CONTENT

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: KF/AFS/05	**Course name:** Ancient Philosophy and Present Times

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: II.

Prerequisities:

Conditions for course completion:
When implementing the subject in the classical - face-to-face - form of teaching:
40% - continuous assessment of student activity at seminars, partial seminar work - assignment.
60% - final test, or seminar paper in the range of 10 A4 standard pages (with compliance with the KF citation standard for seminar and qualification papers.
In the case of a transition to distance education, students will be assigned sub-tasks for studying philosophical texts and processing the task in written form, which must be submitted by the set deadline, will be assigned points (partial assessment) and at the end will prepare a seminar paper to the same extent as in the face-to-face form teaching.

Learning outcomes:

Brief outline of the course:
Point out the roots of Western civilization that go back to the Greeks. The ancient Greeks, as one of the 3 pillars of European culture, reveal the origins of democracy and critical thinking. Emphasizing the interconnectedness of ancient philosophy and EPISTEME will enable a better understanding of the issues of thought formation, the relationship between philosophy and science, and modern society, where the emergence of mathematical natural science in the 17th century is the pillar on which Europe and European humanity stand. The student will be able to understand the questions and problems of today if he discovers the foundations and contexts leading to serious questions of today's form of society, thinking, science and culture.

Recommended literature:

Course language:

Notes:

Course assessment
Total number of assessed students: 31

A	B	C	D	E	FX
80.65	6.45	6.45	0.0	6.45	0.0

Provides: doc. PhDr. Peter Nezník, CSc.

Date of last modification: 24.08.2022
Approved: prof. RNDr. Michal Jaščur, CSc.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚFV/ APR/17	**Course name:** Astronomical instrumetation
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: To successfully complete the course, the student must demonstrate a sufficient understanding of the physical principles of operation of astronomical instruments and light detectors. Must master the principles of photometry and spectroscopy. In addition to direct participation in teaching, the student's independent work is also required within the self-study of professional topics assigned by the teacher. In order to obtain an evaluation and thus also credits, the student must meet the requirements of a continuous written test (with a weight of 30% of the total evaluation) and pass a written final exam (with a weight of 70% of the total evaluation). Credit evaluation of the course takes into account the following student workload: direct teaching (2 credits), self-study (2 credits), individual consultations (1 credit), and exam (1 credit). Rating scale: A (90-100%), B (80-89%), C (70-79%), D (60-69%), E (50-59%), F (0-49%).	
Learning outcomes: After completing the lectures and exercises and on the basis of the final evaluation, the student will demonstrate adequate mastery of the content standard of the course, which is defined by a brief syllabus of the course and recommended literature. Mastering the content of the subject allows him to acquire knowledge about the construction of astronomical telescopes, light detectors, will master the principles of obtaining astronomical data by methods such as photometry and spectroscopy, and will be able to perform the basic reduction of this data. They will understand the physical principles of the operation of instruments and light detectors in various spectral regions.	
Brief outline of the course: The time schedule of the course content is updated in the electronic bulletin board of the course. 1. Principle of geometric optics, optical errors and their correction, 2. Types of telescopes and their construction 3. Telescope mounts 4. Radio telescopes, UV and X-telescopes, 5. Lght detectors - eye, photographic plate, photomultiplier 6. Light detectors - CCD, CMOS, EMCCD 7. Introduction to photometry - basic concepts, photometric filters 8. Principle of photometry - differential, all-sky, 9. Aperture and PSF psf photometry	

10. Photometry cabibration - transformation into a standard system
11. Introduction to spectroscopy - types of spectroscopes
12. Spectrum processing and calibration

Recommended literature:

1. Howell : 2000, Handbook of CCD Astronomy, Cambridge University Press.
2. Cheng, J.: 2009, The Principles of Astronomical Telescope Design, Springer-Verlag
3. Kitchin, C.R., 2013, Telescopes and Techniques, Springer, 3rd edition
4. Lena et al.: 1996, Observational Astrophysics, Springer-Verlag
5. Martinez a Klotz: 1998, A practical giude to CCD Astronomy, Cambridge University Press.
6. Romano: 2009, Geometric Optics: Theory and Design of Astronomical Optical Systems Using Mathematica 7. Schroeder: 1999, Astronomical Optics, Academic Press

Course language:
Slovak, English

Notes:

Course assessment
Total number of assessed students: 7

A	B	C	D	E	FX
57.14	0.0	42.86	0.0	0.0	0.0

Provides: doc. Mgr. Štefan Parimucha, PhD.

Date of last modification: 22.09.2021

Approved: prof. RNDr. Michal Jaščur, CSc.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚFV/ MSSAA/14	**Course name:** Astronomy and Astrophysics

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/PHD/17 and ÚFV/MPH1/13 and ÚFV/FSL1/13

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
81.82	0.0	9.09	0.0	9.09	0.0

Provides:

Date of last modification: 19.12.2021

Approved: prof. RNDr. Michal Jaščur, CSc.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚFV/ APMM/19	**Course name:** Atomistic Computer MOdeling of Materials

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., 4.

Course level: II.

Prerequisities:

Conditions for course completion:

Learning outcomes:

Brief outline of the course:
1. Many-body Schrödinger Equation. Born–Oppenheimer, independent electron approximation, and mean-field approximation. Hartree-Fock equations.
2. Introduction to Density Functional Theory.
3. Hohenberg-Kohn variational principle. Local density approximation.
4. Kohn-Sham equations. Self-consistent field calculations.
5. Pseudopotentional theory. Norm-conserving pseudopotentials. PAW method.
6. Equilibrium structures of materials. Adiabatic approximation. Atomic forces. Verlet's algorithm.
7. Calculation of elastic material properties.
8. Quantum molecular dynamics. Car-Parrinello algorithm.
9. Phonons calculations. Frozen phonon method. Density functional perturbation theory.
10. Calculation of optical properties and excitation spectra. Time-dependent density functional theory.
11. Wannier functions and maximally localized Wannier functions.
12. Density functional theory for magnetic materials.

Recommended literature:
Giustino, F. Materials Modelling using Density Functional Theory. Oxford University Press, 2014.
Kohanoff, J. Electronic Structure Calculations for Solids and Molecules. Cambridge University Press, 2006.
Martin, R. M. Electronic Structure, Basic Theory and Practical Methods. Cambridge University Press, 2004.
Bluegel, S. et al. Computing Solids. Lecture Notes of the 45th IFF Spring School, 2014.
Springborg, M. Methods of Electronic-Structure Calculations: From Molecules to Solids. Wiley, 2000.

Course language:

Notes:

Course assessment
Total number of assessed students: 12

A	B	C	D	E	FX
58.33	16.67	16.67	8.33	0.0	0.0

Provides: RNDr. Martin Gmitra, PhD.

Date of last modification: 29.11.2022

Approved: prof. RNDr. Michal Jaščur, CSc.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚFV/ NME/17	**Course name:** Celestial mechanics

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:
To successfully complete the course, the student must demonstrate sufficient knowledges of the mathematical apparatus necessary to calculate and run simple numerical simulations using available software packages. In addition to direct participation in teaching, the student's independent work is also required within the self-study of professional topics assigned by the teacher. Active participation in the exercises and passing the oral final exam is required to obtain the evaluation and thus also the credits. Credit evaluation of the course takes into account the following student workload: direct teaching (2 credits), self-study (3 credits), individual consultations (1 credit), and exam (1 credit), Rating scale: A (90-100%), B (80-89%), C (70-79%), D (60-69%), E (50-59%), F (0-49%) .

Learning outcomes:
After completing lectures and exercises and on the basis of the final evaluation, the student will prove
adequate mastery of the content standard of the subject, which is defined by a brief syllabus
subject and recommended literature. He will be able to solve the problem of 2 bodies, he will understand the mathematical apparatus necessary for calculations in celestial mechanics and he will be able to apply these in numerical simulations of the problem of n-bodies

Brief outline of the course:
The time schedule of the course content is updated in the electronic bulletin board of the course.
1.Equations of motion for "n" material bodies,
2. Restricted three-body problem, equations in the non-rotating frame, equations in the rotating coordinate frame,
3. Jacobi integral, surfaces and curves of zero velocity (Hill surfaces),
4. Lagrange libration points,
5. Tisserand criterion.
6. Numerical integration of orbits, perturbation function.
7. Practical use of numerical integrators. Method of variation of constants,
8.Elements of orbit as a function of time
9. Langrange brackets,
10. Whittaker method of the detemination of Lagrange brackets,

11. Lagrange equations, Lagrange equations for canonical elements,
12. Gauss form of the Lagrange equations.

Recommended literature:

1. Andrle P., 1971, Základy nebeské mechaniky. Academia, Praha
2. Brouwer D., Clemence G. M., 1961, Methods of Celestial Mechanics, Academia Press, New York and London,
3. Roy A. E., 1978, Orbital Motion, Adam Hilger Ltd., Bristol
4. Everhart E., 1985, An efficient integrator that uses Gauss-Radau spacings, in: Dynamics of Comets: Their Origin and Evolution, eds. A. Carusi and G. B. Valsecchi, Reidel, Dordrecht, s, 185-202
5. Boccaletti D., Pucacco G., 2001, Theory of Orbits. 1. Integrable Systems and Non-perturbative Methods, Springer, Berlin - Heidelberg
6. Boccaletti D., Pucacco G., 2002, Theory of Orbits. 2. Perturbative and Geometrical Methods, Springer, Berlin - Heidelberg - New York,
7. Neslušan, L., 2017, 2017, Elementárny úvod do nebeskej mechaniky, VEDA, SAV, Bratislava

Course language:
slovak, english

Notes:

Course assessment
Total number of assessed students: 8

A	B	C	D	E	FX
50.0	0.0	12.5	0.0	37.5	0.0

Provides: Mgr. Marián Jakubík, PhD.

Date of last modification: 22.09.2021

Approved: prof. RNDr. Michal Jaščur, CSc.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: KF/KDF/05	**Course name:** Chapters from History of Philosophy of 19th and 20th Centuries (General Introduction)

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: 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: 10

A	B	C	D	E	FX
50.0	20.0	10.0	0.0	10.0	10.0

Provides: PhDr. Dušan Hruška, PhD.

Date of last modification: 03.05.2015

Approved: prof. RNDr. Michal Jaščur, CSc.

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. Michal Jaščur, CSc.

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: 56

A	B	C	D	E	FX
53.57	16.07	16.07	10.71	1.79	1.79

Provides: prof. RNDr. Milan Žukovič, PhD.

Date of last modification: 14.09.2021

Approved: prof. RNDr. Michal Jaščur, CSc.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚFV/ PAST/17	**Course name:** Computer astrophysics

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:
To successfully complete the course, the student must demonstrate a sufficient understanding of the various numerical methods used in astrophysics, the principles of machine learning, and the processing of large amounts of data. Must be able to work with astronomical software packages as well as the astropy library. In addition to direct participation in teaching, independent student work is also required within the self-study of special topics. To obtain the evaluation and thus the credits, the student must develop a software project on a topic assigned by the teacher and present it at the exercise (with a weight of 70% of the total evaluation) and pass a written final exam (with a weight of 30% of the total evaluation). The credit evaluation of the course takes into account the following student workload: direct teaching (1 credit), self-study (3 credits) and exam (1 credit).
Rating scale: A (90-100%), B (80-89%), C (70-79%), D (60-69%), E (50-59%), F (0-49%) .

Learning outcomes:
After completing lectures and exercises and on the basis of the final evaluation, the student will demonstrate adequate mastery of the content standard of the course, which is defined by a brief syllabus of the course and recommended literature. Mastering the content of the subject allows him to control various packages of astronomical software and work with a package of astropy. They will get acquainted with the concept of a virtual observatory for access to different data. They will be able to independently create software for processing and analysis of observations, and processing large amounts of data using machine learning.

Brief outline of the course:
The time schedule of the course content is updated in the electronic bulletin board of the course.
1. Sources of professional astronomical information on the Internet: VIZIER database, NASA ADS Abstract Service, arXiv, astronomical journals
2. Virtual observatory - concept and basic means of VO
3. Virtual observatory - use of VO in astronomy, VO and big data in astronomy
4. FITS file format for storing astronomical data
5. Working with MIDAS, IRAF and IDL packages
6. Basics of Python language
7. Astropy library, creating graphs, working with tables and figures,
8. Astropy Library - works with time data and coordinates

9. Working with FITS files in the astropy library
10. Introduction to machine learning
11 .ML in astrophysics - identification of galaxies
12. ML in astrophysics - detection of variable stars

Recommended literature:
1. Ghedini: 1982, Software for Photometric astronomy
2. Press et al., 1992, Numerical Recipes in C, The art of scientific Computing, CUP
3. Schmith, W.,, Völschow, M., 2021, Numerical Python in Astronomy and Astrophysics, Springer
4. manuals of software packages

Course language:
Slovak, English

Notes:

Course assessment
Total number of assessed students: 8

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

Provides: doc. Mgr. Štefan Parimucha, PhD.

Date of last modification: 22.09.2021

Approved: prof. RNDr. Michal Jaščur, CSc.

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. Michal Jaščur, CSc.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚFV/DPO/21 | **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: 20

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: 7

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

Provides:

Date of last modification: 22.02.2022

Approved: prof. RNDr. Michal Jaščur, CSc.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚFV/EKF/04 | **Course name:** Econophysics

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: 3.

Course level: II.

Prerequisities:

Conditions for course completion:
To successfully complete the course, the student must demonstrate a sufficient understanding of the ways of applying several statistical physics concepts in the field of economics and finance. 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. The credit evaluation 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 student to employ the aquired knowledge from physics in different disciplines such as economy, finantial analysis and sociology. Student will learn how statistical physics concepts such as stochastic dynamics, short- and long-range correlations, self-similarity and scaling permit an understanding of the global behavior of economic systems.

Brief outline of the course:
1. Introduction. Pareto and Bachelier approach.
2. The physical "philosophy" in the formulation of models of social and economic models.
3. The system of measurable quantities in economy, the logarithmic price, the uints of time and price in economy.
4. The stochastic models, random processess and distribution functions, stability of distributions, infinitely divisible process.
5. Scaling of distribution functions, Gauss and Lévy distribution, the simulation of random processes via computer.
6. Selected parallels between economy and fluid turbulence, market volatility and intermittence.
7. Correlations of markets, the markets in mutual correlations and anticorrelations.
8. Autocorrelations and analysis of time series.
9. Portfolio taxonomy and the strategy of the joining of enterprises and formation of corporations.
10. Computer modeling of GARCH and ARCH random processes with variable dispersion of volatility.

11. Models based on the stochastic diferential equations, Black-Scholes model of the rational option price.
12. Internet as a source of current economic information, M&P 500 indices, DJIA.

Recommended literature:
Basic literature:
MANTEGNA, R.N., STANLEY, H.E., An Introduction to Econophysics: Correlations and Complexity in Finance, Cambridge University Press 2000.
Other literature:
VOIT, J., The Statistical Mechanics of Financial Markets, Springer 2003.
SINHA, S. a kol., Econophysics: An Introduction, Wiley VCH 2011.

Course language:

Notes:

Course assessment
Total number of assessed students: 16

A	B	C	D	E	FX
75.0	18.75	6.25	0.0	0.0	0.0

Provides: prof. RNDr. Milan Žukovič, PhD.

Date of last modification: 14.09.2021

Approved: prof. RNDr. Michal Jaščur, CSc.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚFV/ESP1/13	**Course name:** Extrasolar Planets

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: 3.

Course level: II.

Prerequisities:

Conditions for course completion:
To successfully complete the course, the student must demonstrate a sufficient understanding of the methods of searching for exoplanets, their basic properties and their origin and evolution. In addition to direct participation in teaching, the student's independent work is also required within the self-study of professional topics assigned by the teacher. In order to obtain an evaluation and thus also credits, the student must meet the requirements of a continuous written test (with a weight of 40% of the total evaluation) and pass a written final exam (with a weight of 60% of the total evaluation). The credit evaluation of the course considers the following student workload: direct teaching (1 credit), self-study (1 credits) and exam (1 credit).
Rating scale: A (90-100%), B (80-89%), C (70-79%), D (60-69%), E (50-59%), F (0-49%) .

Learning outcomes:
After completing the lectures and on the basis of the final evaluation, the student will demonstrate adequate mastery of the content standard of the course, which is defined by a brief syllabus of the course and recommended literature. Mastering the content of the subject allows him to master the various methods of searching for exoplanets, to orientate in their properties and to understand the laws of their origin and development.

Brief outline of the course:
The time schedule of the course content is updated in the electronic bulletin board of the course.
1. History of solar system research and search for extrasolar planets
2. Overview of methods for searching for exoplanets and their limits
3. Radial velocity method - basic principles
4. Radial velocity method - surveys and instruments and their results
5. Transit method - basic principles
6. Transit method - surveys and results - satellite observations CoRoT, Kepler, TESS
7. Other methods - direct imaging, astrometry, microlensing, TTV
8. Basic properties of exoplanets and their determination using various observational methods
9. Origin and evolution of exoplanets - prostellar disks and planet formation
10. The origin of giant planets, their dynamics in systems
11. Earth-like planets - habitable zone
12. Statistical properties of exoplanets

Recommended literature:
1. Barnes, R.:2010, Formation and Evolution of Exoplanets, Wiley-VCH
2. Cassen et al:2006, Extrasolar planets, Springer
3. Haswell C. A.: 2010, Transiting exoplanets, Cambridge University Press
4. Lena et al.: 2011, Observational Astrophysics, Springer-Verlag
5. Mason, J.: 2008, Exoplanets: Detection, Formation, Properties, Habitability, Springer
6. Perryman, M.: 2011, The Exoplanet Handbook, Cambridge University Press

Course language:
Slovak, English

Notes:

Course assessment
Total number of assessed students: 16

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

Provides: doc. Mgr. Štefan Parimucha, PhD.

Date of last modification: 22.09.2021

Approved: prof. RNDr. Michal Jaščur, CSc.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚFV/ GEA1/13	**Course name:** Galactic and Extragalactic Astronomy
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: 5	
Recommended semester/trimester of the course: 2.	
Course level: II.	
Prerequisities: ÚFV/TAF1/13	

Conditions for course completion:

To successfully complete the course, the student must demonstrate a sufficient understanding of the structure of our Galaxy, its individual parts and their relationship, as well as the origin and evolution of different types of galaxies. In addition to direct participation in teaching, the student's independent work is also required within the self-study of professional topics assigned by the teacher. In order to obtain an evaluation and thus also credits, the student must meet the requirements of a continuous written test (with a weight of 40% of the total evaluation) and pass a written final exam (with a weight of 60% of the total evaluation). The credit evaluation of the course considers the following student workload: direct teaching (1 credit), self-study (2 credits), individual consultations (1 credit) and exam (1 credit). Rating scale: A (90-100%), B (80-89%), C (70-79%), D (60-69%), E (50-59%), F (0-49%) .

Learning outcomes:

After completing the lectures and on the basis of the final evaluation, the student will demonstrate adequate mastery of the content standard of the course, which is defined by a brief syllabus of the course and recommended literature. Mastering the content of the subject allows him to master the various methods of distance determination in the Universe, will be able to identify different types of galaxies, and gain sufficient knowledge about the structure of our Galaxy, the motion of stars, and its position in space.

Brief outline of the course:

The time schedule of the course content is updated in the electronic bulletin board of the course.

1. The Milky Way as a galaxy
2. Instruments of Galatic astronomy - GAIA satellite
3. Determination of he distances in space.
4. Stars motion in the Galaxy and around the Sun.
5. The motion of the Sun in space - Oort constants
6. Stellar statistics.
7. The structure of the Galaxy - the core
8. Subsystems, population and spiral structure of the Galaxy
9. Galaxies in space, their classification.
10. Local group of galaxies,

11. Clusters and superclusters of galaxies.
12. Evolution of galaxies and large-scale structure of the universe.

Recommended literature:

1. Bertin a Lin: 1996, Spiral Structure in Galaxies, The MIT Press.
2. Ciotti, L., 2021, Introduction to Stellar Dynamics, Cambridge university Press
3. Combes et al.: 2003, Galaxies and Cosmology, Springer, Berlin
4. Harwitt: 1998, Astrophysical Concepts, Springer, Berlin
5. Mihalas: 1968, Galactic Astronomy, Freeman Publishing
6. Schneider, P. 2016, Extragalactic Astronomy and Cosmology, Springer

Course language:
Slovak, English

Notes:

Course assessment
Total number of assessed students: 15

A	B	C	D	E	FX
80.0	13.33	6.67	0.0	0.0	0.0

Provides: doc. Mgr. Štefan Parimucha, PhD.

Date of last modification: 22.09.2021

Approved: prof. RNDr. Michal Jaščur, CSc.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚFV/TRV1/00 | **Course name:** General 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: 2.

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: 99

A	B	C	D	E	FX
84.85	6.06	8.08	0.0	1.01	0.0

Provides: RNDr. Tomáš Lučivjanský, PhD.

Date of last modification: 16.11.2021

Approved: prof. RNDr. Michal Jaščur, CSc.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: KF/ DF2p/03	**Course name:** History of Philosophy 2 (General Introduction)
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:	
Course level: I., II.	
Prerequisities:	
Conditions for course completion: The condition for awarding the evaluation will be the active approach of students to fulfilling their study obligations, independent work with selected philosophical texts in the library, active participation and creative work in seminars. In connection with the possibility of interrupting face-to-face teaching, there will be greater demands on the student's independent study and the processing of professional literature, which will be continuously evaluated, using e-mail to communicate with the teacher, at the end of the semester, preparing and handing in the semester's seminar work by the set date, or also passing a knowledge test - about which the students will be informed in advance in sufficient time.	
Learning outcomes: Deepening knowledge about the development of spiritual culture in the European spiritual space and pointing out the most important sources of this development: (1) ancient philosophy and science, (2) Christianity as the second pillar of Europe, (3) the Renaissance and the emergence of modern science (mathematical natural science) as the third pillar of European development. Development of critical thinking skills, active position in professional (ethics of science), public and private life (ethics of responsibility). Transcending narrowly specialized views of the world.	
Brief outline of the course:	
Recommended literature: Antológia z diel filozofov. Predsokratovci a Platon. Zost. J. Martinka. Bratislava: Nakladateľstvo Epocha 1970; Antológia z diel filozofov. Od Aristotela po Plotina. Zost. J. Martinka. Bratislava: Nakladateľstvo Pravda 1972. Predsokratovci a Platon. Antológia z diel filozofov. Zost. J. Martinka. Bratislava: Vydavateľstvo Iris 1998. Od Aristotela po Plotina. Antológia z diel filozofov. Zost. J. Martinka. Bratislava: Vydavateľstvo IRIS 2006. Anzenbacher,A.: Úvod do filozofie. Prel. K. Šprunk. Praha: SPN 1990. Barthes, R.: Mytologie. Prel. J. Fulka. Praha: Dokořán 2004. Bělohradský, V.: Společnost nevolnosti. Eseje z pozdější doby. Praha: SLON 2009. Benjamin, W.: Iluminácie. Prel. A. Bžoch; J. Truhlářová. Bratislava: Kalligram 1999. Borges, J. L.: Borges ústne. Prednášky a eseje. Prel. P. Šišmišová. Bratislava: Kalligram 2005. Cassirer, E.: Esej o človeku. Prel. J. Piaček. Bratislava: Nakladateľstvo Pravda 1977. Debord, G.: Společnost spektáklu. Prel. J. Fulka; P. Siostrzonek. Praha: Nakladatelství :intu: 2007. Farkašová, E.: Na rube plátna. Bratislava: Vydavateľstvo Spolku slovenských spisovateľov 2013.	

Feyerabend, P.: Věda jako umění. Prel. P. Kurka. Praha: JEŽEK 2004. Freud, S.: Nepokojenost v kultuře. Prel. L. Hošek. Praha: Hynek 1998. Hadot, P.: Co je antická filosofie. Prel. M. Křížová. Praha: Vyšehrad 2017. Hippokratés: Vybrané spisy. Prel. H. Bartoš; J. Černá; J. Daneš; S. Fischerová. Praha: OIKOYMENH 2012. Husserl, E.: Filosofie jako přísná věda. Prel. A. Novák. Praha: Togga 2013. Kuhn, T. S.: Štruktúra vedeckých revolúcií. Prel. J. Viceník. Bratislava: Nakladateľstvo Pravda 1981. Leško,V., Mihina, F. a kol.: Dejiny filozofie. Bratislava. Iris 1993 Leško, V.: Dejiny filozofie I. Od Tálesa po Galileiho. Prešov: v. n. 2004, 2007. Leško, V.: Dejiny filozofie II. Od Bacona po Nietzscheho. Prešov: v. n. 2008. McLuhan, M.: Jak rozumět médiím. Extenze člověka. Prel. M. Calda. Praha: Mladá fronta 2011. Patočka, J.: Duchovní člověk a intelektuál. In: Patočka, J.: Péče o duši III. Praha: OIKOYMENH 2002, s. 355 - 371. Popper, K. R.: Otevřená společnost a její nepřátelé I. Platónovo zaříkávání. Prel. M. Calda; J. Moural. Praha: OIKOYMENH 2011. Sloterdijk, P.: Kritika cynického rozumu. Prel. M. Szabó. Bratislava: Kalligram 2013. Störig,H .J.:Malé dějiny filozofie. Prel. P. Rezek. Praha: Zvon 1991. Wittgenstein, L.: Filozofické skúmania. Prel. F. Novosád. Bratislava: Nakladateľstvo Pravda 1979. Wright von, H. G.: Humanizmus ako životný postoj. Prel. M. Žitný. Kalligram 2001. Žižek, S.: Mor fantázií. Prel. M. Gálisová; V. Gális. Bratislava: Kalligram 1998.

Course language:

Notes:

Course assessment
Total number of assessed students: 746

A	B	C	D	E	FX
60.59	14.21	12.6	8.58	3.35	0.67

Provides: doc. PhDr. Peter Nezník, CSc.

Date of last modification: 11.07.2022

Approved: prof. RNDr. Michal Jaščur, CSc.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: KF/ IH2/03	**Course name:** Idea Humanitas 2 (General Introduction)
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: 100% graded credit: 40% (evaluated participation in seminars, processing of partial seminar work - separate assignment) 60% (final seminar work - student project). In the case of implementation of the classical form of teaching - face-to-face - active participation of the student in the seminar; study and reflection of assigned philosophical texts, attempt to interpret them. In the case of the introduction of distance education (as was the case due to Covid-19), the student will have to actively fulfill tasks of a partial nature, where increased demands will be placed on the student and his independent work with philosophical texts and literature. Tasks will be assigned to the students by the teacher on an ongoing basis. The student must study the assigned philosophical texts, think through and process them, submit them as a seminar paper, i.e. in written form. In both cases, the study of literature is necessary to pass the subject. The conclusion of the subject is the preparation of a seminar paper - the final seminar paper - in the range of at least 10 - 12 pages of A4 (with compliance with the bibliographic standard of the Department of Philosophy (KF) for seminar and qualification papers).	
Learning outcomes: To supplement and expand the interest of natural science students in social science issues related to the issues of the development of philosophy, science and human leadership, which are manifested in the urgent problems of today's world and society. Special emphasis is placed on the formation of humanistic ideas, their origin, transformation and possible pitfalls and risks. In addition to thinking about serious questions of the past and present, it also includes thinking about the present and the current contexts of major topics in philosophy and Western culture in particular. Therefore, the preparation and implementation of a program aimed at cooperation with alternative directions of pedagogy in the conditions of our transforming education system is understood as a practical output.	
Brief outline of the course: The age of the image of the world. Doubt as a principle of philosophy. The emergence of the image of the world (Weltbild); the differences of ancient theoria, medieval scientia, the emergence of mathematical natural science. Science as an operation (Betrieb); institutionalization of science. Philosophy, science and the modern world. The movement of human life: acceptance, defense, freedom as struggle, submission to finitude. The modern world and the search for meaning. Bureaucracy, impersonality, predominance of technocratic approaches. Fatigue as a modern threat	

to Europe. The paths to freedom lead through the rediscovery of one's own Self and creativity. The basic condition for the educability of any education is the care of the soul. The crisis of European humanity. Antiquity. Philosophy - the emergence of a special community of people, the beginnings of education - paideia. The winding road of leadership. The origin and birthplace of calculating thinking. Europe and the post-European era. Care of the soul as a basic idea of Patočka's philosophy. The difference in the position of Plato and Democritus in understanding the care of the soul. The idea of caring for the soul and Aristotle.

Recommended literature:

Hadot, P.: What is ancient philosophy. Transl. M. Křížová. Prague: Vyšehrad 2017. Hegel, G. W. F.: Phenomenology of Spirit. Prague: NČSAV 1960 Husserl, E.: The Crisis of European Humanity and Philosophy. In: Crisis of European sciences and transcendental phenomenology. Prague: Academie 1996. Mokrejš, A.: Eros as a Theme of Greek Thought. Prague: Triton 2009. Patočka, J.: Péče o duši I. Prague. OIKOYMENH 1996. Patočka, J.: Care of the soul II. Prague. OIKOYMENH 1999. Vernant, J.-P.: The beginnings of Greek thought. Prague: OIKOYMENH 1995. Wright von, G.H.: Humanism as a life attitude. Bratislava: Kalligram 2001.

Course language:

Notes:

Course assessment

Total number of assessed students: 12

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

Provides: doc. PhDr. Peter Nezník, CSc.

Date of last modification: 24.08.2022

Approved: prof. RNDr. Michal Jaščur, CSc.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚFV/ MPH1/13	**Course name:** Interpalnetary Matter

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

Number of ECTS credits: 6

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 process of origin, mutual interaction and development of various components of interplanetary matter. In addition to direct participation in teaching, the student's independent work is also required within the self-study of professional topics assigned by the teacher. In order to obtain an assessment and thus also credits, the student must meet the requirements of a continuous written test (with a weight of 50% of the total assessment)
and pass the oral final exam (weighing 50% of the total assessment). Credit evaluation of the course takes into account the following student workload: direct teaching (2 credits), self-study (2 credits), individual consultations (1 credit), and exam (1 credit) ,
Rating scale: A (90-100%), B (80-89%), C (70-79%), D (60-69%), E (50-59%), F (0-49%) .

Learning outcomes:
After completing the lectures and on the basis of the final evaluation, the student will prove adequate mastery of the content standard of the subject, which is defined by a brief syllabus subject and recommended literature. They will understand nature of individual components of interplanetary matter, their mutual interaction and development and physical and dynamic properties.

Brief outline of the course:
1. Discoveries and naming of asteroids
2. Astrometry and photometry of asteroids
3. Physical properties of asteroids - masses, rotation, dimensions
4. Composition of asteroids
5. Observational methods of meteoric astronomy
6. Time variations of observed frequencies of sporadic meteors
7. Radiants of meteor swarms
8. Meteorites
9. Origin and evolution of comets
10. Characteristics of the cometary spectrum, cometary emissions and their mother molecules 11. Chemical composition, structure, and physical properties of the cometary nucleus
12. Cometary tails and their dynamics

Recommended literature:
J.S. Lewis: Physics and Chemistry of the Solar System, London, Academic Press, 1997 (kapitoly VI, VII, VIII).
Michel, P., Demeo, F.E., Bottke, W.F.: Asteroids IV, Tucson, University of Arizona Press, 2015.
Brandt, J.C., Chapman, D.: Introduction to comets, Cambridge, Cambridge University Press, 2004.
Murad, E., Williams I.P.: Meteors in the Earth`s Atmosphere, Cambridge, Cambridge University Press, 2002.

Course language:
Slovak, English

Notes:

Course assessment
Total number of assessed students: 15

A	B	C	D	E	FX
66.67	13.33	20.0	0.0	0.0	0.0

Provides: doc. RNDr. Ján Svoreň, DrSc.

Date of last modification: 22.09.2021

Approved: prof. RNDr. Michal Jaščur, CSc.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚFV/ UEM/17	**Course name:** Introduction to Exactly Solvable Models in Statistical Mechanics

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: 4.

Course level: II.

Prerequisities:

Conditions for course completion:

To successfully complete the course, the student must demonstrate sufficient understanding of the basics terms, concepts and applications of statistical physics. Knowledge of basic concepts of statistical physics is required at the level of their mathematical definition as well as their physical content and concrete applications. During the semester, the student must continuously master the content of the curriculum in order to gain the acquired knowledge that he actively and creatively uses in solving specific tasks during the exercises and written test taken into account in the overall evaluation of the subject. The condition for obtaining credits is passing 1 continuous written test in exercises and an oral exam, which consists of one more complex computational task and theoretical questions. The credit evaluation of the course takes into account the following student workload: direct teaching (2 credits), self-study (1 credit), individual consultations (1 credit) and assessment (1 credit). Minimum threshold for passing the subject is to obtain at least 50% of the total score, while the following rating scale is used: A (90-100%), B (80-89%), C (70-79%), D (60-69%), E (50-59%), F (0-49%).

Learning outcomes:

After completing lectures and exercises, the student will have sufficient physical skills, knowledge and mathematical apparatus enabling the exact solution of a wide range traditional and current scientific problems in statistical physics. The student also gets an overview of applications of statistical physics in various fields of physics such as atomic and molecular physics, magnetism, condensed matter physics.

Brief outline of the course:

1. Exact solution of one-dimensional Ising models in zero and non-zero external magnetic field: combinatorial approach and transition-matrix method.
2. Spontaneous dimerization as a consequence of magneto-elastic interaction of one-dimensional Ising models, spin-Peierls instability.
3. Exact solution of one-dimensional Ising models with interactions between more distant spins, Dobson's method.
4. Rigorous solution of the Ising model on Bethe lattices using the method of exact recursive relations.

5. Exact solution of one-dimensional classical Heisenberg model in zero external magnetic field. Violation of the validity of the 3rd law of thermodynamics.
6. Exact solution of geometrically frustrated quantum Heisenberg models using lattice-gas models, theory of localized magnons.
7. Exact solution for a one-dimensional six-vertex model as an ice model. Non-zero residual entropy of ice.
8. Exact solution for a one-dimensional six-vertex model as a model of KDP ferroelectrics. The first-order phase transitions and latent heat.
9: Exact solution for a one-dimensional sixteen-vertex model. Absence of phase transitions in Takagi's model.
10. Exact solution for the one-dimensional eight-vertex model and Suzuki's hypothesis of weak universality. Continuously changing critical indices with a weak-universal critical behavior.
11. Eight-vertex model as the Ising model with two-spin and four-spin interactions.

Recommended literature:

1. R. J. Baxter, Exactly Solved Models in Statistical Mechanics (Academic, New York, 1982).
2. F. Y. Wu, Exactly Solvable Models: A Journey in Statistical Mechanics (World Scientific, Singapore, 2008).
3. J. Strečka, Exactly Solvable Models in Statistical Physics, supportive textbook, (ESF 2005/NP1-051 11230100466, Košice, 2008).

Course language:
1. Slovak; 2. English

Notes:

Course assessment
Total number of assessed students: 9

A	B	C	D	E	FX
22.22	66.67	0.0	0.0	0.0	11.11

Provides: doc. RNDr. Jozef Strečka, PhD.

Date of last modification: 19.09.2021

Approved: prof. RNDr. Michal Jaščur, CSc.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚINF/ UNS1/15	**Course name:** Introduction to neural networks
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: I., II., N	
Prerequisities:	
Conditions for course completion: The condition for passing the course is the realization of a project with the application of neural networks, successful completion of two written tests in the field of neural networks, their basic types, and genetic algorithms, as well as successful completion of the written and oral part of the exam.	
Learning outcomes: The result of the education is an understanding of the basic principles of neural networks and genetic algorithms. The student will gain the ability to apply the acquired knowledge in intelligent data analysis and also work with a selected tool for modeling neural networks.	
Brief outline of the course: 1. Basic concept arising from biology. Linear threshold units, polynomial threshold units, functions calculable by threshold units. 2. Perceptrons. Linear separable objects, adaptation process (learning), convergence of perceptron learning rule, higher order perceptrons. 3. Forward neural networks, hidden neurons, adaptation process (learning), backpropagation method. 4. Recurrent neural networks. Hopfield neural networks, properties, associative memory model, energy function, learning, optimization problems (business traveler problem). 5. Model of gradually created network. ART network, architecture, operations, initialization phase, recognition phase, search and adaptation phase. Use of the ART network. 6. Applications of studied models in solving practical problems. 7. Written test I. 8. Motivation to model genetic elements. Genetic algorithm. Application of genetic algorithms. 9. Genetic programming, root trees, Read's linear code. Basic stochastic optimization algorithms: blind algorithm and climbing algorithm. Forbidden search method. 10. Genetic and evolutionary programming with typing, examples of use. Grammatical evolution. 11. Special techniques of evolutionary computations. Selection mechanisms in evolutionary algorithms. 12. Use of genetic algorithms in training neural networks. Artificial life. 13. Written test II.	

Recommended literature:

1. AGGARWAL, Charu C. Neural networks and deep learning: a textbook. Cham: Springer, 2018. ISBN 978-3319944623.
2. KVASNIČKA, Vladimír. Úvod do teórie neurónových sietí. [Slovenská republika]: IRIS, 1997. ISBN 80-88778-30-1.
3. KVASNIČKA, Vladimír. Evolučné algoritmy. Bratislava: Vydavateľstvo STU, 2000. Edícia vysokoškolských učebníc. ISBN 80-227-1377-5.
4. MITCHEL, Melanie. An Introduction to Genetic Algorithms. Cambridge: MIT Press, 2002. ISBN 0-262-63185-7.
5. SINČÁK, Peter, ANDREJKOVÁ, G. Úvod do neurónových sietí, I. diel, Košice: ELFA, 1996. ISBN 808878638X

Course language:
Slovak or English

Notes:
Content prerequisites:
Basics of programming in Python, or another alternative programming language suitable for data analysis

Course assessment
Total number of assessed students: 472

A	B	C	D	E	FX
17.16	17.58	22.25	17.8	21.19	4.03

Provides: doc. RNDr. Ľubomír Antoni, PhD., RNDr. Šimon Horvát, PhD.

Date of last modification: 23.11.2021

Approved: prof. RNDr. Michal Jaščur, CSc.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚFV/ FNT1/03	**Course name:** Low Temperature Physics

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

Number of ECTS credits: 6

Recommended semester/trimester of the course: 1.

Course level: II.

Prerequisities:

Conditions for course completion:
To successfully complete the course, the student must demonstrate sufficient understanding of the basics concepts, applications and applications in low temperature physics with emphasis on experimental examples. Knowledge of basic concepts about superfluidity, superconductivity, electrical and thermal conductivity, heat capacity of matter at low temperatures is required.
The credit evaluation of the course takes into account the following student workload: direct teaching (2 credits), self-study (2 credits) and assessment (2 credits). During the semester, the student must continuously master the content of the curriculum and pass two written tests. The final evaluation consists of the averaged results of two tests, each with a minimum success rate of 50%, evaluation scale: A (90-100%), B (80-89%), C (70-79%), D (60-69%), E (50-59%), F (0-49%).

Learning outcomes:
The cours gives knowledge of methods and techniques used in low-temperature physics and information on basic physical properties of condensed matter at low temperatures.

Brief outline of the course:
1. The concept of temperature. Thermodynamic absolute temperature. International Practical Scale ITS - 90. Overview of the properties of cryogenic liquids. Phase diagram of 4He. Thermal properties of 4He. Transport properties of 4He.
2. Superfluidity of 4He - Two-component theory, Bose condensation, Landau's theory of He-II, criterion of superfluidity. Thermodynamic functions of He-II. Wave propagation in helium. Quantum vortices. Motion of charged particles in He.
3. Properties of 3He - phase diagram of 3He. Manifestation of Fermi-Dirac statistics on the properties of liquid 3He. Landau's theory of Fermi fluid. Zero sound in Fermi fluid. Superfluid phases of 3He and their properties. Topology of superfluid phases 3He. Description of 3He superfluidity using an order parameter.
4. Properties of liquid solutions of 3He-4He. Elementary excitations in 3He-4He solutions. Properties of solid 4He. Properties of solid 3He. Phase transition in solid 3He. Solid solutions of 3He-4He. Quantum crystals. Quantum diffusion. Kapitza resistance.
5. Basic properties of superconductors, penetration depth, coherence length. Classification of superconductors.

6. Phenomenological theory of superconductivity and basics of BCS theory. High temperature superconductivity.
7. Tunneling phenomena in superconductors. Quantum interference and SQUID.
8. Electrical conductivity of metals at low temperatures. Classical and quantum size effects. Mesoscopic objects (Quantum Hall effect, ballistic transport, properties of 2D electron gas).
9. Heat capacity at low temperatures. Lattice and electron specific heat. Schottky's contribution. Heat capacity of superconductors and semiconductors. Thermal conductivity of metals. Electron and phonon component and their separation. Thermal conductivity of semiconductors, insulators and superconductors.
10. Methods of measuring low and very low temperatures. Gas thermometer. Condensation thermometers. Resistance thermometers. Thermocouples. Paramagnetic thermometers. Nuclear orientation thermometer. NMR thermometry. Noise thermometer.
11. 4He cryostats, 3He refrigerator. 3He-4He refrigerator. Pomeranchuk refrigerator. Adiabatic demagnetization of paramagnetic salts. Cryocoolers - pulsed-tube refrigerator.
12. Nuclear demagnetization. Hyperfine nuclear cooling. Nuclear magnetism in metals. Nanokelvin and negative temperatures.

Recommended literature:

Skrbek L. a kol.: Fyzika nízkych teplôt, Matfyzpress, MFF KU Praha, 2011.
C. Enss, S. Hucklinger, Low-Temperature Physics, Springer, 2005.
Jánoš Š.: Fyzika nízkych teplôt, ALFA Bratislava, 1980.
A. Kent: Experimental low-temperature physics. Mac Millan Press Ltd., 1993.
D.S. Betts: An introduction to Milikelvin Technology. Cambridge University Press, 1989.
P.V.E. McClintok et al.: Low-Temperature Physics. Blackie, Galsgow and London 1992.
F. Pöbell: Matter an Methods at Low Temperatures. Springer - Verlag, Berlin, 1992.

Course language:
slovak

Notes:
Teaching is carried out in person or remotely using the MS Teams tool. The form of teaching is specified by the teacher, updated continuously.

Course assessment
Total number of assessed students: 70

A	B	C	D	E	FX
87.14	7.14	5.71	0.0	0.0	0.0

Provides: doc. RNDr. Erik Čižmár, PhD.

Date of last modification: 18.11.2021

Approved: prof. RNDr. Michal Jaščur, CSc.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚFV/ MKL/03	**Course name:** Magnetic Properties of Solids

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

Number of ECTS credits: 6

Recommended semester/trimester of the course: 2.

Course level: II., III.

Prerequisities:

Conditions for course completion:
To successfully complete the course (presence, if necessary distance) the student must demonstrate sufficient understanding of the concepts, phenomena and laws of magnetism of condensed matter, so that his knowledge of the physics of condensed matter is holistic. Knowledge of intrinsic magnetic properties of solids, types of energy, behavior of solids in a magnetic field and, in the case of ferromagnets and ferromagnets, also their domain structure is required. Knowledge of the basic use of magnetic materials in practice is also required.
Credit evaluation takes into account the scope of teaching (4 hours of lectures), evaluation (2 credits) and the fact that it is a profile subject that is part of the master's state exam. If the subject is included in the doctoral study of Progressive Materials, the fact that the subject is highly demanding for graduates of non-physical education is taken into account.
The minimum limit for successful completion of the course is to obtain 50 points in the oral exam from the subsequent point evaluation
Rating scale
A 100-91
B 90-81
C 80-71
D 70-61
E 60-50
Fx 49-0

Learning outcomes:
After completing the lectures and taking the exam, the student will have a deep knowledge of the magnetism of condensed matter and will have the ability to enter into a systematic theoretical and experimental solution of the problems of magnetism of condensed matter. He will also gain basic knowledge about the possibilities of using magnetic materials in technical practice.

Brief outline of the course:
1. week:
The classification of solids according to their magnetic properties. Classical diamagnetic, paramagnetic and ferromagnetic materials.
Magnetic quantities.

Magnetic moment. Orbital and spin momentum, orbital and spin magnetic moment.
2. week:
Atom with one electron and with more electrons. Hund's rules. Gyromagnetic experiments, resonance experiments.
The sources of magnetic fields (solenoid, toroid, Helmholtz coil, superconducting solenoid, electromagnet).
3. week:
The methods of measuring of the magnetic field. (Induction methods, fluxmeter method, magnetooptical effects, magnetoresistance, Hall effect, flux-gate method, SQUID method)
Diamagnetism. The classsical and Landau's diamagnetism. De Haas - van Alphen effect. Diamagnetism of superconductors.
4. week:
Paramagnetism.. The classical and quantum theory of paramagnetism. Pauli paramagnetism.
The methods of measuring the magnetic susceptibility of diamagnetics and paramagnetics. (Weiss method, torsion scales, Goy - Pascal scales).
5. week:
Ferromagnetism. Magnetization, Weiss theory of ferromagnetism. Exchange interactions. Curie temperature. Ferromagnetism of metals, alloys, rare earths and compounds.
6. week:
Thermal properties, thermal capacity, magnetocaloric effect and phase transitions.
Antiferromagnetism (structure, magnetization, susceptibility and Curie temperature).
7. week:
Ferrimagnetism (structure, spontaneous magnetization susceptibility to Curie and Neel temperature).
Study of spontaneous magnetic arrangement by neutron diffraction.
8. week:
Temperature dependence of spontaneous magnetic polarization, determination of Curie temperature (Extrapolation methods, line method of equal polarization, measurement of thermodynamic coefficients).
Energy of ferromagnets energy. (exchange, crystallographic magnetic anisotropy, magnetostriction, magnetoelastic, magnetostatic)
9. week:
Magnetic anisotropy.
Methods for measuring anisotropy constants (by measuring magnetization work, torsional anisometer).
Electrical resistance, Hall effect and magnetoresistance of ferromagnets.
10. week:
Domain structure of ferromagnets. Geometry and energy of domain walls. Primary and secondary domain structure.
Methods of domain structure monitoring (powder pattern method, magneto-optical phenomena, electron microscopy, X-ray method, ferromagnetic probe method).
11. week:
Magnetostriction, Villary effect.
Spontaneous magnetostriction. Magnetostriction of a monodomain particle, single crystals and polycrystalline substances.
Methods of measuring magnetostriction constants (strain gauge measurement, mechanical - optical, interference methods).
12. week:
Magnetization curves.

Demagnetizing effect of the sample. Magnetic circuit, yoke.
Basic ideas for the magnetization process. Elementary magnetization processes. Barkhausen phenomenon.
Methods for investigating the Barkhausen effect.
Mechanism of magnetic reversal, magnetic hysteresis, remanence and coercivity.
13. week:
Methods of recording the primary magnetization curve and the hysteresis loop (static and dynamic).
Premagnetization losses and methods of their measurement (wattmer, phase shift method, calorimetric, hysteresis loop area measurement).
Types of susceptibility of ferromagnetic substances (initial, maximum, reversible, irreversible, differential).
Measurement of susceptibility of ferromagnetic substances (Maxwell - Wien bridge, Owen bridge).

Recommended literature:

1. S. Chikazumi: Physics of Magnetism, J.Willey and Sons, Inc. New York, London, Sydney, 1997.
2. J. M. D. Coey: Magnetism and Magnetic Materials, Cambridge University Press, 2009
3. H. Kronmüller, S. Parkin - Handbook of Magnetism and Advanced Magnetic Materials, Wiley 2007
4. F. Fiorillo, Measurement and Characterization of Magnetic Materials, _Elsevier 2004
5. S. Tumanski, Handbook of Magnetic Measurements, CRC Press, 2011

Course language:
english

Notes:
Presence form represents a standart form for the course, if a need arises, the course is performed using MS Teams.

Course assessment
Total number of assessed students: 125

A	B	C	D	E	FX	N	P
38.4	14.4	9.6	2.4	2.4	4.0	2.4	26.4

Provides: prof. RNDr. Peter Kollár, DrSc.

Date of last modification: 22.11.2021

Approved: prof. RNDr. Michal Jaščur, CSc.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚMV/ MPA/19	**Course name:** Markov's processes and their applications

Course type, scope and the method:
Course type: Lecture / Practice
Recommended course-load (hours):
Per week: 3 / 2 **Per study period:** 42 / 28
Course method: present

Number of ECTS credits: 6

Recommended semester/trimester of the course: 1.

Course level: II.

Prerequisities:

Conditions for course completion:
Total evaluation based on 2 written tests (2x40p) + assignment (5p) and oral exam (40p).
At least 50% must be obtained from each part.
Final evaluation: ≥90% A; ≥80% B; ≥70% C; ≥60% D; ≥50% E; <50% FX.

Learning outcomes:
Student should:
1. Obtain the knowledge about modelling of real stochastic processes.
2. Apply theoretical knowledge in practical problems solving in queuing and renewal theory.
3. Obtain basic skills with CAS software SageMath based on Python.

Brief outline of the course:
1. Stochastic (random) processes (definition, characteristics, classification of processes).
2. Markov chains (Markov property, transition matrix, discrete-time Markov chains).
3. Classification of states of the process.
4. Evaluation of transitions, optimal strategies, Howard´s algorithm.
5. Special chains with continuous time (continuous-time Markov chains, intensity of transition, Kolmogorov´s differential equations, Poisson process).
6. Birth-and-death processes.
7. Applications in queuing theory (Kendall´s classification of queuing systems, efficiency indicators, opened systems without waiting).
8.-9. Opened systems with waiting, closed systems.
10. Applications in renewal theory and reliability. Markov chains in discrete renewal models.
11. Renewal process with continuous time.
12. Reliability of the system of elements.
13. Limit theorems of renewal theory.

Recommended literature:

1. Skřivánková V., Hančová M.: Náhodné procesy a ich aplikácie, UPJŠ, Košice, 2018 (in Slovak)
2. Beichelt F.: Applied Probability and Stochastic Processes, 2nd Ed., Chapman and Hall, 2016
3. Ross S. M.: Introduction to Probability Models, 12th ed., Elsevier, 2019
4. Janková, K. a kol. Markovove reťazce a ich aplikácie, epos, 2014 (in Slovak)

5. Prášková Z., Lachout P.: Základy náhodných procesu, MFF UK, Praha, 1998 (in Czech)

Course language:
Slovak

Notes:
The students are required to have basic knowledge about axiomatical theory of probability, distributions and characteristics of random variables.

Course assessment
Total number of assessed students: 80

A	B	C	D	E	FX
25.0	15.0	21.25	20.0	16.25	2.5

Provides: doc. RNDr. Martina Hančová, PhD., RNDr. Andrej Gajdoš, PhD.

Date of last modification: 13.09.2021

Approved: prof. RNDr. Michal Jaščur, CSc.

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: 26

A	B	C	D	E	FX
65.38	7.69	15.38	11.54	0.0	0.0

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

Date of last modification: 18.11.2021

Approved: prof. RNDr. Michal Jaščur, CSc.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚFV/ NOT1a/03	**Course name:** Nontraditional Optimization Techniques 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: I., II.

Prerequisities:

Conditions for course completion:
Oral examination (50%), results and quality of the
personal presentation of the projects (50%).
Monitoring progress in solving applied projects. From given set of problems, the student must pick 1 to 3 projects and develop functioning implementation of the solution in form of computer program. In case of more challenging problems, collaborative work of students is acceptable, but each student must be able to present her/his individual contribution.

Learning outcomes:
To familiarize students with biologically and physically inspired optimization, simulation and prediction techniques. To expand students' creativity and programming skills by applying heuristic techniques in solving applied problems.
Upon successful completion of course, student shall possess knowledge about most typical non-traditional optimization techniques, as well as practical experience of solving concrete problems.

Brief outline of the course:
1. Fundamentals terms and definitions of optimization theory. Physical laws as optimization tasks. Variational principle.
2. Model optimization problems. Basic types of objective functions. Classification of optimization methods. Computational scaling of optimization methods. Big O notation. Parallelization, Metcalf's law, Amdahl's bottleneck.
3. Exhaustive search, Gradient-based optimization techniques.
4. Evolutionary algorithms. Canonical Genetic algorithm. Genetic algorithms as Markov processes. Statistical Mechanics description of Genetic Algorithms.
5. Monte Carlo simulation and simulated annealing. Metropolis algorithm and statistics of sampling in solution space.
6. Swarm optimization. Ant algorithms.
7. Cellular Automata and their applications in simulations of complex systems.
8. data structures and representation of solution space and optimization problems. Compression of information and symmetry. Manifolds.
9. Generators. grammars and languages. Genetic programming. AST and operations on AST representation of programs.

10. Fractals. Lindenmayer systems. Life-like and agent-based models.
11. Evolutionary games. Evolution of cooperation.
12. Fundamentals of Neural Networks. Stochastic gradient optimization.

Recommended literature:

Hartmann, A. K., Rieger, H., Optimization Algorithms in Physics, Wiley, 2002
Reeves, C. R., Rowe, J. E., Genetic Algorithms: Principles and perspectives, Kluwer, 2003
Mitchell, M., Complexity. A Guided Tour, Oxford University Press, 2009
Solé, R. V., Phase Transitions, Princeton University Press, 2011
Ilachinski, A., Cellular Automata. A Discrete universe, World Scientific, 2002
Haykin, S., Neural Networks. A Comprehensive Foundation, Prentice-Hall, 1999
Actual literature and data related to problem sets

Course language:

English language is essential for students as "lingua franca" for the latest advancements and applications of optimization techniques.

Notes:

The subject is taught using direct contact form. Should the epidemiological situation (or other relevant circumstances) mandate, the distant form will be used, preferentially using MS Teams learning environment.

Course assessment

Total number of assessed students: 94

A	B	C	D	E	FX
68.09	19.15	7.45	2.13	3.19	0.0

Provides: doc. RNDr. Jozef Uličný, CSc.

Date of last modification: 22.11.2021

Approved: prof. RNDr. Michal Jaščur, CSc.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚFV/ NOT1b/03	**Course name:** Nontraditional Optimization Techniques 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: I., II.

Prerequisities:

Conditions for course completion:
Presentation of the project in written form. Oral exam and discussion of the presented project. Should corona-virus quarantine persist, written report and answer to posed questions suffice.

Learning outcomes:
By using examples from the biology to learn applications of optimization techniques on study and interpretation of complex systems. Introduction to new paradigms in the area of systems biology, including parasite/host coevolution.

Brief outline of the course:
Complex systems, emergent behavior. Evolutionary theory and memetics. Application of optimization techniques on complex systems. Application of methods /genetic algorithms, simulated annealing, taboo search/ on selected problems of biomolecular simulations. Molecular dynamics, protein folding. Population dynamics, metabolic networks and complexity in bioinformatics.

Recommended literature:
The actual scientific papers.

Course language:

Notes:

Course assessment
Total number of assessed students: 55

A	B	C	D	E	FX
87.27	5.45	5.45	1.82	0.0	0.0

Provides: doc. RNDr. Jozef Uličný, CSc.

Date of last modification: 08.09.2021

Approved: prof. RNDr. Michal Jaščur, CSc.

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: 135

A	B	C	D	E	FX
55.56	11.85	11.85	14.07	6.67	0.0

Provides: prof. RNDr. Milan Žukovič, PhD.

Date of last modification: 19.11.2021

Approved: prof. RNDr. Michal Jaščur, CSc.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚFV/ PSP/19	**Course name:** Practical Guide to Scientific Routine for Students

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., 4.

Course level: II.

Prerequisities:

Conditions for course completion:
During the continuous and final evaluation, the student should demonstrate adequate mastery of the course content standard. The basis of continuous assessment is active participation in teaching and demonstration of the ability to work independently. The condition for successful completion of the course is the elaboration of homework and final evaluation. The final evaluation consists of submitting a written project proposal for financing own virtual or real research according to the provided form and oral presentation of the research within a short 15 minutes talk. The final evaluation takes into account all required activities with relevant weight.
To obtain 2 ECTS credits the following should be fulfilled: participation in direct teaching, self-study and individual homework (1 ECTS credit) and submission of a semester project and final presentation (1 ECTS credit). Final rating scale: A 100% - 90%, B 89% - 75%, C 74% - 60%, D 59% - 40%, E 39% - 20%, FX 19% - 0.

Learning outcomes:
Selected topics of current interest in physics used as a source material for gaining practical experience in reading, writing and preparing a scientific visual and oral presentation utilized not only for further career growth in the academic environment. The student will learn how to work with online academic libraries, acquire the basics of writing in LaTeX, processing of scientific data and their graphical visualization. The aim of the exercises is to apply the acquired practical skills to improve the level of independence in reading and writing of scientific texts, research papers and skills in oral presentation. The choice of working material can be agreed according to individual needs. Students can work on their own project, diploma or dissertation thesis.

Brief outline of the course:
1. Work with academic citation databases (Web of Science, Scopus, Google Scholar). Personal Publication Manager (Zotero).
2. Research funding, grant schemes (at University, local and European), European Commission portal (https://ec.europa.eu). Curriculum Vitae - EUROPASS.
3. Basics of writing in LaTeX, collaborative cloud-based editor (www.overleaf.com). Formulation of goals and tasks of academic writing.
4. Guide to a scientific research proposal writing.
5. Processing of scientific data and their graphical representation (matplotlib, gnuplot).

6. Data visualization and 3D modeling (inkscape, Mayavi, Povray, Blender).
7. Guide to scientific poster preparation and presentation.
8. Research dissemination and social research networks (www.researchgate.net).
9. Scientific conferences. Guide to talk preparation. Communication soft skills and small talks.
10. High-performance computing, Supercomputing Centers, Portable Batch System for job scheduling. The PRACE mission (http://www.prace-ri.eu).

Recommended literature:

M. Aliotta, Mastering Academic Writing in the Sciences : A Step-by-Step Guide, CRC Press 2018.
B. Gastel, R. A. Day, How to Write and Publish a Scientific Paper, GreenWood 2016.
J. Schimel, Writing Science, Oxford University Press 2012.
B. Gustavii, How to Write and Illustrate Scientific Papers, Cambridge University Press 2008.
S. Bailey, Academic Writing: A Practical Guide for Students, Routledge 2004.
P. Dunleavy, Authoring a PhD Thesis: How to Plan, Draft, Write and Finish a Doctoral Dissertation, Palgrave Macmillan 2003.
R. S. Brause, Writing Your Doctoral Dissertation: Invisible Rules for Success, Routledge 1999.
Selected articles from high impact factor journals or other scientific peer-reviewed publications.

Course language:

Notes:

Course assessment

Total number of assessed students: 10

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

Provides: RNDr. Martin Gmitra, PhD.

Date of last modification: 14.02.2022

Approved: prof. RNDr. Michal Jaščur, CSc.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚFV/PRA/13	**Course name:** Practice in Astronomy

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: 1.

Course level: II.

Prerequisities: ÚFV/APR/17

Conditions for course completion:
To successfully complete the course, the student must demonstrate an understanding of basic astronomical observations, be able to work with online tools for preparing observations and programs to control telescopes. In order to obtain an evaluation and thus also credits, the student must prepare a semester work according to the assignment of the teacher and present the obtained results. The credit evaluation of the course takes into account the following student workload: direct teaching (1 credit), self-study (2 credits). The minimum limit for completing the course is to obtain at least 50% of the total score.

Learning outcomes:
After completing the practise, the student will be able to work with astronomical telescopes, will be able to work with programs to control instruments and telescopes and will be able to use online tools to prepare observations.

Brief outline of the course:
1. Working with telescopes
2. Software for controlling of telescopes and CCD cameras
3. Overview of online tools
4. Preparation of astronomical observations
5. Practical observation

Recommended literature:

1. Budding E., Demircan O.: Introduction to Astronomical Photometry (Second Edition). Cambridge University Press, New York, 2007
2. Howell S. B.: Handbook of CCD Astronomy (Second Edition). Cambridge University Press, New York, 2006
3. Roth G. D.: Handbook of Practical Astronomy, Springer-Verlag, Heidelberg, 2009
4. Warner B. D. : A Practical Guide to Lightcurve Photometry and Analysis, Springer, New York, 2006
5. URL: http://www.minorplanetcenter.net/
6. URL: http://ssd.jpl.nasa.gov/?horizons
7. niektoré vybrané kapitoly z Asteroids III a IV

Course language:
Slovak, English

Notes:

Course assessment
Total number of assessed students: 13

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

Provides: Mgr. Marek Husárik, PhD.

Date of last modification: 21.09.2021

Approved: prof. RNDr. Michal Jaščur, CSc.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚFV/ PRAF/13	**Course name:** Practice in Astrophysics
Course type, scope and the method: **Course type:** Practice **Recommended course-load (hours):** **Per week:** 4 **Per study period:** 56 **Course method:** present	
Number of ECTS credits: 4	
Recommended semester/trimester of the course: 2.	
Course level: II.	
Prerequisities: ÚFV/TAF1/13	
Conditions for course completion: To successfully complete the course, the student must demonstrate an understanding of the basics of spectroscopic observations, and be able to process and calibrate astronomical spectra. In order to obtain an evaluation and thus also credits, the student must prepare a semester esay according to the assignment of the teacher and present the obtained results. Credit evaluation of the course takes into account the following student workload: direct teaching (1 credit), self-study (2 credits), individual consultations (1 credit). The minimum limit for completing the course is to obtain at least 50% of the total score.	
Learning outcomes: After completing of the practice, the student will master the basics of spectroscopy, will be able to distinguish the manifestations of various physical processes in the spectrum of stars. he gains the skills necessary to process, reduce and calibrate spectra.	
Brief outline of the course: 1. Introduction to spectroscopy 2. Acquaintance with instrumentation 3. Acquisition of spectra, 4. Basic reduction 5. Spectrum calibration 6. Measurement of radial velocities and line intensities, 7. Determination of the chemical composition of the atmosphere of the Sun and stars 8. Determination of the radial velocity curve	
Recommended literature: 1. Appenzeller, I., Introduction to Astronomical Spectroscopy, Cambridge University Press, 2012 2. Gray, R,O., Corbally, C,J., Stellar Spectral Clasification, Princeton University Press, 2009 3. Kitchin, C.R., Optical Astronomical Spectroscopy, IoP Publishing, 1995 4. Kitchin, C.R., Telescopes and Techniques, Springer, 3rd edition, 2013	
Course language: Slovak, English	
Notes:	

Course assessment
Total number of assessed students: 13

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

Provides: doc. Mgr. Štefan Parimucha, PhD.

Date of last modification: 22.09.2021

Approved: prof. RNDr. Michal Jaščur, CSc.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: KPPaPZ/PPZMg/12	**Course name:** Psychology and Health Psychology (Master´s Study)

Course type, scope and the method:
Course type: Lecture / Practice
Recommended course-load (hours):
Per week: 1 / 2 **Per study period:** 14 / 28
Course method: present

Number of ECTS credits: 4

Recommended semester/trimester of the course:

Course level: II.

Prerequisities:

Conditions for course completion:
Conditions for the continuous assessment during the semester:
Active work (maximum 5 points, 2 absences are allowed).
Preparation, presentation and discussion on a selected topic - max. 15 points.
Written examination (maximum 30 points).
Conditions for admission to the exam: min. 25 points.
Conditions for the final assessment:
Exam: written form (max. 50 points, min. 25 points)
Conditions for successful completion of the course: participation in lessons, fulfillment of assignments and at least 66 points from the overall evaluation.
Detailed information in the electronic bulletin board of the course in AIS2. The teaching of the subject will be realized by a combined method.

Learning outcomes:
The student will understand the basic concepts and theories of health psychology, can explain salutogenic factors as well as the consequences of risk behavior related to health. He is able to apply the knowledge especially in the field of prevention of burnout syndrome and support of mental health in the work of a teacher.

Brief outline of the course:
1 Introduction to health psychology
2 Psychoimmunology
3 Personality factors and health
4 Social support as a protective factor in relation to health
5 Subjective well-being
6 Stress and stressful situations and ways to manage them
7 Burnout syndrome
8 Health-promoting behavior, mental hygiene
9 Health risk behavior
10 School as an important factor of health

Recommended literature:
Křivohlavý, J.: Psychologie zdraví. Portál, Praha 2001.

Křivohlavý, J.: Psychologie nemoci. Grada, Praha, 2002.
Křivohlavý, J.: Psychologie moudrosti a dobrého života. Grada, Praha, 2009.
Kebza, V.: Psychosociální determinanty zdraví. Academia, Praha 2005.
Kahneman, D., Diener, E., Schwarz, N.(Eds), Well-Being. The Foundations of Hedonic Psychology. New York, Russell Sage Foundation, 2003.
Kaplan, R. M.: Zdravie a správanie človeka. SPN, Bratislava 1996.
Sarafino, E. P.: Health Psychology. Biopsychosocial interactions. John Wiley and sons 1994.
Baštecký, J., Šavlík, J., Šimek, J. 1993. Psychosomatická medicína. Praha: Grada
Tress, W., Krusse, J., Ott,J.: Základní psychosomatická péče. Portál, Praha 2008.

Course language:
slovak

Notes:

Course assessment
Total number of assessed students: 226

A	B	C	D	E	FX
19.47	25.22	25.66	13.27	15.93	0.44

Provides: PhDr. Anna Janovská, PhD., Mgr. Lucia Barbierik, PhD.

Date of last modification: 07.07.2021

Approved: prof. RNDr. Michal Jaščur, CSc.

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: 75

A	B	C	D	E	FX
46.67	18.67	10.67	8.0	14.67	1.33

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

Date of last modification: 16.11.2021

Approved: prof. RNDr. Michal Jaščur, CSc.

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: 65

A	B	C	D	E	FX
52.31	29.23	9.23	4.62	4.62	0.0

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

Date of last modification: 15.12.2021

Approved: prof. RNDr. Michal Jaščur, CSc.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚFV/ KTM/14	**Course name:** Quantum Theory of Magnetism

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: 5

Recommended semester/trimester of the course: 3.

Course level: II., III.

Prerequisities:

Conditions for course completion:
To successfully complete the course, the student must demonstrate sufficient understanding of the basics terms, concepts, and applications of quantum theory of magnetism. Knowledge of basic concepts of quantum physics at the level of their mathematical definition is required, as well as understanding of their physical content and specific applications in the field of magnetism. During the semester, the student must continuously master the content of the curriculum, so that he can actively and creatively use the acquired knowledge in solving specific tasks assigned to independent solutions at home. The condition for obtaining credits is passing an oral exam, which consists of one more demanding computational task and theoretical questions covering the entire scope of the course. The credit evaluation of the course takes into account the following student workload: direct teaching (2 credits), self-study (1 credit), individual consultations (1 credit) and assessment (1 credit). 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:
After completing lectures, the student will have sufficient physical skills, knowledge and mathematical apparatus enabling independent solution of a wide range traditional and current scientific problems in quantum theory of magnetism. At the same time, he will gain an overview of the applications of quantum theory of magnetism for a description of insulating magnetic materials.

Brief outline of the course:
1. Introduction to quantum theory of magnetism, definition of basic lattice-statistical models in magnetism: Ising model, Heisenberg model, Hubbard model, t-J model.
2. Exchange interaction and its quantum-mechanical origin. Formalism of the second quantization and basic commutation relations between ladder spin operators.
3. Elementary quantum theory of a pair of interacting magnetic particles: Heisenberg dimer.
4. Elementary quantum theory of a pair of interacting magnetic particles: Hubbard dimer.
5. One-dimensional quantum Heisenberg model, spin waves as collective excitations of ferromagnetic spin chain, one-magnon spectrum.

6. One-dimensional quantum Heisenberg model with ferromagnetic interaction, two-magnon spectrum, free and bound spin waves, basics of Bethe-ansatz method.
7. Crystal of singlet dimers as a basic state of frustrated quantum Heisenberg models (Majumdar-Ghosh model and Gelfand ladder).
8. Fermionization of one-dimensional quantum XX model in transverse magnetic field: Jordan-Wigner and Fourier transform. Quantum critical point and thermodynamic behavior.
9. Fermionization of one-dimensional quantum Ising model in transverse magnetic field: Jordan-Wigner, Fourier and Bogoliubov transformation.
10. Variational description of quantum phase transitions in dimerized quantum Heisenberg spin models.
11. Theory of localized magnons as a tool for a simple description of the thermodynamic behavior of frustrated quantum Heisenberg models at nonzero temperatures.
12. Spin-wave theory for a generalized quantum Heisenberg model of arbitrary spatial dimension and spin size. Bosonization through the Holstein-Primakoff transformation.

Recommended literature:

1. J. B. Parkinson, D. J. J. Farnell, An Introduction to Quantum Spin Systems, Lecture Notes in Physics 816 (Springer, Berlin Heidelberg, 2010).
2. U. Schollwock, J. Richter, D. J. J. Farnell, R. F. Bishop, Quantum Magnetism, Lecture Notes in Physics 645 (Springer, Berlin Heidelberg, 2004).
3. N. Majlis, The Quantum Theory of Magnetism (World Scientific, Singapore, 2000).

Course language:

EN - english

Notes:

The subject is realized in presence form, in case of need in distance form in MS Teams enviroment.

Course assessment

Total number of assessed students: 29

A	B	C	D	E	FX	N	P
10.34	31.03	13.79	3.45	13.79	3.45	6.9	17.24

Provides: doc. RNDr. Jozef Strečka, PhD.

Date of last modification: 19.11.2021

Approved: prof. RNDr. Michal Jaščur, CSc.

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: 2 **Per study period:** 28
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: 54

abs	n
11.11	88.89

Provides: Mgr. Agata Dorota Horbacz, PhD.

Date of last modification: 29.03.2022

Approved: prof. RNDr. Michal Jaščur, CSc.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚFV/VTFTL/20	**Course name:** Selected Topics in Solid State Physics: Computational Physics Applications

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: 1., 3.

Course level: II.

Prerequisities: ÚFV/TKL1/99

Conditions for course completion:

Learning outcomes:

Brief outline of the course:

Recommended literature:

Course language:

Notes:

Course assessment
Total number of assessed students: 7

A	B	C	D	E	FX
57.14	14.29	14.29	14.29	0.0	0.0

Provides: RNDr. Martin Gmitra, PhD.

Date of last modification: 03.10.2021

Approved: prof. RNDr. Michal Jaščur, CSc.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚFV/ SPTFAa/14	**Course name:** Semestral Work 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: To successfully complete the course, the student must demonstrate mastery of the assigned tasks set by the project leader at the beginning of the semester to the required extent and level. Specific study and research assignments are formulated at the beginning of the semester by the project leader, who is usually the supervisor of the final thesis. Tasks include, for example, studying literature in a selected field of theoretical physics, astrophysics or astronomy, mastering the theoretical, computer and experimental methods and procedures needed to solve specific research problems, mastering the operation of experimental equipment, obtaining original scientific data and their processing, interpretation and eventual presentation within a joint seminar. Credit evaluation reflects the student's workload when working on a semester project in the range of 50 hours per semester. Individual activities of the student are evaluated by the project leader and the overall work of the student is evaluated on a scale of 0-100 points. The minimum limit for obtaining the evaluation is 50% of the evaluation scale, which is determined as follows: A 100-91% B 90-81% C 80-71% D 70-61% E 60-50% Fx 49-0% .	
Learning outcomes: By completing the course the student will master the experimental and theoretical methods necessary for the study of scientific research issues according to the assignment of the final thesis. The student will gain skills and experience with independent acquisition and processing of original scientific results necessary for the final thesis.	
Brief outline of the course: The program for the semester project is prepared for each student individually by the project leader at the beginning of each semester. The program can be focused on the study of literature for the field of research, preparation and implementation of experimental measurements, study of the necessary mathematical apparatus and methods of theoretical physics, creation of software for collection, processing, evaluation and interpretation of scientific data and presentation of results at the department seminar. The specific content of the project for each semester is determined by the project leader.	
Recommended literature: Scientific articles and other literary sources according to the assignment of the final master's thesis.	

Course language:
slovak, english

Notes:

Course assessment
Total number of assessed students: 36

A	B	C	D	E	FX
86.11	8.33	0.0	0.0	5.56	0.0

Provides:

Date of last modification: 26.12.2021

Approved: prof. RNDr. Michal Jaščur, CSc.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚFV/ SPTFAb/14	**Course name:** Semestral Work 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: 4

Recommended semester/trimester of the course: 2.

Course level: II.

Prerequisities:

Conditions for course completion:
To successfully complete the course, the student must demonstrate mastery of the assigned tasks set by the project leader at the beginning of the semester to the required extent and level. Specific study and research assignments are formulated at the beginning of the semester by the project leader, who is usually the supervisor of the final thesis. Tasks include, for example, studying literature in a selected field of theoretical physics, astrophysics or astronomy, mastering the theoretical, computer and experimental methods and procedures needed to solve specific research problems, mastering the operation of experimental equipment, obtaining original scientific data and their processing, interpretation and eventual presentation within a joint seminar. Credit evaluation reflects the student's workload when working on a semester project in the range of 100 hours per semester. Individual activities of the student are evaluated by the project leader and the overall work of the student is evaluated on a scale of 0-100 points. The minimum limit for obtaining the evaluation is 50% of the evaluation scale, which is determined as follows: A 100-91% B 90-81% C 80-71% D 70-61% E 60-50% Fx 49-0%.

Learning outcomes:
By completing the course the student will master the experimental and theoretical methods necessary for the study of scientific research issues according to the assignment of the final thesis. The student will gain skills and experience with independent acquisition and processing of original scientific results necessary for the final thesis.

Brief outline of the course:
The program for the semester project is prepared for each student individually by the project leader at the beginning of each semester. The program can be focused on the study of literature for the field of research, preparation and implementation of experimental measurements, study of the necessary mathematical apparatus and methods of theoretical physics, creation of software for collection, processing, evaluation and interpretation of scientific data and presentation of results at the department seminar. The specific content of the project for each semester is determined by the project leader.

Recommended literature:
Scientific articles and other literary sources according to the assignment of the final master's thesis.

Course language:
slovak, english

Notes:

Course assessment
Total number of assessed students: 35

A	B	C	D	E	FX
85.71	8.57	0.0	0.0	5.71	0.0

Provides:

Date of last modification: 26.12.2021

Approved: prof. RNDr. Michal Jaščur, CSc.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚFV/ SPTFAc/14	**Course name:** Semestral Work 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: 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 mastery of the assigned tasks set by the project leader at the beginning of the semester to the required extent and level. Specific study and research assignments are formulated at the beginning of the semester by the project leader, who is usually the supervisor of the final thesis. Tasks include, for example, studying literature in a selected field of theoretical physics, astrophysics or astronomy, mastering the theoretical, computer and experimental methods and procedures needed to solve specific research problems, mastering the operation of experimental equipment, obtaining original scientific data and their processing, interpretation and eventual presentation within a joint seminar. Credit evaluation reflects the student's workload when working on a semester project in the range of 100 hours per semester. Individual activities of the student are evaluated by the project leader and the overall work of the student is evaluated on a scale of 0-100 points. The minimum limit for obtaining the evaluation is 50% of the evaluation scale, which is determined as follows: A 100-91% B 90-81% C 80-71% D 70-61% E 60-50% Fx 49-0%.	
Learning outcomes: By completing the course the student will master the experimental and theoretical methods necessary for the study of scientific research issues according to the assignment of the final thesis. The student will gain skills and experience with independent acquisition and processing of original scientific results necessary for the final thesis.	
Brief outline of the course: The program for the semester project is prepared for each student individually by the project leader at the beginning of each semester. The program can be focused on the study of literature for the field of research, preparation and implementation of experimental measurements, study of the necessary mathematical apparatus and methods of theoretical physics, creation of software for collection, processing, evaluation and interpretation of scientific data and presentation of results at the department seminar. The specific content of the project for each semester is determined by the project leader.	
Recommended literature: Scientific articles and other literary sources according to the assignment of the final master's thesis.	

Course language:

Notes:

Course assessment
Total number of assessed students: 31

A	B	C	D	E	FX
80.65	6.45	12.9	0.0	0.0	0.0

Provides:

Date of last modification: 26.12.2021

Approved: prof. RNDr. Michal Jaščur, CSc.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: KPPaPZ/SPVKE/07	**Course name:** Social-Psychological Training of Coping with Critical Life Situations

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: 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: 126

abs	n	z
97.62	2.38	0.0

Provides: Mgr. Ondrej Kalina, PhD.

Date of last modification: 24.06.2022

Approved: prof. RNDr. Michal Jaščur, CSc.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚFV/ FSL1/13	**Course name:** Solar Physics

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

Number of ECTS credits: 6

Recommended semester/trimester of the course: 2.

Course level: II.

Prerequisities:

Conditions for course completion:
To successfully complete the course, the student must demonstrate sufficient understanding of the physical processes that take place in the Sun, from its core to its surface. In addition to direct participation in teaching, the student's independent work is also required within the self-study of professional topics assigned by the teacher. In order to obtain an evaluation and thus also credits, they must pass an oral final exam. Credit evaluation of the course takes into account the following student workload: direct teaching (2 credits), self-study (2 credits), individual consultations (1 credit), and exam (1 credit).
Rating scale: A (90-100%), B (80-89%), C (70-79%), D (60-69%), E (50-59%), F (0-49%) .

Learning outcomes:
After completing the lectures and on the basis of the final evaluation, the student will prove adequate mastery of the content standard of the subject, which is defined by a brief syllabus subject and recommended literature. Mastering the content of the subject allows him to understand the physical processes taking place in the Sun, from its deepest central regions to the visible surface and solar atmosphere. The student will get acquainted with the cycle of solar activity, its manifestations in the interplanetary environment, and influences on the Earth (so-called solar-earth relations).

Brief outline of the course:
The time schedule of the course content is updated in the electronic bulletin board of the course.
1 Introductory definitions and assumptions, basic physical facts about the Sun,
2. Internal structure of the Sun, energy production, the problem of solar neutrinos,
3. Energy transfer by radiation and convection,
4. Helioseismology,
5. Solar atmosphere, photosphere radiation and structures in the photosphere,
6. Chromosphere, transition region and corona,
7. Optically thin radiation, solar flares, coronal mass ejections,
8. Magnetic fields in the atmosphere of the Sun, measuring the magnitude of magnetic induction, Stokes parameters,
9. Basic magneto-hydrodynamic equations,
10. Dynamics of the Sun, differential rotation and its description,

11. Standard model of the Sun, solar activity and its cycle,
12. Solar wind, solar-earth relations, space weather.

Recommended literature:
H. Zirin: Astrophysics of the Sun, Cambridge Univ. Press, Cambridge, 1988.
M. Stix: The Sun, An Introduction, Springer, 2nd edition, 2002.
E. R. Priest: Solar Magnetohydrodynamics, Reidel, 1982.
K. R. Lang: The Sun from Space, Springer, 2000.
Physics of the Sun I. II. III. Geophysics and Astrophysics Monorgaphs, eds: P.A. Sturrock, T. E. Holzer, D.M. Mihalas, R.K. Ulrich, Riedel Publ. Dodrecht 1968.

Course language:
Slovak, basic English

Notes:

Course assessment
Total number of assessed students: 15

A	B	C	D	E	FX
66.67	6.67	26.67	0.0	0.0	0.0

Provides: Mgr. Peter Gömöry, PhD.

Date of last modification: 22.09.2021

Approved: prof. RNDr. Michal Jaščur, CSc.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚFV/ SSA/13	**Course name:** Special Seminar in Astronomy

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:
To successfully complete the course, the student must demonstrate an overview of the latest results of astrophysical research in fields such as extrasolar planets, cataclysmic variable stars, quasars, dark matter and more. The condition for obtaining credits is the preparation and presentation of the semester essay. The credit evaluation of the course considers the following student workload: direct teaching (1 credit), self-study (1 credits) and exam (1 credit). The minimum limit for completing the course is to obtain at least 50% of the total score.

Learning outcomes:
After completing the course, the student will have an overview of the latest results of astrophysical research in areas such as extrasolar planets, cataclysmic variable stars, quasars, dark matter and more. He will also have sufficient physical knowledge and mathematical apparatus to enable independent solution of a wide range of astrophysical problems.

Brief outline of the course:
1. Extrasolar planets: history of exoplanet discoveries, definitions of planets, exoplanets, dwarf planets, small bodies of the Solar system.
2. Methods of exoplanet detection: radial velocities, planetary transits.
3. Other methods of exoplanet detection: timing, microlensing, imaging, astrometry.
4. Properties of exoplanets, equations of internal structure, atmosphere of exoplanets, classification of exoplanets.
5. Brown dwarfs: history of brown dwarf discoveries, spectral classification (M, L, T, Y), definitions.
6. Observations, properties, interior and atmosphere of brown dwarfs, formation, and evolution of brown dwarfs.
7. Cataclysmic variable stars: mass transfer in binary systems, accretion disks.
8. Polars and intermediate polars, novae and supernovae.
9. High energy astrophysics: physical processes leading to the production of X-rays and gamma rays.
10. X-ray binary stars, active galactic nuclei, quasars and blazars, X-rays of the cosmic background.
11. Structure and distribution of matter in the universe, the origin of elements in the universe.
12. Dark matter, dark energy, antimatter, WIMP particles.

Recommended literature:
Current articles in astronomical and astrophysical journals, internet.

Course language:
Slovak, English

Notes:

Course assessment
Total number of assessed students: 13

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

Provides: doc. RNDr. Rudolf Gális, PhD., doc. Mgr. Štefan Parimucha, PhD.

Date of last modification: 22.09.2021

Approved: prof. RNDr. Michal Jaščur, CSc.

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., I.II., 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: 14548

abs	abs-A	abs-B	abs-C	abs-D	abs-E	n	neabs
86.46	0.07	0.0	0.0	0.0	0.05	8.41	5.02

Provides: Mgr. Agata Dorota Horbacz, PhD., Mgr. Dávid Kaško, PhD., Mgr. Zuzana Küchelová, PhD., doc. PaedDr. Ivan Uher, PhD., MPH, prof. RNDr. Stanislav Vokál, DrSc., Mgr. Marcel Čurgali, Mgr. Patrik Berta, Mgr. Ladislav Kručanica, PhD., Mgr. Richard Melichar, Mgr. Petra Tomková, PhD., MUDr. Peter Dombrovský

Date of last modification: 29.03.2022

Approved: prof. RNDr. Michal Jaščur, CSc.

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., I.II., 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: 13211

abs	abs-A	abs-B	abs-C	abs-D	abs-E	n	neabs
84.35	0.51	0.02	0.0	0.0	0.05	10.78	4.29

Provides: Mgr. Agata Dorota Horbacz, PhD., Mgr. Dávid Kaško, PhD., Mgr. Zuzana Küchelová, PhD., doc. PaedDr. Ivan Uher, PhD., MPH, prof. RNDr. Stanislav Vokál, DrSc., Mgr. Marcel Čurgali, Mgr. Patrik Berta, Mgr. Ladislav Kručanica, PhD., Mgr. Richard Melichar, Mgr. Petra Tomková, PhD., MUDr. Peter Dombrovský

Date of last modification: 29.03.2022

Approved: prof. RNDr. Michal Jaščur, CSc.

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., I.II., 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: 8879

abs	abs-A	abs-B	abs-C	abs-D	abs-E	n	neabs
88.62	0.07	0.01	0.0	0.0	0.02	4.25	7.03

Provides: Mgr. Marcel Čurgali, Mgr. Agata Dorota Horbacz, PhD., Mgr. Dávid Kaško, PhD., Mgr. Zuzana Küchelová, PhD., doc. PaedDr. Ivan Uher, PhD., MPH, prof. RNDr. Stanislav Vokál, DrSc., Mgr. Patrik Berta, Mgr. Ladislav Kručanica, PhD., Mgr. Richard Melichar, Mgr. Petra Tomková, PhD., MUDr. Peter Dombrovský

Date of last modification: 29.03.2022

Approved: prof. RNDr. Michal Jaščur, CSc.

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., I.II., 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: 5628

abs	abs-A	abs-B	abs-C	abs-D	abs-E	n	neabs
82.66	0.28	0.04	0.0	0.0	0.0	8.05	8.97

Provides: Mgr. Marcel Čurgali, Mgr. Agata Dorota Horbacz, PhD., Mgr. Dávid Kaško, PhD., Mgr. Zuzana Küchelová, PhD., doc. PaedDr. Ivan Uher, PhD., MPH, prof. RNDr. Stanislav Vokál, DrSc., Mgr. Patrik Berta, Mgr. Ladislav Kručanica, PhD., Mgr. Richard Melichar, Mgr. Petra Tomková, PhD., MUDr. Peter Dombrovský

Date of last modification: 29.03.2022

Approved: prof. RNDr. Michal Jaščur, CSc.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚMV/ NPR/19	**Course name:** Stochastic processes
Course type, scope and the method: **Course type:** Lecture / Practice **Recommended course-load (hours):** **Per week:** 3 / 2 **Per study period:** 42 / 28 **Course method:** present	
Number of ECTS credits: 6	
Recommended semester/trimester of the course: 4.	
Course level: II.	
Prerequisities:	
Conditions for course completion: Total evaluation based on a written test (30p) + individual project work (30p) and oral exam (40p). At least 50% must be obtained from each part. Final evaluation: ≥90% A; ≥80% B; ≥70% C; ≥60% D; ≥50% E; <50% FX.	
Learning outcomes: To obtain knowledge of the stationary stochastic processes analysis in time domain and spectral domain. To study properties of random processes with discrete time (time series) and continuous time and their application in finance. To obtain skills in time series analysis with software R.	
Brief outline of the course: 1.-2. Stationary precess, linear process. 3. Causal and invertible process. 4. Time domain analysis (autocovariance, autocorrelation and partial autocorrelation function). 5. Sample characteristic of time series and their properties. 6.-7. Frequency domain analysis (spectral density and distribution function, periodogram). 8. Prediction of time series. 9. Random processes with continuous time (fundamental concepts). 10. Brownian motion, Itô's process, Itô's lemma and its application. 11.-12. The Black-Scholes formula.	
Recommended literature: 1. Brockwell P., Davis R.: Introduction to Time Series and Forecasting, 3rd ed., Springer, New York, 2016 2. Prášková Z.: Základy náhodných procesů II, Karolinum, Praha, 2004 (in Czech) 3. Tsay R.: Analysis of Financial Time Series, 3rd ed., Wiley Interscience, New Jersey, 2010 4. Shumway R., Stoffer D.: Time Series Analysis and Its Applications with R Examples, 4th ed., Springer, New York, 2017 5. Melicherčík I., Olšarová L., Úradníček V.: Kapitoly z finančnej matematiky, Epos, Bratislava, 2005 (in Slovak) 6. Oksendal B.K.: Stochastic Differential Equations, 6th ed., Springer, 2014	

Course language:
Slovak

Notes:
The students are required to have basic knowledge about random vectors and their characteristics, conditional distribution, estimation theory and hypothesis testing.

Course assessment
Total number of assessed students: 78

A	B	C	D	E	FX
39.74	23.08	17.95	10.26	6.41	2.56

Provides: doc. RNDr. Martina Hančová, PhD.

Date of last modification: 19.04.2022

Approved: prof. RNDr. Michal Jaščur, CSc.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚFV/ SVK/13	**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:	
Course level: I., 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: 18	
abs	n
100.0	0.0
Provides:	
Date of last modification: 30.11.2021	
Approved: prof. RNDr. Michal Jaščur, CSc.	

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: 2 **Per study period:** 28
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: 209

abs	n
37.32	62.68

Provides: Mgr. Dávid Kaško, PhD.

Date of last modification: 29.03.2022

Approved: prof. RNDr. Michal Jaščur, CSc.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚFV/ PAF/13	**Course name:** Summer Practice in Astrophysics

Course type, scope and the method:
Course type: Practice
Recommended course-load (hours):
Per week: **Per study period:** 7d
Course method: present

Number of ECTS credits: 5

Recommended semester/trimester of the course: 2.

Course level: II.

Prerequisities:

Conditions for course completion:
To successfully complete the course, the student must create his/her own observation project in the field of study of exoplanets, variable stars or interplanetary matter, for which they will use observational instruments of UPJŠ and possibly cooperating organizations (AI SAS, Viholtat Observatory in Humenné). In order to obtain an evaluation and thus also credits, the student must evaluate the basic physical properties of the examined objects and present the obtained results. The credit evaluation of the course takes into account the following student workload: direct teaching (1 credit), self-study (2 credits), individual consultations (2 credits). The minimum limit for completing the course is to obtain at least 50% of the total score.

Learning outcomes:
After completing the course, the student will have the knowledge with which he/she will be able to prepare an observation proposal for different types of observations and for different observational instruments. He/she will gain practical experience with photometric and spectroscopic observation and processing of observed data, which he/she will be able to apply in his/her further research.

Brief outline of the course:
1. Introduction to astronomical observations.
2. Preparation of the observational proposal.
3. Preparation for observation.
4. Practical photometric and spectroscopic observations of variable stars using telescopes and detectors at the Astronomical Observatory UPJŠ Kolonické sedlo.
5. Reduction and analysis of obtained observations and their basic interpretation.
6. Presentation of results.

Recommended literature:
1. Howell, S. B., Handbook of CCD Astronomy, Cambridge University Press, Cambridge, 2000;
2. Léna, P., Rouan, D., Lebrun, F., Mignard, F., Pelat, D., Observational Astrophysics, Springer-Verlag, Berlin, 1996;
3. Martinez P., Klotz A., A practical guide to CCD Astronomy, Cambridge University Press, Cambridge, 1998;

Course language:

Slovak, English

Notes:

Course assessment
Total number of assessed students: 13

abs	n	z
100.0	0.0	0.0

Provides:

Date of last modification: 22.09.2021

Approved: prof. RNDr. Michal Jaščur, CSc.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚFV/ TAF1/13	**Course name:** Theoretical Astrophysics 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:

To successfully complete the course, the student must demonstrate sufficient understanding of the astronomical knowledge related to the structure and evolution of stars. Knowledge of stellar structure equations, models of stars, energy sources in stars, formation, evolution, and final stages of stellar evolution is required. During the semester, the student must continuously master the content of the curriculum so that he can use the acquired knowledge in solving computational tasks during the exercises and pass written tests taken into account in the overall evaluation of the subject. The condition for obtaining credits is passing 2 written tests during exercises and an oral exam, which consists of three theoretical questions in the scope of the lectured subject matter. The credit evaluation of the course considers the following student workload: direct teaching (2 credits), self-study (2 credit) and assessment (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%), Fx (0-49%).

Learning outcomes:

After completing lectures and exercises, the student will master the basic equations of stellar structure, models of stars, energy sources in stars, knowledge about the origin, evolution, and final stages of stellar evolution. It will also have sufficient physical knowledge and mathematical apparatus to enable independent solving of a wide range of astronomical problems related to the structure and evolution of stars.

Brief outline of the course:

1. Stellar matter: state equation, polytrophic process, a mixture of gas and radiation.
2. Excitation, Boltzmann equation, ionization, Saha equation.
3. Distribution functions, state equation of degenerate gas, temperature of degeneration.
4. Stellar structure: hydrostatic equilibrium, estimation of state quantities in the stellar center, radiative equilibrium.
5. Energy transfer by radiation, opacity, energy transfer by conduction and convection, condition of convective instability.
6. Basic equations of stellar structures, Lane–Emden equation and its solution.
7. Models of main sequence stars, model of the outer layers of stars.

8. Sources of energy in stars: virial theorem, gravitational energy, nuclear reactions, the rate of energy production.
9. Stellar and explosive nucleosynthesis, proton-proton cycle, CNO cycle, 3-alpha process.
10. Origin of stars: Jeans' criterion, adiabatic and non-adiabatic contraction, fragmentation, rotation, influence of magnetic field.
11. Evolution of stars: collapse of interstellar cloud, evolution of protostars.
12. Evolution of stars on the main sequence, post main sequence evolution, red giants, shell source.
13. The final stages of stellar evolution: model of degenerate stars, white dwarfs, neutron stars, pulsars, black holes.

Recommended literature:

1. Böhm-Vittense, E., Introduction to Stellar Astrophysics, III, Cambridge University Press, Cambridge, 1989;
2. Kipenhahn, R., Weigert, A., Stellar Structure and evolution, Springer-Verlag, Berlin, 1990;
3. Hansen, C.J., Kawaler, S.D., Stellar Interiors – Physical Principles, Structure and Evolution, Springer-Verlag, New York, 1994;
4. Vanýsek, V., Základy astronómie a astrofyziky, Academia, Praha, 1980;

Course language:
Slovak, English

Notes:

Course assessment
Total number of assessed students: 15

A	B	C	D	E	FX
53.33	20.0	6.67	20.0	0.0	0.0

Provides: doc. RNDr. Rudolf Gális, PhD.

Date of last modification: 16.09.2021

Approved: prof. RNDr. Michal Jaščur, CSc.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚFV/ TAF2/13	**Course name:** Theoretical Astrophysics 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:

Conditions for course completion:
To successfully complete the course, the student must demonstrate sufficient understanding of the basis of the formation of spectra in stellar atmospheres and their properties. Knowledge of basic concepts of stellar atmosphere physics, radiation and convection energy transfer, continuous and line absorption coefficients, photosphere model and spectral line properties is required. During the semester, the student must continuously master the content of the curriculum so that he can use the acquired knowledge in solving computational tasks during the exercises and pass written tests taken into account in the overall evaluation of the subject. The condition for obtaining credits is passing 2 written tests during exercises and an oral exam, which consists of three theoretical questions in the scope of the lectured subject matter. The credit evaluation of the course considers the following student workload: direct teaching (2 credits), self-study (2 credit) and assessment (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%), Fx (0-49%).

Learning outcomes:
After completing lectures and exercises, the student will master the basic concepts of the physics of stellar atmospheres, knowledge related to energy transfer by radiation and convection, continuous and line absorption coefficients, photosphere model and the properties of spectral lines. It will also have sufficient physical knowledge and mathematical apparatus to enable the independent solution of a wide range of astronomical problems related to the analysis of stellar spectra.

Brief outline of the course:
1. Basic concepts and definitions: radiation flux, intensity, K-integral and radiation pressure.
2. Optical depth, absorption and emission coefficient, source function, scattering and absorption, Einstein coefficients.
3. Energy transfer in the stellar atmosphere: equation of radiative transfer and its formal solution, spherical geometry, exponential integrals.
4. Radiative equilibrium, gray atmosphere, Milne equations, convection in the stellar atmospheres.
5. Continuous absorption coefficient: origin of continuous absorption, individual absorbers: neutral hydrogen.

6. Individual absorbers: negative hydrogen ion, negative helium ion and metals, electron scattering, the total absorption coefficient.
7. Model photosphere: hydrostatic equilibrium, temperature distribution in the solar photosphere and in other stars.
8. Pg-Pe-T relation, completion of the model, geometrical depth, computation of the spectrum.
9. Properties of models, effect of chemical composition, changes with temperature and pressure.
10. Line absorption coefficient: natural atomic absorption, damping constant.
11. Broadening of spectral lines due to collisions and thermal motion, combining absorption coefficients, the equivalent width of spectral lines.
12. Behaviour of spectral lines: line transfer equation and source function in a spectral line, depth of formation of a spectral line, contribution function.
13. Calculation of spectral line profile in LTE, the dependence on temperature, pressure, abundance.

Recommended literature:
1. Tennyson, J., Astronomical spectroscopy, Imperial College Press, London, 2005
2. Gray, D.F., The observation and analysis of stellar photospheres, Cambridge University Press, Cambridge, 1992;
3. Böhm-Vitense, E., Introduction to stellar astrophysics II, Stellar atmospheres, Cambridge University Press, Cambridge,1997;

Course language:
Slovak, English

Notes:

Course assessment
Total number of assessed students: 11

A	B	C	D	E	FX
63.64	36.36	0.0	0.0	0.0	0.0

Provides: doc. RNDr. Rudolf Gális, PhD.

Date of last modification: 16.09.2021

Approved: prof. RNDr. Michal Jaščur, CSc.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚFV/ MSSTF/14	**Course name:** Theoretical 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/KTP1b/03

Conditions for course completion:
The condition for passing the course is to demonstrate sufficient knowledge of key subjects of theoretical physics at the master's degree level. Successful completion of the oral exam is a necessary condition for completing a master's degree.

Learning outcomes:

Brief outline of the course:
A) Condensed matter theory:
Electrons in a periodic crystal potential. Bloch theorem. Born-van Kárman boundary conditions. Brillouin zone. Mean electron velocity in a crystal. Effective mass. Density of states. Approximation of nearly free electrons. Tight-binding method. Band structure. Electrons in a magnetic field. Landau levels. Lattice vibrations in harmonic approximation. Acoustic and optical modes in a linear chain with one and two atoms in a unit cell. Lattice vibrations of three dimensional lattice. Phonons. Specific heat of crystals. Optical properties of solids. Dielectric function. Optical conductivity. Superconductivity and effect on
physical properties of solids. Electron-phonon attractive interaction. Cooper pairs. Ground state and excited state of a superconductor. Itinerant and localized magnetism in solids. Magnons and spin waves in insulators.
B) Phase transitions and critical phenomena:
Phase equilibrium and phase transitions. Classical (Ehrenfest) and modern classification of phase transitions. Landau description of phase transitions: order parameter and symmetry breaking at continuous phase transitions. Critical indices and universality. Basic microscopic models of magnetic phase transitions: Heisenberg and Ising model. Exact solution of a one-dimensional Ising model in an external magnetic field. Mean (molecular) field approximation for Ising model. Phenomenological Landau theory of phase transitions. Tricritical point.
C) Quantum field theory:
Classical and quantum fields - general definition. Lagrange formalism for classical fields. Euler equations for fields. Symmetry and conservation laws. General dynamic invariants. Energy-momentum tensor. Free classical scalar (real and complex) field, Klein-Gordon equation. Dynamic invariants for scalar fields. Free classical electromagnetic field, Maxwell equations in covariant form. Dynamic invariants for electromagnetic fields. Free spinor field, Dirac equation. Dynamic

invariants for a spinor field. Quantization of classical free fields, heuristic approach and general rules. Scalar field quantization. Spinor field quantization. Electromagnetic field quantization as an example of quantization of fields with constrains. Interacting fields, basic rules for introducing coupling members into Lagrangians. Local calibration invariance, minimal interaction of spinor and electromagnetic fields. Lagrangian of quantum electrodynamics. The concept of N -, S - and T - products of quantum-field operators. Wick theorem for the N-product. Wick theorem for T-product. Evolution operator, S-operator and S-matrix. Green functions as vacuum means of T products of free and interacting quantum fields. Generating functional of Green functions. Feynman diagram technique, general rules for graph construction. General rules for calculation of Green functions using perturbation theory. Compton scattering: calculation of the S matrix and the effective cross section for non-polarized particles in the leading order approximation.

Recommended literature:

Course language:

Notes:

Course assessment
Total number of assessed students: 15

A	B	C	D	E	FX
66.67	13.33	13.33	6.67	0.0	0.0

Provides:

Date of last modification: 21.12.2021

Approved: prof. RNDr. Michal Jaščur, CSc.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚFV/ TKL1/99	**Course name:** Theory of Condensed Matter

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:
1. Attendance at lessons in accordance with the study rules and the teacher's instructions.
2. Activity at exercises.
3. Self-study and submission of independently solved homework.
Conditions for the final evaluation:
1. Final written exam, solving of problems.
2. Final oral exam or multiple choice test.
Conditions for successful completion of the course and obtaining 8 ECTS credits:
1. Participation at lessons in accordance with the study regulations and according to the instructions of the teacher (40% share of ECTS credits).
2. Mastering conditions of continuous assessment of self-study and homeworks at the level in the assessment scale of at least 60% in total (50% share of ECTS credits).
3. Mastering conditions of the final evaluation in the overall expression at the level of at least 20% from solving of problems and an oral exam or test (10% share of ECTS credits).
4. Rating scale: A 100% - 90%, B 89% - 75%, C 74% - 60%, D 59% - 40%, E 39% - 20%, FX 19% - 0.

Learning outcomes:
The graduate of the course will master basic concepts of the condensed matter structure and acquire knowledge of derivation their properties from the quantum nature of electrons, phonons, photons, magnons and their mutual interactions, which are modulated by the periodic arrangement of atoms. The graduate will learn the quasiparticle formalism in order to the describe electrical properties, optical properties, superconductivity, and will be able to calculate dispersions of quasiparticles and deduce basic properties of the condensed matter. The graduate will acquire sufficient physical and mathematical knowledge to independently solve current scientific problems in the physics of condensed matter and in the study of material properties.

Brief outline of the course:
1. Theoretical description of solid state structure. Electrons in periodic lattice, Bloch's theorem, reciprocal lattice and Brillouin zone, Born-von Karmán periodic boundary conditions.
2. Velocity of Bloch states, density of states, approximation of nearly-free electrons.
3. Band structure. Tight-binding method.

4. k.p method and Wannier functions.
5. Electrons in magnetic field. Properties of materials, heat capacity and susceptibility.
6. Lattice vibrations in harmonic approximation, thermodynamics of crystal solids.
7. Quantum theory of lattice vibration in solids, phonons.
8. Optical properties of solids, dielectric function, optical conductivity, excitons.
9. Superconductivity, electron-phonon effective attractive interaction.
10. Cooper pairs, BCS theory. Ground and excited state of superconductor.
11. Magnetism in solids, itinerant and localized ferromagnetism, Laudau diamagnetism.
12. Magnons and spin waves in insulators, thermodynamics of magnons. Spin dynamics.

Recommended literature:
Simon, S. H. The Oxford Solid State Basics. Oxford University Press, 2013.
Girvin, S. M., Yang, K. Modern Condensed Matter Physics. Cambridge University Press, 2019.
Cohen, M. L., Louie, S. G. Fundamentals of Condensed Matter Physics. Cambridge University Press, 2016.
Ketterson, J. B. The Physics of Solids. Oxford University Press, 2016.
Kaxiras, E. Atomic and Electronic Struture of Solids, Cambridge University Press, 2003.
Ashcroft, N. W., Mermin, N. D. Solid State Physics. Harcourt College Publishers, 1976.

Course language:

Notes:
The course is implemented in a full-time form, if necessary remotely in the MS Teams environment.

Course assessment
Total number of assessed students: 106

A	B	C	D	E	FX
53.77	13.21	16.98	6.6	9.43	0.0

Provides: RNDr. Martin Gmitra, PhD.

Date of last modification: 18.11.2021

Approved: prof. RNDr. Michal Jaščur, CSc.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚFV/ TRANS/18	**Course name:** Transport properties of solids
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., 4.	
Course level: II.	
Prerequisities:	
Conditions for course completion: During the continuous and final assessment, the student will demonstrate adequate mastery of the course content standard and a sufficient level of understanding of the topics covered in the course outline. The basis of the mid-term evaluation is active participation in the class and submission of independently solved homework assignments at the overall level of 50% correct solutions for the entire semester. A condition for successful completion of the course is the final assessment, which consists of a written part - problem solutions and their oral presentation, and a test on theory. The final assessment takes into account all the required activities with the relevant weighting. The 4 ECTS credit assessment takes into account the following: participation in direct teaching (2 ECTS credits), self-study and individual homework solution (1 ECTS credit), and passing the final examination (1 ECTS credit). Final grade scale: A 100% - 85%, B 84% - 70%, C 69% - 55%, D 54% - 40%, E 39% - 20%, FX 19% - 0.	
Learning outcomes: The student will learn the basics of electron and thermal transport in the classical and quantum regime. The student will master Boltzmann and quantum Landauer-Büttiker formalisms to solve standard transport problems and to apply the knowledge independently to similar physics problems. The knowledge gained will help the student to interpret experimental measurements or determine relevant transport physical mechanisms.	
Brief outline of the course:	
Recommended literature: 1. K. Hirose, N. Kobayashi, Quantum Transport Calculations for Nanosystems, Pan Standford Publishing, 2014. 2. D. K. Ferry, An Introduction to Quantum Transport in Semiconductors, Pan Standford Publishing, 2018. 3. M. Galperin, Quantum Transport, Lecture Notes, 1998. 4. S. Datta, Electronic Transport in Mesoscopic Systems, Cambridge University Press, 1995. 5. M. Di Ventra, Electrical Transport in Nanoscale Systems, Cambridge University Press, 2009. 6. T. Ihn, Electronic Quantum Transport in Mesoscopic Semiconductor Structures, Springer Tracts in Modern Physics, Volume 192, 2004.	

7. T. Heinzel, Mesoscopic Electronics in Solid State Nanostructures, Wiley-VCH, 2003.
8. N. W. Ashcroft, N. D. Mermin, Solid State Physics, Harcourt College Publisher, 1976.
7. M. P. Marder, Condensed Matter Physics, Wiley, 2010.
9. J. B. Ketterson, The Physics of Solids, Oxford University Press, 2016.
10. J. Sólyom, Fundamentals of the Physics of Solids, Volume 2 – Electronic Properties, Springer, 2009.

Course language:

Notes:
The course is implemented in a full-time form, if necessary remotely in the MS Teams environment.

Course assessment
Total number of assessed students: 17

A	B	C	D	E	FX
23.53	11.76	35.29	11.76	17.65	0.0

Provides: RNDr. Martin Gmitra, PhD.

Date of last modification: 31.01.2022

Approved: prof. RNDr. Michal Jaščur, CSc.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚFV/ PHD/17	**Course name:** Variable and binary stars

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:
To successfully complete the course, the student must demonstrate a sufficient understanding of the physical properties of different types of variable stars, their origin, and evolution, as well as methods of their search and detection. In addition to direct participation in teaching, the student's independent work is also required within the self-study of professional topics assigned by the teacher. In order to obtain an evaluation and thus also credits, the student must meet the requirements of a continuous written test (with a weight of 50% of the total evaluation) and pass a written final exam (with a weight of 50% of the total evaluation).Credit evaluation of the course takes into account the following student workload: direct teaching (2 credits), self-study (2 credits), individual consultations (1 credit), and exam (1 credit) . Rating scale: A (90-100%), B (80-89%), C (70-79%), D (60-69%), E (50-59%), F (0-49%).

Learning outcomes:
After completing the lectures and exercises and on the basis of the final evaluation, the student will demonstrate adequate mastery of the content standard of the course, which is defined by a brief syllabus of the course and recommended literature. Mastering the content of the subject allows him to acquire knowledge about different types of variable stars and binaries, they will be able to determine the period of their changes and their basic properties from the light curve. They will be able to identify different types of variability such as the presence of other bodies in the systems.

Brief outline of the course:
The time schedule of the course content is updated in the electronic bulletin board of the course.
1. Definition of variable stars and historical overview of their research
2. Basic concepts necessary for the study of variable stars
3. Methods of finding variability and its periodicity.
4. Classification of variable stars and basic properties.
5. Eclipsing binaries
6. Rotating variable stars
7. Pulsating variable stars
8. Eruptive variable stars
9. Two-body problem and orbital parameters
10. Roche potential and model of close binary stars

11. Mass transfer and change of system period
12. Multiple systems and their detection

Recommended literature:

1. Egglecton: 2006: Evolutionary Processes in Binary and Multiple Stars, Cambridge University Press
2. Hilditch: 2001, Close binaries, Cambridge University Press
3. Kallrath J., Milone E.F.: 2009, Eclipsing Binary Stars - Modeling and Analysis, Springer
4. Lena et al.: 1996, Observational Astrophysics, Springer-Verlag
5. Roth G.: 1994, Compendium of Practical Astronomy, Springer-Verlag
6. Sterken a Jashek, 1996, Light Curves of variable Stars, Cambridge University Press
7. Warner: 1995, Cataclysmic Variables, Cambridge University Press

Course language:
Slovak, English

Notes:

Course assessment
Total number of assessed students: 8

A	B	C	D	E	FX
50.0	50.0	0.0	0.0	0.0	0.0

Provides: doc. Mgr. Štefan Parimucha, PhD.

Date of last modification: 22.09.2021

Approved: prof. RNDr. Michal Jaščur, CSc.