastering the conditions of the interim and final evaluation in the overall expression at the level of at least 80%.

Learning outcomes:
During the continuous and final evaluation, the student will demonstrate adequate understanding of the content of the subject. He will gain a basic overview of the properties of cosmic rays of ultra-high energies and showers of secondary cosmic rays in the Earth's atmosphere. Understand the principles of current and future experiments to observe ultra-high energy particles, specifically the JEM-EUSO experiment. Student will understand the basics of numerical solution of the motion of cosmic rays in the Galaxy and in interstellar space. They will learn the basics of working with software tools to simulate atmospheric showers.

Brief outline of the course:
1) MAin characteristics of cosmic rays of ultra high energies (UHECR). Discovery of UHECR particles, composition and energy spectrum.
2) Experimental basics, principles of UHECR particle registration
3) Extenxive Air Showers (EAS) - shower development, basic characteristics, EAS components, reconstruction, Monte-Carlo simulation of EAS cascades.
4) Overview of experiments - history, current experiments. History of UHECR particle measurements - experiments HiRes, AGASA. Current experiments to monitor UHECR - Pierre Auger Observatory, Telescope Array.
5) Measurement of UHECR from space, reasons / motivation. JEM-EUSO experiment (I) - observation principle, basic technical description, mission pathfinders.

6) JEM-EUSO experiment (II) - case selection - trigger, simulation, reconstruction, analysis, pattern recognition.
7) Acceleration mechanisms, acceleration of particles in the cosmos, Hillas plot
8) Propagation of UHECR through galaxy and intergalactic space. Galactic and intergalactic magnetic field, Fokker-Planck equation (FPE).
9) FPE solution, general form of diffusion tensor.
10) Greisen – Zatsepin – Kuzmin effect.
11) Possible sources of UHECR.
12) Software tools for simulation of atmospheric showers of secondary cosmic rays.

Recommended literature:

Cosmic rays at Earth, P.K.F. Grieder, Elsevier Science B.V. 2001
Extensive Air Showers, P.K.F. Grieder, Springer-Verlag Berlin Heidelberg 2010
The JEM-EUSO mission, New Journal of Physics, Volume 11, Issue 6, pp. 065009, 2009
Web: http://jemeuso.riken.jp
Ultra High Energy Cosmic Rays: origin and propagation, Todor Stanev, ICRC'07 Merida
Origin and Propagation of Extremely High Energy Cosmic Rays, P.Bhattacharjee, arXiv:astroph/9811011
Features of the Energy Spectrum of Cosmic Rays above 2.5×10^18 eV Using the Pierre Auger Observatory, Phys. Rev. Lett. 125, 121106 – Published 16 September 2020

Course language:

Notes:

Course assessment
Total number of assessed students: 7

A	B	C	D	E	FX
100.0	0.0	0.0	0.0	0.0	0.0

Provides: RNDr. Pavol Bobik, PhD., RNDr. Marián Putiš, PhD., RNDr. Blahoslav Pastirčák, CSc.

Date of last modification: 18.11.2021

Approved: prof. RNDr. Milan Žukovič, PhD.