# 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 credits:** 2

**Recommended semester/trimester of the course:** 1.

**Course level:** III.

**Prerequisities:**

**Conditions for course completion:**

**Learning outcomes:**

**Brief outline of the course:**

**Recommended literature:**

**Course language:**

**Course assessment**
Total number of assessed students: 525

| N | Ne | P | Pr | abs | neabs |
|---|---|---|---|---|---|
| 0.0 | 0.0 | 58.29 | 0.0 | 41.71 | 0.0 |

**Provides:** PhDr. Helena Petruňová, CSc., Mgr. Zuzana Kolaříková, PhD.

**Date of last modification:** 04.10.2016

**Approved:** Co-guaranteedoc. RNDr. Alžbeta Orendáčová, DrSc.Co-guaranteeDr.h.c. prof. RNDr. Alexander Feher, DrSc.Guaranteeprof. Ing. Martin Orendáč, CSc.

**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 credits:** 3

**Recommended semester/trimester of the course:** 2.

**Course level:** III.

**Prerequisities:**

**Conditions for course completion:**

**Learning outcomes:**

**Brief outline of the course:**

**Recommended literature:**

**Course language:**

**Course assessment**
Total number of assessed students: 528

| N | Ne | P | Pr | abs | neabs |
|---|---|---|---|---|---|
| 0.0 | 0.0 | 91.86 | 1.52 | 6.63 | 0.0 |

**Provides:** PhDr. Helena Petruňová, CSc., Mgr. Zuzana Kolaříková, PhD.

**Date of last modification:** 04.10.2016

**Approved:** Co-guaranteedoc. RNDr. Alžbeta Orendáčová, DrSc.Co-guaranteeDr.h.c. prof. RNDr. Alexander Feher, DrSc.Guaranteeprof. Ing. Martin Orendáč, CSc.

## COURSE INFORMATION LETTER

**University:** P. J. Šafárik University in Košice

**Faculty:** Faculty of Science

| **Course ID:** ÚFV/ AKTP/12 | **Course name:** Aplikácie kvantovej teórie poľa v súčasnej fyzike kondenzovaných látok |
|---|---|

**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 credits:** 5

**Recommended semester/trimester of the course:**

**Course level:** III.

**Prerequisities:**

**Conditions for course completion:**
exam

**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 equaiton; 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

**Course assessment**
Total number of assessed students: 0

| N | P |
|---|---|
| 0.0 | 0.0 |

| |
|---|
| **Provides:** prof. RNDr. Michal Hnatič, DrSc. |
| **Date of last modification:** 24.02.2017 |
| **Approved:** Co-guaranteedoc. RNDr. Alžbeta Orendáčová, DrSc.Co-guaranteeDr.h.c. prof. RNDr. Alexander Feher, DrSc.Guaranteeprof. Ing. Martin Orendáč, CSc. |

**COURSE INFORMATION LETTER**

**University:** P. J. Šafárik University in Košice

**Faculty:** Faculty of Science

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

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

**Number of credits:** 3

**Recommended semester/trimester of the course:**

**Course level:** II., III.

**Prerequisities:**

**Conditions for course completion:**
Exam

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

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

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

**Course language:**
slovak, english

**Course assessment**
Total number of assessed students: 3

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

**Provides:** prof. RNDr. Rastislav Varga, DrSc.

**Date of last modification:** 24.02.2017

**Approved:** Co-guaranteedoc. RNDr. Alžbeta Orendáčová, DrSc.Co-guaranteeDr.h.c. prof. RNDr. Alexander Feher, DrSc.Guaranteeprof. Ing. Martin Orendáč, CSc.

**COURSE INFORMATION LETTER**

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|---|---|
| **University:** P. J. Šafárik University in Košice | |
| **Faculty:** Faculty of Science | |
| **Course ID:** ÚFV/ DZS/14 | **Course name:** Doctoral Thesis Examination |
| **Course type, scope and the method:**<br>**Course type:**<br>**Recommended course-load (hours):**<br>**Per week: Per study period:**<br>**Course method:** present | |
| **Number of credits:** 5 | |
| **Recommended semester/trimester of the course:** | |
| **Course level:** III. | |
| **Prerequisities:** | |
| **Conditions for course completion:**<br>Obtaining required number of credits as given by the study plan. | |
| **Learning outcomes:**<br>Evaluation of competences of the student according to his/her scientific profile. | |
| **Brief outline of the course:**<br>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:**<br>english | |
| **Course assessment**<br>Total number of assessed students: 72 | |

| N | P |
|---|---|
| 0.0 | 100.0 |

| |
|---|
| **Provides:** |
| **Date of last modification:** 01.03.2017 |
| **Approved:** Co-guaranteedoc. RNDr. Alžbeta Orendáčová, DrSc.Co-guaranteeDr.h.c. prof. RNDr. Alexander Feher, DrSc.Guaranteeprof. Ing. Martin Orendáč, CSc. |

## COURSE INFORMATION LETTER

**University:** P. J. Šafárik University in Košice

**Faculty:** Faculty of Science

| **Course ID:** ÚFV/ EMFNT/12 | **Course name:** Experimenálne metódy fyziky nízkych teplôt |
|---|---|

**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 credits:** 3

**Recommended semester/trimester of the course:**

**Course level:** III.

**Prerequisities:**

**Conditions for course completion:**
Succesful passing test and final exam.

**Learning outcomes:**
Introduction to fundamental principles and methods of cooling to low and ultra low temperatures and technical realization of low temperature facilities. Fundamentals of the vacuum physics and techniques. Introduction to low and ultra low temperature measurements and specifics of the low temperature physical measurements. Applications of low temperature physics and techniques in ordinary life.

**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 apparatures. 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 nízkych 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 nízkych teplôt, Alfa, Bratislava 1982.
J. Jelínek a Z. Málek: Kryogénní technika, SNTL Paraha 1982.

**Course language:**
Slovak, English

**Course assessment**
Total number of assessed students: 7

| N | P |
|---|---|
| 0.0 | 100.0 |
| **Provides:** RNDr. Peter Skyba, DrSc. | |
| **Date of last modification:** 24.02.2017 | |
| **Approved:** Co-guaranteedoc. RNDr. Alžbeta Orendáčová, DrSc.Co-guaranteeDr.h.c. prof. RNDr. Alexander Feher, DrSc.Guaranteeprof. Ing. Martin Orendáč, CSc. | |

**COURSE INFORMATION LETTER**

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|---|---|
| **University:** P. J. Šafárik University in Košice | |
| **Faculty:** Faculty of Science | |
| **Course ID:** ÚFV/ FVT/12 | **Course name:** Fyzika vysokých tlakov |

**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 credits:** 5

**Recommended semester/trimester of the course:**

**Course level:** III.

**Prerequisities:**

**Conditions for course completion:**
Succesful passing final exam

**Learning outcomes:**
Introduction to the high pressure physics and technique including experimental practice. Students will learn about importance of thermodynamic parameter – pressure in the study of superconducting, magnetic, strongly correlated or structure properties of materials.

**Brief outline of the course:**
Pressure as parameter in solid state physics and general mechanism of pressure effect on physical properties in condense matter. Experimental techniques for high pressure generation: piston cylinder and Bridgman cells, diamond anvil and Al2O3 cells. Pressure induced structural phase transitions. The measurement of magnetic, transport and thermal properties of solid state at high pressures and very low temperatures. Spectroscopy under pressure: Raman, UV VIS, Moesbauer, NMR and neutron diffraction. Typical examples of high pressure physics study: pressure induced quantum phase transitions in electronic systems (metal-insulator transition, anti-/ferromagnet-superconductor transition, Non-Fermi-liquid behavior). Influence of pressure on electronic structure, strongly correlated systems and superconductivity. Tuning of magnetic properties of molecular magnets by pressure.

**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

**Course assessment**
Total number of assessed students: 10

| N | P |
|---|---|
| 0.0 | 100.0 |
| **Provides:** doc. RNDr. Slavomír Gabáni, PhD., RNDr. Marián Mihálik, CSc., RNDr. Mária Zentková, CSc. | |
| **Date of last modification:** 24.02.2017 | |
| **Approved:** Co-guaranteedoc. RNDr. Alžbeta Orendáčová, DrSc.Co-guaranteeDr.h.c. prof. RNDr. Alexander Feher, DrSc.Guaranteeprof. Ing. Martin Orendáč, CSc. | |

# 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 credits:** 2

**Recommended semester/trimester of the course:**

**Course level:** III.

**Prerequisities:**

**Conditions for course completion:**

**Learning outcomes:**

**Brief outline of the course:**

**Recommended literature:**

**Course language:**

**Course assessment**
Total number of assessed students: 115

| abs | n |
|---|---|
| 100.0 | 0.0 |

**Provides:** doc. RNDr. Vladimír Zeleňák, PhD.

**Date of last modification:** 13.02.2017

**Approved:** Co-guaranteedoc. RNDr. Alžbeta Orendáčová, DrSc.Co-guaranteeDr.h.c. prof. RNDr. Alexander Feher, DrSc.Guaranteeprof. Ing. Martin Orendáč, CSc.

**COURSE INFORMATION LETTER**

**University:** P. J. Šafárik University in Košice

**Faculty:** Faculty of Science

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

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

**Number of credits:** 5

**Recommended semester/trimester of the course:**

**Course level:** II., III.

**Prerequisities:**

**Conditions for course completion:**

**Learning outcomes:**

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

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

**Course language:**
EN - english

**Course assessment**
Total number of assessed students: 13

| A | B | C | D | E | FX | N | P |
|---|---|---|---|---|---|---|---|
| 7.69 | 38.46 | 15.38 | 7.69 | 15.38 | 0.0 | 0.0 | 15.38 |

**Provides:** doc. RNDr. Jozef Strečka, PhD.

**Date of last modification:** 21.02.2017

**Approved:** Co-guaranteedoc. RNDr. Alžbeta Orendáčová, DrSc.Co-guaranteeDr.h.c. prof. RNDr. Alexander Feher, DrSc.Guaranteeprof. Ing. Martin Orendáč, CSc.

**COURSE INFORMATION LETTER**

**University:** P. J. Šafárik University in Košice

**Faculty:** Faculty of Science

| **Course ID:** ÚFV/ MGCH/04 | **Course name:** Magnetotochemistry |
|---|---|

**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 credits:** 5

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

**Course level:** III.

**Prerequisities:**

**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. Termodynamics and EPR of paramagnetic atoms in the crystal field. Exchange and dipole interaction.Heisenberg Hamiltonian. Magnetic dimer. Long-range and short- range order. Low-dimensional magnets. Spatial anisotropy of exchange coupling. Exchange anisotropy. Heisenberg, Ising and XY model.

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

**Course language:**
english

**Course assessment**
Total number of assessed students: 29

| N | P |
|---|---|
| 0.0 | 100.0 |

**Provides:** doc. RNDr. Alžbeta Orendáčová, DrSc., RNDr. Róbert Tarasenko, PhD.

**Date of last modification:** 24.02.2017

**Approved:** Co-guaranteedoc. RNDr. Alžbeta Orendáčová, DrSc.Co-guaranteeDr.h.c. prof. RNDr. Alexander Feher, DrSc.Guaranteeprof. Ing. Martin Orendáč, CSc.

# 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 |
|---|---|

**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 credits:** 5

**Recommended semester/trimester of the course:** 1.

**Course level:** III.

**Prerequisities:**

**Conditions for course completion:**
Two written tests from topics "Superconductivity" and "Superfluidity"
Evaluation is based on th eresults of the two tests. If score of one of the tests is lower than "C", then student has to pass oral exam.

**Learning outcomes:**

**Brief outline of the course:**
Superconductivity: experiment and theory. High-temperature superconductivity. Josephson effect. Superfluidity of 3He and 4He and 3He-4He solutions. Quantum vortices. Quantum crystals. Superconductivity and superfluidity in other systems. Quantum Hall effect. Macroscopic quantum tunneling in magnetic systems. Bose-Einstein condensation of weakly interacting atoms.

**Recommended literature:**
W. Buckel: Superconductivity. VCH, Weinheim, 1991.
K. H. Bennemann, J. B. Ketterson: The Physics of liquid and solid Helium. A Wiley Interscience Publication.
K.N.Shrivastava; Introduction to Quantum Hall Effect; Nova Science, Hauppauge, N.Y. 2002
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.
D. R. Tilley, J. Tilley: Superfluidity and Superconductivity. Adam Hilger ltd., Bristol.
E. R. Dobbs: Helium Three. Oxford Science publications, 2000.

**Course language:**
Slovak, English

**Course assessment**
Total number of assessed students: 18

| N | P |
|---|---|
| 0.0 | 100.0 |

**Provides:** Dr.h.c. prof. RNDr. Alexander Feher, DrSc., doc. RNDr. Karol Flachbart, DrSc.

**Date of last modification:** 24.02.2017

**Approved:** Co-guaranteedoc. RNDr. Alžbeta Orendáčová, DrSc.Co-guaranteeDr.h.c. prof. RNDr. Alexander Feher, DrSc.Guaranteeprof. Ing. Martin Orendáč, CSc.

**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 credits:** 3

**Recommended semester/trimester of the course:**

**Course level:** III.

**Prerequisities:**

**Conditions for course completion:**
Successful passing of the final exam

**Learning outcomes:**
Elucidate to students the properties of heavy fermion systems, the principles and applications of SQUIDs, the formation and properties of Bose - Einstein condensates in diluted gases, and the quantum Hall effect and its utilization. During the course students will learn and acquire the relations between these effects, and the quantum and macroscopic quantum phenomena.

**Brief outline of the course:**
Heavy fermions - their formation and properties, unconventional superconductivity in these systems. Tunneling in superconductors and the Josephson effect. SQUIDs - their principles and applications. Further applications of superconductivity. Bose - Einstein condensation in weakly interacting diluted gases, principles of their cooling by lasers. Methods of condensate formation and the observation of its properties. The quantum Hall effect - conditions of its appearance and applications of this effect. The fractional quantum Hall effect - its properties and explanation.

**Recommended literature:**
J.F. Annet: Superconductivity, Superfluids and Condensates, Oxford Univ. Press, Oxford (2003),
2. W. Buckel, R. Kleiner: Superconductivity, Wiley-WCH, Weinheim (2004).

**Course language:**
Slovak, English

**Course assessment**
Total number of assessed students: 8

| N | P |
|---|---|
| 0.0 | 100.0 |

**Provides:** doc. RNDr. Karol Flachbart, DrSc.

**Date of last modification:** 24.02.2017

**Approved:** Co-guaranteedoc. RNDr. Alžbeta Orendáčová, DrSc.Co-guaranteeDr.h.c. prof. RNDr. Alexander Feher, DrSc.Guaranteeprof. Ing. Martin Orendáč, CSc.

## 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 credits:** 5

**Recommended semester/trimester of the course:** 2.

**Course level:** III.

**Prerequisities:** ÚFV/MSA1/03

**Conditions for course completion:**
75% written test
25% the ppt presentation from selected topic

**Learning outcomes:**
To obtain knowledges about frontier microskopic techniques and XRD techniques for structural analysis of materials.

**Brief outline of the course:**
New trends in Optic microscopy, Electron microscopy, Electron diffraction. Electron microprobe analysis: WDX spectrometer, EDX spectrometer, Auger spectroscopy. Self-emision microscopy. Modern electron diffracion 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

**Course assessment**
Total number of assessed students: 61

| N | P |
|---|---|
| 0.0 | 100.0 |

**Provides:** prof. RNDr. Pavol Sovák, CSc., Ing. Karel Saksl, DrSc.

| |
|---|
| **Date of last modification:** 24.02.2017 |
| **Approved:** Co-guaranteedoc. RNDr. Alžbeta Orendáčová, DrSc.Co-guaranteeDr.h.c. prof. RNDr. Alexander Feher, DrSc.Guaranteeprof. Ing. Martin Orendáč, CSc. |

## COURSE INFORMATION LETTER

**University:** P. J. Šafárik University in Košice

**Faculty:** Faculty of Science

| **Course ID:** ÚFV/ MVV1/07 | **Course name:** Magnetic 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 credits:** 5

**Recommended semester/trimester of the course:**

**Course level:** III.

**Prerequisities:**

**Conditions for course completion:**
test and oral examination.

**Learning outcomes:**
To obtain a general view on the magnetic properties an application of soft and hard magnetic materials.

**Brief outline of the course:**
Magnetic properties of iron, cobalt and nickel and alloys. Magnetic properties of Fe-Si steels (oriented and non-oriented). Structure and magnetic properties af amorphous and nanocrystalline alloys. Magnetic properties of permanent magnets. The principle of magnetic recording and magnetic recording media. Preparation, structure and magnetic properties of thin films and multilayers.

**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

**Course language:**

**Course assessment**
Total number of assessed students: 32

| N | P |
|---|---|
| 0.0 | 100.0 |

**Provides:** doc. RNDr. Ján Füzer, PhD., RNDr. Ivan Škorvánek, CSc.

**Date of last modification:** 24.02.2017

**Approved:** Co-guaranteedoc. RNDr. Alžbeta Orendáčová, DrSc.Co-guaranteeDr.h.c. prof. RNDr. Alexander Feher, DrSc.Guaranteeprof. Ing. Martin Orendáč, CSc.

**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 credits:** 5

**Recommended semester/trimester of the course:**

**Course level:** III.

**Prerequisities:**

**Conditions for course completion:**
Final written test: 50%
The ppt presentation from selected topic:50%

**Learning outcomes:**
To obtain the newest information about processing of nanostructured materials. To use concrete examples of nanostructured materials for documentation of their unique properties and also to indicate their possibilities for applications in real technical practise.

**Brief outline of the course:**
Processing of magnetic nanomaterials using litography methods. Production and properties of thin films and multilayers. Processing of nanocrystalline metals, alloys and composites by electrodeposition. Diffusion in nanocrystalline materials: modelling of interface diffusion, specific aspects, correlation between diffusion and grain boundaries, selected examples of diffusion. Magnetic nanoparticles and their applications, fundamental physics of nanoparticles: bulk feromagnetism, magnetic clusters, molecular magnetism, ideal monodomain particle, surface and interface effects, exchange interactions between nanoparticles. Magnetic properties of some nanosystems: amorphous Fe-M-B alloys, FINEMET, influence of atomic substitutions on properties of FINEMET based alloys, Fe-Zr-Nb-B alloys, Fe-Nb-B-P-Cu alloys produced in atmosphere, influence of grain size on Currie temperature and on volume fraction of amorphous matrix. Mechanical properties of NCM: models and computer simulations of mechanical behaviour, density, pores and microcracks, hardness, yield and ultimate strengths, ductility of NCM. Nanostructured Electronics and Optoelectronic materials: NCM and data storage, nanorobotics, nanoelectronics – superlattice, quantum waves and dots, porous Si and Si clusters.

**Recommended literature:**
1. C.C. Koch, Nanostructured Materials – processing, Properties and Applications, WA Publishing, 2007.
Springer Hanbook of Nanotechnology, B. Bhusnan (Ed.), Springer 2007.
2. Nanomagnetism and Spintronics, T. Shinjo (Ed.) Elsevier 2009.
3. M.A. White, Physical Properties of Materials, CRC Press 2012.
4. N. Dahotre and A. Samant, Laser Machining of Advanced Materials, CRC Press 2011.
5. R. Oganov, Modern Methods of Crystal structure Prediction, Wiley-VCH, 2011.
6. G.B. Sergeev, Nanochemistry, Elsevier 2008.

7. M.A.Mayers et al: Nano and Microstructural Design of Advanced Materials, Elsevier 2003.

**Course language:**
english

**Course assessment**
Total number of assessed students: 13

| N | P |
|---|---|
| 0.0 | 100.0 |

**Provides:** Mgr. Vladimír Komanický, Ph.D., prof. RNDr. Pavol Sovák, CSc.

**Date of last modification:** 24.02.2017

**Approved:** Co-guaranteedoc. RNDr. Alžbeta Orendáčová, DrSc.Co-guaranteeDr.h.c. prof. RNDr. Alexander Feher, DrSc.Guaranteeprof. Ing. Martin Orendáč, CSc.

# 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 credits:** 30

**Recommended semester/trimester of the course:**

**Course level:** III.

**Prerequisities:**

**Conditions for course completion:**

**Learning outcomes:**

**Brief outline of the course:**

**Recommended literature:**

**Course language:**

**Course assessment**
Total number of assessed students: 39

| N | P |
|---|---|
| 0.0 | 100.0 |

**Provides:**

**Date of last modification:** 01.03.2017

**Approved:** Co-guaranteedoc. RNDr. Alžbeta Orendáčová, DrSc.Co-guaranteeDr.h.c. prof. RNDr. Alexander Feher, DrSc.Guaranteeprof. Ing. Martin Orendáč, CSc.

**COURSE INFORMATION LETTER**

**University:** P. J. Šafárik University in Košice

**Faculty:** Faculty of Science

| **Course ID:** ÚFV/ RSM/12 | **Course name:** Rastrovacie sondové mikroskopie |
|---|---|

**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 credits:** 3

**Recommended semester/trimester of the course:**

**Course level:** III.

**Prerequisities:**

**Conditions for course completion:**
exam

**Learning outcomes:**
Students will learn basic principles and state of the art techniques of scanning probe microscopies

**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

**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
P. Samuely (ed.), Kryofyzika a nanoelektronika, ÚEF SAV 2011

**Course language:**
Slovak or English

**Course assessment**
Total number of assessed students: 5

| N | P |
|---|---|
| 0.0 | 100.0 |

**Provides:** Mgr. Tomáš Samuely, PhD.

**Date of last modification:** 24.02.2017

**Approved:** Co-guaranteedoc. RNDr. Alžbeta Orendáčová, DrSc.Co-guaranteeDr.h.c. prof. RNDr. Alexander Feher, DrSc.Guaranteeprof. Ing. Martin Orendáč, CSc.

# 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 credits:** 3

**Recommended semester/trimester of the course:** 1.

**Course level:** III.

**Prerequisities:**

**Conditions for course completion:**
Active participation at seminars.

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

**Brief outline of the course:**
Contents is determined by the lectures and varies every year.

**Recommended literature:**
Selected scientific journals.

**Course language:**
Slovak, English

**Course assessment**
Total number of assessed students: 81

| abs | n |
|---|---|
| 100.0 | 0.0 |

**Provides:** doc. RNDr. Alžbeta Orendáčová, DrSc., Dr.h.c. prof. RNDr. Alexander Feher, DrSc.

**Date of last modification:** 24.02.2017

**Approved:** Co-guaranteedoc. RNDr. Alžbeta Orendáčová, DrSc.Co-guaranteeDr.h.c. prof. RNDr. Alexander Feher, DrSc.Guaranteeprof. Ing. Martin Orendáč, CSc.

# 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 credits:** 3

**Recommended semester/trimester of the course:** 2.

**Course level:** III.

**Prerequisities:**

**Conditions for course completion:**
Active participation at seminars.

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

**Brief outline of the course:**
Contents is determined by the lectures and varies every year.

**Recommended literature:**
Selected scientific journals.

**Course language:**

**Course assessment**
Total number of assessed students: 80

| abs | n |
|---|---|
| 100.0 | 0.0 |

**Provides:** Dr.h.c. prof. RNDr. Alexander Feher, DrSc., prof. Ing. Martin Orendáč, CSc.

**Date of last modification:** 24.02.2017

**Approved:** Co-guaranteedoc. RNDr. Alžbeta Orendáčová, DrSc.Co-guaranteeDr.h.c. prof. RNDr. Alexander Feher, DrSc.Guaranteeprof. Ing. Martin Orendáč, CSc.

**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 credits:** 3

**Recommended semester/trimester of the course:** 3.

**Course level:** III.

**Prerequisities:**

**Conditions for course completion:**
Active participation at seminars.

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

**Brief outline of the course:**
Contents is determined by the lectures and varies every year.

**Recommended literature:**
Selected scientific journals.

**Course language:**
Slovak, English

**Course assessment**
Total number of assessed students: 66

| abs | n |
|---|---|
| 100.0 | 0.0 |

**Provides:** doc. RNDr. Alžbeta Orendáčová, DrSc., Dr.h.c. prof. RNDr. Alexander Feher, DrSc.

**Date of last modification:** 24.02.2017

**Approved:** Co-guaranteedoc. RNDr. Alžbeta Orendáčová, DrSc.Co-guaranteeDr.h.c. prof. RNDr. Alexander Feher, DrSc.Guaranteeprof. Ing. Martin Orendáč, CSc.

**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 credits:** 3

**Recommended semester/trimester of the course:** 4.

**Course level:** III.

**Prerequisities:**

**Conditions for course completion:**

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

**Brief outline of the course:**
Contents is determined by the lectures and varies every year.

**Recommended literature:**
Selected scientific journals.

**Course language:**

**Course assessment**
Total number of assessed students: 69

| abs | n |
|---|---|
| 100.0 | 0.0 |

**Provides:** prof. Ing. Martin Orendáč, CSc., Dr.h.c. prof. RNDr. Alexander Feher, DrSc.

**Date of last modification:** 24.02.2017

**Approved:** Co-guaranteedoc. RNDr. Alžbeta Orendáčová, DrSc.Co-guaranteeDr.h.c. prof. RNDr. Alexander Feher, DrSc.Guaranteeprof. Ing. Martin Orendáč, CSc.

# 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 credits:** 3

**Recommended semester/trimester of the course:** 5.

**Course level:** III.

**Prerequisities:**

**Conditions for course completion:**
Active participation at seminars.

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

**Brief outline of the course:**
Contents is determined by the lectures and varies every year.

**Recommended literature:**
Selected scientific journals.

**Course language:**
Slovak, English

**Course assessment**
Total number of assessed students: 55

| abs | n |
|---|---|
| 100.0 | 0.0 |

**Provides:** doc. RNDr. Alžbeta Orendáčová, DrSc., Dr.h.c. prof. RNDr. Alexander Feher, DrSc.

**Date of last modification:** 24.02.2017

**Approved:** Co-guaranteedoc. RNDr. Alžbeta Orendáčová, DrSc.Co-guaranteeDr.h.c. prof. RNDr. Alexander Feher, DrSc.Guaranteeprof. Ing. Martin Orendáč, CSc.

## 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 credits:** 3

**Recommended semester/trimester of the course:** 6.

**Course level:** III.

**Prerequisities:**

**Conditions for course completion:**
Active participation at seminars.

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

**Brief outline of the course:**
Contents is determined by the lectures and varies every year.

**Recommended literature:**
Selected scientific journals.

**Course language:**
Slovak, English

**Course assessment**
Total number of assessed students: 55

| abs | n |
|---|---|
| 100.0 | 0.0 |

**Provides:** Dr.h.c. prof. RNDr. Alexander Feher, DrSc., prof. Ing. Martin Orendáč, CSc.

**Date of last modification:** 24.02.2017

**Approved:** Co-guaranteedoc. RNDr. Alžbeta Orendáčová, DrSc.Co-guaranteeDr.h.c. prof. RNDr. Alexander Feher, DrSc.Guaranteeprof. Ing. Martin Orendáč, CSc.

# 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 credits:** 3

**Recommended semester/trimester of the course:** 7.

**Course level:** III.

**Prerequisities:**

**Conditions for course completion:**
Active participation at seminars.

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

**Brief outline of the course:**
Contents is determined by the lectures and varies every year.

**Recommended literature:**
Selected scientific journals.

**Course language:**
Slovak, English

**Course assessment**
Total number of assessed students: 44

| abs | n |
|---|---|
| 100.0 | 0.0 |

**Provides:** doc. RNDr. Alžbeta Orendáčová, DrSc., Dr.h.c. prof. RNDr. Alexander Feher, DrSc.

**Date of last modification:** 24.02.2017

**Approved:** Co-guaranteedoc. RNDr. Alžbeta Orendáčová, DrSc.Co-guaranteeDr.h.c. prof. RNDr. Alexander Feher, DrSc.Guaranteeprof. Ing. Martin Orendáč, CSc.

**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 credits:** 3

**Recommended semester/trimester of the course:** 8.

**Course level:** III.

**Prerequisities:**

**Conditions for course completion:**
Active participation at seminars.

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

**Brief outline of the course:**
Contents is determined by the lectures and varies every year.

**Recommended literature:**
Selected scientific journals.

**Course language:**
Slovak, English

**Course assessment**
Total number of assessed students: 45

| abs | n |
|---|---|
| 100.0 | 0.0 |

**Provides:** Dr.h.c. prof. RNDr. Alexander Feher, DrSc., prof. Ing. Martin Orendáč, CSc.

**Date of last modification:** 24.02.2017

**Approved:** Co-guaranteedoc. RNDr. Alžbeta Orendáčová, DrSc.Co-guaranteeDr.h.c. prof. RNDr. Alexander Feher, DrSc.Guaranteeprof. Ing. Martin Orendáč, CSc.

# 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 credits:** 5

**Recommended semester/trimester of the course:**

**Course level:** III.

**Prerequisities:**

**Conditions for course completion:**
successful passing final exam

**Learning outcomes:**
Obtaining knowledge on preparation, structure, influence of defects, phase equilibrium and phase transformation in selected types of unconventional materials.

**Brief outline of the course:**
Crystal structure of metals, alloys, intermetalics, ceramics and glasses. Crystal defects and their influence on properties of materials. Phase diagrams and phase transformations, solidification, crystal growth. Preparation and properties of progressive single-crystalline, polycrystalline, nano-crystalline and glassy materials.

**Recommended literature:**
J. M. Ziman, The Physics of Metals, Cambridge University press, Cambridge, 2011.
J. Blackman, Handbook of Metal Physics: Metalic Nanoparticles, Elsevier Science, 2009.

**Course language:**
Slovak, English

**Course assessment**
Total number of assessed students: 0

| N | P |
|---|---|
| 0.0 | 0.0 |

**Provides:** Ing. Pavel Diko, DrSc.

**Date of last modification:** 24.02.2017

**Approved:** Co-guaranteedoc. RNDr. Alžbeta Orendáčová, DrSc.Co-guaranteeDr.h.c. prof. RNDr. Alexander Feher, DrSc.Guaranteeprof. Ing. Martin Orendáč, CSc.

**COURSE INFORMATION LETTER**

**University:** P. J. Šafárik University in Košice

**Faculty:** Faculty of Science

| **Course ID:** ÚFV/TS/12 | **Course name:** Termodynamika supravodičov |
|---|---|

**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 credits:** 3

**Recommended semester/trimester of the course:**

**Course level:** III.

**Prerequisities:**

**Conditions for course completion:**
Succesful passing final exam

**Learning outcomes:**
Introduction of basic theoretical and experimental aspects of thermodynamic properties of superconductors with a focus on the modulated calorimetry.

**Brief outline of the course:**
Thermodynamic properties of superconductors (entropy, heat capacity in normal and superconducting state). Methods of heat capacity measurements (adiabatic, relaxation, pulsed, modulated). Modulated calorimetry – historical overview. Modulated calorimetry – theoretical basis. Modulated calorimetry – experiment (experimental setup, measurement of temperature and temperature oscillations). Heat capacity of superconductors in zero magnetic field – alpha model. Heat capacity of superconductors in zero and non-zero magnetic field – temperature dependence and its relation to the properties of an s-wave superconductor (determination of the upper critical field, thermodynamic critical field, superconducting energy gap, type of coupling). Heat capacity of superconductors in non-zero magnetic field – field dependence and its relation to the the properties of a superconductor. Heat capacity in special cases – two-gap superconductor, d-wave superconductor.

**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

**Course assessment**
Total number of assessed students: 6

| N | P |
|---|---|
| 0.0 | 100.0 |

**Provides:** RNDr. Jozef Kačmarčík, PhD., RNDr. Zuzana Vargaeštoková, PhD.

| |
|---|
| **Date of last modification:** 24.02.2017 |
| **Approved:** Co-guaranteedoc. RNDr. Alžbeta Orendáčová, DrSc.Co-guaranteeDr.h.c. prof. RNDr. Alexander Feher, DrSc.Guaranteeprof. Ing. Martin Orendáč, CSc. |

# 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 credits:** 5

**Recommended semester/trimester of the course:**

**Course level:** III.

**Prerequisities:**

**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

**Course assessment**
Total number of assessed students: 6

| N | P |
|---|---|
| 0.0 | 100.0 |

**Provides:** RNDr. Pavol Farkašovský, DrSc.

**Date of last modification:** 24.02.2017

**Approved:** Co-guaranteedoc. RNDr. Alžbeta Orendáčová, DrSc.Co-guaranteeDr.h.c. prof. RNDr. Alexander Feher, DrSc.Guaranteeprof. Ing. Martin Orendáč, CSc.

## COURSE INFORMATION LETTER

**University:** P. J. Šafárik University in Košice

**Faculty:** Faculty of Science

| **Course ID:** ÚFV/ TVTH/04 | **Course name:** Transposr properties of solids |
|---|---|

**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 credits:** 5

**Recommended semester/trimester of the course:** 1.

**Course level:** III.

**Prerequisities:**

**Conditions for course completion:**
Exam

**Learning outcomes:**
The students will obtain skills in various theoretical approaches in describing transport properties of solids.

**Brief outline of the course:**
Boltzmann approach in theory of transport processes, transport coefficients, Green functions, Kubo-Greenwood formula, percolation theory of transport, transportn phenomena in metals, semiconductors and insulators, superonductors (BCS theory, Josephson´s effect) and disordered systems, Ziman´s theory, metal - insulator transition, hopping transport, Kondo effect, quantum Hall effect, cyclotron resonance, Azbel-Kaner resonance, Schubnik - de Haassov effect, de Haass - van Alphenov effect.

**Recommended literature:**
R. Berman, Thermal conductivity in Solids, Clarendon Press, Oxford, 1976.

**Course language:**
Slovak, English

**Course assessment**
Total number of assessed students: 16

| N | P |
|---|---|
| 0.0 | 100.0 |

**Provides:** doc. RNDr. Peter Kopčanský, CSc.

**Date of last modification:** 24.02.2017

**Approved:** Co-guaranteedoc. RNDr. Alžbeta Orendáčová, DrSc.Co-guaranteeDr.h.c. prof. RNDr. Alexander Feher, DrSc.Guaranteeprof. Ing. Martin Orendáč, CSc.

**COURSE INFORMATION LETTER**

**University:** P. J. Šafárik University in Košice

**Faculty:** Faculty of Science

| **Course ID:** ÚFV/ VKFKL/04 | **Course name:** Intruduction to Condensed Matter |
|---|---|

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

**Number of credits:** 9

**Recommended semester/trimester of the course:** 1.

**Course level:** III.

**Prerequisities:**

**Conditions for course completion:**
Oral examination

**Learning outcomes:**
Introduction to basic pronciples of solid state physics as well as recently studied phenomena

**Brief outline of the course:**
Crystal structure. Crystal bonds. Phonons. Fermi gas of free electrons. Energy bands. Fermi surfaces and metals. Superconductivity. Non conventional superconductivity. Diamagnetism and paramagnetism. Ferro- and antiferromagnetism. Strongly correlated electron systems.

**Recommended literature:**
Ch. Kittel: Introduction to Solid State Physics, 7th edition, John Wiley and sons, New York 1996.
H.Ibach, H.Luth: Solid-State Physics, Springer, Berlin 1996.
M Tinkham: Introduction to Superconductivity, 2-nd edition, Mc Graw- Hill, New York 1996

**Course language:**
slovak, english

**Course assessment**
Total number of assessed students: 68

| N | P |
|---|---|
| 0.0 | 100.0 |

**Provides:** prof. RNDr. Peter Samuely, DrSc., prof. Ing. Martin Orendáč, CSc.

**Date of last modification:** 24.02.2017

**Approved:** Co-guaranteedoc. RNDr. Alžbeta Orendáčová, DrSc.Co-guaranteeDr.h.c. prof. RNDr. Alexander Feher, DrSc.Guaranteeprof. Ing. Martin Orendáč, CSc.