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:

Learning outcomes:

Brief outline of the course:

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: 17.09.2020

Approved:

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚFV/ ARE1a/99	**Course name:** Automatization of Physical Experiments

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

Number of ECTS credits: 3

Recommended semester/trimester of the course: 1.

Course level: II.

Prerequisities:

Conditions for course completion:
Exam, according to the topics of the lectures.

Learning outcomes:
Design of automated setups for performing selected types of physical measurements, learning real properties of components of measuring and controlling subsystem. Obtaining skills in building experimental setup using standard communication protocols. Programming simple experimental setups in Python.

Brief outline of the course:
1. Introduction to systems of automated measurements and control. Measuring and control subsystem. Enhancement of metrological properties of instrumentation by incorporating microcomputers. Sensors, basic characteristics, examples of technical realization of selected sensors.
2. Analog converters for acquisition of analog signal, analysis of selected types of converters. Analysis of the selected types of converters. Using operational amplifiers in the converters. Examples of operational networks.
3. Standard communication protocols for serial and paralel data transfer in experimental setups – RS 232, HPIB. Basic characterization. Synchronous and asynchronous regime for data transfer in serial mode. Detection of errors in serial mode. Hamming code. Structure of data bus in HPIB protocol. Selected system functions. Using handshake in transferring data. Interface and instrumentational messages.
4. Analog to digital converter (ADC), technical principle, examples for application. Direct converter, successive approximation technique, tracking method. Suppressing mains in integration converter.
5. Digital to analog converter (DAC), technical principle, examples for application. Converters with various resistance networks. Converter using voltage – time conversion. Differential and integral nonlinearity of DAC and ADC. Calculation and measuring differential and integral nonlinearity. Grain noise.
6. Digital filtering of data. Transmission function for analog and digital system. Laplace and Z-transformations. Methods for digital filter design. Design of the filter with infinite impulse response.

7. Analog and digital regulators. Properties of proportional, integral and derivative regulator. Program simulation of regulators operation.
Programming in Python:
Introduction to programming in Python using Pycharm editor, communication with measuring instruments. Types of variables, conversion of types. Functiones and methods. Working with data, basic data structures. Reading/writing data to files, numerical acquisition, graphical output. Basic types of program structures - sequence, cycle, conditional commands. Programming simple experimental setups.
8. Introduction to graphical programming in Python – type of variables, conversions among types, data operations.
9. Acquisition, creation, reading/storing data files in Python. Functions and methods.
10. Subroutines, using selected libraries.
11. Basic types of program structures – sequence, cycle, conditional commands.
12. Graphical output. Data transfer and communication among measuring units in Python.

Recommended literature:

J. Uffenbeck, Microcomputers and microprocessors, Prentice Hall, 1985.
P. Horowitz, W. Hill, The Art of Electronics, Cambridge University Press 1989.
S. Hack, Python Programming, Chopra International Consulting Ltd., 2021.

Course language:
slovak, english

Notes:

Course assessment
Total number of assessed students: 58

A	B	C	D	E	FX
41.38	34.48	10.34	12.07	1.72	0.0

Provides: prof. Ing. Martin Orendáč, DrSc.

Date of last modification: 30.06.2021

Approved:

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚFV/ ARE1b/99	**Course name:** Automatization of Physical Experiments

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: ÚFV/ARE1a/99

Conditions for course completion:
Evaluation of results reached during solving given tasks.
Final evaluation of the obtained results.

Learning outcomes:
Obtaining practical skills in programing automated experimental setups. Extension of knowledge about properties of non-ideal digital to analog and analog to digital converters. Obtaining skills in practical programming of model situations for experimental setups designed for investigation of thermodynamic properties of solids as well as in design of digital filters. A student will also become familiar with handling selected automatedl setups designed for experimental studying solids.

Brief outline of the course:
Basic programing in Python language.
Problem solving for selected setups for automation:
Temperature controller. Nonlinearity of digital - analog and analog -digital converters. Analog - digital converter with feedback. Analog signal filtering. Study of heat flow in materials with low thermal conductivity. Digital filtering of signal.

Recommended literature:
Supporting material is available.

Course language:
slovak, english

Notes:

Course assessment
Total number of assessed students: 33

A	B	C	D	E	FX
66.67	12.12	21.21	0.0	0.0	0.0

Provides: prof. Ing. Martin Orendáč, DrSc.

Date of last modification: 29.03.2020

Approved:

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:

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:	
Learning outcomes:	
Brief outline of the course:	
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: 24.06.2021
Approved:

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚFV/ PSM/18	**Course name:** Computer simulations in magnetochemistry

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: 3

Recommended semester/trimester of the course: 2., 4.

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: 3

A	B	C	D	E	FX
33.33	66.67	0.0	0.0	0.0	0.0

Provides: RNDr. Vladimír Tkáč, PhD., doc. RNDr. Erik Čižmár, PhD.

Date of last modification: 18.08.2021

Approved:

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚFV/ MSSFKL/15	**Course name:** Condensed Matter 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/MKL/03,ÚFV/MSA1/03,ÚFV/FNT1/03,ÚFV/TKL1/99

Conditions for course completion:
Obtaining required number of the credits given by the study plane.

Learning outcomes:
Evaluation of the competences of the students according to the profile.

Brief outline of the course:
The state exam consists of defending diploma thesis and exam which has two blocks. The student is obliged to pass the exam from the compulsory block and one of two optional blocks.
I. Block – compulsory
Theory of condensed mater
1. Basic approximations in solid state physics. The Born-Oppenheimer adiabatic approximation. The Hartreeho-Fock method.
2. The definition of ideal crystal. The direct and reciprocal lattice. The Wigner-Seitz elementary cell.
3. Electrons in a periodic potential field. The effective mass.
4. The finite crystal and Born-Kárnan boundary conditions. Brilluoin zones.
5. The approximation of nearly-fee electrons. The band structure of energy spectrum.
6. The tight binding method. Differences of the band structure in comparison with the approximation of nearly-fee electrons.
7. The harmonic approximation and lattice vibrations . Vibrations of the linear chain with one atom per unit cell.
8. Vibrations of the linear chain with two atoms per unit cell.
9. Quantum theory of harmonic vibrations. Phonons.
10. The second quantization.
11. The electron-phonon interaction.
II. Optional block
Magnetic properties of solids
1. Magnetic moment of atom.
2. Diamagnetism.
3. Paramagnetis.
4. Ferromagnetism.
5. Antiferromagnetism.

6. Ferrimagnetism.
7. Energy of ferromagnets.
8. Domain structure.
9. Magnetization processes.
Experimental methods
10. Measurement of intensity a induction of magnetic field.
11. Measurement of magnetostriction and anisotropy.
12. Physical principle of electron microscopy, construction of electron microscop.
13. X – ray and electron diffraction and their applications in solid state physics.
14. Analytical methods for determination of surface chemical composition (EDX, WDX).
III. Optional block
Low temperature physics
1. Superfluidity of 4He.
2. Superfluidity of 3He.
3. Properties of liquid solutions 3He - 4He.
4. Quantum crystals.
5. Introduction to superconductivity – Josephson effect and its applications.
6. BCS a GLAG theories of superconductivity.
7. Unconventional superconductivity.
8. Transport of charge and heat at low temperatures.
9. Methods of reaching very low temperatures.
10. Methods of measurements of low temperatures.
Experimental methods
11. Specific heat at low temperatures - measurement techniques and data acquisition.
12. Low level signal measurements.
13. Electron - paramagnetic resonance.

Recommended literature:

Course language:
english

Notes:

Course assessment
Total number of assessed students: 22

A	B	C	D	E	FX
50.0	36.36	4.55	9.09	0.0	0.0

Provides:

Date of last modification: 03.05.2015

Approved:

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

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

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

Number of ECTS credits: 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: 65

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

Provides:

Date of last modification: 03.05.2015

Approved:

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚFV/ DDS/15 | **Course name:** Domain and Domain Walls

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., III.

Prerequisities:

Conditions for course completion:
Oral examination

Learning outcomes:
The objective is to acquaint the students witrh the basis of the domain and domain wall formation, their structure, static and dynamic properties in magnetic materials.

Brief outline of the course:
Domain structure. Experimental study of domain structure. Calculation of domain structure. Anisotropies. Domain wall types. Domain wall potential. Domain wall dynamics. Domain wall motion induced by electrical current.

Recommended literature:
1. B.D. Cullity, C.D. Graham, „Introduction to magnetic materials“, John Wiley & Sons, New Jersy (2009) 2. S. Chikazumi, Physics of Ferromagnetism, Oxford University Press, USA (2009) 3. S. Tumanski, Handbook of Magnetic Measurements, CRC Press (2011) 4. N. A. Spaldin, Magnetic Materials: Fundamentals and Device Applications, Cambridge University Press (2003)

Course language:
slovak, english

Notes:

Course assessment
Total number of assessed students: 7

A	B	C	D	E	FX	N	P
71.43	0.0	28.57	0.0	0.0	0.0	0.0	0.0

Provides: prof. RNDr. Rastislav Varga, DrSc.

Date of last modification: 23.07.2021

Approved:

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚFV/ EMT1/03	**Course name:** Experimental Methods in Solid State Physics I
Course type, scope and the method: **Course type:** Lecture **Recommended course-load (hours):** **Per week:** 2 **Per study period:** 28 **Course method:** present	
Number of ECTS credits: 3	
Recommended semester/trimester of the course: 1.	
Course level: II.	
Prerequisities:	
Conditions for course completion: Knowledge of topics which are addressed in the lectures. Exam.	
Learning outcomes: Clarification of selected experimental techniques applied in the experimental study of solids. Discussion of physical phenomena associated with the techniques and design of model experimental setups.	
Brief outline of the course: Following topics are addressed during semester, for each topic one lecture is anticipated: 1. Characterization of the course. Introduction to low-level signal measurements. Methods of suppressing noise depending on the frequency of the useful signal. Communication with controlling computer. 2. Grounding and shielding techniques in experimental setups. Active guarding. Ground loops. Using of isolation transformer. 3. Signal and noise bandwidth of filters. Method of phase sensitive detection. Lock-in amplifier. Principle of operation. Examples of application. Using lock-in amplifier for modulation of the measured signal. 4. Experimental methods for calorimetry. Contributions to specific heat. Adiabatic and relaxation techniques. Contactless magnetocalorimetry. Calorimetric determination of absorption of optical elements. 5. Experimental study of thermal conductivity. Contributions to thermal conductivity in solids. Measurements of boundary resistance between a thin conductive layer and substrate. 6. Investigation of dielectric properties of solids. Classification of measurement techniques according to excitation frequency. 7. Capacitor partially filled with dielectric. Properties of real capacitors from experimental setups. Measurements at low and medium frequencies. Bridge techniques. 8. Investigation of dielectric properties at high frequencies. Circuits with concentrated and distributed parameters. 9. Dielectric measurements at very high frequencies. Modes of electromagnetic field in cavity resonators and waveguides. Analysis of the results of dielectric measurements.	

10. Characteristic properties of semiconductors. Determination of the magnitude of the energy gap, energies of donor and acceptor states, concentration of donors and acceptors.
11. Mobility of charge carriers in semiconductors. Experimental study of mobility of charge carriers. Deviations from Ohm law. Study of Hall effect in semiconductors and metals.
12. Experimental determination of Hall constant and electrical conductivity. Analysis of electrical resistivity in semiconductors. Thermoelectric effects in semiconductors. Determination of the temperature dependence of Fermi energy.

Recommended literature:
Supporting material from scientific papers is available.

Course language:
slovak, english

Notes:

Course assessment
Total number of assessed students: 54

A	B	C	D	E	FX
37.04	37.04	14.81	7.41	3.7	0.0

Provides: prof. Ing. Martin Orendáč, DrSc.

Date of last modification: 02.07.2021

Approved:

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚFV/ EM1/03	**Course name:** Experimental Methods in Solid State Physics II

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:
Oral Exam

Learning outcomes:
The subjects provides a basic overview of the solid state methods and techniques studying the surface structures as well as the quasiparticle spectra.

Brief outline of the course:
Experimental methods focused on structural studies of solid-state surfaces, superconducting vortices, magnetic and electrical surface structures. Spectroscopies with high energy resolution for studies of electron and other quasiparticles in solids.
1. Introduction and historical overview of microscopy
Optical microscopy, electron microscopy, scanning tunneling microscopy, atomic force microscopy.
2. Scanning tunneling microscopy (STM)
Basic principles of STM, piezoelectric effect, methods of approaching the STM tip to the surface of the sample, controller electronics, scanning modes, principles of the PID feedback loop, topography imaging, effect of electronic structure on topography.
3. Atomic force microscopy (AFM)
History: from STM to AFM, differences and common features, advantages and disadvantages, types of probes – surface interaction, scanning modes, tribology, force curves, imaging of organic nanostructures
4. Experimental methods
Mechanical design; low temperature and high vacuum equipment; sample preparation: surface cleaning, preparation of thin films and nanostructures by evaporation, sputtering etc.; STM tip preparation: cold welding, electron bombardment, etching etc.
5. Examples of other Scanning probe microscopies (SPM)
Magnetic force microscopy, Kelvin probe microscopy, scanning Hall probe microscopy, spin polarized STM, Inelastic Electron Tunneling Spectroscopy, electrochemical STM etc. Lithography by SPM: dip pen, local anodic oxidation, nano scratching, nanoindentation etc.
6. Tunneling spectroscopy (TS)
Principles of quantum tunneling, tunneling through planar and vacuum barrier, electronic structure of metals, semiconductors and superconductors; Current vs. voltage and differential conductance

vs. voltage characteristics, controller electronics, lock-in amplifier, conductance imaging tunneling spectroscopy (CITS), numerical methods of data analysis; TS of metals, semiconductors, molecules and various nanostructures.
7. TS of superconductors
Superconducting energy gap, tunneling contacts between normal metal and superconductor and between two superconductors, superconducting tip characterization, superconductivity in nanostructures, effect of temperature and magnetic field.
8. Superconducting vortices
Type I and II superconductors, interaction with magnetic field, imaging of vortices, vortex pinning, dynamics
9. Point contact spectroscopy (PCS)
Principles of PCS, from tunneling to point contact, hetero contacts, signal modulation techniques, fabrication of point contacts, effect of temperature and magnetic field.
10. PCS of superconductors
Andreev reflection, Josephson effect, Blonder – Tinkham – Klapwijk model, characterization of the superconducting order parameter
11. Visit of SPM and nanotechnology laboratory, experiment preparation and realization.
12. Visit of low temperature PCS and STM laboratory, experiment preparation and realization.

Recommended literature:
Hajko V a kol.: Physics in Experiment, Veda, Bratislava 1998.
Kittel Ch.: Introduction to Solid State Physics, 7th edition, John Wiley and sons, NY, 1996
M. Tinkham: Introduction to Superconductivity, McGraw-Hill, Nwe York, 1996

Course language:
Slovak or English

Notes:

Course assessment
Total number of assessed students: 62

A	B	C	D	E	FX
90.32	4.84	4.84	0.0	0.0	0.0

Provides: Mgr. Tomáš Samuely, PhD.

Date of last modification: 15.06.2021

Approved:

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚFV/GPP/18	**Course name:** Graphic programming

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

Number of ECTS credits: 2

Recommended semester/trimester of the course: 1., 3.

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: doc. RNDr. Erik Čižmár, PhD.

Date of last modification: 18.08.2021

Approved:

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:

Learning outcomes:

Brief outline of the course:

Recommended literature:

Course language:

Notes:

Course assessment
Total number of assessed students: 742

A	B	C	D	E	FX
60.78	13.88	12.67	8.63	3.37	0.67

Provides: Doc. PhDr. Peter Nezník, CSc., PhDr. Katarína Mayerová, PhD., doc. Mgr. Róbert Stojka, PhD.

Date of last modification: 25.03.2020

Approved:

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚFV/ DEJ1/99	**Course name:** History of Physics

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

Number of ECTS credits: 2

Recommended semester/trimester of the course: 2., 4.

Course level: I., II.

Prerequisities:

Conditions for course completion:
term project
examination

Learning outcomes:
Basic facts in the history of physics.

Brief outline of the course:
1.-2. Evolution of knowledge before Galileo.
3.-4. Evolution of physics within the mechanical picture of the world.
5.-6. Evolution and limits of classical physics, phase of breakthrough in physics.
7.-8. Origin and evolution of the theory of relativity. Quantum physics and prospects of further evolution of physics and their application.
9.-10. Atomic and nuclear physics.
11.-12. Subnuclear physics. Contemporary state of physical research and its application in technology, natural sciences and philosophy. Position of physics in our society.

Recommended literature:
1. R.Zajac, J.Chrapan: Dejiny fyziky, skriptá, MFF UK, Bratislava, 1982.
2. V.Malíšek: Co víte o dějinách fyziky, Horizont, Praha, 1986.
3. I.Kraus, Fyzika v kulturních dějinách Evropy, Starověk a středověk, Nakladatelství ČVUT, Praha, 2006.
4. A.I.Abramov: Istoria jadernoj fiziky, KomKniga, Moskva, 2006.
5. L.I.Ponomarev: Pod znakom kvanta, Fizmatlit, Moskva, 2006.
6. I.Kraus, Fyzika v kulturních dějinách Evropy, Od Leonarda ke Goethovi, Nakladatelství ČVUT, Praha, 2007.
7. I.Kraus, Fyzika od Thaléta k Newtonovi, Academia, Praha, 2007.
8. I.Štoll, Dějiny fyziky, Prometheus, Praha, 2009.
9. www-pages.
10.Brandt S., The harvest of a century, Discoveries of modern physics in 100 episodes, Oxford, 2009.

Course language:

slovak and english

Notes:

Course assessment
Total number of assessed students: 35

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

Provides: prof. RNDr. Stanislav Vokál, DrSc., doc. RNDr. Janka Vrláková, PhD.

Date of last modification: 06.08.2021

Approved:

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:

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
90.0	10.0	0.0	0.0	0.0	0.0

Provides: Doc. PhDr. Peter Nezník, CSc.

Date of last modification: 12.02.2021

Approved:

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚFV/ KAK/14	**Course name:** Liquid crystals

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

Number of ECTS credits: 2

Recommended semester/trimester of the course: 1., 3.

Course level: II.

Prerequisities:

Conditions for course completion:
Discussion accompanied with the preparation and presentation of a short project

Learning outcomes:
Student will obtain basic information about structural, mechanical and optical properties of liquid crystals as well as about their applications in technical praxis.

Brief outline of the course:
Basic properties of liquid crystals. Classification of liquid crystals. Liquid crystalline phases and chemical structure. Optical anisotropy. Interaction of liquid crystals with electric and magnetic field – Freedericksz transitions. Applications. Composite systems based on liquid crystals.

Recommended literature:
1. P.G.de Gennes, The Physics of Liquid Crystals, Clarendon Press, Oxford 1974
2. N.Tomašovičová, P.Kopčanský, N.Éber: Magnetically Active Anisotropic Fluids Based on Liquid Crystals, Anisotropy Research: New Developments, ed. Hirpa Lemu, Nova Science Pub Incorporated, 2012.

Course language:
english

Notes:

Course assessment
Total number of assessed students: 4

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

Provides: RNDr. Natália Tomašovičová, CSc.

Date of last modification: 23.06.2021

Approved:

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: 3.

Course level: II.

Prerequisities:

Conditions for course completion:
Two tests during the semester. Final examination consists of the results of two tests and oral exam. The oral exam may be waived of if the tests results are better then D.

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:

Notes:

Course assessment

Total number of assessed students: 63

A	B	C	D	E	FX
90.48	3.17	6.35	0.0	0.0	0.0

Provides: doc. RNDr. Erik Čižmár, PhD., Dr.h.c. prof. RNDr. Alexander Feher, DrSc.

Date of last modification: 30.08.2021

Approved:

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:
Elaboration of written texts.
Distance oral exam.

Learning outcomes:
To obtain a general view on basic magnetic phenomena, intrinsic magnetic properties of various magnetic materials, magnetization processes and domain structure.

Brief outline of the course:
Magnetic materials and magnetization. Magnetic quantities. Carriers of magnetic moment. Vector model of the atom. Magnetic field sources. Measurements of magnetic field. Diamagnetism. Paramagnetism. Ferromagnetism. Antiferromagnetism. Ferrimagnetism. Mgnetic behavior and structure of materials. Neutron diffraction. Magnetic anisotropy. Hall effect, magnetoresistance. Domain structure. Magnetostriction. Technical magnetization. Dynamic magnetization processes. Susceptibility. Thin films.

Recommended literature:
S. Chikazumi: Physics of Magnetism, Oxford University Press 2009
D. Jiles: Introduction to magnetism and magnetic materials, Chapman&Hall, London, New York, Tokyo, Melbourne, Madras, 1991

Course language:
english

Notes:

Course assessment
Total number of assessed students: 114

A	B	C	D	E	FX	N	P
40.35	15.79	9.65	2.63	1.75	1.75	0.88	27.19

Provides: prof. RNDr. Peter Kollár, DrSc.

Date of last modification: 26.03.2020

Approved:

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚFV/ MAG/08/08	**Course name:** Magnetochemistry

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.

Course level: II.

Prerequisities:

Conditions for course completion:
Exam

Learning outcomes:
Introduction to the basic interactions in the electron subsystem of insulators, demonstration of the correlations between the structure and magnetic properties. Students will learn the basic standard methods used in the analysis of thermodynamic data (specific heat, susceptibility, magnetization) and EPR, since the study of magnetic properties yield an important information about the structure of material especially at low temperatures.

Brief outline of the course:
Electronic states in hydrogen atom, electronic configuration, term, multiplet. Paramagnetic and diamagnetic atoms. Atom in magnetic field: specific heat, susceptibility, magnetization and electron paramagnetic resonance (EPR). Atom in the crystal field. Freezing of angular momentum. Spin Hamiltonian. Termodynamics and EPR of paramagnetic atoms in the crystal field. Exchange and dipole interaction.Heisenberg Hamiltonian. Magnetic dimer. Long-range and short- range order. Low-dimensional magnets. Spatial anisotropy of exchange coupling. Exchange anisotropy. Heisenberg, Ising and XY model.

Recommended literature:
1.R.L. Carlin, A.J. Duyneveldt: Magnetic properties of transition metal compounds. New York, inc. Springer Verlag, 1977.
2. A.B.P.Lever, Inorganic electronic spectroscopy, Elsevier, Amsterdam, 1987.

Course language:
english

Notes:

Course assessment
Total number of assessed students: 22

A	B	C	D	E	FX
54.55	18.18	18.18	4.55	4.55	0.0

Provides: doc. RNDr. Alžbeta Orendáčová, DrSc., RNDr. Róbert Tarasenko, PhD.
Date of last modification: 15.06.2021
Approved:

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚFV/ MOP/14	**Course name:** Magnetooptics

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:
exam

Learning outcomes:
The goal is to teach students the basics on magnetooptical parameters, measurements and overview of magnetooptical materials.

Brief outline of the course:
Introduction, polarized light, magneto-optical phenomena, microscopic mechanisms the magnetooptical activity, magneto-optical materials, dielectrics, ferrites, metals and their alloys, applied magnetooptics

Recommended literature:
Zvezdin AK, Kotov VA, Modern magnetooptics and magnetooptical materials, Taylor & Francis ,1997
Sugano S., Kojima N., Magneto-optics, Springer, 1999

Course language:
slovak or english

Notes:

Course assessment
Total number of assessed students: 3

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

Provides: RNDr. Kornel Richter, PhD.

Date of last modification: 03.05.2015

Approved:

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚFV/ MNK/17	**Course name:** Mechanika kontinua

Course type, scope and the method:
Course type: Lecture / Practice
Recommended course-load (hours):
Per week: 2 / 0 **Per study period:** 28 / 0
Course method: present

Number of ECTS credits: 3

Recommended semester/trimester of the course: 2.

Course level: II., III.

Prerequisities:

Conditions for course completion:

Learning outcomes:
This course follows the basics of continuum mechanics presented within Theoretical mechanics in order to focus on more advanced problems of continuum mechanics. The main objective of this course is to provide an introduction to the continuum mechanics, where mechanical properties of materials are modeled as continuous mass rather than as discrete particles.

Brief outline of the course:
Approximation of continuum nature of matter assumes that the substance of the object completely fills the space it occupies. Such consideration ignores the fact that matter is made of atoms, completely ignoring its microphysical structure. However, on lengths scales much greater than that of interatomic distances, such models are highly accurate. Fundamental physical laws such as the conservation of mass, the conservation of momentum, and the conservation of energy may be applied to such models to derive differential equations describing the behavior of solids and liquids within the frame of continuous mechanics. At the beginning of the course, a brief introduction to the mathematical apparatus of the continuum mechanics is provided. Next, deformation of solids and classical theory of elasticity are studied. Hook law and dynamical equation of isotropic homogeneous media will be evaluated. Within the frame of continuum mechanics, a propagation of waves in unlimited media will be studied (transverse and longitudinal modes) and equations of wave propagation for geometrically confined solids (wave reflection, Rayleigh waves). Equations of free and forced oscillations of strings, membranes rods will be evaluated. Finally, basic equations of mechanics of liquids will be evaluated.

Recommended literature:
1. M. Brdlička, L. Samek, B. Sopko, Mechanika kontinua, Praha : Academia, 2011. 878 s. ISBN 978-80-200-2039-0.
2. M. Okrouhlík, C. Höschl, J. Plešek, S. Pták, J. Nadrchal, Mechanika poddajných těles,numerická matematika a superpočítače, Ústav termomechaniky AV ČR, 1997.
3. G.A.Holzapfel: Nonlinear Solid Mechanics, Wiley, 2000.

Course language:

Notes:

Course assessment Total number of assessed students: 0	
abs	n
0.0	0.0
Provides: RNDr. Kornel Richter, PhD.	
Date of last modification: 20.02.2017	
Approved:	

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚFV/ MSA1/03	**Course name:** Methods of Structural Analysis

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: 7

Recommended semester/trimester of the course: 2.

Course level: I., II., III.

Prerequisities:

Conditions for course completion:
Elaboration of practical projects on electron microscopy and XRD diffractometry topics (75%) and final test with oral examination (25%)

Learning outcomes:
The course is oriented on modern methods of structural analysis of metals. Main topics are: optic microscopy, electron microscopy (TEM, SEM),electron microprobe analysis and X-ray diffractometry.

Brief outline of the course:
Optic microscopy. Electron microscopy: Electron beam instruments, Electron optics, Electron lences and deflection systems, Transmission electron microscopy - principle and construction. Electron – specimen interactions. Electron diffraction. Kikuchy lines. Scanning electron microscopy – principle and cnstrucion. Scanning transmission electron microscopy. High Voltage electron microscopy. Electron microprobe analysis: WDX spectrometer, EDX spectrometer, Auger electron spectrometer. Self-emision microscopy. Convergent beam diffraction.
X-ray diffractometry: Scattering of x-rays, Neutrons and neutron scattering, CW - diffractometer, Ewald´s sphere, Diffraction on powder samples, The main characteristics of powder diffraction pattern, Structure factor, Ocupation factor, Atomic displacement factor, Peak intensity, shape and symmetry, Sherrer equation. Peak profile, Rietweld method. Qualitative phase analysis, parameters of elementary cell, Profile analysis of diffraction peak and interpretation of profile analysis.

Recommended literature:
1. P. Sovák et al, Vybrané moderné metódy štruktúrnej analýzy kovov, VŠ učebné texty, UPJŠ, 2007
2. P.W. Hawkes, J.C.H Spence, Science of Microscopy, Springer, ISBN10: 0-387-25296-7, 2007
3. C. B. Carter, J. B. Williams, Transmission electron microscopy, ISBN 978-0-387-76500-6, 2012
4.Structure Determination from Powder Diffraction Data, Edited by W.I.F. David, K. Shankland, L.B. McCusker, C. Bärlocher, Oxford University Press, 2006

Course language:
1. English

Notes:

Course assessment
Total number of assessed students: 86

A	B	C	D	E	FX	N	P
39.53	22.09	8.14	1.16	0.0	0.0	0.0	29.07

Provides: prof. RNDr. Pavol Sovák, CSc., doc. Ing. Karel Saksl, DrSc., Ing. Vladimír Girman, PhD.

Date of last modification: 28.06.2021

Approved:

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚFV/ MPN/14	**Course name:** Methods of preparation and characterization of nanostructures

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: 3

Recommended semester/trimester of the course: 2.

Course level: II.

Prerequisities:

Conditions for course completion:
powerpoint review of selected topic

Learning outcomes:
The goal of this course is to make an overview of methods used for fabrication of nanostructures and nanodevices.

Brief outline of the course:
This course teaches student about methods for fabrication of microelectromechanical devices, microanalytical devices and nanoobjects using top-down methods. I will make an overview of forces acting upon nanoobjects, thermodynamics on nanoscale. Overview of thin film preparation methods will be also given. I will talk about conventional and unconventional nanopatterning methods. Also application of nanostructures in fundamental and applied science will be described. Part of this course is also laboratory practice.

Recommended literature:
1. B. Bhushan Ed., Handbook of nanotechnology, Springer Academic Publishers, 2nd edition, 2007.
2. J. A. Rogers, H. H. Lee, Unconventional nanopatterning techniques and applications, Wiley, 1990.
3. G. Hornyak, J. Dutta, H. F. Tibbals, A. K. Rao, Introduction to nanocience CRC Press, 2008.
4. G. A. Ozin, A. C. Arsenault, L. Cademartiri, Nanochemistry A Chemical Approach to Nanomaterials, RSC Publishing, 2005.

Course language:
Slovak, English

Notes:

Course assessment
Total number of assessed students: 48

A	B	C	D	E	FX	N	P
50.0	12.5	6.25	0.0	0.0	0.0	0.0	31.25

Provides: Mgr. Vladimír Komanický, Ph.D.
Date of last modification: 29.03.2020
Approved:

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚFV/ NANO/09	**Course name:** Nanomaterials and Nanotechnologies

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

Number of ECTS credits: 4

Recommended semester/trimester of the course: 2.

Course level: II., III.

Prerequisities:

Conditions for course completion:
Test or preparation of the ppt presentation on a selected topic in the field of nanomaterials.

Learning outcomes:
To acquaint students with the basic concepts of nanotechnology and to bring them knowledge about physical and chemical properties of nanomaterials. Provide students with a comprehensive view of the wide applications using nanomaterials.

Brief outline of the course:
Classification of nanomaterials (thin films and surfaces, carbon nanotubes, inorganic nanotubes, nanodots, biopolymers, nanoparticles, nanocomposites, fullerenes, dendrimers, quantum dots). Nanomanufacturing and fabrication techniques (chemical synthesis: reverse micelle method, sol-gel method, precipitation, self- assembly, positional assembly, chemical vapour deposition, MBE molecular beam epitaxy, ultra-precision, , lithography, SPD (spark plasma deposition). Possible adverse health, environmental and safety impacts. Magnetic nanomaterials, physical properties and structural properties of nanomaterials (superparamagnetism, quantum size effect, quantum of magnetization, effect of monodomains particles). Magnetic nanomaterials as advanced materials for information technology, biotechnology and industry.

Recommended literature:
1. Nanoscience and nanotechnologies, The Royal Society, London 2004.
2. C. Burda, X. Chen, et al., Chemical Review 105, (2005) 1025-1102.
3. J. A. Mydosh, Spin glasses, Taylor and Francis 1993.

Course language:

Notes:
Week 1:
Definition, history, present and future of nanotechnologies. Basic concepts and metrology in nanotechnologies.
Week 2:
Nanomaterials in 1D dimension: thin films, thin films and surfaces; nanomaterials in 2D dimensions: carbon nanotubes, inorganic nanotubes, nanowires, biopolymers, nanomaterials in 3D dimensions: nanoparticles, fullerenes, dendrimers, and quantum dots.

Week 3:
Preparation of nanomaterials. Preparation of nanomaterials by bottom-up techniques: chemical syntheses (micelle method, reverse micelle method, sol-gel method, precipitation), self-assembly, controlled assembly, spin coating, dip coating.
Week 4:
Bottom-up techniques PVD, CVD method (physical/chemical vapor deposition), MBE method (molecular beam epitaxy).
Week 5:
Preparation of nanomaterials by top-down techniques: cutting, grating, etching, lithography, SPD (spark plasma deposition).
Week 6:
Nnaocarbon: fullerens, nanocons, carnon nanotubes (SWCNT, MWCNT), properties and applications
Week 7:
Nanogold. Suface plasmon resonance. Preparation and classification nanogold materials.
Week 8:
Origin of nanomagnetism. Density of electron states.
Week 9:
The phenomenon of superparamagnetism in magnetic nanomaterials. Behavior of spin glass, comparison of theoretical models and experiment. Nanomagnetic models. Modeling of physical and structural properties of magnetic nanomaterials
Week 10:
Magnetic nanomaterials in biotechnology and nano-medicine: drug carriers, DNA chips, materials for MRI (magnetic resonance imaging), nanomaterials in the treatment of cancer.
Week 11:
Magnetic nanomaterials for industrial catalysis and gas separation: nanoparticles in ordered porous matrices.
Week 12:
Magnetic nanomaterials in information-telecommunication technologies and optoelectronics: computer chips, high-density recording media, hard disks, memories, sensors, quantum cryptographs, photon crystals for quantum computers.

Course assessment
Total number of assessed students: 42

A	B	C	D	E	FX	N	P
40.48	0.0	0.0	0.0	0.0	0.0	0.0	59.52

Provides: doc. RNDr. Adriana Zeleňáková, PhD.

Date of last modification: 25.03.2021

Approved:

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚFV/ NAS/14	**Course name:** Nanoscopic systems

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:
Test or preparation of the ppt presentation on a selected topic in the field of nanoscale systems.

Learning outcomes:
Knowledge and understanding of nanotechnology with special emphasis on the physicochemical and physical principles in nanotechnology. Students gain knowledge in areas such as electronic structure of nanosystems, magnetic properties, dependence of thermodynamic properties on the size of the systems as well as an overview of the application potential of nanosystems and ethical implications of nanotechnology.

Brief outline of the course:
The Origin of Nanomagnetic Behavior. Sample Dimensions and Characteristic Lengths. Dimensionality and Density of Electronic States. Dimensionality and Reduced Coordination Number. Nanoscopic Samples and Proportion of Surface Atoms. Nanoscopic Samples and Magnetization Reversal. Dimensionality and Critical Behavior. Superparamagnetism. Magnetic behavior of nanosystems at different temperature. The practical application of nanoscopic systems.

Recommended literature:
1. Emil Roduner, Nanoscopic Materials: Size-Dependent Phenomena, RSC Publishing 2006, ISBN: 0 85404 857.

Course language:
slovak, english

Notes:
1. The Origin of Nanomagnetic Behavior.
2. Sample Dimensions and Characteristic Lengths.
3. Dimensionality and Density of Electronic States.
4. Dimensionality and Reduced Coordination Number.
5. Nanoscopic Samples and Proportion of Surface Atoms.
6. Nanoscopic Samples and Magnetization Reversal.
7. Dimensionality and Critical Behavior.
8. Superparamagnetism.
9. Magnetic behavior of nanosystems at different temperature.

10. Termodynamical behavior of nanosystems.
11. The practical application of nanoscopic systems.

Course assessment
Total number of assessed students: 3

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

Provides: doc. RNDr. Adriana Zeleňáková, PhD.

Date of last modification: 25.03.2021

Approved:

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚFV/ NERO/14	**Course name:** Neutron scattering in 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: 3.

Course level: II.

Prerequisities:

Conditions for course completion:
Final exam

Learning outcomes:
Lectures are devoted to the description of experimental methods based on elastic and inelastic neutron scattering and its application in condensed matter physics and materials research. Analysis and interpretation of experimental data will be shown for specific cases.

Brief outline of the course:
1. week: Properties of neutron, neutron scattering from a fixed point, cross section.
2. week: Law of neutron scattering, intensity of scattered neutrons.
3. week: Fermi's golden rule, coherent and incoherent scattering, dynamic structure factor.
4.-5. week: Diffraction, static structure factor, Bragg's law, reciprocal lattice.
6. week: small angle scattering, critical and diffusive scattering.
7. week: inelastic and quasi-elastic scattering.
8. week: Application of inelastic neutron scattering for the study of phonons and magnetic excitation spectra.
9. week: neutron source, two-axes and thee-axes spectrometer.
10. week: chopper time-of-flight spectrometer.
11. week: aplication of polarized neutrons.
12. week: determination of magnetic structure using neutrons.

Recommended literature:
Smetana, Šíma, Neutronová difrakce, MFF UK, Praha, 1982;Dianoux, Lander, Neutron Data Booklet, OCP Science, Grenoble, 2003; Pynn, A Neutron Scattering Primer, LANCSE, Los Alamos, 1990; http://www.ill.fr; http://www.isis.rl.ac.uk; http://www.esrf.fr

Course language:
english

Notes:

Course assessment
Total number of assessed students: 11

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

Provides: RNDr. Róbert Tarasenko, PhD.

Date of last modification: 31.08.2021

Approved:

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚFV/ NKM1/99	**Course name:** Non-Conventionals Metallic Materials

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

Number of ECTS credits: 3

Recommended semester/trimester of the course: 1.

Course level: II., III.

Prerequisities:

Conditions for course completion:
The final exam consists of written and oral examination.

Learning outcomes:
The course gives information about basics of materials science, standard and advanced materials, and relations between structure states and mechanical and physical properties of metalic alloys.

Brief outline of the course:
Real metalic structures, Binary diagrams, Lattice imperfections, hyperstructures, Streghtening mechanisms, Precipitation and segregation processes, Defomation mechanisms, Crystallization. Fe - based alloys, advanced high-strenght alloys. Metallic biomaterials. Corrosive processes and materials for corrosion environment. Ti, Al, Co, Ni - based progressive materials. Materials dedicated to automotive, aircraft, armament and nuclear industry. Superplasticity, shape memory effect and its alloys. Materials for cryogenic applications. Intermetallics. Quasicrystals. High entropy alloys. Biodegradable metals. Metallic glasses.

Recommended literature:
W. D. Callister Jr., D. G. Rethwisch, Materials Science and Engineering: An Introduction, 10th Edition, ISBN 978-1-119-40549-8, 2018
L. Ptáček a kol.: Náuka o materiálu I a II, ISBN 8072042483, 2002
Š. Nižník: Základy Fyziky tuhých látok, Učebné texty, Košice, 2002
M. Fujda: Základné rovnovážne diagramy, Učebné texty, košice, 2010

Course language:
Slovak language

Notes:
None.

Course assessment
Total number of assessed students: 34

A	B	C	D	E	FX	N	P
35.29	17.65	0.0	2.94	2.94	0.0	0.0	41.18

Provides: Ing. Vladimír Girman, PhD.
Date of last modification: 28.06.2021
Approved:

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:
Monitoring progress in solving applied projects.
examination (50%), quality of the project (50%)
examination

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.

Brief outline of the course:
Fundamentals of optimization theory. Basic optimization problems. Basic types of objective functions. Classification of optimization techniques. Gradient-based optimization techniques. Evolutionary algorithms. Genetic algorithms. Genetic algorithms as Markov processes. Statistical Mechanics Approximations of Genetic Algorithms. Monte Carlo simulation and simulated annealing. Swarm optimization. Cellular Automata and their applications in simulations of complex systems. Fractals. Agent-based models. Evolutionary games. Evolution of cooperation. Fundamentals of Neural Networks. Application of singular value decomposition to solve least squares problems.

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

Course language:

Notes:

Course assessment
Total number of assessed students: 85

A	B	C	D	E	FX
69.41	16.47	8.24	2.35	3.53	0.0

Provides: doc. RNDr. Jozef Uličný, CSc.

Date of last modification: 03.05.2015

Approved:

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:
Oral examination

Learning outcomes:
To acquaint students with based problems of the phase transitions and critical phenomena.

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. Phenomenological theory of phase transitions.
12. Landau's theory of phase transitions.

Recommended literature:
Basic literature:
- A. Bobák, 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, Singapore, 1994.
- Kadanoff L.P.: Statistical Physics, Statistics, Dynamics and Renormalization, World Scientific, Singapore, 2000.

Course language:
1. Slovak,
2. English

Notes:

Course assessment
Total number of assessed students: 122

A	B	C	D	E	FX
56.56	11.48	11.48	14.75	5.74	0.0

Provides: prof. RNDr. Andrej Bobák, DrSc., prof. RNDr. Milan Žukovič, PhD.

Date of last modification: 01.07.2021

Approved:

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚFV/ LEK1/02	**Course name:** Physical Principles of Medical Diagnostics and Therapy

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

Number of ECTS credits: 2

Recommended semester/trimester of the course: 1., 3.

Course level: II.

Prerequisities:

Conditions for course completion:

Learning outcomes:

Brief outline of the course:

Recommended literature:

Course language:

Notes:

Course assessment
Total number of assessed students: 35

A	B	C	D	E	FX
85.71	11.43	2.86	0.0	0.0	0.0

Provides: doc. RNDr. Karol Flachbart, DrSc.

Date of last modification: 03.05.2015

Approved:

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚFV/FRKP/19	**Course name:** Physical realization of quantum computer

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., 4.

Course level: II.

Prerequisities: ÚFV/KVM I/11

Conditions for course completion:

Learning outcomes:

Brief outline of the course:

Recommended literature:

Course language:

Notes:

Course assessment
Total number of assessed students: 4

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

Provides: Mgr. Tomáš Samuely, PhD., doc. RNDr. Erik Čižmár, PhD.

Date of last modification: 18.08.2021

Approved:

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚFV/FTV/14	**Course name:** Physics and technics of vacuum

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:
Final test exam.

Learning outcomes:
Overview of basic topics in vacuum physics - volume transport properties of gas, gas flow, gas on solids. Principles of the measurement and creation of low pressure conditions. Basics of the vacuum equipment construction and the leak-tightness testing. The use of vacuum technology in advanced material preparation and cryogenics.

Brief outline of the course:
1. Overview of the basic topic in low pressure physics based on the kinetic theory of gases. Mean-free path, energy distibution of gas particles.
2. Volume transport properties of gas - diffusion, viskosity.
3. Volume transport gas properties - thermal conductivity and thermal transpiration.
4. Gas flow, definition of throughput and conductivity. Viscous flow.
5. Molecular flow. Viscous-molecular flow.
6. Surface effects, adsorbtion and desorbtion, adsorbtion isoterms.
7. Non-equillibrium surface effects. Transport of adsorbed molecules, migration, evaporation.
8. Gas flow through leak - capillary, capillary condensation, gas flow through porous material. Permeation.
9. Characterization of the pumping system.
10. Low-pressure production - mechanical (rotary vane pump, Roots pump, oil-vapor diffusion pump, turbomolecular pump), ion, sorbtion pumps.
11. Total and partial pressure measurement.
12. Leak testing methods, mass spectrometer, design of vacuum ducts.

Recommended literature:
J.F. O'Hanlon, A User's Guide to Vacuum Technology, Wiley-Interscience; 2003;

Course language:
Slovak, partially 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. Erik Čižmár, PhD.

Date of last modification: 18.08.2021

Approved:

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚFV/ FMT/07	**Course name:** Physics of Materials

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:
70% written test
30% exam

Learning outcomes:
The course gives basic information about Physics of Metals. Main topics are: diffusion in metals, classification of surfaces, models of grain boundary, segregation kinetics, dislocations, plastic deformation.

Brief outline of the course:
Imperfections in crystal lattice. Diffusion in metals: 1st and 2nd Fick's laws, diffusion coefficient, solution of Ficks' laws for different marginal conditions, Kirkendall effect, diffusion-controlled growth of precipitates, up-hill diffusion, diffusion in dilute and alloy systems. Experimental methods of diffusion coefficient determination.
Classification of surfaces, models of grain boundary. Grain boundary segregation in solids: equilibrium segregation (McLean's and Guttmann's models), site competition effect, non-equilibrium segregation, segregation kinetics.
Dislocations: classification, properties, movement and dislocation reactions. Dilocation structure in bcc, fcc and hcp lattice. Elastic deformation. Elastic stretching. Plastic deformation. Mechanism of strain hardening. Mechanical properties and behaviour. Creep, Stress, Rupture and Stress Corrosion.

Recommended literature:
1.Heumann: Diffusion in Metallen, Springer-Verlag, Berlin 1992 (in German).
2. W. Cahn and P. Haasen: Physical Metallurgy, Elsevier Science Publishers, Amsterdam 1996.Shewmon: Diffusion in solids, TMS, Warrendale 1989.
3. D.R. Askeland, P. Phulé, The Science and Engineering of Materials, Thomson, 2003.

Course language:
english

Notes:

Course assessment
Total number of assessed students: 14

A	B	C	D	E	FX
64.29	14.29	21.43	0.0	0.0	0.0

Provides: prof. RNDr. Pavol Sovák, CSc.

Date of last modification: 03.05.2015

Approved:

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚFV/PP1/99	**Course name:** Physics of Semiconductor Elements

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:
Exam, its contents is given by topics of lectures.

Learning outcomes:
Acquiring knowledge about principle of operation of semiconductor elements and their applications in experimental research and technology.

Brief outline of the course:
Basic properties of semiconductors. Termistors. Hall device, magnetoresistor, cryosar, Gunn device, varistor, tensoelektric elements. Semiconductor devices with one PN junction. Bipolar junction transistor. Junction field-effect transistors. MOS field-effect transistors. Contact metall-semiconductor. Silicon chip technology and fabrication techniques. Optoelektronic devices. Charge coupled devices

Recommended literature:
D.J. Roulston, An introduction to the physics of semiconductor devices, Oxford University Press, 1999

Course language:
english

Notes:

Course assessment
Total number of assessed students: 25

A	B	C	D	E	FX
76.0	16.0	8.0	0.0	0.0	0.0

Provides: prof. RNDr. Peter Kollár, DrSc.

Date of last modification: 03.05.2015

Approved:

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚFV/ PCHZ/14	**Course name:** Preparation and characterization of metalic alloys

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: 3.

Course level: II.

Prerequisities:

Conditions for course completion:
Active participation and preparation of measurement protocols.

Learning outcomes:
The ability of individually production of metal alloys using arc melting, casting into a copper mold, melt spinning, milling etc..

Brief outline of the course:
Production of alloys using arc melting. Production of alloys using casting into a copper mold. Production of alloys using melt spinning method. Production of alloys by milling of precursor.

Recommended literature:
Hilzinger R, Rodewald W, Magnetic materials, Vacuumschmelze, 2013
Chen CW, Magnetism and metalurgy of soft magnetic materials, Dover publications, 1986

Course language:
slovak or english

Notes:

Course assessment
Total number of assessed students: 18

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

Provides: Mgr. Vladimír Komanický, Ph.D., doc. RNDr. Ján Füzer, PhD., RNDr. Ladislav Galdun, PhD.

Date of last modification: 03.05.2015

Approved:

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:

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:

Learning outcomes:

Brief outline of the course:
The definition of basic lattice-statistical models in the quantum theory of magnetism. The one-dimensional quantum Heisenberg model, spin waves and the grounds of Bethe-ansatz method. Valence-bond-crystal ground states of the Majumdar-Ghosh and Shastry-Sutherland models. The one-dimensional quantum XY model in a transverse magnetic field, Jordan-Wigner fermionization and quantum critical points. The spin-wave theory, bosonization and 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:

Course assessment
Total number of assessed students: 22

A	B	C	D	E	FX	N	P
13.64	36.36	18.18	4.55	9.09	4.55	0.0	13.64

Provides: doc. RNDr. Jozef Strečka, PhD.

Date of last modification: 03.05.2015

Approved:

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚFV/ RPM/14	**Course name:** Relaxation processes in molecular magnets

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

Number of ECTS credits: 2

Recommended semester/trimester of the course: 1., 3.

Course level: II.

Prerequisities:

Conditions for course completion:
Discussion accompanied with the preparation and presentation of a short project

Learning outcomes:
Student obtains basic knowledge about the dynamics of the energy transport between a lattice and spins, so called relaxation phenomena, demonstrating in spectroscopy, ac susceptibility, ac calorimetry, thermal conductivity, etc.

Brief outline of the course:
Spin-spin interactions. Interaction of spin with electromagnetic field. Spin-lattice relaxation due to phonons – Waller's mechanism. Spin-lattice relaxation due to crystal field modulation. Direct process. Orbach process. Raman process of the first and second order. Phonon bottleneck effect. Thermally activated magnetic relaxation. Superparamagnetism. Neél-Arrhenious law. Blocking temperature. Relaxation due to quantum tunnelling. Thermally asisted quantum tunnelling. Relaxation processes due to localized modes. E´ centres. „Rattling“ modes. Optical modes. Casimir and du Pré theory. Ac susceptibility. Cole-Cole diagram. Debye relaxation. Distribution of relaxation times. Examples of spin-lattice relaxation in molecular and single-ion magnets. Observation of relaxation phenomena using various experimental techniques.

Recommended literature:
1. D. Gatteschi et al. Molecular Nanomagnets, Oxford University Press, 2006.
2. A. Abragam and B. Bleaney, Electron Paramagnetic Resonance of Transition Ions, Clarendon Press Oxford 2012.

Course language:
english

Notes:

Course assessment
Total number of assessed students: 2

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

Provides: doc. RNDr. Alžbeta Orendáčová, DrSc.
Date of last modification: 15.06.2021
Approved:

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚFV/ SKM/14	**Course name:** Scanning probes microscopy of nanostructures
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: exam	
Learning outcomes: The students will learn about various methods of visualization and fabrication of nanostructures on surfaces.	
Brief outline of the course: Historical overview of microscopy, resolution limits of optical microscopy. Scanning and transmission electron microscopy – principles and applications. Basics of tunneling spectroscopy, local density of electron states, molecular orbitals. Scanning tunneling microscopy of molecules and organic nanostructures. Principles of atomic force microscopy, imaging of organic nanostructures. Force curves method. Overview and basic principles of various other scanning probes microscopies (magnetic force microscopy, Kelvin probe microscopy, electrochemical scanning tunneling microscopy, scanning near-field optical microscopy etc.). Scanning probe microscopy at low temperatures and in ultra-high vacuum. Dynamic visualization by scanning probe microscopies. Manipulation of nanostructures using scanning probe microscopies. The course includes practical demonstrations of some of the discussed techniques in the laboratory.	
Recommended literature: 1. Roland Wiesendanger: Scanning Probe Microscopy and Spectroscopy: Methods and Applications, Cambridge University Press 1994 2. E.L. Wolf: Principles of electron tunneling spectroscopy, Oxford university press, 1989 3. N. Yao, Z. L. Wang (ed.), Handbook of microscopy for nanotechnology, Kluwer academic publishers 2005 4. P. Samuely (ed.), Kryofyzika a nanoelektronika, ÚEF SAV 2011	
Course language: Slovak or English	
Notes:	

Course assessment
Total number of assessed students: 12

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

Provides: Mgr. Tomáš Samuely, PhD.

Date of last modification: 03.05.2015

Approved:

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚTVŠ/ÚTVŠ/CM/13	**Course name:** Seaside Aerobic Exercise

Course type, scope and the method:
Course type: Practice
Recommended course-load (hours):
Per week: Per study period: 36s
Course method: combined, present

Number of ECTS credits: 2

Recommended semester/trimester of the course:

Course level: I., II.

Prerequisities:

Conditions for course completion:
Conditions for course completion:
Attendance

Learning outcomes:
Learning outcomes:
Students will be provided an overview of possibilities how to spend leisure time in seaside conditions actively and their skills in work and communication with clients will be improved. Students will acquire practical experience in organising the cultural and art-oriented events, with the aim to improve the stay and to create positive experiences for visitors.

Brief outline of the course:
Brief outline of the course:
1. Basics of seaside aerobics
2. Morning exercises
3. Pilates and its application in seaside conditions
4. Exercises for the spine
5. Yoga basics
6. Sport as a part of leisure time
7. Application of projects of productive spending of leisure time for different age and social groups (children, young people, elderly)
8. Application of seaside cultural and art-oriented activities in leisure time

Recommended literature:

Course language:

Notes:

Course assessment
Total number of assessed students: 41

abs	n
12.2	87.8

Provides: Mgr. Agata Horbacz, PhD.
Date of last modification: 15.03.2019
Approved:

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚFV/VPM/18	**Course name:** Selected problems of numerical methods in micro-magnetism

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

Number of ECTS credits: 2

Recommended semester/trimester of the course: 2., 4.

Course level: II., III.

Prerequisities:

Conditions for course completion:

Learning outcomes:

Brief outline of the course:

Recommended literature:

Course language:

Notes:

Course assessment
Total number of assessed students: 0

A	B	C	D	E	FX	N	P
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Provides: RNDr. Kornel Richter, PhD.

Date of last modification: 09.03.2018

Approved:

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚFV/SPFKLa/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:
Succesful meeting the goals formulated by the supervisor at the beginning of the semester in required extent.

Learning outcomes:
Students become familiar and obtain skills in scientific work related to experimental study of solids by involving them in solving scientific problems in research teams.

Brief outline of the course:
Solving of selected problems associated with experimental study in solid state physics.

Recommended literature:
Selected scientific journals and books.

Course language:
slovak, english

Notes:

Course assessment
Total number of assessed students: 29

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

Provides:

Date of last modification: 03.05.2015

Approved:

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚFV/ SPFKLb/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: 6

Recommended semester/trimester of the course: 2.

Course level: II.

Prerequisities: ÚFV/SPFKLa/14

Conditions for course completion:
Succesful meeting the goals formulated by the supervisor at the beginning of the semester in required extent.

Learning outcomes:
Students become familiar and obtain skills in scientific work related to experimental study of solids by involving them in solving scientific problems in research teams.

Brief outline of the course:
Solving of selected problems associated with experimental study in solid state physics.

Recommended literature:
Selected scientific journals and books.

Course language:
slovak, english

Notes:

Course assessment
Total number of assessed students: 30

A	B	C	D	E	FX
93.33	0.0	6.67	0.0	0.0	0.0

Provides:

Date of last modification: 03.05.2015

Approved:

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚFV/ SPFKLc/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: 6

Recommended semester/trimester of the course: 3.

Course level: II.

Prerequisities: ÚFV/SPFKLb/14

Conditions for course completion:
Succesful meeting the goals formulated by the supervisor at the beginning of the semester in required extent.

Learning outcomes:
Students become familiar and obtain skills in scientific work related to experimental study of solids by involving them in solving scientific problems in research teams.

Brief outline of the course:
Solving of selected problems associated with experimental study in solid state physics.

Recommended literature:
Selected scientific journals and books.

Course language:
slovak, english

Notes:

Course assessment
Total number of assessed students: 26

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

Provides: doc. RNDr. Alžbeta Orendáčová, DrSc., prof. Ing. Martin Orendáč, DrSc., doc. RNDr. Erik Čižmár, PhD., Mgr. Tomáš Samuely, PhD.

Date of last modification: 28.03.2020

Approved:

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚFV/ OSA1/99	**Course name:** Seminar in Solid State Physics

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

Number of ECTS credits: 1

Recommended semester/trimester of the course: 1.

Course level: II.

Prerequisities:

Conditions for course completion:
1. Participation on the seminars (valid also for on-line form of presentations). Students are obliged to participate on the seminars. Reasons should be given for any absence, students may absent up to twice per semester without further consequences. For more frequent absence student will prepare presentation focused on a topic which will be consulted with the supervisor of the seminar. Each student has to present at least one his/her contribution, usually before defending his/her diploma thesis.
2. Activity on the seminar, participation in discussion. Level of presenting student´s own presentation.

Learning outcomes:
Students will obtain informations about scientific results of various research groups from Košice and from their cooperating foreign institutions and will be stimulated for scientific discussion.

Brief outline of the course:
The program of seminars from condensed matter physics is prepared every year and is devoted to the recent results achieved in the field of condensed matter physics and material research at the laboratories in Košice and abroad. Scientific workers from laboratories from Košice as well as domestic and foreign guests give the talks. The program also involves presentation of PhD and diploma theses.

Recommended literature:
Scientific journals.

Course language:
slovak, english

Notes:

Course assessment
Total number of assessed students: 46

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

Provides: doc. RNDr. Alžbeta Orendáčová, DrSc., Dr.h.c. prof. RNDr. Alexander Feher, DrSc., prof. Ing. Martin Orendáč, DrSc.
Date of last modification: 02.07.2021
Approved:

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚFV/ OSB1/99	**Course name:** Seminar in Solid State Physics

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

Number of ECTS credits: 1

Recommended semester/trimester of the course: 2.

Course level: II.

Prerequisities:

Conditions for course completion:
1. Participation on the seminars (valid also for on-line form of presentations). Students are obliged to participate on the seminars. Reasons should be given for any absence, students may absent up to twice per semester without further consequences. For more frequent absence student will prepare presentation focused on a topic which will be consulted with the supervisor of the seminar. Each student has to present at least one his/her contribution, usually before defending his/her diploma thesis.
2. Activity on the seminar, participation in discussion. Level of presenting student´s own presentation.

Learning outcomes:
Students will obtain informations about scientific results of various research groups from Košice and from their cooperating foreign institutions and will be stimulated for scientific discussion.

Brief outline of the course:
The program of seminars from condensed matter physics is prepared every year and is devoted to the recent results achieved in the field of condensed matter physics and material research at the laboratories in Košice and abroad. Scientific workers from laboratories from Košice as well as domestic and foreign guests give the talks. The program also involves presentation of PhD and diploma theses.

Recommended literature:
Scientific journals.

Course language:
slovak, english

Notes:

Course assessment
Total number of assessed students: 46

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

Provides: doc. RNDr. Alžbeta Orendáčová, DrSc., prof. Ing. Martin Orendáč, DrSc.
Date of last modification: 02.07.2021
Approved:

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚFV/ OSC1/99	**Course name:** Seminar in Solid State Physics

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

Number of ECTS credits: 1

Recommended semester/trimester of the course: 3.

Course level: II.

Prerequisities:

Conditions for course completion:
1. Participation on the seminars (valid also for on-line form of presentations). Students are obliged to participate on the seminars. Reasons should be given for any absence, students may absent up to twice per semester without further consequences. For more frequent absence student will prepare presentation focused on a topic which will be consulted with the supervisor of the seminar. Each student has to present at least one his/her contribution, usually before defending his/her diploma thesis.
2. Activity on the seminar, participation in discussion. Level of presenting student´s own presentation.

Learning outcomes:
Students will obtain informations about scientific results of various research groups from Košice and from their cooperating foreign institutions and will be stimulated for scientific discussion.

Brief outline of the course:
The program of seminars from condensed matter physics is prepared every year and is devoted to the recent results achieved in the field of condensed matter physics and material research at the laboratories in Košice and abroad. Scientific workers from laboratories from Košice as well as domestic and foreign guests give the talks. The program also involves presentation of PhD and diploma theses.

Recommended literature:
Scientific journals.

Course language:
slovak, english

Notes:

Course assessment
Total number of assessed students: 46

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

Provides: Dr.h.c. prof. RNDr. Alexander Feher, DrSc., prof. Ing. Martin Orendáč, DrSc.
Date of last modification: 02.07.2021
Approved:

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚFV/ OSD1/99	**Course name:** Seminar in Solid State Physics

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

Number of ECTS credits: 1

Recommended semester/trimester of the course: 4.

Course level: II.

Prerequisities:

Conditions for course completion:
1. Participation on the seminars (valid also for on-line form of presentations). Students are obliged to participate on the seminars. Reasons should be given for any absence, students may absent up to twice per semester without further consequences. For more frequent absence student will prepare presentation focused on a topic which will be consulted with the supervisor of the seminar. Each student has to present at least one his/her contribution, usually before defending his/her diploma thesis.
2. Activity on the seminar, participation in discussion. Level of presenting student´s own presentation.

Learning outcomes:
Students will obtain informations about scientific results of various research groups from Košice and from their cooperating foreign institutions and will be stimulated for scientific discussion.

Brief outline of the course:
The program of seminars from condensed matter physics is prepared every year and is devoted to the recent results achieved in the field of condensed matter physics and material research at the laboratories in Košice and abroad. Scientific workers from laboratories from Košice as well as domestic and foreign guests give the talks. The program also involves presentation of PhD and diploma theses.

Recommended literature:
Scientific journals.

Course language:
slovak, english

Notes:

Course assessment
Total number of assessed students: 47

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

Provides: Dr.h.c. prof. RNDr. Alexander Feher, DrSc., prof. Ing. Martin Orendáč, DrSc.
Date of last modification: 02.07.2021
Approved:

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚFV/SAA/18	**Course name:** Sensors and actuators based on selected physical phenomena

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

Number of ECTS credits: 2

Recommended semester/trimester of the course: 2., 4.

Course level: II., III.

Prerequisities:

Conditions for course completion:

Learning outcomes:

Brief outline of the course:

Recommended literature:

Course language:

Notes:

Course assessment
Total number of assessed students: 3

A	B	C	D	E	FX	N	P
33.33	0.0	0.0	0.0	0.0	0.0	0.0	66.67

Provides: prof. RNDr. Rastislav Varga, DrSc., RNDr. Ladislav Galdun, PhD.

Date of last modification: 09.03.2018

Approved:

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: 11.02.2021

Approved:

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚFV/ SPE1/03	**Course name:** Solid State Spectroscopy

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: 5

Recommended semester/trimester of the course: 3.

Course level: II.

Prerequisities:

Conditions for course completion:
Exam interwiew.

Learning outcomes:
Explanation of the principles and applications of the infrared and Raman spectroscopy and radiospectroscopy (electron paramagnetic resonance, nuclear magnetic resonance). The theoretical knowledge will be completed by the work in research laboratories.

Brief outline of the course:
Raman spectroscopy: interaction of light with condensed matter. Raman shift, Stokes and AntiStokes lines.Infrared spectroscopy: Harmonic and anharmonic oscilator. Vibrational spectra. IR spectrometers, techniques, sample preparation. NMR/EPR spectroscopy: Electron spin. Crystal field. Electron spectra and transitions. EPR technique. Interactions of nuclei with magnetic and electric fields. Nuclear paramagnetism. Continual wave and pulse nuclear magnetic resonance techniques. Relaxation processes in nuclear spin system. One dimensional 1H and 13C NMR of liquid samples. Two-dimensional NMR spectra. Principles, measuring techniques. Solid-state NMR. NMR of feromagnetics.

Recommended literature:
1. G. Schatz a A. Weidinger: Nuclear Condensed Matter Physics, Nuclear methods and applications, Wiley, 1996.
2. Slichter C. P.: Principles of Magnetic Resonance, Springer-Verlag, London, 1990.

Course language:
english

Notes:

Course assessment
Total number of assessed students: 43

A	B	C	D	E	FX
58.14	18.6	11.63	9.3	2.33	0.0

Provides: doc. RNDr. Alžbeta Orendáčová, DrSc., doc. RNDr. Ján Imrich, CSc., RNDr. Natália Tomašovičová, CSc.
Date of last modification: 23.06.2021
Approved:

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚFV/ SPR1/00	**Course name:** Special Practical Exercises I

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:

Conditions for course completion:
Participation in exercises, reports from all exercies.

Learning outcomes:
The objectives of the laboratory are:
a. To gain some physical inside into some of the concepts presented in the lectures.
b. To gain some practice in data collection, analysis and interpretation of resumance.
c. To gain experience and report writing presentation and results.

Brief outline of the course:
Measurement of basic magnetic properties at ac and dc magnetisation, domain structure observation.
Measurement of magnetic properties using a SQUID magnetometer. Measurement of the dynamics of domain walls and measurement of magnetostriction.

Recommended literature:
Tumanski S, Handbook of magnetic measurements, CRC press, 2011.
Fiorillo F, Characterization and Measurement of Magnetic Materials, Elsevier, 2004.
Dufek M., Hrabák J., Trnaka Z.: Magnetická měření, SNTL, 1964, Praha
Brož J. a kol.: Základy fysikálnich měření, SPN, 1974, Praha.

Course language:
Slovak or English

Notes:

Course assessment
Total number of assessed students: 33

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

Provides: doc. RNDr. Adriana Zeleňáková, PhD., doc. RNDr. Ján Füzer, PhD., RNDr. Ladislav Galdun, PhD.

Date of last modification: 28.09.2015

Approved:

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚFV/ SPR2/09	**Course name:** Special Practicum II

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: 4

Recommended semester/trimester of the course: 2.

Course level: II.

Prerequisities:

Conditions for course completion:
Theoretical background of the practices, the activities and knowledges by the experiments. The analysis of the experimental data and quality of the reports.
Summary of the work on practices (theoretical background of the practices, the activities and knowledges by the experiments. The analysis of the experimental data and quality of the reports.

Learning outcomes:
Obtaining fundamental theoretical, experimental skills and ability to analyze the obtained experimental data in selected areas of physical research in condensed matter, primarily at low temperatures.

Brief outline of the course:
Exercises n. 1. – 6. are given by prof. Ing. M. Orendáč, CSc., exercises n. 7. – 12. are given by doc. RNDr. E. Čižmár, PhD.
1.Calibration of resistance thermometers. Choice of a function for the analysis of the calibration curve, determination of the degree of the fitting polynom. Analysis of the temperature dependence of the relative deviation.
2. Determination of the magnitude of the spin from calorimetric data. Determination of the molar specific heat. Standard extrapolations for the calulation of the magnetic entropy at low and high temperatures. Calculation of contributions to magnetic entropy.
3. Magnetocaloric effect. Calculation of the temperature dependence of the isothermal change of magnetic entropy from calorimetric data. Comparisson of the data for quantum spin chain and S=1/2 paramagnet.
4. Study of spin dynamics from the data of alternating susceptibility. Cole – Cole diagram and its construction. Width of the distribution of relaxation times. Temperature dependence of relaxation processesin a selected model system.
5. Study of critical behavior from calorimetric data. Analysis of the specific heat data in a critical region for different magnetic fields. Critical indexes, their dependence on external magnetic field. Comparisson of the values of critical indexes with predictions from selected models.
6. Estimation of the saturation field (Hsat) from the energy gap in the excitation spectrum. Determination of the magnitude of the energy gaps from specific heat data obtained in high

(H>Hsat) magnetic fields. Study of the variation of the energy gap with alternating magnetic field. Estimation of the saturation magnetic field.
7. Vacuum technique. Methods of leak detection in vacuum systems.
8. Preparation of the samples. Specific heat measurements in cryogenic devices. Analysis and intrepretation of the experimental results.
9. Susceptibility and magnetization of magnetic systems. Preparation of the sample, setting sequence of measurement for SQUID magnetometer.
10. Analysis of the experimental data of magnetization and susceptibility (Curie – Weiss law, Brillouin function, determination of the nature of exchange coupling)
11. Electron paramagnetic resonance in magnetic systems. Preparation of the sample, collection of the data. Analysis of the obtained data (Determination of the anisotropy of g-factor, analysis of the resonance linewidth)
12. Electrical resistivity in normal metals and superconductors. Preparation of the sample, setting sequence of measurement for PPMS device. Analysis of the obtained data (determination of RRR, residual resistivity, critical temperature of a superconductor).

Recommended literature:

J. H. Moore and N. D. Spencer: Encyclopedia o Chemical Physics and Physical Chemistry Vol. I., II. and III., IoP Publishing Ltd. 2001, ISBN 0750303131.
Selected scientific publications.
E. Čižmár, Špeciálne praktikum II - štúdium magnetických vlastností tuhých látok, UPJŠ, 2016, Košice.

Course language:
Slovak, English

Notes:

Course assessment
Total number of assessed students: 31

A	B	C	D	E	FX	N	P
70.97	9.68	9.68	0.0	0.0	0.0	0.0	9.68

Provides: doc. RNDr. Erik Čižmár, PhD., prof. Ing. Martin Orendáč, DrSc.

Date of last modification: 25.08.2021

Approved:

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:** combined, 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:	
Course language:	
Notes:	

Course assessment
Total number of assessed students: 12859

abs	abs-A	abs-B	abs-C	abs-D	abs-E	n	neabs
87.01	0.08	0.0	0.0	0.0	0.04	8.1	4.77

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

Date of last modification: 13.05.2021

Approved:

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: combined, 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:

Course language:

Notes:

Course assessment
Total number of assessed students: 11675

abs	abs-A	abs-B	abs-C	abs-D	abs-E	n	neabs
84.52	0.56	0.02	0.0	0.0	0.05	10.63	4.22

Provides: Mgr. Agata Horbacz, PhD., Mgr. Dávid Kaško, PhD., Mgr. Zuzana Küchelová, PhD., doc. PaedDr. Ivan Uher, PhD., prof. RNDr. Stanislav Vokál, DrSc., Mgr. Marcel Čurgali, Mgr. Patrik Berta, Mgr. Ladislav Kručanica, PhD., Bc. Richard Melichar, Mgr. Petra Tomková, PhD.
Date of last modification: 13.05.2021
Approved:

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: combined, 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:

Course language:

Notes:

Course assessment
Total number of assessed students: 7873

abs	abs-A	abs-B	abs-C	abs-D	abs-E	n	neabs
88.8	0.05	0.01	0.0	0.0	0.03	4.08	7.04

Provides: Mgr. Marcel Čurgali, Mgr. Agata Horbacz, PhD., Mgr. Dávid Kaško, PhD., Mgr. Zuzana Küchelová, PhD., doc. PaedDr. Ivan Uher, PhD., prof. RNDr. Stanislav Vokál, DrSc., Mgr. Patrik Berta, Mgr. Ladislav Kručanica, PhD., Bc. Richard Melichar, Mgr. Petra Tomková, PhD.
Date of last modification: 13.05.2021
Approved:

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: combined, 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:

Course language:

Notes:

Course assessment
Total number of assessed students: 5125

abs	abs-A	abs-B	abs-C	abs-D	abs-E	n	neabs
83.14	0.31	0.04	0.0	0.0	0.0	7.75	8.76

Provides: Mgr. Marcel Čurgali, Mgr. Agata Horbacz, PhD., Mgr. Dávid Kaško, PhD., Mgr. Zuzana Küchelová, PhD., doc. PaedDr. Ivan Uher, PhD., prof. RNDr. Stanislav Vokál, DrSc., Mgr. Patrik Berta, Mgr. Ladislav Kručanica, PhD., Bc. Richard Melichar, Mgr. Petra Tomková, PhD.
Date of last modification: 13.05.2021
Approved:

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚFV/ XRAY/20	**Course name:** Structure characterization by X-ray based techniques

Course type, scope and the method:
Course type: Lecture / Practice
Recommended course-load (hours):
Per week: 2 / 0 **Per study period:** 28 / 0
Course method: present

Number of ECTS credits: 3

Recommended semester/trimester of the course: 2.

Course level: II., III.

Prerequisities:

Conditions for course completion:

Learning outcomes:
To understand basic concepts of the X-ray crystallography and X-ray powder diffraction. Be able to perform phase analysis, refine the value of the lattice constant and estimate the average grain size from raw diffraction data. To understand basic concepts of the synchrotron radiation and its properties. Get familiarized with selected scattering, spectroscopy and imaging techniques utilizing synchrotron radiation.

Brief outline of the course:
X-rays are a unique tool to characterize the atomic and electronic structure of many materials, including periodic/ordered and non-periodic/disordered systems. X-ray diffraction and scattering methods provide structural information of mainly periodic systems down to atomic resolution. The course is divided in two sections. The first part covers basic concepts of the X-ray crystallography and X-ray powder diffraction, which represents one of the most essential tools in the structural characterization of materials. The first part is complemented with a hands-on laboratory section which aims to prepare reader to be able to independently deploy the technique for use in own research. The second part of the course covers basics concepts of the synchrotron radiation. Perspective reader will learn about unique properties of synchrotron radiation and its use in various scattering, spectroscopy and imaging techniques. The layout of typical synchrotron beamline with all essential components (monochromator, mirrors, focusing lenses, slit systems, sample stage and detectors) will be presented. Experimental techniques such as Small Angle X-ray Scattering (SAXS), Pair Distribution Function (PDF), X-ray Absorption Spectroscopy and X-ray Computed Tomography will be introduced in more details. At the end there will be a lesson covering recent development in the emerging field of X-ray Free Electron Lasers (XFELs)

Recommended literature:
[1] V. K. Pecharsky and P. Y. Zavalij, „Fundamentals of Powder Diffraction and Structural Characterization of Materials“, Springer, New York, 2005.
[2] D. Attwood and A. Sakdinawat, „X-Rays and Extreme Ultraviolet Radiation: Principles and Applications“, 2nd Edition, Cambridge University Press, 2016.
[3] M. Watanabe, S. Sato, I. Munro and G.S. Lodha, „A Guide to Synchrotron Radiation Science“, Narosa Publishing House. New Delhi, 2016

[4] U. Bergmann, V. K. Yachandra and J. Yano, „ X-Ray Free Electron Lasers: Applications in Materials, Chemistry and Biology“, The Royal Society of Chemistry, London, 2017

Course language:

Notes:

Course assessment
Total number of assessed students: 6

abs	n
100.0	0.0

Provides: RNDr. Jozef Bednarčík, PhD.

Date of last modification: 20.02.2020

Approved:

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚFV/ SVKK/99	**Course name:** Student Scientific Conference

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

Number of ECTS credits: 4

Recommended semester/trimester of the course: 2., 4.

Course level: II.

Prerequisities:

Conditions for course completion:
Research activities of a student during semester
Presentation of the achieved results at the Scientific Student Conference at the faculty level.

Learning outcomes:
Students will obtain experience with presentation of achieved scientific results.

Brief outline of the course:
As required by individual topics of research.

Recommended literature:
According to requirements of individual topics of student works

Course language:
slovak, english

Notes:

Course assessment
Total number of assessed students: 56

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

Provides: doc. RNDr. Adriana Zeleňáková, PhD.

Date of last modification: 03.05.2015

Approved:

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚTVŠ/ LKSp/13	**Course name:** Summer Course-Rafting of TISA River
Course type, scope and the method: **Course type:** Practice **Recommended course-load (hours):** **Per week: Per study period:** 36s **Course method:** present	
Number of ECTS credits: 2	
Recommended semester/trimester of the course:	
Course level: I., II.	
Prerequisities:	
Conditions for course completion: Conditions for course completion: Attendance Final assessment: Raft control on the waterway (attended/not attended)	
Learning outcomes: Learning outcomes: Students have knowledge of rafts (canoe) and their control on waterway.	
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:	
Course language:	
Notes:	

Course assessment Total number of assessed students: 153	
abs	n
45.75	54.25
Provides: Mgr. Dávid Kaško, PhD.	
Date of last modification: 18.03.2019	
Approved:	

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚFV/FPO/14	**Course name:** Surface science

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

Number of ECTS credits: 3

Recommended semester/trimester of the course: 1.

Course level: II.

Prerequisities:

Conditions for course completion:
report from selected scientific problems, exam

Learning outcomes:
The goal of this course is to introduce student to theory and physical properties of surfaces, processes and phenomena on surfaces and methods used for their study.

Brief outline of the course:
In the introduction i will make general overview of terminology in physics of surfaces, electronic structure of solids with application to surfaces. I will make detailed overview of experimental methods used for surface characterization. Student will learn about theory of adsorption and diffusion on surfaces, with thermodynamics and kinetics of processes on surfaces and growth of layers. I will show examples of physical and chemical processes on surfaces in real applications. Student will gain basic knowledge about theory of interfaces and about processes stimulated by laser and electrons and about manipulation on surfaces on nanoscale.

Recommended literature:
1. K. W. Kolasinski, Surface Science Foundations of Catalysis and Nanoscience, John Wiley and Sons, Ltd. 2008. 2. Ch. Kittel, Introduction to Solid State Physics, 7th edition, John Wiley and Sons, 1995. 3. A. Zangwill Physics at Surfaces, Cambridge university press, 1988

Course language:
slovak, english

Notes:

Course assessment
Total number of assessed students: 20

A	B	C	D	E	FX
60.0	40.0	0.0	0.0	0.0	0.0

Provides: Mgr. Vladimír Komanický, Ph.D.

Date of last modification: 03.05.2015

Approved:

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚTVŠ/ KP/12	**Course name:** Survival Course
Course type, scope and the method: **Course type:** Practice **Recommended course-load (hours):** **Per week: Per study period:** 36s **Course method:** combined, present	
Number of ECTS credits: 2	
Recommended semester/trimester of the course:	
Course level: I., II.	
Prerequisities:	
Conditions for course completion: Conditions for course completion: Attendance Final assessment: continuous fulfilment of all tasks within the course	
Learning outcomes: Learning outcomes: Students will be familiarized with principles of safe stay and movement in extreme natural conditions as they will obtain theoretical knowledge and practical skills to solve the extraordinary and demanding situations connected with survival and minimization of damage to health. The course develops team work and students will learn how to manage and face the situations that require overcoming of obstacles.	
Brief outline of the course: Brief outline of the course: Lectures: 1. Principles of behaviour and safety for movement and stay in unknown mountains 2. Preparation and leadership of tour 3. Objective and subjective danger in mountains 4. Principles of hygiene and prevention of damage to health in extreme conditions Exercises: 1. Movement in terrain, orientation and navigation in terrain (compasses, GPS) 2. Preparation of improvised overnight stay 3. Water treatment and food preparation.	
Recommended literature:	
Course language:	
Notes:	

Course assessment Total number of assessed students: 393	
abs	n
44.53	55.47
Provides: MUDr. Peter Dombrovský, Mgr. Ladislav Kručanica, PhD.	
Date of last modification: 15.03.2019	
Approved:	

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚFV/ ZTE/03	**Course name:** Technology of Condensed Maters
Course type, scope and the method: **Course type:** Lecture **Recommended course-load (hours):** **Per week:** 2 **Per study period:** 28 **Course method:** present	
Number of ECTS credits: 3	
Recommended semester/trimester of the course: 1.	
Course level: II.	
Prerequisities:	
Conditions for course completion: 50 % maintained output, written test 50% final output, wtitten test	
Learning outcomes: The course gives information about principles of solidification, precipitatin. Thermodynamics of phase transitions, Plastic deformation, strethenning and Racrystallisation and Hot working	
Brief outline of the course: Principles of solidification: solidification defects, casting processes for manufacturing components, ingot casting, directional solidification, single crystal growth and epitaxial growth, joining of metallic materials. Solid solutions and phase equilibrium: phase diagrams,solubility and solutions, solid-solution strengthening. Relationship between properties and phase diagram. Nonequiblirium solidificatin and segregation. Dispersion strengthening and eutectic phase diagram: intermetallic compounds, eutectic phase diagram, eutectic alloys. Dispersion strengthening by phase transformations and heat treatment: nucleation and growth in solid-state reactions, precipitation hardening, age hardening, eutectoid reaction – pearlite, bainite and martensitic reaction, Strain hardening snd annealing. Hot working, recrystallisation. Superplastic forming. Ferrous alloys.	
Recommended literature: 1. D.R.Askeland and P.P. Phulé, The Science and Engineering of Materials, Thomson 2003. 2. R.W. Cahn et al, Physical Metalurgy I, Elsevier, 1983, ISBN - 0-444-86786-4 3. R.W. Cahn et al, Physical Metalurgy I, Elsevier, 1983, ISBN - 0-444-86787-2	
Course language: English	
Notes:	

Course assessment
Total number of assessed students: 38

A	B	C	D	E	FX
60.53	36.84	2.63	0.0	0.0	0.0

Provides: prof. RNDr. Pavol Sovák, CSc.

Date of last modification: 03.05.2015

Approved:

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚFV/VOM/09	**Course name:** The Universe at Microscopic Level

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

Number of ECTS credits: 3

Recommended semester/trimester of the course: 1., 3.

Course level: II.

Prerequisities:

Conditions for course completion:

Learning outcomes:
To provide the students with the recent knowledge of the structure of the Universe at the elementary particle level.

Brief outline of the course:
The lectures provide an insight into the microstructure of the Universe - starting with early cosmic phases like quark-gluon plasma, baryogenesis and first nuclei creation and continue with the structure of nowadays Universe: main sequence stars, white dwarfs, neutron stars, black holes, interstellar and inter galactic space, dark matter and dark energy and cosmic rays.

Recommended literature:
1. D. Griffiths: Introduction to Elementary Particles, Wiley-VCH, Weinheim, 2004
2. D. Perkins: Particle Astrophysics, Oxford University Press, Oxford, 2003
3. D. Prialnik: An Introduction to the Theory of Stellar Structure and Evolution, Cambridge University Press, Cambridge, 2000

Course language:

Notes:

Course assessment
Total number of assessed students: 21

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

Provides: doc. RNDr. Marek Bombara, PhD.

Date of last modification: 03.05.2015

Approved:

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:
Successful passing of the final oral exam.

Learning outcomes:
To manage basic methods of quasiparticle formalism of Solid State Physics (electrons, phonons, electron-electron, electron-phonon interactions, magnons)

Brief outline of the course:
Born-Openheimer and Hartree-Fock aproximatins. The structure of solids and its theoretical description. The ideal crystal, direct and recipcal lattice. Brawaiss elementary cell. Electron in a periodic potential field, Bloch's theorem. Born-Karmán boundary conditions, Brillouin zones. Nearly free electron theory. Tight binding approximation. Existence of energy bands. Effective mass tensor. Lattice waves. Dynamical matrix. Linear monoatomic and diatomic lattices. Acoustic and optical modes. Phonons in solids. Electron-phonon interactions. The Fröhlich Hamiltonian. The atractive interaction between electrons.

Recommended literature:
[1.] Ch. Kittel: Quantum Theory of Solids, John Wiley & Sons Inc, 1985.
[2.] N.W. Ashcroft, N.D. Mermin: Solid State Physics, Harcourt College Publishers, 1976.
[3.] P.L. Taylor: A Quantum Approach to the Solid State, Prentice-Hall, Inc., Englewood Cliffs, New Jersey, 1970.
[4.] J.M. Ziman, Principles of the Theory of Solids, University Press, Cambridge, 1972.
[5.] A.O.E. Animalu, Intermediate Quantum Theory of Crystalline Solids, Prentice-Hall, Inc., Englewood Cliffs, New Jersey, 1981.

Course language:

Notes:

Course assessment
Total number of assessed students: 100

A	B	C	D	E	FX
57.0	11.0	17.0	7.0	8.0	0.0

Provides: RNDr. Martin Gmitra, PhD.
Date of last modification: 03.05.2015
Approved:

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:	
Learning outcomes:	
Brief outline of the course: Phenomenological approach, Electron transport in solids, DC conductivity in metals, Drude theory, Electron gas, electric and heat currents, Diffusive transport, Transport Boltzmann equation, Linear response, Electronic transport in mesoscopic systems, Ballistic transport, Resistance of ballistic condutor, Landauer formula and its applications, Quantum Hall effects, Tunneling and Coulomb blockade, Quantum dots, Single molecule transport, STEM basics, Spin polarized transport, Anomalous Hall effect, Berry curvature	
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. T. Heinzel, Mesoscopic Electronics in Solid State Nanostructures, Wiley-VCH 2003 6. N. W. Ashcroft, N. D. Mermin, Solid State Physics, Harcourt College Publisher 1976 7. M. P. Marder, Condensed Matter Physics, Wiley 2010 8. J. B. Ketterson, The Physics of Solids, Oxford University Press 2016 9. J. Sólyom, Fundamentals of the Physics of Solids, Volume 2 – Electronic Properties, Springer 2009	
Course language:	
Notes: https://ktfa.science.upjs.sk/people/martin-gmitra/teaching/transport-properties-in-solid-state/	

Course assessment
Total number of assessed students: 12

A	B	C	D	E	FX
33.33	8.33	25.0	16.67	16.67	0.0

Provides: RNDr. Martin Gmitra, PhD.

Date of last modification: 07.05.2020

Approved: