

Course descriptions

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COURSE DESCRIPTION

Academic year: 2024/2025	
University: Comenius University Bratislava	
Faculty:	
Course ID: FMFL.KEF/3-FKL-007/24	Course title: Ab initio Modelling of Materials
Educational activities: Type of activities: practicals / lecture Number of hours: per week: 1 / 2 per level/semester: 14 / 28 Form of the course: on-site learning, distance learning	
Number of credits: 10	
Recommended semester: 2.	
Educational level: III.	
Prerequisites:	
Recommended prerequisites: The course requires knowledge of standard classical MD/MC simulation methods on the level of the course FMFL.KEF/2-FTL-110/22 Computer simulations of condensed matter.	
Course requirements: At the end of the semester a simulation problem will be assigned and the student will provide a written report on the solution. The score will be based on the evaluation of the report. Minimal score: 50% Scale of assessment (preliminary/final): 0/100	
Learning outcomes: The course provides an introduction to current methods of materials modeling based on ab initio approaches. It focuses on static and dynamical simulations (ab initio molecular dynamics) based on the density functional theory (DFT) for electrons and their applications to various condensed matter systems. Quantum Monte Carlo methods for electrons (Diffusion Monte Carlo) and ions (Path Integral Monte Carlo) will be mentioned too. Besides that new approaches to force-field generation based on machine learning will be shown, as well as other possible applications of machine learning in materials simulations. The methods will be illustrated on a number of examples and in the exercises the student will learn to use the freely available ab initio code Quantum Espresso.	
Class syllabus: materials modeling, structural prediction, calculation of properties density functional theory (DFT), Hohenberg - Kohn theorems Kohn - Sham method and equations approximate DFT functionals - LDA, GGA, hybrid practical approach to solving Kohn-Sham equations - plane-wave basis expansion of wavefunctions, pseudopotentials ab initio molecular dynamics evolutionary algorithms and crystal structure prediction Diffusion Quantum Monte Carlo approach (DMC) Path Integral Monte Carlo methods	

machine-learning-based methods of generating force-fields further applications of machine learning in materials simulations							
Recommended literature: F. Giustino, Materials Modelling using Density Functional Theory, Oxford University Press 2014 D.S. Sholl, J.A. Steckel, Density functional theory (A practical introduction), John Wiley & sons, 2009 Wolfram Koch, Max C. Holthausen, A Chemist's Guide to Density Functional Theory, 2001 Wiley#VCH Verlag GmbH							
Languages necessary to complete the course: Slovak, English							
Notes:							
Past grade distribution Total number of evaluated students: 0							
A	ABS	B	C	D	E	FX	NEABS
0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Lecturers: prof. Ing. Roman Martoňák, DrSc.							
Last change: 26.08.2024							
Approved by: prof. Ing. Roman Martoňák, DrSc.							

COURSE DESCRIPTION

Academic year: 2024/2025	
University: Comenius University Bratislava	
Faculty:	
Course ID: FMFL.KEF/3-FKL-007/22	Course title: Ab initio Modelling of Materials
Educational activities: Type of activities: practicals / lecture Number of hours: per week: 2 / 2 per level/semester: 28 / 28 Form of the course: on-site learning	
Number of credits: 10	
Recommended semester: 2.	
Educational level: III.	
Prerequisites:	
Recommended prerequisites: The course requires knowledge of standard classical MD/MC simulation methods on the level of the course FMFL.KEF/2-FTL-110/22 Computer simulations of condensed matter.	
Course requirements: At the end of the semester a simulation problem will be assigned and the student will provide a written report on the solution. The score will be based on the evaluation of the report. Minimal score: 50% Scale of assessment (preliminary/final): 0/100	
Learning outcomes: The course provides an introduction to current methods of materials modeling based on ab initio approaches. It focuses on static and dynamical simulations (ab initio molecular dynamics) based on the density functional theory (DFT) for electrons and their applications to various condensed matter systems. Quantum Monte Carlo methods for electrons (Diffusion Monte Carlo) and ions (Path Integral Monte Carlo) will be mentioned too. Besides that new approaches to force-field generation based on machine learning will be shown, as well as other possible applications of machine learning in materials simulations. The methods will be illustrated on a number of examples and in the exercises the student will learn to use the freely available ab initio code Quantum Espresso.	
Class syllabus: materials modeling, structural prediction, calculation of properties density functional theory (DFT), Hohenberg - Kohn theorems Kohn - Sham method and equations approximate DFT functionals - LDA, GGA, hybrid practical approach to solving Kohn-Sham equations - plane-wave basis expansion of wavefunctions, pseudopotentials ab initio molecular dynamics evolutionary algorithms and crystal structure prediction Diffusion Quantum Monte Carlo approach (DMC) Path Integral Monte Carlo methods	

machine-learning-based methods of generating force-fields further applications of machine learning in materials simulations							
Recommended literature: F. Giustino, Materials Modelling using Density Functional Theory, Oxford University Press 2014 D.S. Sholl, J.A. Steckel, Density functional theory (A practical introduction), John Wiley & sons, 2009 Wolfram Koch, Max C. Holthausen, A Chemist's Guide to Density Functional Theory, 2001 Wiley#VCH Verlag GmbH							
Languages necessary to complete the course: Slovak, English							
Notes:							
Past grade distribution Total number of evaluated students: 3							
A	ABS	B	C	D	E	FX	NEABS
0,0	100,0	0,0	0,0	0,0	0,0	0,0	0,0
Lecturers: prof. Ing. Roman Martoňák, DrSc.							
Last change: 01.02.2022							
Approved by: prof. Ing. Roman Martoňák, DrSc.							

COURSE DESCRIPTION

Academic year: 2024/2025	
University: Comenius University Bratislava	
Faculty:	
Course ID: FMFI.KEF/3-FKL-601/24	Course title: Condensed Matter Physics Seminar
Educational activities: Type of activities: seminar Number of hours: per week: 2 per level/semester: 28 Form of the course: on-site learning	
Number of credits: 5	
Recommended semester:	
Educational level: III.	
Prerequisites:	
Course requirements:	
Learning outcomes:	
Class syllabus:	
Recommended literature:	
Languages necessary to complete the course:	
Notes:	
Past grade distribution Total number of evaluated students: 2	
ABS	NEABS
100,0	0,0
Lecturers: prof. Ing. Roman Martoňák, DrSc., doc. RNDr. Tomáš Plecenik, PhD.	
Last change:	
Approved by: prof. Ing. Roman Martoňák, DrSc.	

COURSE DESCRIPTION

Academic year: 2024/2025	
University: Comenius University Bratislava	
Faculty:	
Course ID: FMFI.KEF/3-FKL-602/24	Course title: Condensed Matter Physics Seminar
Educational activities: Type of activities: seminar Number of hours: per week: 2 per level/semester: 28 Form of the course: on-site learning	
Number of credits: 5	
Recommended semester:	
Educational level: III.	
Prerequisites:	
Course requirements:	
Learning outcomes:	
Class syllabus:	
Recommended literature:	
Languages necessary to complete the course:	
Notes:	
Past grade distribution Total number of evaluated students: 2	
ABS	NEABS
100,0	0,0
Lecturers: prof. Ing. Roman Martoňák, DrSc., doc. RNDr. Tomáš Plecenik, PhD.	
Last change:	
Approved by: prof. Ing. Roman Martoňák, DrSc.	

COURSE DESCRIPTION

Academic year: 2024/2025							
University: Comenius University Bratislava							
Faculty:							
Course ID: FMFL.KJP/3-MXX-101/15				Course title: Course of English for PhD Studies (1)			
Educational activities: Type of activities: practicals Number of hours: per week: 2 per level/semester: 28 Form of the course: on-site learning, distance learning							
Number of credits: 5							
Recommended semester: 1.							
Educational level: III.							
Prerequisites:							
Course requirements:							
Learning outcomes:							
Class syllabus:							
Recommended literature:							
Languages necessary to complete the course:							
Notes:							
Past grade distribution Total number of evaluated students: 218							
A	ABS	B	C	D	E	FX	NEABS
38,53	57,34	0,46	0,0	0,0	1,83	0,0	1,83
Lecturers: PhDr. Alena Zemanová, Mgr. Simona Dobiašová, PhD., Mgr. Aneta Barnes							
Last change: 13.01.2025							
Approved by: prof. Ing. Roman Martoňák, DrSc.							

COURSE DESCRIPTION

Academic year: 2024/2025							
University: Comenius University Bratislava							
Faculty:							
Course ID: FMFI.KJP/3-MXX-102/15				Course title: Course of English for PhD Studies (1)			
Educational activities: Type of activities: practicals Number of hours: per week: 2 per level/semester: 28 Form of the course: on-site learning, distance learning							
Number of credits: 5							
Recommended semester: 2.							
Educational level: III.							
Prerequisites: FMFI.KJP/3-MXX-101/15 - Course of English for PhD Studies (1)							
Course requirements:							
Learning outcomes:							
Class syllabus:							
Recommended literature:							
Languages necessary to complete the course:							
Notes:							
Past grade distribution Total number of evaluated students: 210							
A	ABS	B	C	D	E	FX	NEABS
41,9	52,38	0,0	0,0	0,0	0,0	0,0	5,71
Lecturers: PhDr. Alena Zemanová, Mgr. Simona Dobiašová, PhD., Mgr. Aneta Barnes							
Last change: 13.01.2025							
Approved by: prof. Ing. Roman Martoňák, DrSc.							

COURSE DESCRIPTION

Academic year: 2024/2025	
University: Comenius University Bratislava	
Faculty:	
Course ID: FMFLKEF/3-FKL-811/24	Course title: Direct Teaching Activities
Educational activities: Type of activities: practicals Number of hours: per week: 2 per level/semester: 28 Form of the course: on-site learning	
Number of credits: 5	
Recommended semester:	
Educational level: III.	
Prerequisites:	
Course requirements:	
Learning outcomes:	
Class syllabus:	
Recommended literature:	
Languages necessary to complete the course:	
Notes:	
Past grade distribution Total number of evaluated students: 2	
ABS	NEABS
100,0	0,0
Lecturers:	
Last change:	
Approved by: prof. Ing. Roman Martoňák, DrSc.	

COURSE DESCRIPTION

Academic year: 2024/2025	
University: Comenius University Bratislava	
Faculty:	
Course ID: FMFLKEF/3-FKL-812/24	Course title: Direct Teaching Activities
Educational activities: Type of activities: practicals Number of hours: per week: 2 per level/semester: 28 Form of the course: on-site learning	
Number of credits: 5	
Recommended semester:	
Educational level: III.	
Prerequisites:	
Course requirements:	
Learning outcomes:	
Class syllabus:	
Recommended literature:	
Languages necessary to complete the course:	
Notes:	
Past grade distribution Total number of evaluated students: 2	
ABS	NEABS
100,0	0,0
Lecturers:	
Last change:	
Approved by: prof. Ing. Roman Martoňák, DrSc.	

STATE EXAM DESCRIPTION

Academic year: 2024/2025	
University: Comenius University Bratislava	
Faculty:	
Course ID: FMFI.KEF/3-FKL-950/15	Course title: Dissertation Examination
Number of credits: 20	
Educational level: III.	
State exam syllabus:	
Last change: 02.06.2015	
Approved by: prof. Ing. Roman Martoňák, DrSc.	

STATE EXAM DESCRIPTION

Academic year: 2024/2025	
University: Comenius University Bratislava	
Faculty:	
Course ID: FMFI.KEF/3-FKL-990/15	Course title: Dissertation Thesis Defense
Number of credits: 30	
Educational level: III.	
State exam syllabus:	
Last change: 02.06.2015	
Approved by: prof. Ing. Roman Martoňák, DrSc.	

COURSE DESCRIPTION

Academic year: 2024/2025	
University: Comenius University Bratislava	
Faculty:	
Course ID: FMFI.KEF/3-FKL-003/22	Course title: Electrons in Disordered and Mesoscopic Systems
Educational activities: Type of activities: seminar / lecture Number of hours: per week: 2 / 2 per level/semester: 28 / 28 Form of the course: on-site learning	
Number of credits: 10	
Recommended semester: 2.	
Educational level: III.	
Prerequisites:	
Course requirements: The form of the evaluation: written test and oral exam. Minimal score: 50% Scale of assessment (preliminary/final): 0/100	
Learning outcomes: After completing the course the student will gain knowledge of basic theoretical methods and experimental facts from the field of quantum electron transport in mesoscopic and disordered systems. He/she will be able to understand physical principles of nanoelectronics devices at the edge of miniaturisation.	
Class syllabus: Persistent current in mesoscopic conducting ring with normal electrons. Electron conductance of weakly-disordered conductor: Lorentz-Drude conductance as a semiclassical limit of quantum transport, quantum transport corrections – Altshuler-Aronov effect and weak localization. Tunneling spectroscopy of weakly disordered conductor – Altshuler-Aronov pseudogap. Single-electron tunneling and Coulomb blockade. Two-dimensional relativistic physics of graphene and boron nitride: tight-binding calculation of electron spectrum, effective description by two-dimensional Dirac equation - relativistic massless and massive fermions, analogy with Dirac equation in three dimensions. Electron transport in graphene, relativistic quantum Hall effect.	
Recommended literature: S. Datta, Electronic Transport in Mesoscopic Systems (Cambridge University Press, Cambridge, UK, 1995). P.A.Mello, N.Kumar, Quantum Transport in Mesoscopic Physics - Complexity and Statistical Fluctuations, Oxford University Press, 2005, pp. 401, ISBN 0-19-852582-6 M. Moško a A. Mošková , Úvod do mezoskopické fyziky (in slovak), http://kflin.elf.stuba.sk/~ballo/SimLab/skripta	
Languages necessary to complete the course: The course is held in Slovak (in English when necessary)	

Notes:	
Past grade distribution	
Total number of evaluated students: 3	
ABS	NEABS
100,0	0,0
Lecturers: doc. RNDr. Martin Moško, DrSc.	
Last change: 01.02.2022	
Approved by: prof. Ing. Roman Martoňák, DrSc.	

COURSE DESCRIPTION

Academic year: 2024/2025	
University: Comenius University Bratislava	
Faculty:	
Course ID: FMFI.KEF/3-FKL-003/24	Course title: Electrons in Disordered and Mesoscopic Systems
Educational activities: Type of activities: lecture Number of hours: per week: 3 per level/semester: 42 Form of the course: on-site learning	
Number of credits: 10	
Recommended semester: 2.	
Educational level: III.	
Prerequisites:	
Course requirements: The form of the evaluation: written test and oral exam. Minimal score: 50% Scale of assessment (preliminary/final): 0/100	
Learning outcomes: After completing the course the student will gain knowledge of basic theoretical methods and experimental facts from the field of quantum electron transport in mesoscopic and disordered systems. He/she will be able to understand physical principles of nanoelectronics devices at the edge of miniaturisation.	
Class syllabus: Persistent current in mesoscopic conducting ring with normal electrons. Electron conductance of weakly-disordered conductor: Lorentz-Drude conductance as a semiclassical limit of quantum transport, quantum transport corrections – Altshuler-Aronov effect and weak localization. Tunneling spectroscopy of weakly disordered conductor – Altshuler-Aronov pseudogap. Single-electron tunneling and Coulomb blockade. Two-dimensional relativistic physics of graphene and boron nitride: tight-binding calculation of electron spectrum, effective description by two-dimensional Dirac equation - relativistic massless and massive fermions, analogy with Dirac equation in three dimensions. Electron transport in graphene, relativistic quantum Hall effect.	
Recommended literature: S. Datta, Electronic Transport in Mesoscopic Systems (Cambridge University Press, Cambridge, UK, 1995). P.A.Mello, N.Kumar, Quantum Transport in Mesoscopic Physics - Complexity and Statistical Fluctuations, Oxford University Press, 2005, pp. 401, ISBN 0-19-852582-6 M. Moško a A. Mošková , Úvod do mezoskopické fyziky (in slovak), http://kflin.elf.stuba.sk/~ballo/SimLab/skripta	
Languages necessary to complete the course: The course is held in Slovak (in English when necessary)	

Notes:	
Past grade distribution	
Total number of evaluated students: 2	
ABS	NEABS
100,0	0,0
Lecturers: doc. RNDr. Martin Moško, DrSc.	
Last change: 26.08.2024	
Approved by: prof. Ing. Roman Martoňák, DrSc.	

COURSE DESCRIPTION

Academic year: 2024/2025	
University: Comenius University Bratislava	
Faculty:	
Course ID: FMFI.KEF/3-FKL-401/24	Course title: Foreign Periodical Cited in Current Contents
Educational activities: Type of activities: Number of hours: per week: per level/semester: Form of the course: on-site learning	
Number of credits: 40	
Recommended semester:	
Educational level: III.	
Prerequisites:	
Course requirements:	
Learning outcomes:	
Class syllabus:	
Recommended literature:	
Languages necessary to complete the course:	
Notes:	
Past grade distribution Total number of evaluated students: 23	
ABS	NEABS
100,0	0,0
Lecturers:	
Last change: 26.08.2024	
Approved by: prof. Ing. Roman Martoňák, DrSc.	

COURSE DESCRIPTION

Academic year: 2024/2025	
University: Comenius University Bratislava	
Faculty:	
Course ID: FMFLKEF/3-FKL-401/10	Course title: Foreign Periodical Cited in Current Contents
Educational activities: Type of activities: Number of hours: per week: per level/semester: Form of the course: on-site learning	
Number of credits: 35	
Recommended semester:	
Educational level: III.	
Prerequisites:	
Course requirements:	
Learning outcomes:	
Class syllabus:	
Recommended literature:	
Languages necessary to complete the course:	
Notes:	
Past grade distribution Total number of evaluated students: 23	
ABS	NEABS
100,0	0,0
Lecturers:	
Last change: 02.06.2015	
Approved by: prof. Ing. Roman Martoňák, DrSc.	

COURSE DESCRIPTION

Academic year: 2024/2025	
University: Comenius University Bratislava	
Faculty:	
Course ID: FMFI.KEF/3-FKL-402/10	Course title: Home Journal Cited in Current Contents
Educational activities: Type of activities: Number of hours: per week: per level/semester: Form of the course: on-site learning	
Number of credits: 30	
Recommended semester:	
Educational level: III.	
Prerequisites:	
Course requirements:	
Learning outcomes:	
Class syllabus:	
Recommended literature:	
Languages necessary to complete the course:	
Notes:	
Past grade distribution Total number of evaluated students: 0	
ABS	NEABS
0,0	0,0
Lecturers:	
Last change: 02.06.2015	
Approved by: prof. Ing. Roman Martoňák, DrSc.	

COURSE DESCRIPTION

Academic year: 2024/2025	
University: Comenius University Bratislava	
Faculty:	
Course ID: FMFI.KEF/3-FKL-102/15	Course title: Individual Study of Resources (1)
Educational activities: Type of activities: independent work Number of hours: per week: 10 per level/semester: 140 Form of the course: on-site learning	
Number of credits: 10	
Recommended semester: 1.	
Educational level: III.	
Prerequisites:	
Course requirements:	
Learning outcomes:	
Class syllabus:	
Recommended literature:	
Languages necessary to complete the course:	
Notes:	
Past grade distribution Total number of evaluated students: 17	
ABS	NEABS
100,0	0,0
Lecturers:	
Last change:	
Approved by: prof. Ing. Roman Martoňák, DrSc.	

COURSE DESCRIPTION

Academic year: 2024/2025	
University: Comenius University Bratislava	
Faculty:	
Course ID: FMFI.KEF/3-FKL-103/15	Course title: Individual Study of Resources (2)
Educational activities: Type of activities: independent work Number of hours: per week: 10 per level/semester: 140 Form of the course: on-site learning	
Number of credits: 10	
Recommended semester: 2.	
Educational level: III.	
Prerequisites:	
Course requirements:	
Learning outcomes:	
Class syllabus:	
Recommended literature:	
Languages necessary to complete the course:	
Notes:	
Past grade distribution Total number of evaluated students: 17	
ABS	NEABS
100,0	0,0
Lecturers:	
Last change:	
Approved by: prof. Ing. Roman Martoňák, DrSc.	

COURSE DESCRIPTION

Academic year: 2024/2025	
University: Comenius University Bratislava	
Faculty:	
Course ID: FMFI.KEF/3-FKL-010/24	Course title: Modern Experimental Methods in Condensed Matter Physics (1)
Educational activities: Type of activities: seminar / lecture Number of hours: per week: 2 / 1 per level/semester: 28 / 14 Form of the course: on-site learning	
Number of credits: 10	
Recommended semester: 1.	
Educational level: III.	
Prerequisites:	
Course requirements:	
Learning outcomes:	
Class syllabus:	
Recommended literature:	
Languages necessary to complete the course:	
Notes:	
Past grade distribution Total number of evaluated students: 0	
ABS	NEABS
0,0	0,0
Lecturers: doc. RNDr. Tomáš Plecenik, PhD.	
Last change:	
Approved by: prof. Ing. Roman Martoňák, DrSc.	

COURSE DESCRIPTION

Academic year: 2024/2025	
University: Comenius University Bratislava	
Faculty:	
Course ID: FMFI.KEF/3-FKL-009/24	Course title: Modern Experimental Methods in Condensed Matter Physics (2)
Educational activities: Type of activities: seminar / lecture Number of hours: per week: 2 / 1 per level/semester: 28 / 14 Form of the course: on-site learning	
Number of credits: 10	
Recommended semester: 2.	
Educational level: III.	
Prerequisites:	
Course requirements: Continuous assessment: homework assignments Exam: oral minimal score: 50%	
Learning outcomes: Gain theoretical and practical knowledge of the latest trends in condensed matter physics and acoustics. Acquire the methodology for independent design and implementation of experiments necessary for the implementation of the dissertation.	
Class syllabus: Methods of preparation of thin films of various types: semiconductor, superconductor, metal, magnetoresistive and other coatings based on metals, nanolayers, layers for optoelectronics, etc. Surface treatment of substrates by various physical processes. Layer characterization.	
Recommended literature: The latest professional scientific articles and publications.	
Languages necessary to complete the course: Slovak, English	
Notes:	
Past grade distribution Total number of evaluated students: 0	
ABS	NEABS
0,0	0,0
Lecturers: doc. RNDr. Tomáš Plecenik, PhD.	
Last change: 26.08.2024	
Approved by: prof. Ing. Roman Martoňák, DrSc.	

COURSE DESCRIPTION

Academic year: 2024/2025	
University: Comenius University Bratislava	
Faculty:	
Course ID: FMFI.KEF/3-FKL-005/22	Course title: Modern Trends in Condensed Matter Physics and Acoustics
Educational activities: Type of activities: seminar / lecture Number of hours: per week: 2 / 2 per level/semester: 28 / 28 Form of the course: on-site learning	
Number of credits: 10	
Recommended semester: 3.	
Educational level: III.	
Prerequisites:	
Course requirements: Continuous assessment: homework assignments Exam: oral minimal score: 50%	
Learning outcomes: Gain theoretical and practical knowledge of the latest trends in condensed matter physics and acoustics. Acquire the methodology for independent design and implementation of experiments necessary for the implementation of the dissertation.	
Class syllabus: Methods of preparation of thin films of various types: semiconductor, superconductor, metal, magnetoresistive and other coatings based on metals, nanolayers, layers for optoelectronics, etc. Surface treatment of substrates by various physical processes. Layer characterization.	
Recommended literature: The latest professional scientific articles and publications.	
Languages necessary to complete the course: Slovak, English	
Notes:	
Past grade distribution Total number of evaluated students: 1	
ABS	NEABS
100,0	0,0
Lecturers: prof. RNDr. Peter Kúš, DrSc.	
Last change: 02.02.2022	
Approved by: prof. Ing. Roman Martoňák, DrSc.	

COURSE DESCRIPTION

Academic year: 2024/2025	
University: Comenius University Bratislava	
Faculty:	
Course ID: FMFI.KEF/3-FKL-701/10	Course title: Obtaining a University Grant
Educational activities: Type of activities: Number of hours: per week: per level/semester: Form of the course: on-site learning	
Number of credits: 20	
Recommended semester:	
Educational level: III.	
Prerequisites:	
Course requirements:	
Learning outcomes:	
Class syllabus:	
Recommended literature:	
Languages necessary to complete the course:	
Notes:	
Past grade distribution Total number of evaluated students: 12	
ABS	NEABS
100,0	0,0
Lecturers:	
Last change: 02.06.2015	
Approved by: prof. Ing. Roman Martoňák, DrSc.	

COURSE DESCRIPTION

Academic year: 2024/2025	
University: Comenius University Bratislava	
Faculty:	
Course ID: FMFI.KEF/3-FKL-008/22	Course title: Quantum Measurements and Technologies
Educational activities: Type of activities: practicals / lecture Number of hours: per week: 2 / 2 per level/semester: 28 / 28 Form of the course: on-site learning	
Number of credits: 10	
Recommended semester: 3.	
Educational level: III.	
Prerequisites:	
Recommended prerequisites: Master in physics or equivalent	
Course requirements: The evaluation of the course will be in the form of oral exam (1/2-1 h), its successful completion reflects the student's knowledge of physical principles of quantum-limited measurements and his ability to design and measure quantum devices. The lowest passing mark: 50% Scale of assessment (preliminary/final): 45/55	
Learning outcomes: The student who completes the course successfully will have the ability to master the physical principles of quantum-limited measurements and will be able to use this knowledge for applications in quantum technologies. He or she will be able to design quantum superconducting devices with applications in quantum cryptography, quantum computers and simulators.	
Class syllabus: Quantum measurements. Standard quantum limit. Backaction of measuring device on the measured object. Electron as a quantum probe. Quantum nondemolition measurements. Linear measurements. Discrete and continuous quantum measurements. Parametric transducers and amplifiers. Squeezed states. Two-level quantum systems (qubits). Superconducting qubits. Single-photon detectors. Quantum cryptography and internet. Quantum computers and simulators.	
Recommended literature: 1. V.B.Braginsky,F.Ya. Khalili, Kip S. Thorn, Quantum Measurement, ISBN-10: 052141928X 2. Quantum Machines - Measurement and Control of Engineered Quantum Systems, Oxford University Press 2014, ISBN 978-0-19-968118-1 3. Single-Photon Generation and Detection, Elsevier Inc. 2013, ISBN: 978-0-12-387695-9	
Languages necessary to complete the course:	

Slovak, English	
Notes:	
Past grade distribution	
Total number of evaluated students: 7	
ABS	NEABS
100,0	0,0
Lecturers: prof. RNDr. Miroslav Grajcar, DrSc., Mgr. Pavol Neilinger, PhD.	
Last change: 02.02.2022	
Approved by: prof. Ing. Roman Martoňák, DrSc.	

COURSE DESCRIPTION

Academic year: 2024/2025	
University: Comenius University Bratislava	
Faculty:	
Course ID: FMFI.KEF/3-FKL-008/24	Course title: Quantum Measurements and Technologies
Educational activities: Type of activities: lecture Number of hours: per week: 3 per level/semester: 42 Form of the course: on-site learning	
Number of credits: 10	
Recommended semester: 3.	
Educational level: III.	
Prerequisites:	
Recommended prerequisites: Master in physics or equivalent	
Course requirements: The evaluation of the course will be in the form of oral exam (1/2-1 h), its successful completion reflects the student's knowledge of physical principles of quantum-limited measurements and his ability to design and measure quantum devices. The lowest passing mark: 50% Scale of assessment (preliminary/final): 45/55	
Learning outcomes: The student who completes the course successfully will have the ability to master the physical principles of quantum-limited measurements and will be able to use this knowledge for applications in quantum technologies. He or she will be able to design quantum superconducting devices with applications in quantum cryptography, quantum computers and simulators.	
Class syllabus: Quantum measurements. Standard quantum limit. Backaction of measuring device on the measured object. Electron as a quantum probe. Quantum nondemolition measurements. Linear measurements. Discrete and continuous quantum measurements. Parametric transducers and amplifiers. Squeezed states. Two-level quantum systems (qubits). Superconducting qubits. Single-photon detectors. Quantum cryptography and internet. Quantum computers and simulators.	
Recommended literature: 1. V.B.Braginsky,F.Ya. Khalili, Kip S. Thorn, Quantum Measurement, ISBN-10: 052141928X 2. Quantum Machines - Measurement and Control of Engineered Quantum Systems, Oxford University Press 2014, ISBN 978-0-19-968118-1 3. Single-Photon Generation and Detection, Elsevier Inc. 2013, ISBN: 978-0-12-387695-9	
Languages necessary to complete the course:	

Slovak, English	
Notes:	
Past grade distribution	
Total number of evaluated students: 1	
ABS	NEABS
100,0	0,0
Lecturers: prof. RNDr. Miroslav Grajcar, DrSc., Mgr. Pavol Neilinger, PhD.	
Last change: 26.08.2024	
Approved by: prof. Ing. Roman Martoňák, DrSc.	

COURSE DESCRIPTION

Academic year: 2024/2025	
University: Comenius University Bratislava	
Faculty:	
Course ID: FMFI.KEF/3-FKL-702/10	Course title: Quotation Registered in SCI or SCOPUS
Educational activities: Type of activities: Number of hours: per week: per level/semester: Form of the course: on-site learning	
Number of credits: 4	
Recommended semester:	
Educational level: III.	
Prerequisites:	
Course requirements:	
Learning outcomes:	
Class syllabus:	
Recommended literature:	
Languages necessary to complete the course:	
Notes:	
Past grade distribution Total number of evaluated students: 4	
ABS	NEABS
100,0	0,0
Lecturers:	
Last change: 02.06.2015	
Approved by: prof. Ing. Roman Martoňák, DrSc.	

COURSE DESCRIPTION

Academic year: 2024/2025	
University: Comenius University Bratislava	
Faculty:	
Course ID: FMFI.KEF/3-FKL-302/10	Course title: Research Work
Educational activities: Type of activities: Number of hours: per week: per level/semester: Form of the course: on-site learning	
Number of credits: 10	
Recommended semester: 3.	
Educational level: III.	
Prerequisites:	
Course requirements:	
Learning outcomes:	
Class syllabus:	
Recommended literature:	
Languages necessary to complete the course:	
Notes:	
Past grade distribution Total number of evaluated students: 14	
ABS	NEABS
100,0	0,0
Lecturers:	
Last change: 02.06.2015	
Approved by: prof. Ing. Roman Martoňák, DrSc.	

COURSE DESCRIPTION

Academic year: 2024/2025	
University: Comenius University Bratislava	
Faculty:	
Course ID: FMFLKEF/3-FKL-303/10	Course title: Research Work
Educational activities: Type of activities: Number of hours: per week: per level/semester: Form of the course: on-site learning	
Number of credits: 20	
Recommended semester: 4.	
Educational level: III.	
Prerequisites:	
Course requirements:	
Learning outcomes:	
Class syllabus:	
Recommended literature:	
Languages necessary to complete the course:	
Notes:	
Past grade distribution Total number of evaluated students: 12	
ABS	NEABS
100,0	0,0
Lecturers:	
Last change: 02.06.2015	
Approved by: prof. Ing. Roman Martoňák, DrSc.	

COURSE DESCRIPTION

Academic year: 2024/2025	
University: Comenius University Bratislava	
Faculty:	
Course ID: FMFI.KEF/3-FKL-304/10	Course title: Research Work
Educational activities: Type of activities: Number of hours: per week: per level/semester: Form of the course: on-site learning	
Number of credits: 25	
Recommended semester: 5.	
Educational level: III.	
Prerequisites:	
Course requirements:	
Learning outcomes:	
Class syllabus:	
Recommended literature:	
Languages necessary to complete the course:	
Notes:	
Past grade distribution Total number of evaluated students: 16	
ABS	NEABS
100,0	0,0
Lecturers:	
Last change: 02.06.2015	
Approved by: prof. Ing. Roman Martoňák, DrSc.	

COURSE DESCRIPTION

Academic year: 2024/2025	
University: Comenius University Bratislava	
Faculty:	
Course ID: FMFI.KEF/3-FKL-304/24	Course title: Research Work
Educational activities: Type of activities: Number of hours: per week: per level/semester: Form of the course: on-site learning	
Number of credits: 20	
Recommended semester: 5.	
Educational level: III.	
Prerequisites:	
Course requirements:	
Learning outcomes:	
Class syllabus:	
Recommended literature:	
Languages necessary to complete the course:	
Notes:	
Past grade distribution Total number of evaluated students: 2	
ABS	NEABS
100,0	0,0
Lecturers:	
Last change: 26.08.2024	
Approved by: prof. Ing. Roman Martoňák, DrSc.	

COURSE DESCRIPTION

Academic year: 2024/2025	
University: Comenius University Bratislava	
Faculty:	
Course ID: FMFLKEF/3-FKL-305/24	Course title: Research Work
Educational activities: Type of activities: Number of hours: per week: per level/semester: Form of the course: on-site learning	
Number of credits: 20	
Recommended semester: 6.	
Educational level: III.	
Prerequisites:	
Course requirements:	
Learning outcomes:	
Class syllabus:	
Recommended literature:	
Languages necessary to complete the course:	
Notes:	
Past grade distribution Total number of evaluated students: 2	
ABS	NEABS
100,0	0,0
Lecturers:	
Last change: 26.08.2024	
Approved by: prof. Ing. Roman Martoňák, DrSc.	

COURSE DESCRIPTION

Academic year: 2024/2025	
University: Comenius University Bratislava	
Faculty:	
Course ID: FMFLKEF/3-FKL-305/10	Course title: Research Work
Educational activities: Type of activities: Number of hours: per week: per level/semester: Form of the course: on-site learning	
Number of credits: 25	
Recommended semester: 6.	
Educational level: III.	
Prerequisites:	
Course requirements:	
Learning outcomes:	
Class syllabus:	
Recommended literature:	
Languages necessary to complete the course:	
Notes:	
Past grade distribution Total number of evaluated students: 16	
ABS	NEABS
100,0	0,0
Lecturers:	
Last change: 02.06.2015	
Approved by: prof. Ing. Roman Martoňák, DrSc.	

COURSE DESCRIPTION

Academic year: 2024/2025	
University: Comenius University Bratislava	
Faculty:	
Course ID: FMFLKEF/3-FKL-306/10	Course title: Research Work
Educational activities: Type of activities: Number of hours: per week: per level/semester: Form of the course: on-site learning	
Number of credits: 25	
Recommended semester: 7.	
Educational level: III.	
Prerequisites:	
Course requirements:	
Learning outcomes:	
Class syllabus:	
Recommended literature:	
Languages necessary to complete the course:	
Notes:	
Past grade distribution Total number of evaluated students: 18	
ABS	NEABS
100,0	0,0
Lecturers:	
Last change: 02.06.2015	
Approved by: prof. Ing. Roman Martoňák, DrSc.	

COURSE DESCRIPTION

Academic year: 2024/2025	
University: Comenius University Bratislava	
Faculty:	
Course ID: FMFLKEF/3-FKL-403/10	Course title: Reviewed Foreign Papers Volume
Educational activities: Type of activities: Number of hours: per week: per level/semester: Form of the course: on-site learning	
Number of credits: 25	
Recommended semester:	
Educational level: III.	
Prerequisites:	
Course requirements:	
Learning outcomes:	
Class syllabus:	
Recommended literature:	
Languages necessary to complete the course:	
Notes:	
Past grade distribution Total number of evaluated students: 2	
ABS	NEABS
100,0	0,0
Lecturers:	
Last change: 02.06.2015	
Approved by: prof. Ing. Roman Martoňák, DrSc.	

COURSE DESCRIPTION

Academic year: 2024/2025	
University: Comenius University Bratislava	
Faculty:	
Course ID: FMFLKEF/3-FKL-404/10	Course title: Reviewed Home Papers Volume
Educational activities: Type of activities: Number of hours: per week: per level/semester: Form of the course: on-site learning	
Number of credits: 20	
Recommended semester:	
Educational level: III.	
Prerequisites:	
Course requirements:	
Learning outcomes:	
Class syllabus:	
Recommended literature:	
Languages necessary to complete the course:	
Notes:	
Past grade distribution Total number of evaluated students: 5	
ABS	NEABS
100,0	0,0
Lecturers:	
Last change: 02.06.2015	
Approved by: prof. Ing. Roman Martoňák, DrSc.	

COURSE DESCRIPTION

Academic year: 2024/2025	
University: Comenius University Bratislava	
Faculty:	
Course ID: FMFLKEF/3-FKL-813/24	Course title: Supervision of Bachelor Thesis
Educational activities: Type of activities: Number of hours: per week: per level/semester: Form of the course: on-site learning	
Number of credits: 10	
Recommended semester:	
Educational level: III.	
Prerequisites:	
Course requirements:	
Learning outcomes:	
Class syllabus:	
Recommended literature:	
Languages necessary to complete the course:	
Notes:	
Past grade distribution Total number of evaluated students: 0	
ABS	NEABS
0,0	0,0
Lecturers:	
Last change:	
Approved by: prof. Ing. Roman Martoňák, DrSc.	

COURSE DESCRIPTION

Academic year: 2024/2025	
University: Comenius University Bratislava	
Faculty:	
Course ID: FMFI.KEF/3-FKL-814/24	Course title: Supervision of Student Scientific Conference
Educational activities: Type of activities: Number of hours: per week: per level/semester: Form of the course: on-site learning	
Number of credits: 10	
Recommended semester:	
Educational level: III.	
Prerequisites:	
Course requirements:	
Learning outcomes:	
Class syllabus:	
Recommended literature:	
Languages necessary to complete the course:	
Notes:	
Past grade distribution Total number of evaluated students: 0	
ABS	NEABS
0,0	0,0
Lecturers:	
Last change:	
Approved by: prof. Ing. Roman Martoňák, DrSc.	

COURSE DESCRIPTION

Academic year: 2024/2025	
University: Comenius University Bratislava	
Faculty:	
Course ID: FMFLKEF/3-FKL-801/10	Course title: Teaching Activities
Educational activities: Type of activities: Number of hours: per week: per level/semester: Form of the course: on-site learning	
Number of credits: 2	
Recommended semester: 1.	
Educational level: III.	
Prerequisites:	
Course requirements:	
Learning outcomes:	
Class syllabus:	
Recommended literature:	
Languages necessary to complete the course:	
Notes:	
Past grade distribution Total number of evaluated students: 8	
ABS	NEABS
100,0	0,0
Lecturers:	
Last change: 02.06.2015	
Approved by: prof. Ing. Roman Martoňák, DrSc.	

COURSE DESCRIPTION

Academic year: 2024/2025	
University: Comenius University Bratislava	
Faculty:	
Course ID: FMFLKEF/3-FKL-802/10	Course title: Teaching Activities
Educational activities: Type of activities: Number of hours: per week: per level/semester: Form of the course: on-site learning	
Number of credits: 2	
Recommended semester: 2.	
Educational level: III.	
Prerequisites:	
Course requirements:	
Learning outcomes:	
Class syllabus:	
Recommended literature:	
Languages necessary to complete the course:	
Notes:	
Past grade distribution Total number of evaluated students: 4	
ABS	NEABS
100,0	0,0
Lecturers:	
Last change: 02.06.2015	
Approved by: prof. Ing. Roman Martoňák, DrSc.	

COURSE DESCRIPTION

Academic year: 2024/2025	
University: Comenius University Bratislava	
Faculty:	
Course ID: FMFLKEF/3-FKL-803/10	Course title: Teaching Activities
Educational activities: Type of activities: Number of hours: per week: per level/semester: Form of the course: on-site learning	
Number of credits: 2	
Recommended semester: 3.	
Educational level: III.	
Prerequisites:	
Course requirements:	
Learning outcomes:	
Class syllabus:	
Recommended literature:	
Languages necessary to complete the course:	
Notes:	
Past grade distribution Total number of evaluated students: 8	
ABS	NEABS
100,0	0,0
Lecturers:	
Last change: 02.06.2015	
Approved by: prof. Ing. Roman Martoňák, DrSc.	

COURSE DESCRIPTION

Academic year: 2024/2025	
University: Comenius University Bratislava	
Faculty:	
Course ID: FMFLKEF/3-FKL-804/10	Course title: Teaching Activities
Educational activities: Type of activities: Number of hours: per week: per level/semester: Form of the course: on-site learning	
Number of credits: 2	
Recommended semester: 4.	
Educational level: III.	
Prerequisites:	
Course requirements:	
Learning outcomes:	
Class syllabus:	
Recommended literature:	
Languages necessary to complete the course:	
Notes:	
Past grade distribution Total number of evaluated students: 4	
ABS	NEABS
100,0	0,0
Lecturers:	
Last change: 02.06.2015	
Approved by: prof. Ing. Roman Martoňák, DrSc.	

COURSE DESCRIPTION

Academic year: 2024/2025	
University: Comenius University Bratislava	
Faculty:	
Course ID: FMFLKEF/3-FKL-805/10	Course title: Teaching Activities
Educational activities: Type of activities: Number of hours: per week: per level/semester: Form of the course: on-site learning	
Number of credits: 2	
Recommended semester: 5.	
Educational level: III.	
Prerequisites:	
Course requirements:	
Learning outcomes:	
Class syllabus:	
Recommended literature:	
Languages necessary to complete the course:	
Notes:	
Past grade distribution Total number of evaluated students: 8	
ABS	NEABS
100,0	0,0
Lecturers:	
Last change: 02.06.2015	
Approved by: prof. Ing. Roman Martoňák, DrSc.	

COURSE DESCRIPTION

Academic year: 2024/2025	
University: Comenius University Bratislava	
Faculty:	
Course ID: FMFLKEF/3-FKL-806/10	Course title: Teaching Activities
Educational activities: Type of activities: Number of hours: per week: per level/semester: Form of the course: on-site learning	
Number of credits: 2	
Recommended semester: 6.	
Educational level: III.	
Prerequisites:	
Course requirements:	
Learning outcomes:	
Class syllabus:	
Recommended literature:	
Languages necessary to complete the course:	
Notes:	
Past grade distribution Total number of evaluated students: 5	
ABS	NEABS
100,0	0,0
Lecturers:	
Last change: 02.06.2015	
Approved by: prof. Ing. Roman Martoňák, DrSc.	

COURSE DESCRIPTION

Academic year: 2024/2025	
University: Comenius University Bratislava	
Faculty:	
Course ID: FMFLKEF/3-FKL-807/10	Course title: Teaching Activities
Educational activities: Type of activities: Number of hours: per week: per level/semester: Form of the course: on-site learning	
Number of credits: 2	
Recommended semester: 7.	
Educational level: III.	
Prerequisites:	
Course requirements:	
Learning outcomes:	
Class syllabus:	
Recommended literature:	
Languages necessary to complete the course:	
Notes:	
Past grade distribution Total number of evaluated students: 6	
ABS	NEABS
100,0	0,0
Lecturers:	
Last change: 02.06.2015	
Approved by: prof. Ing. Roman Martoňák, DrSc.	

COURSE DESCRIPTION

Academic year: 2024/2025	
University: Comenius University Bratislava	
Faculty:	
Course ID: FMFLKEF/3-FKL-808/10	Course title: Teaching Activities
Educational activities: Type of activities: Number of hours: per week: per level/semester: Form of the course: on-site learning	
Number of credits: 2	
Recommended semester: 8.	
Educational level: III.	
Prerequisites:	
Course requirements:	
Learning outcomes:	
Class syllabus:	
Recommended literature:	
Languages necessary to complete the course:	
Notes:	
Past grade distribution Total number of evaluated students: 0	
ABS	NEABS
0,0	0,0
Lecturers:	
Last change: 02.06.2015	
Approved by: prof. Ing. Roman Martoňák, DrSc.	

COURSE DESCRIPTION

Academic year: 2024/2025	
University: Comenius University Bratislava	
Faculty:	
Course ID: FMFI.KEF/3-FKL-006/22	Course title: Theory of Condensed Matter
Educational activities: Type of activities: seminar / lecture Number of hours: per week: 2 / 2 per level/semester: 28 / 28 Form of the course: on-site learning	
Number of credits: 10	
Recommended semester: 1.	
Educational level: III.	
Prerequisites:	
Recommended prerequisites: 2-FTL-107 Structure and mechanical properties of solids 2-FTL-108 Electronic and optical properties of solids 2-FTL-205 Many body physics	
Course requirements: seminars, homeworks + oral exam minimal score: 50% Scale of assessment (preliminary/final): 55/45	
Learning outcomes: The students will be able to formulate the many-body problems in the language of quantum field theory. They will know the basic principles of selected theoretical techniques used in condensed matter theory and they will know in which circumstances they can be applied.	
Class syllabus: Linear response theory and correlation functions. Green's functions: relation to observables, formal properties. Perturbation theory and Feynman diagrams. Adiabatic continuity, renormalization group, and effective Hamiltonians. Variational methods. Upon agreement with the students, these notions and methods will be illustrated in the context of quantum magnetism, superfluidity and superconductivity, disordered systems, correlated electrons, and/or coupled electron-phonon problems.	
Recommended literature: http://www.st.fmph.uniba.sk/~hlubina1/ Green's functions and condensed matter / G. Rickayzen. Academic Press, 1980 Fundamentals of the Physics of Solids, Vols. 1-3 / J. Sólyom. Springer 2007 - 2010 Principles of condensed matter physics / P. M. Chaikin, T. C. Lubensky. Cambridge Univ. Press, 1995 Basic notions of condensed matter physics / P. W. Anderson. Addison Wesley, 1984	
Languages necessary to complete the course:	

english							
Notes:							
Past grade distribution							
Total number of evaluated students: 6							
A	ABS	B	C	D	E	FX	NEABS
0,0	66,67	0,0	0,0	0,0	0,0	0,0	33,33
Lecturers: doc. RNDr. Richard Hlubina, DrSc.							
Last change: 01.02.2022							
Approved by: prof. Ing. Roman Martoňák, DrSc.							

COURSE DESCRIPTION

Academic year: 2024/2025	
University: Comenius University Bratislava	
Faculty:	
Course ID: FMFLKEF/3-FKL-006/24	Course title: Theory of Condensed Matter
Educational activities: Type of activities: lecture Number of hours: per week: 3 per level/semester: 42 Form of the course: on-site learning, distance learning	
Number of credits: 10	
Recommended semester: 1.	
Educational level: III.	
Prerequisites:	
Recommended prerequisites: 2-FTL-107 Structure and mechanical properties of solids 2-FTL-108 Electronic and optical properties of solids 2-FTL-205 Many body physics	
Course requirements: seminars, homeworks + oral exam minimal score: 50% Scale of assessment (preliminary/final): 55/45	
Learning outcomes: The students will be able to formulate the many-body problems in the language of quantum field theory. They will know the basic principles of selected theoretical techniques used in condensed matter theory and they will know in which circumstances they can be applied.	
Class syllabus: Linear response theory and correlation functions. Green's functions: relation to observables, formal properties. Perturbation theory and Feynman diagrams. Adiabatic continuity, renormalization group, and effective Hamiltonians. Variational methods. Upon agreement with the students, these notions and methods will be illustrated in the context of quantum magnetism, superfluidity and superconductivity, disordered systems, correlated electrons, and/or coupled electron-phonon problems.	
Recommended literature: http://www.st.fmph.uniba.sk/~hlubina1/ Green's functions and condensed matter / G. Rickayzen. Academic Press, 1980 Fundamentals of the Physics of Solids, Vols. 1-3 / J. Sólyom. Springer 2007 - 2010 Principles of condensed matter physics / P. M. Chaikin, T. C. Lubensky. Cambridge Univ. Press, 1995 Basic notions of condensed matter physics / P. W. Anderson. Addison Wesley, 1984	
Languages necessary to complete the course:	

english							
Notes:							
Past grade distribution							
Total number of evaluated students: 2							
A	ABS	B	C	D	E	FX	NEABS
0,0	100,0	0,0	0,0	0,0	0,0	0,0	0,0
Lecturers: doc. RNDr. Richard Hlubina, DrSc.							
Last change: 26.08.2024							
Approved by: prof. Ing. Roman Martoňák, DrSc.							