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COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚFV/ IG/04	Course name: Acquirement of Internal Grant
Course type, scope and the method: Course type: Recommended course-load (hours): Per week: Per study period: Course method: present	
Number of ECTS credits: 10	
Recommended semester/trimester of the course:	
Course level: III.	
Prerequisites:	
Conditions for course completion:	
Learning outcomes:	
Brief outline of the course:	
Recommended literature:	
Course language:	
Notes:	
Course assessment Total number of assessed students: 141	
abs	n
100.0	0.0
Provides:	
Date of last modification:	
Approved: prof. Ing. Martin Orendáč, DrSc.	

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚFV/ AKTP/12	Course name: Applications of Quantum Field Theory in Contemporary Condensed Matter 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: 5	
Recommended semester/trimester of the course:	
Course level: III.	
Prerequisites:	
Conditions for course completion: To successfully complete the course, the student must demonstrate sufficient theoretical knowledge of the methods of quantum field theory used in the study of phase transitions in condensed matter. The credit evaluation of the subject takes into account the following student workload: direct learning - 2 credits, study of recommended literature - 1 credit, exam preparation - 2 credits.	
Learning outcomes: To acquaint the students with modern methods of quantum field theory and their application in the condensed matter physics.	
Brief outline of the course: Hypothesis of scaling (critical scaling) in thermodynamics; Ising model and thermodynamics of ferromagnetism; Scaling of Green functions; Landau theory; Fluctuation theory and critical behaviour; Foundations of quantum field theory; Physical quantum fields and their equations – Dirac equations, Klein-Gordon equation; Quantization of fields; Evolution operator; S-matrix; Green functions and generation functional; T- and N-products; Wick theorems; Feynman diagrammatic technique; Functional form of Green functions, generating functional and statistical sum; Phase transitions; Universal behaviour of statistical sum in the vicinity of phase transition point; Landau fluctuation theory for description of phase transitions; Anomalous scaling; Renormalization of Landau theory; Epsilon-expansion and calculation of renormalization constants; Renormalization group and differential equations for Green functions; Asymptotic scaling solutions in the region of large scales, determination of their stability; Calculation of anomalous and critical exponents.	
Recommended literature: 1. N.N. Bogolyubov, D.V. Shirkov: Quantum fields, Nauka, Moskva, 2005 (in russian) 2. A.N. Vasilev: Renormalization group in Critical Behavior Theory and Stochastic Dynamics Chapman & Hall/CRS, Boca Raton London New York Washington D.C., 2004.	
Course language: slovak, english	

Notes:

The course is carried out in the full-time form, or if necessary remotely in the MS Teams environment.

Course assessment

Total number of assessed students: 2

N	P
0.0	100.0

Provides: prof. RNDr. Michal Hnatič, DrSc.

Date of last modification: 22.11.2021

Approved: prof. Ing. Martin Orendáč, DrSc.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚFV/ PVS/04	Course name: Author's patents, discoveries, software
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:	
Course level: III.	
Prerequisites:	
Conditions for course completion: Patent filed, invention, software product created.	
Learning outcomes: The PhD student demonstrates the ability to create an innovative product in a given scientific field, or with impact on an interdisciplinary scale or in technical practice.	
Brief outline of the course:	
Recommended literature:	
Course language:	
Notes:	
Course assessment Total number of assessed students: 46	
abs	n
100.0	0.0
Provides:	
Date of last modification: 08.11.2022	
Approved: prof. Ing. Martin Orendáč, DrSc.	

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚFV/ CM/04	Course name: Citation in monograph
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: III.	
Prerequisites:	
Conditions for course completion:	
Learning outcomes:	
Brief outline of the course:	
Recommended literature:	
Course language:	
Notes:	
Course assessment Total number of assessed students: 1	
abs	n
100.0	0.0
Provides:	
Date of last modification:	
Approved: prof. Ing. Martin Orendáč, DrSc.	

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚFV/ CZC/04	Course name: Citation in scientific journal published abroad
Course type, scope and the method: Course type: Recommended course-load (hours): Per week: Per study period: Course method: present	
Number of ECTS credits: 10	
Recommended semester/trimester of the course:	
Course level: III.	
Prerequisites:	
Conditions for course completion:	
Learning outcomes:	
Brief outline of the course:	
Recommended literature:	
Course language:	
Notes:	
Course assessment Total number of assessed students: 74	
abs	n
100.0	0.0
Provides:	
Date of last modification:	
Approved: prof. Ing. Martin Orendáč, DrSc.	

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚFV/ CDC/04	Course name: Citation in scientific journal published in the country of residence
Course type, scope and the method: Course type: Recommended course-load (hours): Per week: Per study period: Course method: present	
Number of ECTS credits: 5	
Recommended semester/trimester of the course:	
Course level: III.	
Prerequisites:	
Conditions for course completion:	
Learning outcomes:	
Brief outline of the course:	
Recommended literature:	
Course language:	
Notes:	
Course assessment Total number of assessed students: 4	
abs	n
100.0	0.0
Provides:	
Date of last modification:	
Approved: prof. Ing. Martin Orendáč, DrSc.	

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚFV/ SCI/04	Course name: Citation registered in Science Citation Index
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: III.	
Prerequisites:	
Conditions for course completion:	
Learning outcomes:	
Brief outline of the course:	
Recommended literature:	
Course language:	
Notes:	
Course assessment Total number of assessed students: 298	
abs	n
100.0	0.0
Provides:	
Date of last modification:	
Approved: prof. Ing. Martin Orendáč, DrSc.	

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚFV/ SMPR/04	Course name: Co-worker of project supported by international grant schemes
Course type, scope and the method: Course type: Recommended course-load (hours): Per week: Per study period: Course method: present	
Number of ECTS credits: 15	
Recommended semester/trimester of the course:	
Course level: III.	
Prerequisites:	
Conditions for course completion: Membership in the research team of an international project.	
Learning outcomes: Active involvement by solving a specific task within a team of international project solvers. The PhD student demonstrates the ability to work in a team, take responsibility for the assigned task, adhere to the time schedule and fulfill the project outputs. The PhD student gains personal experience from the implementation of an international project, participation in its key stages, creation of measurable outputs, grant funding of science	
Brief outline of the course:	
Recommended literature:	
Course language:	
Notes:	
Course assessment Total number of assessed students: 113	
abs	n
100.0	0.0
Provides:	
Date of last modification: 08.11.2022	
Approved: prof. Ing. Martin Orendáč, DrSc.	

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚFV/ SDPR/04	Course name: Co-worker of project supported by national grant schemes
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:	
Course level: III.	
Prerequisites:	
Conditions for course completion:	
Learning outcomes:	
Brief outline of the course:	
Recommended literature:	
Course language:	
Notes:	
Course assessment Total number of assessed students: 616	
abs	n
100.0	0.0
Provides:	
Date of last modification:	
Approved: prof. Ing. Martin Orendáč, DrSc.	

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚFV/ODZP/14	Course name: Defence of Doctoral Thesis
Course type, scope and the method: Course type: Recommended course-load (hours): Per week: Per study period: Course method: present	
Number of ECTS credits: 30	
Recommended semester/trimester of the course:	
Course level: III.	
Prerequisites:	
Conditions for course completion: The Dissertation thesis is the result of the student's own scientific research. It must not show elements of academic fraud and must meet the criteria of correct research practice defined in the Rector's Decision no. 21/2021, which lays down the rules for assessing plagiarism at Pavel Jozef Šafárik University in Košice and its constituents. Fulfillment of the criteria is verified mainly in the process of supervising and in the process of the thesis defense. Failure to do so is grounds for disciplinary action.	
Learning outcomes: The Dissertation thesis has elements of a scientific work and the student demonstrates extensive mastery of the theory and professional terminology of the field of study, acquisition of knowledge, skills and competences in accordance with the declared profile of the graduate of the field of study, as well as the ability to apply them in an original way in solving selected problems of the field of study. The student demonstrates the ability of independent scientific work in terms of content, formal and ethical aspects. Further details of the Dissertation thesis are determined by Directive no. 1/2011 on the essential prerequisites of final theses and by the Study Rules of Procedure at UPJŠ in Košice for doctoral studies. The doctoral student demonstrated the ability and readiness for independent scientific and creative activity in the field of study of philology in accordance with the expectations of the relevant qualification framework and the profile of the graduate.	
Brief outline of the course:	
Recommended literature:	
Course language:	
Notes:	
Course assessment Total number of assessed students: 104	
N	P
0.96	99.04

Provides:
Date of last modification: 08.11.2022
Approved: prof. Ing. Martin Orendáč, DrSc.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚFV/ DZS/14	Course name: Dissertation examination
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: III.	
Prerequisites:	
Conditions for course completion: Obtaining required number of credits as given by the study plan.	
Learning outcomes: Evaluation of competences of the student according to his/her scientific profile.	
Brief outline of the course: Presentation of the results in the thesis for disertation exam, responding to referee's comments, answering questions of exam committee. Two questions are selected subsequently from one compulsory and one optional subject, respectively. The subjects are selected by guarantee of the program according to the study plan and scientific profile of the student. The third question addresses the current state of work on dissertation thesis.	
Recommended literature:	
Course language: english	
Notes:	
Course assessment Total number of assessed students: 133	
N	P
0.0	100.0
Provides:	
Date of last modification: 03.05.2015	
Approved: prof. Ing. Martin Orendáč, DrSc.	

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚFV/DDS/15	Course name: Domains 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:	
Course level: II., III.	
Prerequisites:	
Conditions for course completion: To successfully complete the course, the student must demonstrate sufficient understanding of basic concepts of magnetism, anisotropy, statics and dynamics of domain structure. Knowledge of basic concepts is required. The student must be able to actively understand the content of the curriculum continuously during the semester, so that the acquired knowledge can be actively and creatively used in solving specific problems. The minimum limit for passing the exam is to obtain 51% of the total score, which takes into account all required activities with relevant weight. Rating scale: A - 91% -100% points, B - 81% -90% points, C - 71% -80% points, D - 61% -70% points, E - 51% -60% points.	
Learning outcomes: After completing the lectures and the final evaluation, the student will demonstrate adequate knowledge of the course standard, which is defined by the brief content of the course and the recommended literature. Theoretical knowledge of the content of the subject allows him to fully participate in the further study of specialized subjects that are related to the assignment of his dissertation. Can find connections between the domain structure of the investigated materials in relation to their crystallographic structure, the method of their preparation or their thermal or mechanical processing. The acquired knowledge will also facilitate the performance of the scientific part of the dissertation.	
Brief outline of the course: Time schedule of the subject contents is updated in electronic board in AiS2 sw. The subject content is focused in the following main topics: 1. The concept of domain structure 2. Experimental techniques for the study of domain structure 3. Examples of domain structures - their calculation 4. Material parameters determining domain structure, anisotropies 5. Domain walls - types, calculations 6. Experimental techniques for the study of statics and dynamics of domain walls 7. Statics of a domain wall - its potential, critical field 8.-9. Domain wall dynamics - basic models and parameters determining DS dynamics. 10. Domain wall dynamics in small magnetic fields - DS dynamics in adiabatic mode.	

11. Dynamics of the domain wall in high magnetic fields - structure of the domain wall, its changes, interaction with phonons 12. Maximum speed of the domain wall - Schlomann and Walker limit 13. Spintronics - application of domain wall promotion in spintronics (Race-Track memory, Logic based on domains and domain walls, sensors), current problems and the future.							
Recommended literature: 1. B.D. Cullity, C.D. Graham, „Introduction to magnetic materials“, John Wiley & Sons, New Jersey (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: Lectures can be done at presence form or online form using MS Teams. Education form is updated at the begining of the subject.							
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: 26.09.2021							
Approved: prof. Ing. Martin Orendáč, DrSc.							

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚFV/ VPBP/04	Course name: Elaboration of reviewer report
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:	
Course level: III.	
Prerequisites:	
Conditions for course completion:	
Learning outcomes:	
Brief outline of the course:	
Recommended literature:	
Course language:	
Notes:	
Course assessment Total number of assessed students: 23	
abs	n
100.0	0.0
Provides:	
Date of last modification:	
Approved: prof. Ing. Martin Orendáč, DrSc.	

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: CJP/AJD1/07	Course name: English Language for PhD Students 1
Course type, scope and the method: Course type: Practice Recommended course-load (hours): Per week: 2 Per study period: 28 Course method: present	
Number of ECTS credits: 2	
Recommended semester/trimester of the course: 1.	
Course level: III.	
Prerequisites:	
Conditions for course completion: Completion of e-course English for PhD Students (lms.upjs.sk), consultations (1-3). Written assignments - Professional/Academic CV, Short Academic Biography.	
Learning outcomes: The development of students' language skills - reading, writing, listening, speaking, improvement of their linguistic competence - students acquire knowledge of selected phonological, lexical and syntactic aspects, development of pragmatic competence - students can effectively use the language for a given purpose, with focus on Academic English and English for specific/professional purposes, level B2.	
Brief outline of the course: Specific aspects of academic and professional English with focus on correct pronunciation, vocabulary development (noun and verb collocations, phrasal verbs, prepositional phrases, word-formation, formal/informal language, etc.), selected aspects of English grammar (prepositions, grammar tenses, passive voice, etc.), academic writing (professional/academic CV, Short Academic Biography).	
Recommended literature: Moore, J.: Oxford Academic Vocabulary Practice. OUP, 2017. Kolaříková, Z., Petruňová, H., Timková, R.: Angličtina v akademickom prostredí – cvičebnica. Košice, Vydavateľstvo ŠafárikPress, 2021. Tomaščíková, S., Rozenfeld, J. Developing Academic English in Speaking and Writing. Vydavateľstvo ŠafárikPress, 2021. McCarthy, M., O'Dell, F.: Academic Vocabulary in Use. CUP, 2008. Štěpánek, L., J. De Haaf a kol.: Academic English-Akademická angličtina. Grada Publishing, a.s., 2011. Armer, T.: Cambridge English for Scientists. CUP, 2011. lms.upjs.sk	
Course language: English, level B2 according to CEFR	
Notes:	

Course assessment					
Total number of assessed students: 738					
N	Ne	P	Pr	abs	neabs
0.0	0.0	48.1	0.0	51.9	0.0
Provides: PhDr. Helena Petruňová, CSc., Mgr. Zuzana Kolaříková, PhD.					
Date of last modification: 16.09.2022					
Approved: prof. Ing. Martin Orendáč, DrSc.					

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: CJP/AJD2/07	Course name: English Language for PhD Students 2
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: 3	
Recommended semester/trimester of the course: 2.	
Course level: III.	
Prerequisites:	
Conditions for course completion: Test, oral exam in accordance with the exam requirements (https://www.upjs.sk/filozoficka-fakulta/cjp/doktorandi-upjs/)	
Learning outcomes: The development of students' language skills - reading, writing, listening, speaking, improvement of their linguistic competence - students acquire knowledge of selected phonological, lexical and syntactic aspects, development of pragmatic competence - students can effectively use the language for a given purpose, with focus on Academic English and English for specific/professional purposes, level B2.	
Brief outline of the course: Academic communication (self-presentation, presenting at scientific meetings and conferences). Specific aspects of academic and professional English with focus on vocabulary development (formality, academic word-list), English grammar (passive voice, nominalisation), language functions (expressing opinion, cause/effect, presenting arguments, giving examples, describing graphs/charts/schemes, etc.). Cross-language interference.	
Recommended literature: Moore, J.: Oxford Academic Vocabulary Practice. OUP, 2017. Kolaříková, Z., Petruňová, H., Timková, R.: Angličtina v akademickom prostredí (cvičebnica). UPJŠ Košice, 2021. Tomaščíková, S., Rozenfeld, J. Developing Academic English in Speaking and Writing. Vydavateľstvo ŠafárikPress, 2021. McCarthy, M., O'Dell, F.: Academic Vocabulary in Use. CUP, 2008. Štěpánek, L., J. De Haaf a kol.: Academic English-Akademická angličtina. Grada Publishing, a.s., 2011. Armer, T.: Cambridge English for Scientists. CUP, 2011.	
Course language: B2 level according to CEFR	
Notes:	

Course assessment					
Total number of assessed students: 729					
N	Ne	P	Pr	abs	neabs
0.27	0.0	93.83	1.1	4.8	0.0
Provides: PhDr. Helena Petruňová, CSc., Mgr. Zuzana Kolaříková, PhD.					
Date of last modification: 10.03.2022					
Approved: prof. Ing. Martin Orendáč, DrSc.					

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚFV/ EMFNT/12	Course name: Experimental Methods of Low-Temperature 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: 3	
Recommended semester/trimester of the course:	
Course level: III.	
Prerequisites:	
Conditions for course completion: In order to complete the course, each student has to show and manifest a sufficient understanding of all fundamental terms, concepts and methods used in low and ultralow temperature physics and techniques. Necessary condition to pass the course, except the presence on the lectures is also an active participation on discussions during the courses, where they are proving their knowledge. Elaboration and presentation of the report on a topic from field of low temperature physics and techniques selected by teacher. Minimal threshold to pass the course is 51% from total amount of evaluation points, taking into account all requested activities with relevant weight. Evaluation scale: A - 91%-100% points, B - 81%-90% points, C - 71%-80% points, D - 61%-70% points, E - 51%-60% points. Credit evaluation takes into account: the presence on the lectures (1 credit), self-study of recommended literature (1 credit), preparation and the report presentation (1 credit).	
Learning outcomes: By completing the course, the students will understand and know the fundamental physical principles and methods how to achieve low and ultralow temperatures including knowledge on technical realisation of the experimental facilities which allow to achieve this. Evenmore, the students will learn how to handle the cryo-liquids, how to operate the superconducting magnets, they will understand fundamentals of the vacuum techniques and the leak detection. They will acquire information on methods and specifications of measurements of physical quantities at low and very low temperatures. Finally, they will obtain information on applications of low temperature physics and techniques in praxis, which maybe used in their everyday life and job.	
Brief outline of the course: Physical principles of cooling below ambient temperature. Liquefaction of gases and manipulation with cryogenic liquids. Fundamentals of vacuum techniques and leak detection of vacuum systems. Physical principles and methods of cooling to low and ultra low temperatures. Measurements of low and ultra low temperatures, temperature scale definition. Physical properties of condensed matters at low temperatures. Construction of low temperature refrigerators and apparatuses. Low temperature electronics and measurements of physical quantities at low and ultra low temperatures. Applications of low and ultra low temperature physics and techniques.	

Recommended literature:

F. Pobell: Matter and Methods at Low Temperatures, Springer Verlag Berlin 1995.
Ch. Enss and S. Hunklinger: Low Temperature Physics, Springer Verlag Berlin 2005.
L. Skrbek a kolektív: Fyzika nízkých teplot, matfyz press, Praha 2011
G.K. White and P.J. Meeson: Experimental Techniques in Low Temperature Physics, Clarendon Press, Oxford 2002.
Š. Jánoš: Fyzika nízkých teplot, Alfa, Bratislava 1982.
J. Jelínek a Z. Málek: Kryogenní technika, SNTL Praha 1982.

Course language:

Slovak, English

Notes:

Lectures are given in a person form. In the case of a need the lectures can be delivered by on-line (MS Teams, etc).

Course assessment

Total number of assessed students: 15

N	P
0.0	100.0

Provides: RNDr. Peter Skyba, DrSc.

Date of last modification: 22.11.2021

Approved: prof. Ing. Martin Orendáč, DrSc.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚFV/DKZU/04	Course name: Home Conference with Foreign Participation
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: III.	
Prerequisites:	
Conditions for course completion:	
Learning outcomes:	
Brief outline of the course:	
Recommended literature:	
Course language:	
Notes:	
Course assessment Total number of assessed students: 320	
abs	n
100.0	0.0
Provides:	
Date of last modification:	
Approved: prof. Ing. Martin Orendáč, DrSc.	

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚFV/ NEM/04	Course name: Implementation of new experimental methodology
Course type, scope and the method: Course type: Recommended course-load (hours): Per week: Per study period: Course method: present	
Number of ECTS credits: 15	
Recommended semester/trimester of the course:	
Course level: III.	
Prerequisites:	
Conditions for course completion:	
Learning outcomes:	
Brief outline of the course:	
Recommended literature:	
Course language:	
Notes:	
Course assessment Total number of assessed students: 91	
abs	n
100.0	0.0
Provides:	
Date of last modification:	
Approved: prof. Ing. Martin Orendáč, DrSc.	

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚFV/ MK/04	Course name: International 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: 6	
Recommended semester/trimester of the course:	
Course level: III.	
Prerequisites:	
Conditions for course completion:	
Learning outcomes:	
Brief outline of the course:	
Recommended literature:	
Course language:	
Notes:	
Course assessment Total number of assessed students: 485	
abs	n
100.0	0.0
Provides:	
Date of last modification:	
Approved: prof. Ing. Martin Orendáč, DrSc.	

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚFV/ ZKC/04	Course name: Journals Registered by Current Contets Database
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: III.	
Prerequisites:	
Conditions for course completion:	
Learning outcomes:	
Brief outline of the course:	
Recommended literature:	
Course language:	
Notes:	
Course assessment Total number of assessed students: 537	
abs	n
100.0	0.0
Provides:	
Date of last modification:	
Approved: prof. Ing. Martin Orendáč, DrSc.	

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚFV/ ZNC/04	Course name: Journals not registered in the Current Contents Connect database and published abroad
Course type, scope and the method: Course type: Recommended course-load (hours): Per week: Per study period: Course method: present	
Number of ECTS credits: 5	
Recommended semester/trimester of the course:	
Course level: III.	
Prerequisites:	
Conditions for course completion:	
Learning outcomes:	
Brief outline of the course:	
Recommended literature:	
Course language:	
Notes:	
Course assessment Total number of assessed students: 69	
abs	n
100.0	0.0
Provides:	
Date of last modification:	
Approved: prof. Ing. Martin Orendáč, DrSc.	

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚFV/ DNC/04	Course name: Journals not registered in the Current Contents Connect database and published in the country of residence
Course type, scope and the method: Course type: Recommended course-load (hours): Per week: Per study period: Course method: present	
Number of ECTS credits: 5	
Recommended semester/trimester of the course:	
Course level: III.	
Prerequisites:	
Conditions for course completion:	
Learning outcomes:	
Brief outline of the course:	
Recommended literature:	
Course language:	
Notes:	
Course assessment Total number of assessed students: 25	
abs	n
100.0	0.0
Provides:	
Date of last modification:	
Approved: prof. Ing. Martin Orendáč, DrSc.	

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚFV/DKC/04	Course name: Journals registered in the Current Contents Connect database and published in the country of residence
Course type, scope and the method: Course type: Recommended course-load (hours): Per week: Per study period: Course method: present	
Number of ECTS credits: 15	
Recommended semester/trimester of the course:	
Course level: III.	
Prerequisites:	
Conditions for course completion:	
Learning outcomes:	
Brief outline of the course:	
Recommended literature:	
Course language:	
Notes:	
Course assessment Total number of assessed students: 9	
abs	n
100.0	0.0
Provides:	
Date of last modification:	
Approved: prof. Ing. Martin Orendáč, DrSc.	

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚFV/ MKS I/04	Course name: Macroscopic quantum systems 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: 5	
Recommended semester/trimester of the course: 1.	
Course level: III.	
Prerequisites:	
Conditions for course completion: To successfully complete the course, the student must demonstrate sufficient knowledge of the nature of macroscopic quantum phenomena based on Bose-Einstein condensation and quantum fluids. At the same time, students will develop a project in the form of a presentation on a given topic, in which they will deal with macroscopic quantum phenomena close to the topic of their dissertation. Credit evaluation of the course takes into account the following student workload: direct teaching - 1 credit, self-study of recommended supplementary literature - 1 credit, project preparation based on scientific and journal literature - 2 credits, preparation for the test - 1 credit. The minimum limit for obtaining the evaluation is 50% of the point evaluation of the test and at least 50% of the points for the quality of the project.	
Learning outcomes: After completing lectures and self-study, the student will gain detailed knowledge in the field of macroscopic quantum phenomena. They will expand their knowledge from the course of Low Temperature Physics from the FKL master's study on the properties of liquid and solid helium, superfluidity, knowledge of Bose-Einstein condensation in magnetic systems, concepts of Luttinger and spin liquid in magnetic systems, topological excitations in spin systems. The acquired knowledge will facilitate his work on the scientific part of the dissertation.	
Brief outline of the course: 1.-3. Selected chapters about superfluidity in 4He , 3He and in their solutions. 4. Solid helium, properties of quantum crystals. 5. Quantum cavitation and evaporation in liquid helium. 6.-7. Spin dynamics and magnetic resonance in superfluid 3He . Magnetic superfluidity and persistent processing domain in 3He-B . Bose-Einstein condensation of magnons in superfluid 3He . 8. Nuclear magnetism. Nanokelvin temperatures. 9. Spin liquid in spin chains and frustrated spin systems. 10.-12. Dimerized spin systems and their energy spectrum. Spin ladder, alternating chain. Luttinger liquid and Bose-Einstein condensation of magnetic excitations.	
Recommended literature: L. Skrbek a kol., Fyzika nízkých teplot, Matfyzpress, MFF KU Praha, 2011. C. Enss, S. Hucklinger, Low-Temperature Physics, Springer, 2005.	

K.H. Bennemann, J.B. Ketterson, The Physics of liquid and solid Helium, A Wiley Interscience Publication, 1978.
D.R. Tilley, J. Tilley, Superfluidity and Superconductivity, Adam Hilger Ltd., Bristol, 1990.
E.R. Dobbs, Helium Three, Oxford Science publications, 2000.
U. Schollwock, J. Richter, D.J.J. Farnell, R.F. Bishop (Eds.), Quantum Magnetism, Lect. Notes Phys. 645, Springer, Berlin Heidelberg, 2004.
E. Čižmár, Energy gap in the excitation spectra of one-dimensional magnets, habilitation thesis, UPJŠ, 2016.
scientific journals

Course language:

Slovak, English

Notes:

Teaching is carried out in person or on-line using MS Teams. Form of teaching specified by the teacher, updated continuously.

Course assessment

Total number of assessed students: 30

N	P
0.0	100.0

Provides: doc. RNDr. Erik Čižmár, PhD.

Date of last modification: 21.09.2021

Approved: prof. Ing. Martin Orendáč, DrSc.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚFV/ MVV1/07	Course name: Magnetic Materials with Outstanding Properties
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: 5	
Recommended semester/trimester of the course:	
Course level: III.	
Prerequisites:	
Conditions for course completion: To successfully complete the course, the student must demonstrate sufficient understanding of the basic phenomena in the field of magnetic materials. Knowledge of basic concepts of magnetism, its origin, properties and division of magnetic materials is required. During the semester, the student must continuously acquire selected magnetic materials, from their preparation to application. The condition for obtaining credits is the presentation of selected magnetic material together with an oral exam, which consists of theoretical questions. The credit evaluation of the course takes into account the following student workload: direct teaching (3 credits), preparation of the presentation (1 credit) and evaluation (1 credit).	
Learning outcomes: After completing the lectures, the student will gain a general overview of the magnetic properties of matter, various types of progressive magnetic materials and the application of soft and hard magnetic materials.	
Brief outline of the course: 1. Magnetism of matter. Paramagnetism, diamagnetism, ferromagnetism and ferrimagnetism. 2. Macroscopic properties of ferromagnets. Domain structure. 3. Magnetic processes. Applications of soft magnetic materials. 4. Magnetic properties of iron-based alloys. 5. Magnetic losses and their separation. 6. Magnetic properties of cobalt and nickel based alloys and their applications. 7. Structure and magnetic properties of soft magnetic ferrites and their applications. 8. Structure and magnetic properties of hard magnetic ferrites and their applications. 9. Structure, preparation and magnetic properties of amorphous alloys. 10. Structure, preparation and magnetic properties of nanocrystalline alloys. 11. Magnetic particles, ferrofluids, magnetic cooling 12. Basic experimental methods of measuring magnetic materials.	
Recommended literature: S. Chikazumi: Physics of Magnetism, J. Willey and Sons, Inc. New York, London, Sydney, 1997. D. Jiles: Introduction to magnetism and magnetic materials, Chapman&Hall, London, New York, Tokyo, Melbourne, Madras, 1991 R. C. O'Handley: Modern Magnetic Materials, Principles and Applications, J. Willey and Sons, Inc. New York, 1999, Modern scientific literature.	

Course language: slovak, english	
Notes: Teaching is carried out in person or remotely using the MS Teams tool. The form of teaching is specified by the teacher at the beginning of the semester and continuously updated.	
Course assessment Total number of assessed students: 43	
N	P
0.0	100.0
Provides: doc. RNDr. Ján Fúzer, PhD., RNDr. Ivan Škorvánek, CSc.	
Date of last modification: 22.11.2021	
Approved: prof. Ing. Martin Orendáč, DrSc.	

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚFV/ MGCH/04	Course name: Magnetochemistry
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: 5	
Recommended semester/trimester of the course: 1., 3.	
Course level: III.	
Prerequisites:	
Conditions for course completion: examination	
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. Thermodynamics 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. Dwyneveldt: Magnetic properties of transition metal compounds. New York, inc. Springer Verlag, 1977. 2. J-P. Launay, M. Verdager, Electrons in Molecules, Oxford 2018. 3. A. Abragam, B. Bleaney, Electron Paramagnetic Resonance of Transition Ions, Oxford, 2012.	
Course language: english	
Notes: eee	

Course assessment	
Total number of assessed students: 38	
N	P
0.0	100.0
Provides: doc. RNDr. Alžbeta Orendáčová, DrSc.	
Date of last modification: 21.09.2021	
Approved: prof. Ing. Martin Orendáč, DrSc.	

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚFV/ MKS II/12	Course name: Makroskopické kvantové systémy II
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: 3	
Recommended semester/trimester of the course:	
Course level: III.	
Prerequisites:	
Conditions for course completion: Successful passing of the final exam	
Learning outcomes: Acquaint students with some special cases of macroscopic quantum systems. These will be mainly superconducting heavy fermion systems, the Bose – Einstein condensate in dilute gases, macroscopic quantum tunnelling, the quantum Hall effect and its applications, the superconducting quantum interference device (SQUID) and its applications.	
Brief outline of the course: the lectures 1. - 7. and 11., 12. are given by Assoc. prof. Dr. K. Flachbart, the lectures 8. - 10. are given by prof. Dr. M. Orendáč. 1. week: Brief review of the basics of superconductivity (formation of the Cooper pairs condensate and its properties). Tunnelling of electrons and Cooper pairs (Josephson effect). Relationship between superconducting current and phase difference at a weak / tunnel connection between two superconductors. Influence of the external magnetic field on phase change. 2. week: Influence of external magnetic field on the phase change between two superconductors. Current passing through two parallel superconducting tunnel junctions. Interference between two parallel superconducting currents. Basics of the DC SQUID operation. 3. week: Construction of a DC SQUID and creation of various gradiometers for measuring very small magnetic fields. Use of SQUID - magnetometers in research, in the search for magnetic anomalies and in medical diagnostics. 4. week: Strongly interacting Fermi gas and its renormalization to free electron model. Simple 2D model of electron correlations. Interaction between conductivity and localized electrons in metals, Kondo phenomenon. Change of electrical and magnetic properties, and change of heat capacity related to the Kondo effect. 5. week: Origin of the Abrikosov - Suhl resonance in the Kondo lattice, origin of heavy-fermion systems. Basic properties of heavy-fermion systems (electrical, magnetic, thermal). RKKY interaction in metallic magnetic systems. Interplay between Kondo and RKKY interactions. 6. week: superconductivity in 4f- and 5f- heavy-fermion systems (examples). Other examples of unconventional superconductivity (high temperature superconductors, superfluid 3He). Pairing and order parameter in various unconventional superconductors.	

7. week: Applications of superconductivity. Transmission of electricity. Possibilities of using superconductivity in transport (superfast trains). Use of superconductivity in medicine - diagnostic and imaging techniques. Use of superconductivity in research (accelerators, fusion reactors, condensed matter physics). Possibilities of using superconductivity in electronics. 8. week: Bose - Einstein condensation. Properties of bosons and fermions, examples of bosonic and fermionic systems. Principles of BE condensation. Examples of BE condensates (e.g. 4He, 3He). Diluted gases, the de Broglie wavelength. Formation of coherence in diluted gases. 9. week: Laser cooling of diluted gases. 1D and 3D cooling, influence of the Doppler effect. Magnetic capture of cooled gas. Further cooling of the condensate via evaporation. Examples of condensates, achieved results and parameters (temperature, density of condensate). Methods of BE condensate detection and properties of BE condensates 10. week: Macroscopic quantum tunnelling in single molecule magnets. Influence of hyperfine interactions and magnetic coupling among single molecule magnets on the probability of quantum tunnelling. Experimental possibilities of detection of quantum tunnelling. 11. week: Quantum Hall effect. Hall effect in metals and semiconductors. Quantization of electron energy in magnetic field, Landau levels and their degeneration. Quantization of Hall resistance in 2D electron gases. 12. week: Observation of the fractional quantum Hall effect. Explanation of the fractional quantum Hall effect using the so-called composite fermions. Influence of magnetic field on 3D systems – the de Haas - van Alphen effect.	
Recommended literature: W. Buckel, R. Kleiner: Superconductivity, Wiley-WCH, Weinheim (2004). L. Skrbek a kol.: Fyzika nízkých teplot, MATFYZPRESS, Praha 2010. Scientific articles. K.N.Shrivastava; Introduction to Quantum Hall Effect; Nova Science, Hauppauge, N.Y. 2002 S.Takagi; Macroscopic Quantum Tunneling; Cambridge U. Press, n.Y. 2002	
Course language: Slovak, English	
Notes:	
Course assessment Total number of assessed students: 15	
N	P
0.0	100.0
Provides: doc. RNDr. Karol Flachbart, DrSc., prof. Ing. Martin Orendáč, DrSc.	
Date of last modification: 22.09.2021	
Approved: prof. Ing. Martin Orendáč, DrSc.	

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚFV/MMTL/04	Course name: Modern Methods of Solids Structure Investigation
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: 5	
Recommended semester/trimester of the course: 2.	
Course level: III.	
Prerequisites: ÚFV/MSA1/03	
Conditions for course completion: For successful completing of the subject student have to show after taking exam adequate knowledge from the area using sophisticated research infrastructure for structural analysis of solids. Content of the subject needs previous study of structure analytical methods as TEM, SEM, STEM and X-ray techniques. After pathing the course student is able to design experiment in X-ray laboratory or at large scale facility (LSF) like XFEL and DESY in Hamburg, ESRF Grenoble, JRN Dubna, ILL Grenoble. To be avaluated student have to path though written exam and to defend ppt project or scientific proposal for LSF. To achieve final evaluation, he/she has to work out ppt project dealing with the topic selected on the beginning of the course. Credits evaluation takes into account taking part at the lectures and study of recommended literature -2 credits, 2 credits – project, 1 credit – study for written test. Minimal value to obtain evaluation for other graduates is reach 50% of each evaluation (test and project) points. Point ratio project/test is 60/40. CMP graduates have to reach as minimum 50% points from the project. Participation at Scientific school for XFEL and synchrotron users “SFEL” is also recommended and it can substitute a proposal.	
Learning outcomes: After completing the lectures and after working out the proposal and taking the written test, the student will have a deep knowledge which allow her/him to find relationships between structure and physical properties of metals and also will have the ability to enter into a systematic theoretical and experimental solution of the problems of structural analysis. Student is also able to design experiment in X-ray laboratory or at large scale facility like XFEL and DESY in Hamburg, ESRF Grenoble, JRN Dubna, ILL Grenoble	
Brief outline of the course: Time schedule of the subject content is updated in electronic board in AiS2 sw. The subject content is focused in the following main topics: New trends in Electron microscopy and Electron diffraction. State of art in Electron microprobe analysis: WDX spectrometer, EDX spectrometer, Auger spectroscopy. Modern electron diffraction methods (CBD, nanodiffraction), X-ray diffractometry, phase and profile analysis. Synchrotron radion: sources and application of SR in material science research, neutron scattering , Small angle scattering. Modern methods of surface observation: STM, AFM. Synchrotron radiation in material science research.	

Recommended literature:

- 1.S. Amelincks, D.van Dyck, J. van Landyut, Electron Microscopy – Principles and Fundamentals, VCH, 1997.
- 2.M.H. Loretto, Electrom beam analysis of materials. Springer, 2002.
- 3.Fundamentals of Powder Diffraction and Structural Characterization of Materials, Vitalij K. Pecharsky & Peter Y. Zavalij , Kluwer Academic Publishers, 2003.
- 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:

English

Notes:

Lectures can be done at presence form or online using MS Teams. Education form is updated at the begining of the subject. All ppt presentations are accesible in LMS UPJŠ.

Course assessment

Total number of assessed students: 70

N	P
0.0	100.0

Provides: prof. RNDr. Pavol Sovák, CSc., doc. Ing. Karel Saksl, DrSc., RNDr. Jozef Bednarčík, PhD.

Date of last modification: 15.09.2021

Approved: prof. Ing. Martin Orendáč, DrSc.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚFV/DK/04	Course name: National 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: 2	
Recommended semester/trimester of the course:	
Course level: III.	
Prerequisites:	
Conditions for course completion: Active participation in the home conference.	
Learning outcomes: By actively participating in the national scientific conference, the PhD student demonstrates a high degree of ability to identify, evaluate, and apply correct scientific methods or research methodology in his scientific field. He demonstrates the ability to reflect on a specific scientific problem by using the latest approaches and applying them critically. Demonstrates competence in using existing theories and concepts in an innovative way, as well as generating new original scientific knowledge and communicating research results to a wider audience using adequate means and through the Slovak language.	
Brief outline of the course:	
Recommended literature:	
Course language:	
Notes:	
Course assessment Total number of assessed students: 168	
abs	n
100.0	0.0
Provides:	
Date of last modification: 08.11.2022	
Approved: prof. Ing. Martin Orendáč, DrSc.	

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚFV/ NZ/04	Course name: Non-reviewed collections of papers and monographs published abroad or in the country of residence
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:	
Course level: III.	
Prerequisites:	
Conditions for course completion:	
Learning outcomes:	
Brief outline of the course:	
Recommended literature:	
Course language:	
Notes:	
Course assessment Total number of assessed students: 114	
abs	n
100.0	0.0
Provides:	
Date of last modification:	
Approved: prof. Ing. Martin Orendáč, DrSc.	

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚFV/ OVTL/21	Course name: Optical properties of solids
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: 4.	
Course level: II., III.	
Prerequisites:	
Conditions for course completion: To successfully complete the course, the student must demonstrate sufficient knowledge of the optical properties of solids, taking into account the knowledge defined in the course syllabus. The credit evaluation of the course takes into account the following student workload: 1 credits: direct teaching and self-study of recommended supplementary literature, 3 credits: exam in the form of an oral exam and a test.	
Learning outcomes: Students will gain knowledge in the field of optical properties of solids, with regard to the following knowledge: Optical properties of isotropic materials: Dielectric function of crystals, Symmetry of dielectric tensor, Neumann principle. Optical properties of anisotropic materials: Light propagation in anisotropic media, birefringence, optical activity, inversion center, calculation of counterclockwise and clockwise circularly polarized waves. Crystal symmetry from the perspective of optics. Distribution of crystals according to symmetry and from the point of view of anisotropy. Polarization catastrophe: Difference between local and macroscopic field, Clausio-Mossotti equation. Optical properties of ionic crystals: Susceptibility of ionic crystals, Dielectric function of ionic crystals, Collective modes in ionic crystals, Lyddan-Sachs-Teller (LST) relation, Ferroelectric instability. Spontaneous and stimulated emission, Quantum theory of light, Luminescence in systems with localized electrons, fluorescence, Franck-Condon effect, luminescence in systems with delocalized electrons. Light scattering and photoemission: Rayleigh scattering, extinction length, critical opalescence, Optical fibers. Raman scattering: Stokes frequency, Selection rules for Raman scattering, Brillouin scattering. Photoemission: principle, presentation of angularly resolved photoemission experiments (ARPES) and their use for characterization of solids. Surface plasmon resonance (SPR) in nanosystems. Experimental methods based on dynamic light scattering. Experimental optical methods for characterization of solids.	
Brief outline of the course: 1. Introduction lecture - reminder of terms: Optical constants, Description of the interaction of solids with light (Maxwell's theory, Lorentz-Drude microscopic theory, Semiclassical approach, Quantum description of interaction, Spintronics).	

2. Optical properties of isotropic materials: Dielectric function of crystals, Symmetry of dielectric tensor, Optical frequencies, Neumann principle.
3. Optical properties of anisotropic materials: Light propagation in anisotropic media, birefringence, optical activity, inversion center, calculation of counterclockwise and clockwise circularly polarized waves.
4. Symmetry of crystals from the point of view of optics. Distribution of crystals according to symmetry and from the point of view of anisotropy. Polarization catastrophe: Difference between local and macroscopic field, Clausio-Mossotti equation.
5. Optical properties of ionic crystals: Susceptibility of ionic crystals, Dielectric function of ionic crystals, Collective modes in ionic crystals, Lyddan-Sachs-Teller (LST) relation, Ferroelectric instability.
6. Luminescence I: Spontaneous and stimulated emission, Quantum theory of light, Luminescence in systems with localized electrons, fluorescence
7. Luminescence II: Franck-Condon phenomenon, luminescence in systems with delocalized electrons.
8. Light scattering and photoemission: Rayleigh scattering, extinction length, critical opalescence, Optical fibers.
9. Raman scattering: Stokes frequency, Selection rules for Raman scattering, Brillouin scattering.
10. Photoemission: principle, presentation of angularly resolved photoemission experiments (ARPES) and their use for characterization of solids.
11. Surface plasmon resonance (SPR) in nanosystems: principle, practical application and demonstrations of experimental measurements using UV VIS method in the laboratory.
12. Experimental methods based on dynamic light scattering: measurement of nanoparticle size and surface charge (Zetapotential). Principle of the method and demonstrations in the laboratory.
13. Experimental optical methods for characterization of solids: Basics of FT-IR spectroscopy, Basics of Raman spectroscopy, ultrafast photoemission method, time-resolved optical microscopy.
14. Consultations, pre-term of the exam.

Recommended literature:

1. Fox M., Optical Properties of Solids, Oxford, 2001
2. Jan Soubusta, Antonín Černoch, Optical properties of solids, Palacky University, 2014.
3. R. Hlubina, Electrical and optical properties of solids, Komensky University 2018.

Course language:

english

Notes:

Lectures can be done at presence form or online form using MS Teams. Education form is updated at the begining of the subject. All ppt presentations are accesible in LMS UPJŠ.

Course assessment

Total number of assessed students: 4

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

Provides: doc. RNDr. Adriana Zeleňáková, PhD.

Date of last modification: 21.11.2021

Approved: prof. Ing. Martin Orendáč, DrSc.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: KPE/ PgVU/17	Course name: Pedagogy for University Teachers
Course type, scope and the method: Course type: Lecture Recommended course-load (hours): Per week: Per study period: 28s Course method: present	
Number of ECTS credits: 5	
Recommended semester/trimester of the course:	
Course level: III.	
Prerequisites:	
Conditions for course completion: 1. Development of a teaching diary—100% 2. Compulsory active participation and attendance in accordance with the Study Regulations.	
Learning outcomes: Students will be able to: Apply didactic principles, methods, forms, and tools in the teaching of a specialised subject. Specify the educational procedures of a university teacher in subject teaching, pedagogical diagnostics, evaluation of learning outcomes, and self-reflection. Present rationalisation and streamlining possibilities in the teaching of specialised subjects. Apply educational competencies of university teachers taking into account the peculiarities of educating university students.	
Brief outline of the course: The personality of a university teacher. Teaching styles. Student in university education. Student learning styles. Possibilities of adapting teaching styles and student learning styles. University teacher–student interaction and communication in the teaching process. Pedagogical competencies of a university teacher. Didactic analysis of the curriculum; teaching materials and textbooks. Forms of university teaching. Methods of university teaching. Verification methods and student assessment. Creation of a didactic test. Designing university teaching process. University teacher self-reflection.	
Recommended literature: Čapek, R. (2015). Moderní didaktika. Lexikon výukových a hodnoticích metod. Praha, Grada Publishing, a.s. Danek, J. (2014). Pedagogická komunikácia na vysokej škole. Trnava, Univerzita sv.Cyrila a Metoda v Trnave. Dargová, J. (2001). Tvorivé kompetencie učiteľa. Prešov, Privat Press. Dvořáček, J. (2014). Základy pedagogiky. Praha, Oeconomica. Hupková, M., Petlák, E. (2004). Sebareflexia a kompetencie v práci učiteľa. Bratislava, IRIS. Kyriacou, CH. (1996). Klíčové dovednosti učitele. Praha, Portál. Mertin, V. a kol. (2012). Metody a postupy poznávání žáka: pedagogická diagnostika. Praha, Wolters Kluwer. Petty, G. (2013). Moderní vyučování. Praha, Portál.	

Prucha, J. (2013). Moderní pedagogika. Praha, Portál.
 Sirotová, M. (2014). Vysokoškolský učiteľ v edukačnom procese. Trnava, Univerzita sv.Cyrila a Metoda v Trnave.
 Slávik, M. a kol. (2012). Vysokoškolská pedagogika. Praha, Grada.
 Šebeň Zaťková, T. (2014). Úvod do vysokoškolskej pedagogiky. Trnava, Univerzita sv.Cyrila a Metoda v Trnave.
 Turek, I. (2014). Didaktika. Bratislava, Wolters Kluwer, s.r.o.
 Zormanová, L. (2014). Obecná didaktika. Praha, Grada.

Course language:

slovak

Notes:

Course assessment

Total number of assessed students: 78

abs	n	neabs
98.72	0.0	1.28

Provides: doc. PaedDr. Renáta Orosová, PhD.

Date of last modification: 07.09.2022

Approved: prof. Ing. Martin Orendáč, DrSc.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚFV/ FVT/12	Course name: Physics of High Pressures
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: 5	
Recommended semester/trimester of the course:	
Course level: III.	
Prerequisites:	
Conditions for course completion: To successfully complete the course, the student must demonstrate sufficient theoretical knowledge about the effect of pressure on basic physical quantities and phenomena, to show the importance of thermodynamic parameter - pressure in the study of superconducting, magnetic, strongly correlated or structural properties of materials. At the same time, an understanding of all the basic techniques of obtaining high pressure and the implementation of physical experiments in it is required. The student must complete the preparation and course of real measurement at high pressures on a particular device. In addition to direct participation in teaching, the student is obliged to study in the self-study a professional topic close to the assignment of the dissertation, which would also be related to high pressures or their possible use in the study topic. Subsequently, the student is required to develop and present this homework. The credit evaluation of the course takes into account the following student workload: direct teaching and self-study - 2 credits, preparation and implementation of the experiment - 2 credits, independent processing of the assigned topic and its presentation - 1 credit. The minimum limit for obtaining credits is 50 % of each evaluation activity.	
Learning outcomes: After completing lectures and experiment, the student will be sufficiently familiar with the physics and technique of high pressures. The acquired knowledge will broaden his horizons in the field of condensed matter physics and help in the study of current physical problems such as: pressure-induced structural or quantum phase transitions, high-temperature and unconventional superconductivity, topological and frustrated states in quantum systems, pressure tuning of magnetic properties in molecular magnets. At the same time, the student will gain an idea, experience and skills with the preparation and implementation of experiments at high pressures at home and abroad, which may be found in future research.	
Brief outline of the course: Distribution of topics by providers: S. Gabáni - 5., 7., 9.-12.; M. Mihalik - 3., 4., 12.; M. Zentková - 1., 2., 6., 8., 12. 1. Pressure as a basic thermodynamic parameter I.: equations of state, electronic structure of solids under the influence of pressure, Bridgman equations.	

2. Pressure as a basic thermodynamic parameter II.: pressure as a parameter in the solid state physics, general mechanisms of action of high pressures on the physical properties of solids, methods of calculation of electronic and crystal structure.
3. Experimental techniques of obtaining high pressures I.: history of pressure experiments, static pressure, pulse pressure experiments, principle of Bridgman cell, liquid and gaseous pressure transmitting medium, piston pressure cells, calibration and measurement of pressure.
4. Measurement of magnetic properties of solids at high pressures. Pressure experiments in SQUID magnetometer, basic mechanisms of pressure influence on magnetic characteristics - Curie temperature, hysteresis loop, influence of pressure on magnetoresistance, influence of pressure on magnetocrystalline anisotropy. Neutron diffraction under pressure, pressure-induced structural phase transitions.
5. Experimental techniques for obtaining high pressures II.: diamond anvil cells for high pressures above 3 GPa, measurement of pressure, heat capacity, electrical resistivity and magnetic susceptibility in these cells.
6. Spectroscopic techniques under pressure: Raman, UV VIS, Moesbauer. Examples of the use of pressure spectroscopic experiments for different types of materials.
7. Nuclear magnetic resonance and point contact spectroscopy under pressure.
8. Pressure tuning of physical properties of molecular magnetic materials. Specifics of the class of molecular magnetic materials, pressure-induced spin crossover transitions.
9. Influence of pressure on superconductivity.
10. Pressure-induced quantum phase transitions in electronic systems. Quantum critical point, "non-Fermi-liquid" behavior, metal-insulator and antiferromagnet-superconductor transitions.
11. Influence of pressure on strongly correlated electron systems. Pressure-induced transition metal-insulator, antiferromagnet-superconductor at temperatures close to absolute zero.
12. Preparation of pressure experiment in piston cells for PPMS and MPMS. Preparation of pressure experiment in diamond anvil cells for PPMS and MPMS. Measurement of magnetic, transport and thermal properties of solids.

Recommended literature:

1. M. I. Eremets: High pressure experimental methods, Oxford University Press, Oxford, (2002)
2. J. Loveday: High pressure physics, CRC Press, Taylor&Francis Group (2012)
3. S. Sachdev: Quantum Phase Transitions, Cambridge University Press, Cambridge (2000)
4. T. Vojta: Quantum phase transitions in electronic systems, Ann. Phys. 9, 403-440 (2000)
5. G. R. Stewart: Non-Fermi-Liquid behavior in d- and f- electron metals, Rev. Mod. Phys. 73, 797-855 (2001)
6. W. Buckel and R. Kleiner: Superconductivity, Wiley-VCH Verlag GmbH & Co. KGaA, Weinheim (2004)

Course language:

Slovak, English

Notes:

The course is provided in the presence form, if necessary by distance form using the MS TEAMS environment.

Course assessment

Total number of assessed students: 16

N	P
0.0	100.0

Provides: doc. RNDr. Slavomír Gabáni, PhD., RNDr. Marián Mihálik, CSc., RNDr. Mária Zentková, CSc.
Date of last modification: 23.09.2021
Approved: prof. Ing. Martin Orendáč, DrSc.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚFV/ UMV/PM/21	Course name: Powder functional composite 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: 4	
Recommended semester/trimester of the course:	
Course level: III.	
Prerequisites:	
Conditions for course completion: The student has to demonstrate sufficient knowledge of compacted powder composite materials with emphasis on methods of preparation of micro- and nano-composite powder material systems, structural and physical properties to successfully complete the course. He will gain basic knowledge of methods of coating, homogenization, pressing and heat treatment of powder materials, principles of structure formation, elastic, electrical and magnetic properties, as well as their applications in electrical engineering and electronics. The credit evaluation of the course takes into account the following student workload: 1 credit: self-study of recommended and supplementary literature. 2 credits: elaboration of a presentation on a selected topic resulting from the content of the course, which is related to the topic of the dissertation. 1 credit: independent preparation for the final exam and its successful completion.	
Learning outcomes: The student will demonstrate adequate mastery of the course content as defined by the course syllabus and recommended literature after completing lectures and presentation. The results of education are: 1. Completion and acquisition of knowledge about the relationship between the parameters of compacting technology, structure and functional properties of powder materials. 2. Knowledge of the specifics of methods for characterizing the functional properties of materials. 3. Creation of terminological and knowledge prerequisites for understanding the applicability of physical phenomena in the field of progressive powder composite materials and technologies.	
Brief outline of the course: The content of the course: 1. Powdered metallic, non-metallic, polymeric and hybrid materials with specific physical properties - basic concepts. 2. Electrical, magnetic, thermal, elastic strength properties of composite materials. 3. Structural properties of functional composite materials. 4. Methods of preparation of powder materials - mechanical alloying, mechanochemical synthesis, coating of powder particles, homogenization of composite powders. 5. Methods of compacting powder composite materials - pressing, sintering, powder injection, isostatic pressing, hot pressing, sintering with the assistance of electric and magnetic fields, laser and electron beam sintering, additive	

production, 3D printing. 6. Characterization of powder composites and methods for measuring functional properties. 7. Progressive compacted powder composite materials and their applications - ferromagnetic, ferrimagnetic materials, soft magnetic composites, sintered hard magnetic materials, multifunctional materials for electronics, smart composites.	
Recommended literature: 1. Šalak A.: Ferrous Powder Metallurgy, Cambridge International Science Publishing, 1997 2. B. D. Cullity, C. D. Graham: Introduction to Magnetic Materials, 2nd edition, IEEE Press, Wiley, 2009, ISBN:9780470386323. https://doi.org/10.1002/9780470386323 3. Isaac Chang and Yuyuan Zhao: Advances in Powder Metallurgy - properties, processing and applications, Woodhead Publishing Limited, 2013, ISBN: 9780857098900. https://doi.org/10.1016/B978-0-12-819726-4.00151-4 4. L.J. Huang, L. Geng, H-X. Peng: Microstructurally inhomogeneous composites: Is a homogeneous reinforcement distribution optimal?, Progress in Materials Science, 71 (2015), 93–168	
Course language: english	
Notes: Teaching is carried out full-time or part-time using the MS Teams tool. The form of teaching is specified by the teacher at the beginning of the semester and it is continuously updated.	
Course assessment Total number of assessed students: 2	
N	P
0.0	100.0
Provides: Ing. Radovan Bureš, CSc., doc. RNDr. Ján Füzér, PhD.	
Date of last modification: 28.09.2021	
Approved: prof. Ing. Martin Orendáč, DrSc.	

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚFV/ VYS/04	Course name: Presentation in Seminar
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:	
Course level: III.	
Prerequisites:	
Conditions for course completion:	
Learning outcomes:	
Brief outline of the course:	
Recommended literature:	
Course language:	
Notes:	
Course assessment Total number of assessed students: 383	
abs	n
100.0	0.0
Provides:	
Date of last modification:	
Approved: prof. Ing. Martin Orendáč, DrSc.	

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚFV/ NSM/12	Course name: Processing, properties and applications of nanomaterials
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: 5	
Recommended semester/trimester of the course:	
Course level: III.	
Prerequisites:	
Conditions for course completion: To successfully complete the course, the student must demonstrate sufficient understanding of the basic concept in field of nanomaterials and their applications. For obtaining credits student must pass midterm written exam about basic concepts in field of nanomaterials. More advanced topics will be part of final oral exam. The credit evaluation of the course takes into account the following student workload: direct teaching 2 credits, self-study 1 credit, study for interim test and final test 2 credits. The minimum threshold for completing the course is to obtain at least 50% of the total score, using the following rating scale: A (90-100%), B (80-89%), C (70-79%), D (60- 69%), E (50-59%), F (0-49%).	
Learning outcomes: The aim of the course is to acquaint students with the preparation and properties of nanomaterials. Based on the discussed specific applications, the student will understand their unique properties and behavior.	
Brief outline of the course: Thematic areas: 1. Preparation of nanomaterials using lithographic methods. Shaping of nanostructures. Optical lithography, electron beam lithography, wet chemical etching, dry etching, focusing electron beam shaping, lithography using scanning probe microscopy. 2. Preparation and properties of thin films and multilayers. Thin film preparation technologies. Steaming, sputtering, so-called atomic layer deposition, epitaxial growth technology, nucleation and growth, planar systems, lateral structured systems, anisotropy in thin films, domain wall in thin films. Magnetic multilayers, GMR effect. 3. Preparation of nanocrystalline metals, alloys and composites by electrodeposition Synthesis of nanostructured composite materials by electrodeposition, structure of nanocrystalline metal electrodeposited layers, properties and applications 4. Data recording and storage using nanotechnologies The current state of commercial data storage devices, the possibilities offered by nanotechnologies, data recording using the so-called millipede concept, race track memories, gmr effect devices, so called phase change memory	

5. Nanoelectronics, optoelectronics and nanorobotics. Single electron transistor concept, manufacturing and physical principle. Single atom transistor: concept, production and physical principle. Optoelectronic devices and advances in nanorobotics. 6. Diffusion in NKM: Modeling of interface diffusion, diffusion in grain boundaries. Diffusion in nanocrystalline metals: specific aspects, nanocrystalline pure metals, relationship between diffusion and grain growth, selected examples of diffusion (magnetically soft and hard NKM,), hydrogen diffusion in NKM 7. Magnetic nanoparticles and their applications: Physics of magnetic nanoparticles: bulk ferromagnetism, magnetic clusters, molecular magnetism, ideal monodomain particle, surface effects and interfacial effects, exchange interaction between nanoparticles. Applications of monodomain magnets: Ferrofluids, biomedical applications, magnetic nanoparticle imaging, data storage media, magnetoresistive devices. 8. Magnetic properties of selected nanosystems: amorphous Fe-MB alloys (amorphous and nanocrystalline state, induced anisotropy), FINEMET, Influence of substitutions on properties of Finemet alloys, Fe-Zr-Nb-B alloys, Fe-Nb-BP-Cu produced in the atmosphere, the effect of grain size distribution on Tc and amorphous residue. 9. Mechanical behavior of NKM: Models and simulation of mechanical properties of NKM, models of deformation, density, pores and microcracks, elastic properties, hardness, tensile strength, ductility, examples of experimental results.					
Recommended literature: 1. C.C. Koch, Nanostructured Materials – processing, Properties and Applications, WA Publishing, 2007. 2. Springer Handbook of Nanotechnology, B. Bhushan (Ed.), Springer 2007. 3. Nanomagnetism and Spintronics, T. Shinjo (Ed.) Elsevier 2009. 4. P.Sovák, A. Zorkovská, Structure and Magnetic Properties of FINEMET based Alloys, UPJŠ, 2008, ISBN 978-80-7097-719-4.					
Course language: slovak and english					
Notes: Teaching is carried out full-time or part-time using the MS teams platform. Form of teaching are specified by the teacher at the beginning of the semester and continuously updated as needed.					
Course assessment Total number of assessed students: 29 <table border="1"> <thead> <tr> <th>N</th><th>P</th></tr> </thead> <tbody> <tr> <td>0.0</td><td>100.0</td></tr> </tbody> </table>		N	P	0.0	100.0
N	P				
0.0	100.0				
Provides: Mgr. Vladimír Komanický, PhD.					
Date of last modification: 27.09.2021					
Approved: prof. Ing. Martin Orendáč, DrSc.					

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: KPPaPZ/PsVU/17	Course name: Psychology for University Lecturers
Course type, scope and the method: Course type: Lecture Recommended course-load (hours): Per week: Per study period: 28s Course method: present	
Number of ECTS credits: 5	
Recommended semester/trimester of the course:	
Course level: III.	
Prerequisites:	
Conditions for course completion: Case study, micro-output, its analysis Current modifications of the course are listed in the electronic bulletin board of the course.	
Learning outcomes: After completing the course, students can: and Understand, summarize and explain selected psychological knowledge from cognitive psychology, emotion and motivation psychology, personality psychology, developmental, social, educational psychology and health psychology. b) apply the above psychological knowledge necessary for the professional, competent performance of university teaching practice of doctoral students c) to create and implement the teaching of a professional topic with applied psychological knowledge d) evaluate their performance and the performance of their classmates, provide feedback	
Brief outline of the course: The content of the course is based on selected psychological knowledge of cognitive psychology, psychology of emotions and motivation, personality psychology, developmental, social, educational psychology and health psychology. Teaching is realized by a combination of lectures with interactive, experiential methods, discussion, open communication with mutual respect, support of independence, activity and motivation of students. Syllabus: University teacher and his work in the teaching process with a focus on: teachers in relation to themselves (cognitive, personal, social and competencies in the use of methods), in relation to students and as part of the teacher-student relationship on the basis of selected areas of cognitive psychology, psychology of emotions and motivation, developmental psychology, social psychology, educational psychology and health psychology with application to the university environment	
Recommended literature: Alexitch, L. R. (2005). Applying social psychology to education. Social Psychology.–Ed.: Schneider F., Gruman J., Coutts L.–Sage Publications, Inc, 205-228. Fry, H., Ketteridge, S., & Marshall, S. (2008). A handbook for teaching and learning in higher education: Enhancing academic practice. Routledge. Mareš, J.: Pedagogická psychologie. Portál, 2013.	

Kniha psychologie. Universum, 2014 Čáp, J., Mareš, J.: Psychologie pro učitele. Praha: Portál 2007. Vágnerová, M.: Školní poradenská psychologie pro pedagogy. Praha: Karolínium 2005.		
Course language: slovak		
Notes:		
Course assessment Total number of assessed students: 70		
abs	n	neabs
100.0	0.0	0.0
Provides: PhDr. Anna Janovská, PhD.		
Date of last modification: 24.06.2022		
Approved: prof. Ing. Martin Orendáč, DrSc.		

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:	
Course level: II., III.	
Prerequisites:	
Conditions for course completion: To successfully complete the course, the student must demonstrate sufficient understanding of the basics terms, concepts, and applications of quantum theory of magnetism. Knowledge of basic concepts of quantum physics at the level of their mathematical definition is required, as well as understanding of their physical content and specific applications in the field of magnetism. During the semester, the student must continuously master the content of the curriculum, so that he can actively and creatively use the acquired knowledge in solving specific tasks assigned to independent solutions at home. The condition for obtaining credits is passing an oral exam, which consists of one more demanding computational task and theoretical questions covering the entire scope of the course. The credit evaluation of the course takes into account the following student workload: direct teaching (2 credits), self-study (1 credit), individual consultations (1 credit) and assessment (1 credit). The minimum threshold for completing the course is to obtain at least 50% of the total score, using the following rating scale: A (90-100%), B (80-89%), C (70-79%), D (60- 69%), E (50-59%), F (0-49%).	
Learning outcomes: After completing lectures, the student will have sufficient physical skills, knowledge and mathematical apparatus enabling independent solution of a wide range traditional and current scientific problems in quantum theory of magnetism. At the same time, he will gain an overview of the applications of quantum theory of magnetism for a description of insulating magnetic materials.	
Brief outline of the course: 1. Introduction to quantum theory of magnetism, definition of basic lattice-statistical models in magnetism: Ising model, Heisenberg model, Hubbard model, t-J model. 2. Exchange interaction and its quantum-mechanical origin. Formalism of the second quantization and basic commutation relations between ladder spin operators. 3. Elementary quantum theory of a pair of interacting magnetic particles: Heisenberg dimer. 4. Elementary quantum theory of a pair of interacting magnetic particles: Hubbard dimer. 5. One-dimensional quantum Heisenberg model, spin waves as collective excitations of ferromagnetic spin chain, one-magnon spectrum.	

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

Recommended literature:

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

Course language:

EN - english

Notes:

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

Course assessment

Total number of assessed students: 29

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

Provides: doc. RNDr. Jozef Strečka, PhD.

Date of last modification: 19.11.2021

Approved: prof. Ing. Martin Orendáč, DrSc.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚFV/ RZ/04	Course name: Reviewed International or National Proceedings
Course type, scope and the method: Course type: Recommended course-load (hours): Per week: Per study period: Course method: present	
Number of ECTS credits: 5	
Recommended semester/trimester of the course:	
Course level: III.	
Prerequisites:	
Conditions for course completion:	
Learning outcomes:	
Brief outline of the course:	
Recommended literature:	
Course language:	
Notes:	
Course assessment Total number of assessed students: 280	
abs	n
100.0	0.0
Provides:	
Date of last modification:	
Approved: prof. Ing. Martin Orendáč, DrSc.	

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚFV/ RSM/12	Course name: Scanning probe microscopy
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:	
Course level: III.	
Prerequisites:	
Conditions for course completion: To successfully complete the course, the student must demonstrate sufficient understanding of the basic physical principles and technical details of state-of-the-art experimental methods based on scanning probe microscopy used in Condensed Matter Physics and nanotechnology. To obtain credits, students are required to prepare a presentation about one of the described experimental methods, or its application and pass an oral examination. The credit evaluation of the course considers the following student workload: direct teaching (1 credit), self-learning and presentation preparation (1 credit), assessment (1 credit). The minimum threshold for completing the course is to obtain at least 50% of the total score, using the following rating scale: A (90-100%), B (80-89%), C (70-79%), D (60- 69%), E (50-59%), F (0-49%).	
Learning outcomes: The course provides a basic overview of the principles and state of the art methods based on scanning probe microscopy.	
Brief outline of the course: Principles of scanning probe microscopies (STM, AFM, MFM etc.), tunneling and point contact spectroscopy of metals and superconductors, experiments in vacuum and at low temperatures, preparation of crystal surfaces, monolayers and thin films. 1. Introduction – From optical microscope to scanning tunneling microscope Optical microscopy, electron microscopy, scanning tunneling microscopy 2. Quantum tunneling History, theory, tunneling current and conductivity, tunneling current vs. barrier, effect of temperature and magnetic field 3. Scanning tunneling microscopy (STM) Piezoelectric effect in STM, methods of approaching the STM tip to the surface of the sample, controller electronics, scanning modes, principles of the PID feedback loop, topography imaging, numerical methods of data analysis. 4. Tunneling spectroscopy (TS) Principles of tunneling spectroscopy, tunneling through planar and vacuum barrier, electronic structure of metals, semiconductors and superconductors; Current vs. voltage and differential conductance vs. voltage characteristics, controller electronics, conductance imaging tunneling	

spectroscopy (CITS), numerical methods of data analysis; TS of metals, semiconductors, molecules and various nanostructures 5. Tunneling spectroscopy of superconductors NIS and SIS tunneling contacts, superconducting energy gap, effect of temperature and magnetic field, superconducting vortices, vortex pinning and dynamics 6. Point contact spectroscopy (PCS) Elastic and non-elastic PCS of metals and superconductors; types of point contacts: thin films, needle – anvil, edge – to – edge, lithography, break junctions; effect of temperature and magnetic field 7. Experimental methods Mechanical design; Low temperatures equipment: historical overview, helium liquefaction, cooling methods, refrigerator types, low temperature technologies; vacuum equipment: pumping, pressure gauges, vacuum technologies; sample preparation: surface cleaning, preparation of thin films and nanostructures by evaporation, sputtering etc. 8. Visit of low temperature STM laboratory, experiment preparation and realization 9. Scanning probe microscopies (SPM) History, principles of atomic force microscope (AFM), scanning modes, detection of the probe - sample interaction; some other types of SPM: magnetic force microscopy, Kelvin probe microscopy, scanning Hall probe microscopy, 10. STM modifications Spin polarized STM, electrochemical STM, Fourier transformation STM, Josephson STM etc. 11. Nanomanipulation, Lithography by SPM Dip pen, local anodic oxidation, nanoscratching, nanoindentation, atomic manipulation etc. 12. Visit of SPM and nanotechnology laboratory, experiment preparation and realization					
Recommended literature: Roland Wiesendanger: Scanning Probe Microscopy and Spectroscopy: Methods and Applications, Cambridge University Press 1994 Yu.G. Naidyuk, I.K. Yanson: Point contact spectroscopy, Springer, 2003 E.L. Wolf: Principles of electron tunneling spectroscopy, Oxford university press, 1989 K. Oura, V.G. Lifshits, A.A. Saranin, A.V. Zotov, M. Katayama: Surface Science: An Introduction, Springer, Berlín 2003					
Course language: Slovak, English					
Notes: The course comprises onsite lectures. If necessary, online lectures will be provided via MS Teams.					
Course assessment Total number of assessed students: 14 <table border="1"> <thead> <tr> <th>N</th><th>P</th></tr> </thead> <tbody> <tr> <td>0.0</td><td>100.0</td></tr> </tbody> </table>		N	P	0.0	100.0
N	P				
0.0	100.0				
Provides: Mgr. Tomáš Samuely, PhD.					
Date of last modification: 27.09.2021					
Approved: prof. Ing. Martin Orendáč, DrSc.					

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.	
Prerequisites:	
Conditions for course completion: To successfully complete the course, the student must understand the basics of micromagnetic simulations. They must know the basic functions of the OOMMF simulation environment and create simple scripts, as well as process the outputs of these simulations. The final assessment is given on an oral exam. Final assessment takes into account the scope of teaching (2 credits), consultations and assessment (1 credit). Grading scale: A - 91%-100% points, B - 81%-90% points, C - 71%-80% points, D - 61%-70% points, E - 51%-60% points.	
Learning outcomes: After completing the lectures, the student will have knowledge of creating micromagnetic simulations of simple systems. It will be able to run these simulations using scripting, thus automating the process.	
Brief outline of the course: 1. Introduction to micromagnetic simulations. Equation of motion of a magnetic moment in external magnetic field. Effective field. Gibbs free energy. Langevin dynamics. Characteristic length of scaling. Numeric methods in micromagnetism. Discretization, final elements. Calculation of a magnetostatic fields. Time integration. 2. Simulation software OOMMF. OOMMF architecture overview. Scripting by command line. Scripting using Python. Parallelization of solution. Input/output parameters of scripting. 3. OOMMF solver – description of a child classes Atlases, Meshes, Energies, Evolvers, Drivers and Field objects. 4. Output of simulations, description of tools mmDataTable, mmDataGraph, mmDisp and mmArchive. 5. Conversion of outputs, conversion of three-dimensional vector fields into bmp, postscript and data tables. Description of *.mif format. Material parameters, initial magnetization, demagnetization fields, parameters of simulations, stop criteria of simulations. 6. Simulation of a domain wall in thin magnetic wire. Compensation of a stray fields produced by free ends of a wire. Various initial spin structures of a domain wall.	

7. Simulation of hysteresis loops of nanowires, Circular discs. Implementation of temperature in a micromagnetic solver.							
Recommended literature: 1. A. Friedman, Micromagnetic simulation v: Mathematics in Industrial Problems. The IMA Volumes in Mathematics and its Applications, vol 57. Springer, New York, NY 2. S. Chikazumi, Physics of Ferromagnetism, Oxford University Press, USA (2009) 3. A. Prohl, Computational Micromagnetism v: Advances in Numerical Mathematics, ISSN 1616-2994, Springer, New York, NY							
Course language: Slovak, English							
Notes: The course is realized via on-site lectures, if necessary, online via MS Teams.							
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: 28.09.2021							
Approved: prof. Ing. Martin Orendáč, DrSc.							

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚFV/ SFKL1a/04	Course name: Seminar in Solid State Physics
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: 3	
Recommended semester/trimester of the course: 1.	
Course level: III.	
Prerequisites:	
Conditions for course completion: 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. 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. They will also improve their presentation skills.	
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: Selected scientific journals.	
Course language: Slovak, English	
Notes:	
Course assessment Total number of assessed students: 108	
abs	n
100.0	0.0

Provides: prof. Ing. Martin Orendáč, DrSc., doc. RNDr. Erik Čižmár, PhD.
Date of last modification: 02.07.2021
Approved: prof. Ing. Martin Orendáč, DrSc.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚFV/ SFKL1b/04	Course name: Seminar in Solid State Physics
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: 3	
Recommended semester/trimester of the course: 2.	
Course level: III.	
Prerequisites:	
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. They will also improve their presentation skills.	
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: Selected scientific journals.	
Course language:	
Notes:	
Course assessment Total number of assessed students: 107	
abs	n
100.0	0.0

Provides: prof. Ing. Martin Orendáč, DrSc., prof. RNDr. Pavol Sovák, CSc.
Date of last modification: 02.07.2021
Approved: prof. Ing. Martin Orendáč, DrSc.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚFV/ SFKL2a/04	Course name: Seminar in Solid State Physics
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: 3	
Recommended semester/trimester of the course: 3.	
Course level: III.	
Prerequisites:	
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. They will also improve their presentation skills.	
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: Selected scientific journals.	
Course language: Slovak, English	
Notes:	

Course assessment	
Total number of assessed students: 93	
abs	n
100.0	0.0
Provides: prof. Ing. Martin Orendáč, DrSc., doc. RNDr. Ján Füzér, PhD.	
Date of last modification: 02.07.2021	
Approved: prof. Ing. Martin Orendáč, DrSc.	

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚFV/ SFKL2b/04	Course name: Seminar in Solid State Physics
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: 3	
Recommended semester/trimester of the course: 4.	
Course level: III.	
Prerequisites:	
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. They will also improve their presentation skills.	
Brief outline of the course: Contents is determined by the lectures and varies every year.	
Recommended literature: Selected scientific journals.	
Course language: english	
Notes:	
Course assessment Total number of assessed students: 96	
abs	n
100.0	0.0
Provides: prof. Ing. Martin Orendáč, DrSc., doc. RNDr. Alžbeta Orendáčová, DrSc.	
Date of last modification: 22.09.2021	

Approved: prof. Ing. Martin Orendáč, DrSc.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚFV/ SFKL3a/04	Course name: Seminar in Solid State Physics
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: 3	
Recommended semester/trimester of the course: 5.	
Course level: III.	
Prerequisites:	
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. They will also improve their presentation skills.	
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: Selected scientific journals.	
Course language: Slovak, English	
Notes:	

Course assessment	
Total number of assessed students: 84	
abs	n
100.0	0.0
Provides: prof. Ing. Martin Orendáč, DrSc., doc. RNDr. Adriana Zeleňáková, PhD.	
Date of last modification: 02.07.2021	
Approved: prof. Ing. Martin Orendáč, DrSc.	

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚFV/ SFKL3b/04	Course name: Seminar in Solid State Physics
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: 3	
Recommended semester/trimester of the course: 6.	
Course level: III.	
Prerequisites:	
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. They will also improve their presentation skills.	
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: Selected scientific journals.	
Course language: Slovak, English	
Notes:	

Course assessment	
Total number of assessed students: 83	
abs	n
100.0	0.0
Provides: prof. Ing. Martin Orendáč, DrSc., Mgr. Vladimír Komanický, PhD.	
Date of last modification: 02.07.2021	
Approved: prof. Ing. Martin Orendáč, DrSc.	

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚFV/ SFKL4a/04	Course name: Seminar in Solid State Physics
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: 3	
Recommended semester/trimester of the course: 7.	
Course level: III.	
Prerequisites:	
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. They will also improve their presentation skills.	
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: Selected scientific journals.	
Course language: Slovak, English	
Notes:	

Course assessment	
Total number of assessed students: 65	
abs	n
100.0	0.0
Provides: prof. Ing. Martin Orendáč, DrSc., prof. RNDr. Peter Kollár, DrSc.	
Date of last modification: 02.07.2021	
Approved: prof. Ing. Martin Orendáč, DrSc.	

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚFV/ SFKL4b/04	Course name: Seminar in Solid State Physics
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: 3	
Recommended semester/trimester of the course: 8.	
Course level: III.	
Prerequisites:	
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. They will also improve their presentation skills.	
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: Selected scientific journals.	
Course language: Slovak, English	
Notes:	

Course assessment	
Total number of assessed students: 66	
abs	n
100.0	0.0
Provides: prof. Ing. Martin Orendáč, DrSc., Mgr. Tomáš Samuely, PhD.	
Date of last modification: 02.07.2021	
Approved: prof. Ing. Martin Orendáč, DrSc.	

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.	
Prerequisites:	
Conditions for course completion: To successfully complete the course, the student must demonstrate sufficient knowledge of the basics of sensors and actuators operating on the basis of physical phenomena with emphasis on basic concepts, properties and parameters of sensors and actuators, static sensor parameters, transmission characteristics and calibration, accuracy, sensitivity, resolution, selectivity, working range, hysteresis and dynamic parameters. Basic physical phenomena used in microsensors such as piezoelectric effect, piezoresistive effect, magnetoresistance effect, Hall effect, Seebeck effect, Peltier effect, magnetostrictive effect, electrostrictive effect, pyroelectric effect. Description of the principle of operation of sensors and actuators based on mechanical, thermal, magnetic, and biochemical domains. The credit evaluation of the course takes into account the following student workload: 1 credits: direct teaching and self-study of recommended supplementary literature, 1 credit: independent preparation for the final test and its successful completion. The minimum threshold for completing the course is to obtain at least 50% of the total score, using the following rating scale: A (90-100%), B (80-89%), C (70-79%), D (60- 69%), E (50-59%), F (0-49%).	
Learning outcomes: After completing the lectures and successfully passing the final test, the student will demonstrate the knowledge of the standard content of the course, which is defined by the brief content of the course and the recommended literature. The result of education is: a) Creation of the necessary terminology and knowledge base for understanding the operation of sensors and actuators based on selected physical phenomena. b) Supplementation and summarization of knowledge in the field of physical phenomena and materials with the possibility of use in sensors and actuators. c) Possibilities of using sensors and actuators in practice.	
Brief outline of the course: Sensors and actuators - introductory terms and definitions. Properties and parameters of sensors and actuators. Basic physical phenomena used in sensors and actuators. Sensors - basic terms and definitions. Mechanical domain based sensors. Thermal domain based sensors. Magnetic domain based sensors. Radiation sensors. Chemical sensors. Tactile sensors. Actuators - basic concepts	

and classification. Electrostatic actuators. Piezoelectric actuators. Actuators based on magnetic principles. Thermal actuators. Optical actuators. Mechanical actuators. Chemical actuators.							
Recommended literature: 1. 1. M. Husák, Mikrosenzory a mikroaktuátory, Nakladatelství Academia, Praha, (2008) 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: Lectures can be done at presence form or online form using MS Teams. Education form is updated at the begining of the subject							
Course assessment Total number of assessed students: 5							
A	B	C	D	E	FX	N	P
20.0	0.0	0.0	0.0	0.0	0.0	0.0	80.0
Provides: prof. RNDr. Rastislav Varga, DrSc., RNDr. Ladislav Galdun, PhD.							
Date of last modification: 27.09.2021							
Approved: prof. Ing. Martin Orendáč, DrSc.							

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: Dek. PF UPJŠ/JSD/14	Course name: Spring School for PhD Students
Course type, scope and the method: Course type: Lecture Recommended course-load (hours): Per week: Per study period: 4d Course method: present	
Number of ECTS credits: 2	
Recommended semester/trimester of the course:	
Course level: III.	
Prerequisites:	
Conditions for course completion: Active participation in the Spring School of PhD students of UPJŠ.	
Learning outcomes: By actively participating in the Spring School of PhD Students of UPJŠ, the PhD student demonstrates a high level of ability to process the issues of his dissertation for a multidisciplinary audience with an emphasis on clarifying the motivation, scientific problem, processing methodology and own contribution to the solution of the selected topic. The PhD student demonstrates the ability to professionally discuss various research topics, present his own positions and accept a plurality of opinions. Demonstrates the ability to communicate research results to a wider professional audience with adequate means and through the Slovak language.	
Brief outline of the course: 1. Interdisciplinary lectures from the fields of medicine, natural sciences, law, public affairs, humanities. Lecturers - top foreign or national experts from the mentioned fields. 2. Scientific lectures in sections created within related disciplines. Lecturers - top experts from UPJŠ from the mentioned fields. 3. Scientific contributions of PhD students in sections of related fields. 4. Panel discussions on the issue of PhD studies and current trends in the development of scientific disciplines at UPJŠ.	
Recommended literature: Proceedings of the Spring School of Doctoral Students.	
Course language:	
Notes:	
Course assessment Total number of assessed students: 187	
abs	n
100.0	0.0
Provides: doc. RNDr. Marián Kireš, PhD.	

Date of last modification: 08.11.2022
Approved: prof. Ing. Martin Orendáč, DrSc.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚFV/ SVM/07	Course name: Structural properties of 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: 5	
Recommended semester/trimester of the course:	
Course level: III.	
Prerequisites:	
Conditions for course completion: To successfully complete the course, the student must demonstrate sufficient understanding of the basic concepts of condensed matter physics and physical metallurgy. On the basis of the acquired knowledge, he / she is able to follow up on specialized courses in condensed matter physics, which are provided by the Department of FKL on the basis of the orientation of his research. These are mainly courses in the field and structure and properties of KL. To obtain an evaluation, the student must meet the requirements of a written test on the topic of crystal lattice disorders. Other topics of the course will be the subject of an oral exam. The credit evaluation of the course takes into account the following student workload: direct teaching 2 credits, self-study of recommended supplementary literature - 1 credit, continuous study for test and evaluation - 2 credits. The minimum limit for obtaining the evaluation is 50% of the sum of the points from the test and the oral exam. The maximum value of points from the test is 30% of the total evaluation. The rating scale is determined as follows: A (90-100%), B (80-89%), C (70-79%), D (60-69%), E (50-59%), F (0- 49%) 50% based on the result of the exam from the syllabus.	
Learning outcomes: By completing the course, the student will demonstrate adequate mastery of the content standard of the course, which is defined by brief content and recommended literature. Theoretical mastery of the basics of defects in crystalline materials, diffusion in solids, thermodynamics of materials with an orientation to phase equilibrium and phase transformations.	
Brief outline of the course: OK	
Recommended literature: 1. P. Kratochvíl, P. Lukáč, B. Sprušil, Úvod do fyziky kovů I.SNTL/ALFA 1984 2. J.D. Verhoeven, Fundamentals Physical Metallurgy, 1975, John Wiley & Sons. 3. L. Ptáček a kolektiv, Nauka o materiálu I., 2003, Akademické nakladatelství CERM, s.r.o.,	
Course language: Slovak, English	
Notes:	

Course assessment	
Total number of assessed students: 3	
N	P
0.0	100.0
Provides: Ing. Pavel Diko, DrSc.	
Date of last modification: 21.10.2021	
Approved: prof. Ing. Martin Orendáč, DrSc.	

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚFV/ ZSP/04	Course name: Study Stay Abroad
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:	
Course level: III.	
Prerequisites:	
Conditions for course completion:	
Learning outcomes:	
Brief outline of the course:	
Recommended literature:	
Course language:	
Notes:	
Course assessment Total number of assessed students: 265	
abs	n
100.0	0.0
Provides:	
Date of last modification:	
Approved: prof. Ing. Martin Orendáč, DrSc.	

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚFV/ VPSV/04	Course name: Supervision of Student's Scientific Activity
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:	
Course level: III.	
Prerequisites:	
Conditions for course completion:	
Learning outcomes:	
Brief outline of the course:	
Recommended literature:	
Course language:	
Notes:	
Course assessment Total number of assessed students: 19	
abs	n
100.0	0.0
Provides:	
Date of last modification:	
Approved: prof. Ing. Martin Orendáč, DrSc.	

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚFV/ VBP/04	Course name: Supervisor/consultant of bachelor thesis
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:	
Course level: III.	
Prerequisites:	
Conditions for course completion:	
Learning outcomes:	
Brief outline of the course:	
Recommended literature:	
Course language:	
Notes:	
Course assessment Total number of assessed students: 44	
abs	n
100.0	0.0
Provides:	
Date of last modification:	
Approved: prof. Ing. Martin Orendáč, DrSc.	

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚFV/ PPC/04	Course name: Teaching activities
Course type, scope and the method: Course type: Recommended course-load (hours): Per week: Per study period: Course method: present	
Number of ECTS credits: 1	
Recommended semester/trimester of the course:	
Course level: III.	
Prerequisites:	
Conditions for course completion:	
Learning outcomes:	
Brief outline of the course:	
Recommended literature:	
Course language:	
Notes:	
Course assessment Total number of assessed students: 268	
abs	n
100.0	0.0
Provides:	
Date of last modification:	
Approved: prof. Ing. Martin Orendáč, DrSc.	

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚFV/ TSK/12	Course name: Teória silne korelovaných elektrónových systémov
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: 5	
Recommended semester/trimester of the course:	
Course level: III.	
Prerequisites:	
Conditions for course completion: Succesful passing test and final exam	
Learning outcomes: To provide students with models, methods and physical applications in the area of strongly correlated electron systems.	
Brief outline of the course: Occupation number representation. Second quantization. Models of strongly correlated electron systems. Hubbard model. Periodic Anderson model. Falicov-Kimball model. t-J model. Analytical and numerical methods in the theory of strongly correlated electron systems. Method of canonical transformations. Green's function method. Perturbation theory. Gutzwiller variation method. Lanczos method. Quantum Monte Carlo method. Collective Phenomena. Valence transitions. Metal-insulator transitions. Formation of charge and spin ordering. Electronic ferroelectricity. Itinerant magnetism. Superconductivity. BCS theory. Ginzburg-Landau theory.	
Recommended literature: [1] P. Farkašovský., H. Čenčariková, Cooperative phenomena in Strongly Correlated Systems, LAP Saarbucken 2011, ISBN: 978-3-8465-0611-0	
Course language: Slovak, English	
Notes:	
Course assessment Total number of assessed students: 6	
N	P
0.0	100.0
Provides: RNDr. Pavol Farkašovský, DrSc.	
Date of last modification: 03.05.2015	
Approved: prof. Ing. Martin Orendáč, DrSc.	

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚFV/ TS/12	Course name: Thermodynamics of Superconductors
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:	
Course level: III.	
Prerequisites:	
Conditions for course completion: Conditions are: to pass the final exam where the student is to prove satisfactory understanding of basic concepts and models used for description of the heat capacity of superconductors. Apart from presence on the course the student is obliged to study scientific papers assigned by the teacher (specific publications related to the heat capacity of particular superconducting materials). Student is obliged also to elaborate home assignment in relation to practical laboratory exercise realized during semester. Minimum level for successful passing the exam is 51 % from the total score, which takes into account all kind of activities with relevant weight. The scale: A - 91%-100% points, B - 81%-90% points, C - 71%-80% points, D - 61%-70% points, E - 51%-60% points.	
Learning outcomes: After successful passing the student will understand basic theoretical and experimental aspects of thermodynamic properties of superconductors, with special emphasis on the experimental method of modulated calorimetry. The student will acquire practical experience with preparation and realization of experiment to determine the heat capacity using this method. From the voltage reading the student will be able to calculate heat capacity of the sample. From temperature and field dependence of the heat capacity, the student will manage to decide which type of superconductor the sample is (s-wave or d-wave), to determine the coupling strength, upper critical magnetic field and other characteristic features or properties of superconducting material.	
Brief outline of the course: Vargaštoková: 1., 2., 3., 8., 9., 11. Kačmarčík: 4., 5., 6., 7., 10., 12. 1. Introduction into superconductivity. Elementary properties of superconductors (zero resistivity, Meissner effect), energy gap, electron-phonon interaction, symmetry of the energy gap, types of superconductors (type I, type II superconductors), phase diagrams Magnetic field vs. Temperature, superconducting vortices. 2. Thermodynamics of the phase transitions. Thermodynamic potentials, their relations and related quantities. 3. Thermodynamic properties of superconductors. Entropy, specific heat in normal and superconducting state, thermodynamic critical field, upper critical field.	

4. Heat capacity measurement methods. Adiabatic, relaxation, pulsed, modulated heat capacity measurements – theory, comparison, advantages and disadvantages, choice of a proper method in specific cases.
5. Modulated calorimetry – theory. Calculation of thermal balance, important relaxation constants, relations between distinct part of the experimental setup, calculation of the heat capacity from oscillations of the temperature for an ideal case, corrections of the heat capacity for a real case, estimation of thermal conductance between the sample and thermal reservoir.
6. Modulated calorimetry – experimental aspects. Experimental setup, measurement of particular physical properties, choice of a frequency for the measurement – frequency test; accurate temperature measurement – calculation of the Seebeck coefficient, correction of the thermal sensors in magnetic field; corrections of the amplifier; regulation of LED diode (temperature stabilization), relation between the diode power and sample temperature, relation between frequency of the heating and measured signal.
7. Modulated calorimetry – data treatment. Programs for a measurement automation and data acquisition – LabView environment; heat capacity data treatment – calculation of the heat capacity from the measured signal, implementation of the corrections (magnetic field corrections, phase shift, ...).
8. Heat capacity of a superconductor in zero magnetic field. Heat capacity in normal and superconducting state – contributions of electrons and lattice; Sommerfeld coefficient; calculation of electronic heat capacity in superconducting state, temperature dependence at low temperatures (s-wave superconductor), overall temperature dependence – alpha model; energy gap value determination.
9. Heat capacity of a superconductor in non-zero magnetic field. Determination of the upper critical field; field dependence of the Sommerfeld coefficient and its relation with other properties of superconductor, corrections in the low-field range (relation between applied magnetic field and the one induced in the sample); influence of superconductor properties on the Sommerfeld coefficient (shrinking of the vortex core, anisotropic energy gap, ...).
10. Experimental determination of the heat capacity of specific superconductor (laboratory exercise).
11. Special cases of superconductors. Heat capacity of a two-gap superconductor – temperature and field dependence of the heat capacity for two-gap superconductors with different anisotropy of the bands – MgB₂ and NbS₂. Heat capacity of the high-temperature superconductors.
12. Modulated calorimetry – overview of different applications. Modulated micro-calorimetry and nano-calorimetry; modulated calorimetry of organic and biological substances; modulated differential scanning calorimetry.

Recommended literature:

M. Tinkham, Introduction to superconductivity, McGraw-Hill, Inc., New York, 1996.
 Yaakov Kraftmakher, Modulation Calorimetry: Theory And Applications, Springer-Verlag, 2004.
 Specific heat of solids, Edited by C. Y. Ho, Hemisphere publishing corporation, 1988.

Course language:

Slovak, English

Notes:

The subject is intended for the presence form, in case of necessity it will be realized in distance form using the MS TEAMS environment.

Course assessment	
Total number of assessed students: 10	
N	P
0.0	100.0
Provides: RNDr. Jozef Kačmarčík, PhD., RNDr. Zuzana Vargaeštoková, PhD.	
Date of last modification: 23.09.2021	
Approved: prof. Ing. Martin Orendáč, DrSc.	

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚFV/ VKFKL/21	Course name: Vybrané kapitoly fyziky kondenzovaných látok
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: 8	
Recommended semester/trimester of the course: 1.	
Course level: III.	
Prerequisites:	
Conditions for course completion:	
Learning outcomes:	
Brief outline of the course:	
Recommended literature:	
Course language:	
Notes:	
Course assessment Total number of assessed students: 4	
N	P
0.0	100.0
Provides: prof. Ing. Martin Orendáč, DrSc., prof. RNDr. Peter Samuely, DrSc., Mgr. Tomáš Samuely, PhD.	
Date of last modification: 15.06.2021	
Approved: prof. Ing. Martin Orendáč, DrSc.	

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚFV/ POVK/04	Course name: Work in Organizing Committee of 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: 2	
Recommended semester/trimester of the course:	
Course level: III.	
Prerequisites:	
Conditions for course completion:	
Learning outcomes:	
Brief outline of the course:	
Recommended literature:	
Course language:	
Notes:	
Course assessment Total number of assessed students: 100	
abs	n
100.0	0.0
Provides:	
Date of last modification:	
Approved: prof. Ing. Martin Orendáč, DrSc.	

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚFV/ PDS/18	Course name: Writing Dissertation Work
Course type, scope and the method: Course type: Recommended course-load (hours): Per week: Per study period: Course method: present	
Number of ECTS credits: 0	
Recommended semester/trimester of the course:	
Course level: III.	
Prerequisites:	
Conditions for course completion:	
Learning outcomes:	
Brief outline of the course:	
Recommended literature:	
Course language:	
Notes:	
Course assessment Total number of assessed students: 22	
N	P
0.0	100.0
Provides:	
Date of last modification:	
Approved: prof. Ing. Martin Orendáč, DrSc.	