Course descriptions

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COURSE DESCRIPTION

Academic year: 2026/2027

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KEF/2-FTL-123/22	Ab initio Modelling of Materials

Educational activities:
Type of activities: lecture / practicals
Number of hours:
per week: 2 / 2 **per level/semester:** 26 / 26
Form of the course: on-site learning

Number of credits: 5

Recommended semester: 2.

Educational level: II.

Prerequisites:

Recommended prerequisites:
The course requires knowledge of standard classical MD/MC simulation methods on the level of the course FMFI.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 grade will be based on the evaluation of the report. Grade: A 90%, B 80%, C 70%, D 60%, E 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: 4

A	B	C	D	E	FX
50,0	0,0	25,0	25,0	0,0	0,0

Lecturers: prof. Ing. Roman Martoňák, DrSc.

Last change: 19.01.2022

Approved by: prof. RNDr. Fedor Šimkovic, CSc.

COURSE DESCRIPTION

Academic year: 2026/2027

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KAI/2-MXX-133/23	Artificial Intelligence for Everyone

Educational activities:
Type of activities: training session / course
Number of hours:
per week: 9 **per level/semester:** 1t / 117
Form of the course: on-site learning

Number of credits: 6

Recommended semester:

Educational level: I.II., II.

Prerequisites:

Course requirements:

Learning outcomes:

Class syllabus:

Recommended literature:

Languages necessary to complete the course:

Notes:

Past grade distribution
Total number of evaluated students: 22

A	B	C	D	E	FX
45,45	36,36	4,55	9,09	4,55	0,0

Lecturers: prof. Ing. Igor Farkaš, Dr.

Last change:

Approved by: prof. RNDr. Fedor Šimkovic, CSc.

COURSE DESCRIPTION

Academic year: 2026/2027

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KTF/2-FTF-125/00	Classical Theory of Radiation

Educational activities:
Type of activities: lecture
Number of hours:
per week: 2 **per level/semester:** 26
Form of the course: on-site learning

Number of credits: 3

Recommended semester: 1.

Educational level: II.

Prerequisites:

Course requirements:
Continuous assessment: problem solving
Exam: written
Indicative assessment scale: A 90%, B 80%, C 70%, D 60%, E 50%
Scale of assessment (preliminary/final): 100/0

Learning outcomes:
Ability to calculate the basic physical quantities characterizing the properties of the electromagnetic field in the near and far field of the charge system, radiating in the classical approximation.

Class syllabus:
Retarded potentials, Lienard-Wiechert potentials, radiation of the linear antenna, multipole expansion of retarded potentials in the quasistatic and wave region, radiation friction, consistency of classical electrodynamics, the natural width of spectral lines, scattering of electromagnetic waves.

Recommended literature:
L.D.Landau, E.M.Lifschitz: The Classical Theory of Fields, Volume 2
J.D.Jackson: Classical electrodynamics, 3.ed.,1998
V.V.Batygin, I.N.Toptygin: Problems in Electrodynamics, 2.ed., 1978.

Languages necessary to complete the course:
Slovak or English

Notes:

Past grade distribution
Total number of evaluated students: 32

A	B	C	D	E	FX
96,88	0,0	0,0	0,0	0,0	3,13

Lecturers: RNDr. Eduard Masár, PhD.

Last change: 25.02.2022

Approved by: prof. RNDr. Fedor Šimkovic, CSc.

COURSE DESCRIPTION

Academic year: 2026/2027	
University: Comenius University Bratislava	
Faculty: Faculty of Mathematics, Physics and Informatics	
Course ID: FMFI.KEF/2-FTL-110/22	**Course title:** Computer Simulations of Condensed Matter
Educational activities: **Type of activities:** lecture / practicals **Number of hours:** **per week:** 2 / 2 **per level/semester:** 26 / 26 **Form of the course:** on-site learning	
Number of credits: 5	
Recommended semester: 1.	
Educational level: II.	
Prerequisites:	
Recommended prerequisites: The course requires knowledge of statistical mechanics on the level of a standard bachelor course.	
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 grade will be based on the evaluation of the report. Grade: A 90%, B 80%, C 70%, D 60%, E 50% Scale of assessment (preliminary/final): 0/100	
Learning outcomes: The course presents the basic principles of modern computer simulation methods and their application to an effective solution of a broad spectrum of problems in various branches of condensed matter physics. The student will also learn to analyze, visualize and interpret the simulation results. The course will focus on the molecular dynamics and Monte Carlo methods. An important ingredient of the course is also solving of complex optimization problems which are often encountered in science, technology and everyday life. During exercises the student will become familiar with the application of the presented methods to clusters, crystals and liquids, including phase transitions. The course covers also simulations of activated processes where the system crosses a free-energy barrier.	
Class syllabus: The role of computer simulations in physics - experiment, theory, simulations Ergodic theorem Molecular dynamics (MD) Description of interactions - force fields for various types of interatomic interactions Periodic boundary conditions, interaction cutoff, Ewald summation for Coulomb systems Constant temperature and pressure MD, MD for molecular systems Post-processing of simulation data - estimation of statistical error Calculation of time correlation functions - relation to physical quantities Monte Carlo methods - simple and importance sampling, detailed balance	

Metropolis algorithm for systems with discrete and continuous degrees of freedom
Optimization algorithms for complex problems - simulated annealing, evolutionary algorithms
Free-energy calculations, phase diagrams
Simulations of 1st and 2nd order phase transitions
Rare events, activated processes, simulation of a crossing of a free-energy barrier
Metadynamics and its application to various systems

Recommended literature:

James P. Sethna: Statistical Mechanics: Entropy, Order Parameters, and Complexity, 2nd edition CLARENDON PRESS OXFORD 2021
Michael P. Allen, Dominic J. Tildesley: Computer Simulation of Liquids, Oxford University Press; 2nd edition (2017)
D. Frenkel, B. Smit, Understanding molecular simulations From algorithms to applications, Academic Press 2nd edition (2001)
Kurt Binder, Dieter W. Heermann: Monte Carlo Simulation in Statistical Physics: An Introduction (Graduate Texts in Physics), Springer; 6th ed. 2019

Languages necessary to complete the course:
Slovak, English

Notes:

Past grade distribution
Total number of evaluated students: 29

A	B	C	D	E	FX
58,62	20,69	3,45	10,34	6,9	0,0

Lecturers: prof. Ing. Roman Martoňák, DrSc.

Last change: 19.01.2022

Approved by: prof. RNDr. Fedor Šimkovic, CSc.

COURSE DESCRIPTION

Academic year: 2026/2027

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KTF/2-FTF-230/16	Conformal Field Theory

Educational activities:
Type of activities: lecture
Number of hours:
per week: 3 **per level/semester:** 39
Form of the course: on-site learning

Number of credits: 5

Recommended semester: 3.

Educational level: II.

Prerequisites:

Course requirements:
Homework and exam.
Scale of assessment (preliminary/final): 40/60

Learning outcomes:
After completing the course, students will know the basic concepts and applications of conformal field theory.

Class syllabus:
Conformal group, conformal anomaly, correspondence of states / operators, development of operator product, Virasoro algebra, rational conformal field theories and minimal models, Kadanoff spin block renormalization, Wilson renormalization group, Zamolodchik's c-theorem, critical exponents of the Ising model

Recommended literature:
Introduction to Conformal Field Theory / R. Blumenhagen, E. Plauschinn : Springer, 2009.
Conformal Field Theory / P. Francesco, P. Mathieu, D. Sénéchal : Springer, 1997.

Languages necessary to complete the course:
Slovak, English

Notes:

Past grade distribution
Total number of evaluated students: 9

A	B	C	D	E	FX
100,0	0,0	0,0	0,0	0,0	0,0

Lecturers: Mgr. Peter Mészáros, PhD., doc. Mgr. Juraj Tekel, PhD.

Last change: 25.02.2022

Approved by: prof. RNDr. Fedor Šimkovic, CSc.

COURSE DESCRIPTION

Academic year: 2026/2027

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KTF/2-FTF-129/00	Connections and Gauge Fields

Educational activities:
Type of activities: lecture
Number of hours:
per week: 2 **per level/semester:** 26
Form of the course: on-site learning

Number of credits: 3

Recommended semester: 2.

Educational level: II.

Prerequisites:

Course requirements:
Mid-term evaluation: submission of homework in written form
Exam: exam
Indicative assessment scale: A 90%, B 80%, C 70%, D 60%, E 50%
Scale of assessment (preliminary/final): 100/0

Learning outcomes:
After completing the course, students will be able to use modern differential geometry in the context of the theory of calibration fields.

Class syllabus:
Reformulation of the theory of linear connection.
Principal fibre bundles, connection on them.
Basics of a traditional approach to gauge fields.
The interrelation between gauge fields and connections.
Action integrals and equations of motion.

Recommended literature:
Diferenciálna geometria a Lieove grupy pre fyzikov / Marián Fecko. Bratislava : Iris, 2004,2008, 2018
Differential geometry and Lie groups for physicists / Marián Fecko. Cambridge : Cambridge University Press, 2006
Applicable differential geometry / M.Crampin, F.Pirani, Cambridge University Press, 1986

Languages necessary to complete the course:
Slovak, English

Notes:

Past grade distribution
Total number of evaluated students: 68

A	B	C	D	E	FX
94,12	2,94	2,94	0,0	0,0	0,0

Lecturers: doc. RNDr. Marián Fecko, PhD.

Last change: 23.02.2022

Approved by: prof. RNDr. Fedor Šimkovic, CSc.

COURSE DESCRIPTION

Academic year: 2026/2027

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KTF/2-FTF-213/00	Cosmology

Educational activities:
Type of activities: lecture / practicals
Number of hours:
per week: 2 / 2 **per level/semester:** 26 / 26
Form of the course: on-site learning

Number of credits: 6

Recommended semester: 3.

Educational level: II.

Prerequisites:

Course requirements:
Continuous assessment: homework
Exam: exam
Indicative assessment scale: A 90%, B 80%, C 70%, D 60%, E 50%
Scale of assessment (preliminary/final): 40/60

Learning outcomes:
After completing the course, students will know the basic concepts and ideas of the standard model in cosmology and know how to determine the cosmological parameters from the data of observations on anisotropies of relic radiation.

Class syllabus:
- dynamics of the Universe
- physical processes in the early Universe
- anisotropies of the cosmic background radiation and the origin of galaxies

Recommended literature:
Fundamentals of cosmology / James Rich. Berlin : Springer, 2001
J. García-Bellido: Astrophysics and Cosmology, hep-ph/0004188

Languages necessary to complete the course:
Slovak, English

Notes:

Past grade distribution
Total number of evaluated students: 53

A	B	C	D	E	FX
67,92	16,98	9,43	3,77	1,89	0,0

Lecturers: Mgr. Peter Mészáros, PhD.

Last change: 25.02.2022

Approved by: prof. RNDr. Fedor Šimkovic, CSc.

COURSE DESCRIPTION

Academic year: 2026/2027

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KJFB/2-FJF-236/00	Detection Methods in High Energy Physics

Educational activities:
Type of activities: lecture
Number of hours:
per week: 2 **per level/semester:** 26
Form of the course: on-site learning

Number of credits: 3

Recommended semester: 3.

Educational level: II.

Prerequisites:

Course requirements:

Learning outcomes:
The course will cover the physics of particle detectors. It will introduce the experimental techniques used in nuclear, particle physics and photon science, and describe the layout and functionality of modern experiments.

Class syllabus:
1. Introductions to instruments for high-energy physics
2. Interaction of Particles with Matter
3. Gaseous detectors
4. Scintillators detectors
5. Solid state detectors
6. Detectors using transition radiation
7. Readout electronics
8. Tracking
9. EM and Hadron calorimeters
10. Particle identifications
11. Complex detector systems
12. Detectors of high energy particles in space research

Recommended literature:
C. Grupen, B. Shwartz, Particle Detectors, Cambridge University Press, 2011, s. 676
C. Grupen,, I.Buvat, Handbook of particle detection and imaging, vol. 1 and vol.2, Springer, 2012, s. 1227
S. Biswas, S. Das, S. K. Ghosh, Advanced Detectors for Nuclear, High Energy and Astroparticle Physics, Springer, 2018, s. 229

Languages necessary to complete the course:

Notes:

Past grade distribution Total number of evaluated students: 46					
A	B	C	D	E	FX
69,57	21,74	4,35	4,35	0,0	0,0
Lecturers: doc. Mgr. Michal Mereš, PhD., doc. RNDr. Tibor Ženiš, PhD.					
Last change: 20.06.2022					
Approved by: prof. RNDr. Fedor Šimkovic, CSc.					

COURSE DESCRIPTION

Academic year: 2026/2027

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KTF/2-FTF-115/24	Differential Equations

Educational activities:
Type of activities: lecture / practicals
Number of hours:
per week: 2 / 2 **per level/semester:** 26 / 26
Form of the course: on-site learning

Number of credits: 5

Recommended semester: 2.

Educational level: II.

Prerequisites:

Course requirements:
Continuous assessment: solving tasks
Exam: exam
Indicative assessment scale: A 90%, B 80%, C 70%, D 60%, E 50%
Scale of assessment (preliminary/final): 40/60

Learning outcomes:
After completing the course, students will be able to use modern mathematical methods in formulating and solving physical problems leading to differential equations and variation problems.

Class syllabus:
Qaulitative theory of ordinary differential equations, distributions and their properties, Laplace and Fourier transforms of distributions, classical differential equations and their generalized formulation, generalized solutions.

Recommended literature:
V. S. Vladimirov: Equations of Mathematical Physics, Marcel Dekker, New York, 1971
A. Yu. Arsenin: Basic Equations and Special Functions, Iliifc, London, 1968

Languages necessary to complete the course:
Slovak, English

Notes:

Past grade distribution
Total number of evaluated students: 8

A	B	C	D	E	FX
62,5	12,5	25,0	0,0	0,0	0,0

Lecturers: doc. Mgr. Juraj Tekel, PhD.

Last change: 07.08.2024

Approved by: prof. RNDr. Fedor Šimkovic, CSc.

COURSE DESCRIPTION

Academic year: 2026/2027

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KTF/2-FTF-914/15	Diploma Thesis (1)

Educational activities:
Type of activities: independent work
Number of hours:
per week: 2 **per level/semester:** 26
Form of the course: on-site learning

Number of credits: 2

Recommended semester: 2.

Educational level: II.

Prerequisites:

Course requirements:
Continuous assessment: homework
Indicative scale of assessment: A 90%, B 80%, C 70%, D 60%, E 50%
Scale of assessment (preliminary/final): 100/0

Learning outcomes:
After completing the course students will actively master the material described in Class Syllabus.

Class syllabus:
Material from specialized journal literature aimed at the topic of the diploma thesis determined by the supervisor of the diploma thesis.

Recommended literature:
Ako písať vysokoškolské a kvalifikačné práce : Ako písať seminárne práce, ročníkové práce, práce študentskej vedeckej a odbornej činnosti, diplomové práce, záverečné a atestačné práce, dizertácie / Dušan Katuščák. Bratislava : Stimul, 1998

Languages necessary to complete the course:
Slovak, English

Notes:

Past grade distribution
Total number of evaluated students: 36

A	B	C	D	E	FX
100,0	0,0	0,0	0,0	0,0	0,0

Lecturers: doc. RNDr. Tomáš Blažek, PhD.

Last change: 17.03.2022

Approved by: prof. RNDr. Fedor Šimkovic, CSc.

COURSE DESCRIPTION

Academic year: 2026/2027

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KTF/2-FTF-915/22	Diploma Thesis (2)

Educational activities:
Type of activities: independent work
Number of hours:
per week: 6 **per level/semester:** 78
Form of the course: on-site learning

Number of credits: 3

Recommended semester: 3.

Educational level: II.

Prerequisites:

Course requirements:
Continuous assessment: homework
Indicative scale of assessment: A 90%, B 80%, C 70%, D 60%, E 50%
Scale of assessment (preliminary/final): 100/0

Learning outcomes:
After completing the course students will actively master the material described in Class Syllabus.

Class syllabus:
Material from specialized journal literature aimed at the topic of the diploma thesis determined by the supervisor of the diploma thesis.

Recommended literature:
Ako písať vysokoškolské a kvalifikačné práce : Ako písať seminárne práce, ročníkové práce, práce študentskej vedeckej a odbornej činnosti, diplomové práce, záverečné a atestačné práce, dizertácie / Dušan Katuščák. Bratislava : Stimul, 1998

Languages necessary to complete the course:
Slovak, English

Notes:

Past grade distribution
Total number of evaluated students: 35

A	B	C	D	E	FX
100,0	0,0	0,0	0,0	0,0	0,0

Lecturers: doc. RNDr. Tomáš Blažek, PhD.

Last change: 17.03.2022

Approved by: prof. RNDr. Fedor Šimkovic, CSc.

COURSE DESCRIPTION

Academic year: 2026/2027

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KTF/2-FTF-916/22	Diploma Thesis (3)

Educational activities:
Type of activities: independent work
Number of hours:
per week: 14 **per level/semester:** 182
Form of the course: on-site learning

Number of credits: 5

Recommended semester: 4.

Educational level: II.

Prerequisites:

Course requirements:
Continuous assessment: homework
Indicative scale of assessment: A 90%, B 80%, C 70%, D 60%, E 50%
Scale of assessment (preliminary/final): 100/0

Learning outcomes:
After completing the course students will actively master the material described in Class Syllabus.

Class syllabus:
Material from specialized journal literature aimed at the topic of the diploma thesis determined by the supervisor of the diploma thesis.

Recommended literature:
Ako písať vysokoškolské a kvalifikačné práce : Ako písať seminárne práce, ročníkové práce, práce študentskej vedeckej a odbornej činnosti, diplomové práce, záverečné a atestačné práce, dizertácie / Dušan Katuščák. Bratislava : Stimul, 1998

Languages necessary to complete the course:
Slovak, English

Notes:

Past grade distribution
Total number of evaluated students: 33

A	B	C	D	E	FX
96,97	3,03	0,0	0,0	0,0	0,0

Lecturers: doc. RNDr. Tomáš Blažek, PhD.

Last change: 17.03.2022

Approved by: prof. RNDr. Fedor Šimkovic, CSc.

STATE EXAM DESCRIPTION

Academic year: 2026/2027	
University: Comenius University Bratislava	
Faculty: Faculty of Mathematics, Physics and Informatics	
Course ID: FMFI.KTF/2-FTF-991/22	**Course title:** Diploma Thesis Defense
Number of credits: 10	
Educational level: II.	
Course requirements: Continuous assessment: the defense of the thesis has no continuous assessmen Exam: defense of the thesis in front of the Examination Board Indicative scale of assessment: A 90%, B 80%, C 70%, D 60%, E 50% Scale of assessment (preliminary/final): 0/100	
Learning outcomes: The result of the successful completing of the subject will be the defense of the thesis	
Class syllabus: Defense of the thesis in front of the Examination Board	
State exam syllabus:	
Recommended literature: Ako písať vysokoškolské a kvalifikačné práce : Ako písať seminárne práce, ročníkové práce, práce študentskej vedeckej a odbornej činnosti, diplomové práce, záverečné a atestačné práce, dizertácie / Dušan Katuščák. Bratislava : Stimul, 1998	
Languages necessary to complete the course: Slovak, English	
Last change: 21.03.2022	
Approved by: prof. RNDr. Fedor Šimkovic, CSc.	

COURSE DESCRIPTION

Academic year: 2026/2027

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KTF/2-FTF-921/10	Diploma Thesis Seminar (1)

Educational activities:
Type of activities: seminar
Number of hours:
per week: 2 **per level/semester:** 26
Form of the course: on-site learning

Number of credits: 2

Recommended semester: 3.

Educational level: II.

Prerequisites:

Course requirements:
Continuous assessment: talks at the seminar
Exam: no exam
Indicative scale of assessment: A 90%, B 80%, C 70%, D 60%, E 50%
Scale of assessment (preliminary/final): 100/0

Learning outcomes:
After completing the course students will be able to give talks on scientific topics they have learned about as well as on their own results in front of an expert auditorium.

Class syllabus:
Topics from monographs and specialized journals determined by the supervisor of the diploma thesis.

Recommended literature:
Monographs and original works from specialized journals based on the assignment of the diploma thesis.

Languages necessary to complete the course:
Slovak, English

Notes:

Past grade distribution
Total number of evaluated students: 71

A	B	C	D	E	FX
100,0	0,0	0,0	0,0	0,0	0,0

Lecturers: doc. Mgr. Samuel Kováčik, PhD., Mgr. Peter Maták, PhD., Mgr. Peter Mészáros, PhD.

Last change: 17.03.2022

Approved by: prof. RNDr. Fedor Šimkovic, CSc.

COURSE DESCRIPTION

Academic year: 2026/2027

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KTF/2-FTF-922/22	Diploma Thesis Seminar (2)

Educational activities:
Type of activities: seminar
Number of hours:
per week: 2 **per level/semester:** 26
Form of the course: on-site learning

Number of credits: 3

Recommended semester: 4.

Educational level: II.

Prerequisites:

Course requirements:
Continuous assessment: talks at the seminar
Exam: no exam
Indicative scale of assessment: A 90%, B 80%, C 70%, D 60%, E 50%
Scale of assessment (preliminary/final): 100/0

Learning outcomes:
After completing the course students will be able to give talks on scientific topics they have learned about as well as on their own results in front of an expert auditorium.

Class syllabus:
Topics from monographs and specialized journals determined by the supervisor of the diploma thesis.

Recommended literature:
Monographs and original works from specialized journals based on the assignment of the diploma thesis.

Languages necessary to complete the course:
Slovak, English

Notes:

Past grade distribution
Total number of evaluated students: 68

A	B	C	D	E	FX
98,53	0,0	1,47	0,0	0,0	0,0

Lecturers: doc. Mgr. Samuel Kováčik, PhD., Mgr. Peter Maták, PhD., Mgr. Peter Mészáros, PhD., doc. RNDr. Vladimír Balek, CSc.

Last change: 17.03.2022

Approved by: prof. RNDr. Fedor Šimkovic, CSc.

COURSE DESCRIPTION

Academic year: 2026/2027

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KEF/2-FTL-108/22	Electronic and Optical Properties of Solids

Educational activities:
Type of activities: lecture / practicals
Number of hours:
per week: 4 / 2 **per level/semester:** 52 / 26
Form of the course: on-site learning

Number of credits: 8

Recommended semester: 2.

Educational level: II.

Prerequisites:

Recommended prerequisites:
1-FYZ-452 Introduction to solid state physics

Course requirements:
homeworks + oral exam
A 90%, B 80%, C 70%, D 60%, E 50%
Scale of assessment (preliminary/final): 55/45

Learning outcomes:
The students will acquire a deeper understanding of the electronic band structure and of those experiments which provide basic information about it. They will gain a working knowledge of the method of second quantization. They will learn how the electronic properties of solids are affected by disorder, Coulomb interactions, as well as by the electron-phonon interaction. They will know what kind of information on solids can be obtained by means of various optical methods.

Class syllabus:
Semiclassical dynamics of electrons. Influence of disorder on the electronic states. Anderson localization in one-dimensional wires. Hall effect and cyclotron resonance. de Haas-van Alphen effect. Quantum Hall effect. Many-body problem and the second quantization. Coulomb gas of electrons. The Wigner, Mott, and Hubbard metal-insulator transition. Electron-phonon coupling. Dielectric function. Clausius-Mossotti formula and polarization catastrophy. Optical properties of ionic crystals. Interband transitions in insulators. Absorption due to excitons and impurity states. Luminescence and the Franck-Condon effect. Scattering of light and photoemission.

Recommended literature:
http://www.st.fmph.uniba.sk/~hlubina1/
Fundamentals of the Physics of Solids, Vols. 1-3, J. Sólyom, Springer 2007 - 2010
Fundamentals of Semiconductors, Yu P. Y. and M. Cardona, Springer, 2010
Condensed matter physics : Corrected printing / Michael P. Marder. New York : John Wiley, 2000
Kvazičástice v pevných látkách / Jan Celý. Brno : Vysoké učení technické VUTIUM, 2004

Languages necessary to complete the course:

english

Notes:

Past grade distribution
Total number of evaluated students: 47

A	B	C	D	E	FX
55,32	6,38	8,51	8,51	21,28	0,0

Lecturers: doc. RNDr. Richard Hlubina, DrSc.

Last change: 31.01.2022

Approved by: prof. RNDr. Fedor Šimkovic, CSc.

COURSE DESCRIPTION

Academic year: 2026/2027

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KAI/2-MXX-130/21	Elements of AI

Educational activities:
Type of activities: independent work
Number of hours:
per week: 25 **per level/semester:** 325
Form of the course: on-site learning

Number of credits: 2

Recommended semester: 1., 7.

Educational level: I.II., II.

Prerequisites:

Course requirements:
Passing the online course https://course.elementsofai.com/ (in Enlish or Slovak version).

Learning outcomes:
The student will get acquainted with selected basic concepts of artificial intelligence and their use in solving various practical tasks.

Class syllabus:
1. What is artificial intelligence: related areas, AI philosophy.
2. Troubleshooting and UI: Browsing and troubleshooting, browsing and games
3. Probability and chance, Bayes' theorem, naive Bayesian classification.
4. Machine learning: nearest neighbor classifier, regression.
5. Neural networks: basics, creation, modern techniques.
6. Consequences: on predicting the future, the effects of AI on society, summary.

Recommended literature:
Russell S., Norwig P. (2010). Artificial Intelligence: A Modern Approach, (3rd ed.), Prentice Hall. Available in faculty library.
Marsland S. (2015). Machine Learning: An Algorithmic Perspective, (2nd ed.), CRC Press.

Languages necessary to complete the course:
Slovak or English

Notes:
The course consists of 20 numerical and 5 text-based tasks. Numerical tasks are checked automatically, text-based tasks are evaluated anonymously by students.

Past grade distribution
Total number of evaluated students: 95

A	B	C	D	E	FX
100,0	0,0	0,0	0,0	0,0	0,0

Lecturers: doc. RNDr. Mária Markošová, PhD.

Last change: 22.08.2021
Approved by: prof. RNDr. Fedor Šimkovic, CSc.

COURSE DESCRIPTION

Academic year: 2026/2027

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KAI/2-MXX-130/21	Elements of AI

Educational activities:
Type of activities: independent work
Number of hours:
per week: 25 **per level/semester:** 325
Form of the course: on-site learning

Number of credits: 2

Recommended semester: 2., 8.

Educational level: I.II., II.

Prerequisites:

Course requirements:
Passing the online course https://course.elementsofai.com/ (in Enlish or Slovak version).

Learning outcomes:
The student will get acquainted with selected basic concepts of artificial intelligence and their use in solving various practical tasks.

Class syllabus:
1. What is artificial intelligence: related areas, AI philosophy.
2. Troubleshooting and UI: Browsing and troubleshooting, browsing and games
3. Probability and chance, Bayes' theorem, naive Bayesian classification.
4. Machine learning: nearest neighbor classifier, regression.
5. Neural networks: basics, creation, modern techniques.
6. Consequences: on predicting the future, the effects of AI on society, summary.

Recommended literature:
Russell S., Norwig P. (2010). Artificial Intelligence: A Modern Approach, (3rd ed.), Prentice Hall. Available in faculty library.
Marsland S. (2015). Machine Learning: An Algorithmic Perspective, (2nd ed.), CRC Press.

Languages necessary to complete the course:
Slovak or English

Notes:
The course consists of 20 numerical and 5 text-based tasks. Numerical tasks are checked automatically, text-based tasks are evaluated anonymously by students.

Past grade distribution
Total number of evaluated students: 95

A	B	C	D	E	FX
100,0	0,0	0,0	0,0	0,0	0,0

Lecturers: doc. RNDr. Mária Markošová, PhD., prof. Ing. Igor Farkaš, Dr., doc. RNDr. Martin Takáč, PhD.
Last change: 22.08.2021
Approved by: prof. RNDr. Fedor Šimkovic, CSc.

COURSE DESCRIPTION

Academic year: 2026/2027

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KJP/1-MXX-233/13	English Conversation Course (1)

Educational activities:
Type of activities: practicals
Number of hours:
per week: 2 **per level/semester:** 26
Form of the course: on-site learning

Number of credits: 2

Recommended semester: 1., 3., 7., 9.

Educational level: I., I.II., II.

Prerequisites:

Course requirements:
tests, presentations, essays
Course prerequisites:
https://fmph.uniba.sk/microsites/kjp/katedra-jazykovej-pripravy/poziadavky-na-udelenie-priebezneho-hodnotenia-aj1aj2aj3-ostatne-kurzy/
Scale of assessment (preliminary/final): 100/0

Learning outcomes:
Continual improvement of all language skills focused on communication/speaking, listening comprehension and writing. The emphasis is on discourse, lexicology and morphology, word-bank broadening of communicational English as well as English for specific purposes appropriate for university students. This course is a follow up of the previously taught ESP course.

Class syllabus:
This course's focus is to broaden spoken/communicational English for students with B2/C1 level of English knowledge.

Recommended literature:
Appropriate study material is supplied based on the participants'level of English by the lecturer. (Sources- The Guardian, The Herald Morning Sun. The Nine News, The West Australian, BBC News and podcasts, CNN podcasts).

Languages necessary to complete the course:

Notes:

Past grade distribution
Total number of evaluated students: 318

A	B	C	D	E	FX
77,36	8,81	4,4	1,26	0,94	7,23

Lecturers: Mgr. Aneta Barnes

Last change: 11.04.2024
Approved by: prof. RNDr. Fedor Šimkovic, CSc.

COURSE DESCRIPTION

Academic year: 2026/2027

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KJP/1-MXX-234/13	English Conversation Course (2)

Educational activities:
Type of activities: practicals
Number of hours:
per week: 2 **per level/semester:** 26
Form of the course: on-site learning

Number of credits: 2

Recommended semester: 2., 4., 8., 10.

Educational level: I., I.II., II.

Prerequisites:

Course requirements:
tests, oral presentations, essays
Course prerequisites:
https://fmph.uniba.sk/microsites/kjp/katedra-jazykovej-pripravy/poziadavky-na-udelenie-priebezneho-hodnotenia-aj1aj2aj3-ostatne-kurzy/
Scale of assessment (preliminary/final): 100/0

Learning outcomes:
Continual improvement of all language skills focused on communication/speaking, listening comprehension and writing. The emphasis is on discourse, lexicology and morphology, word-bank broadening of communicational/spoken English as well as English for specific purpose appropriate for university students. This course is a follow up of the Conversational English course 1.

Class syllabus:
This course's focus is to broaden spoken/communicational English for students with B2/C1 level of English knowledge(Upper-Intermediate/Lower Advanced).

Recommended literature:
Appropriate study material is supplied based on the participants'level of English by the lecturer. (Sources- The Guardian, The Herald Morning Sun. The Nine News, The West Australian, BBC News and podcasts, CNN podcasts).

Languages necessary to complete the course:

Notes:

Past grade distribution
Total number of evaluated students: 201

A	B	C	D	E	FX
82,09	8,96	2,49	1,0	0,0	5,47

Lecturers: Mgr. Aneta Barnes

Last change: 11.04.2024
Approved by: prof. RNDr. Fedor Šimkovic, CSc.

COURSE DESCRIPTION

Academic year: 2026/2027

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KJP/1-MXX-141/00	French Language (1)

Educational activities:
Type of activities: practicals
Number of hours:
per week: 2 **per level/semester:** 26
Form of the course: on-site learning

Number of credits: 2

Recommended semester: 1., 7.

Educational level: I., I.II., II.

Prerequisites:

Course requirements:
Scale of assessment (preliminary/final): 100/0

Learning outcomes:

Class syllabus:
French language is taught at two levels: beginner and intermediate. Students opt for one of them depending on whether they wish to obtain the fundamentals of the language or wish to maintain and/or improve previous knowledge of French.

Recommended literature:
Capelle Guy, Menand Robert: Le Nouveau taxi 1, Hachette FLE Paris, France 2009, ISBN 978-2-01-155548 - 9

Languages necessary to complete the course:

Notes:

Past grade distribution
Total number of evaluated students: 499

A	B	C	D	E	FX
48,5	19,44	16,63	7,82	2,0	5,61

Lecturers: Mgr. Ľubomíra Kožehubová

Last change: 20.06.2022

Approved by: prof. RNDr. Fedor Šimkovic, CSc.

COURSE DESCRIPTION

Academic year: 2026/2027

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KJP/1-MXX-142/00	French Language (2)

Educational activities:
Type of activities: practicals
Number of hours:
per week: 2 **per level/semester:** 26
Form of the course: on-site learning

Number of credits: 2

Recommended semester: 2., 8.

Educational level: I., I.II., II.

Prerequisites:

Course requirements:
Scale of assessment (preliminary/final): 100/0

Learning outcomes:

Class syllabus:
The subject continues the program of French language (1) and provides courses of essential and intermediate French language.

Recommended literature:
Capelle Guy, Menand Robert: Le Nouveau taxi 1, Hachette FLE Paris, France 2009, ISBN 978-2-01-155548 - 9

Languages necessary to complete the course:

Notes:

Past grade distribution
Total number of evaluated students: 307

A	B	C	D	E	FX
45,6	22,48	16,94	8,79	2,28	3,91

Lecturers: Mgr. Ľubomíra Kožehubová

Last change: 20.06.2022

Approved by: prof. RNDr. Fedor Šimkovic, CSc.

COURSE DESCRIPTION

Academic year: 2026/2027

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KJP/1-MXX-241/00	French Language (3)

Educational activities:
Type of activities: practicals
Number of hours:
per week: 2 **per level/semester:** 26
Form of the course: on-site learning

Number of credits: 2

Recommended semester: 3., 9.

Educational level: I., I.II., II.

Prerequisites:

Course requirements:
Scale of assessment (preliminary/final): 100/0

Learning outcomes:

Class syllabus:
The subject provides a course of intermediate French language, covering not only general, but also technical language.

Recommended literature:
Capelle Guy, Menand Robert: Le Nouveau taxi 1, Hachette FLE Paris, France 2009, ISBN 978-2-01-155548 - 9

Languages necessary to complete the course:

Notes:

Past grade distribution
Total number of evaluated students: 128

A	B	C	D	E	FX
48,44	24,22	17,19	5,47	0,78	3,91

Lecturers: Mgr. Ľubomíra Kožehubová

Last change: 20.06.2022

Approved by: prof. RNDr. Fedor Šimkovic, CSc.

COURSE DESCRIPTION

Academic year: 2026/2027

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KJP/1-MXX-242/00	French Language (4)

Educational activities:
Type of activities: practicals
Number of hours:
per week: 2 **per level/semester:** 26
Form of the course: on-site learning

Number of credits: 2

Recommended semester: 4., 10.

Educational level: I., I.II., II.

Prerequisites:

Course requirements:
Scale of assessment (preliminary/final): 100/0

Learning outcomes:

Class syllabus:
The subject provides a course of intermediate French covering not only general, but also technical French language.

Recommended literature:
Menand Robert: Le Nouveau taxi 2, Hachette FLE, Paris, France 2009, ISBN 978-2-01-155551 - 9

Languages necessary to complete the course:

Notes:

Past grade distribution
Total number of evaluated students: 79

A	B	C	D	E	FX
43,04	32,91	16,46	2,53	1,27	3,8

Lecturers: Mgr. Ľubomíra Kožehubová

Last change: 20.06.2022

Approved by: prof. RNDr. Fedor Šimkovic, CSc.

COURSE DESCRIPTION

Academic year: 2026/2027

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KTF/2-FTF-117/00	General Relativity

Educational activities:
Type of activities: lecture / practicals
Number of hours:
per week: 3 / 2 **per level/semester:** 39 / 26
Form of the course: on-site learning

Number of credits: 7

Recommended semester: 1.

Educational level: II.

Prerequisites:

Course requirements:
Continuous assessment: homework
Exam: exam
Indicative assessment scale: A 90%, B 80%, C 70%, D 60%, E 50%
Scale of assessment (preliminary/final): 40/60

Learning outcomes:
After completing the course, students will know how the general theory of relativity is constructed and will be acquainted with its most important applications

Class syllabus:
Description of gravity in general relativity (metric space-time tensor, equations of motion of matter in the gravitational field, Einstein's equations), applications of general relativity (post-Newtonian approximation, relativistic stars and black holes, gravitational waves, relativistic cosmological models)

Recommended literature:
Ch. W. Misner, K. S. Thorne, J. A. Wheeler: Gravitation, W. H. Freeman and Comp., San Francisco (1973), Princeton University Press (2017)
A first course in general relativity / Bernard F. Schutz. Cambridge : Cambridge University Press, 1985
Spacetime and geometry : An introduction to general relativity / Sean Carroll. San Francisco : Addison Wesley, 2004

Languages necessary to complete the course:
Slovak, English

Notes:

Past grade distribution Total number of evaluated students: 71					
A	B	C	D	E	FX
53,52	23,94	15,49	5,63	1,41	0,0
Lecturers: doc. Mgr. Samuel Kováčik, PhD., Mgr. Peter Mészáros, PhD.					
Last change: 25.02.2022					
Approved by: prof. RNDr. Fedor Šimkovic, CSc.					

COURSE DESCRIPTION

Academic year: 2026/2027

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KTF/2-FTF-130/00	Geometrical Methods in Classical Mechanics

Educational activities:
Type of activities: lecture
Number of hours:
per week: 2 **per level/semester:** 26
Form of the course: on-site learning

Number of credits: 3

Recommended semester: 2.

Educational level: II.

Prerequisites:

Course requirements:
Mid-term evaluation: submission of homework in written form
Exam: exam
Indicative assessment scale: A 90%, B 80%, C 70%, D 60%, E 50%
Scale of assessment (preliminary/final): 100/0

Learning outcomes:
After completing the course, students will be able to use modern differential geometry in the context of classical Hamiltonian and Lagranj mechanics.

Class syllabus:
Fibre bundles in general.
Tangent and cotangent bundles and differential geometry on them.
Application of this knowledge to the global description of classical mechanics.
Symmetries and conservation laws.

Recommended literature:
Diferenciálna geometria a Lieove grupy pre fyzikov / Marián Fecko. Bratislava : Iris, 2004,2008, 2018
Differential geometry and Lie groups for physicists / Marián Fecko. Cambridge : Cambridge University Press, 2006
Applicable differential geometry / M.Crampin, F.Pirani, Cambridge University Press, 1986

Languages necessary to complete the course:
Slovak, English

Notes:

Past grade distribution
Total number of evaluated students: 62

A	B	C	D	E	FX
93,55	1,61	3,23	1,61	0,0	0,0

Lecturers: doc. RNDr. Marián Fecko, PhD.
Last change: 23.02.2022
Approved by: prof. RNDr. Fedor Šimkovic, CSc.

COURSE DESCRIPTION

Academic year: 2026/2027

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KJP/1-MXX-151/00	German Language (1)

Educational activities:
Type of activities: practicals
Number of hours:
per week: 2 **per level/semester:** 26
Form of the course: on-site learning

Number of credits: 2

Recommended semester: 1., 7.

Educational level: I., I.II., II.

Prerequisites:

Course requirements:
Scale of assessment (preliminary/final): 100/0

Learning outcomes:
To master the fundamentals of the common language and basic technical terms of particular fields of study (depending on the student's level of German proficiency)

Class syllabus:
German language is taught at three levels: beginner, intermediate and advanced. Students opt for one of them depending on whether they need to learn the fundamentals or maintain and/or improve their previous knowledge.
This course's focus is to master the fundamentals of the common language and basic technical terms of particular fields of study (depending on the student's level of German proficiency)

Recommended literature:
Appropriate study material is supplied by teacher based on the participants'level of German proficiency.

Languages necessary to complete the course:

Notes:

Past grade distribution
Total number of evaluated students: 874

A	B	C	D	E	FX
38,33	24,71	18,42	8,81	2,86	6,86

Lecturers: Mgr. Alexandra Maďarová, Mgr. Simona Dobiašová, PhD.

Last change: 05.09.2025

Approved by: prof. RNDr. Fedor Šimkovic, CSc.

COURSE DESCRIPTION

Academic year: 2026/2027

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KJP/1-MXX-152/00	German Language (2)

Educational activities:
Type of activities: practicals
Number of hours:
per week: 2 **per level/semester:** 26
Form of the course: on-site learning

Number of credits: 2

Recommended semester: 2., 8.

Educational level: I., I.II., II.

Prerequisites:

Course requirements:
Scale of assessment (preliminary/final): 100/0

Learning outcomes:
To master the fundamentals of the common language and basic technical terms of particular fields of study (depending on the student's level of German proficiency)

Class syllabus:
German language is taught at two levels: beginner and intermediate. Students opt for one of them depending on whether they wish to obtain the fundamentals of the language or wish to maintain and/or improve previous knowledge of German.
This course’s focus is to to master the fundamentals of the common language and basic technical terms of particular fields of study (depending on the student's level of German proficiency)

Recommended literature:
Appropriate study material is supplied by teacher based on the participants’level of German proficiency

Languages necessary to complete the course:

Notes:

Past grade distribution
Total number of evaluated students: 542

A	B	C	D	E	FX
38,01	19,56	19,56	12,36	3,51	7,01

Lecturers: Mgr. Alexandra Maďarová, Mgr. Simona Dobiašová, PhD.

Last change: 05.09.2025

Approved by: prof. RNDr. Fedor Šimkovic, CSc.

COURSE DESCRIPTION

Academic year: 2026/2027

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KJP/1-MXX-251/00	German Language (3)

Educational activities:
Type of activities: practicals
Number of hours:
per week: 2 **per level/semester:** 26
Form of the course: on-site learning

Number of credits: 2

Recommended semester: 3., 9.

Educational level: I., I.II., II.

Prerequisites:

Course requirements:
Scale of assessment (preliminary/final): 100/0

Learning outcomes:
Master the basics of general language and basic professional terminology of individual fields of study (depending on the advanced level of students)

Class syllabus:
The course is a follow-up to the German language (1,2). The subject provides a course of intermediate or advanced German language.
This course's focus is to deepen the knowledge of the common language and basic technical terms of particular fields of study (depending on the student's level of German proficiency).

Recommended literature:
Appropriate study material is supplied by teacher based on the participants'level of German proficiency.

Languages necessary to complete the course:

Notes:

Past grade distribution
Total number of evaluated students: 191

A	B	C	D	E	FX
45,03	23,04	19,37	6,81	2,09	3,66

Lecturers: Mgr. Alexandra Maďarová, Mgr. Simona Dobiašová, PhD.

Last change: 05.09.2025

Approved by: prof. RNDr. Fedor Šimkovic, CSc.

COURSE DESCRIPTION

Academic year: 2026/2027

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KJP/1-MXX-252/00	German Language (4)

Educational activities:
Type of activities: practicals
Number of hours:
per week: 2 **per level/semester:** 26
Form of the course: on-site learning

Number of credits: 2

Recommended semester: 4., 10.

Educational level: I., I.II., II.

Prerequisites:

Course requirements:
Scale of assessment (preliminary/final): 100/0

Learning outcomes:
Master the basics of general language and basic professional terminology of individual fields of study (depending on the advanced level of students)

Class syllabus:
The course is a follow-up to the German language (1-3). It provides a course of intermediate and advanced German language.
This course's focus is to deepen the knowledge of the common language and basic technical terms of particular fields of study (depending on the student's level of German proficiency).

Recommended literature:
Appropriate study material is supplied by teacher based on the participants'level of German proficiency.

Languages necessary to complete the course:

Notes:

Past grade distribution
Total number of evaluated students: 104

A	B	C	D	E	FX
44,23	22,12	14,42	10,58	3,85	4,81

Lecturers: Mgr. Alexandra Maďarová, Mgr. Simona Dobiašová, PhD.

Last change: 05.09.2025

Approved by: prof. RNDr. Fedor Šimkovic, CSc.

COURSE DESCRIPTION

Academic year: 2026/2027

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.CENAM/2-MXX-134/26	Innovation and Entrepreneurship in Natural and Technical Sciences

Educational activities:
Type of activities: lecture / independent work
Number of hours:
per week: 2 / 1 **per level/semester:** 26 / 13
Form of the course: on-site learning

Type, volume, methods and workload of the student - additional information
2/1 (lecture / individual work)

Number of credits: 3

Recommended semester: 1., 7.

Educational level: I.II., II.

Prerequisites:

Course requirements:
The condition for admission to the exam is active participation in at least 80% of the lessons.
The final assessment consists of a presentation of the semester project. To successfully complete the course, it is necessary to achieve at least 50% of the overall score.
Scale of assessment (preliminary/final): 0/100

Learning outcomes:
After completing the course, students can describe the possibilities for commercialization of scientific and technological research. They can identify market needs, assess the market potential of a technological solution, and are familiar with the terminology of entrepreneurship, technology transfer, and intellectual property protection. They understand the overall structure of a business plan and the main forms of financing for technological projects. They are familiar with the principles of communication, teamwork, and team leadership and can apply them appropriately in project work and its presentation.

Class syllabus:
1. Commercialization of scientific research.
2. Fundamentals of entrepreneurship and startup terminology.
3. Identification of problems and customer needs analysis (design thinking).
4. Technology transfer. Technology Readiness Levels (TRL).
5. Intellectual property and its protection.
6. Market, customer, and market potential of a technological solution.
7. Business Model Canvas. Revenue models.
8. Sources of financing for technological projects.
9. Pitching and communication of the solution.
10. Fundamentals of management and leadership.
11. Innovation support and incubation structures at national and international levels.

Recommended literature:
Clark, Timothy R., et al. Business Model Generation. Wiley, 2010

Languages necessary to complete the course:
Slovak

Notes:

Past grade distribution
Total number of evaluated students: 0

A	B	C	D	E	FX
0,0	0,0	0,0	0,0	0,0	0,0

Lecturers: doc. RNDr. Tomáš Plecenik, PhD., Mgr. Veronika Hidaši Turiničová, PhD.

Last change: 13.03.2026

Approved by: prof. RNDr. Fedor Šimkovic, CSc.

COURSE DESCRIPTION

Academic year: 2026/2027

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KDMFI+KAI/2-MXX-131/21	International Team-based Research Project

Educational activities:
Type of activities: course / independent work
Number of hours:
per week: 3 **per level/semester:** 39 / 30s
Form of the course: on-site learning

Number of credits: 5

Recommended semester: 1., 7.

Educational level: I.II., II.

Prerequisites:

Course requirements:
Continuous assessment: active participation in research in an international student team (25%), presentation of work in a workshop (25%), scientific article (50%)
Indicative evaluation scale: A 90 %, B 80 %, C 70 %, D 60 %, E 50 %
Scale of assessment (preliminary/final): 100/0

Learning outcomes:
Students will learn in the team to agree on a common research topic, formulate research questions, determine research methods for the problem, collect and evaluate data, discuss their findings, present research results to the professional public, analyze and evaluate the scientific work of their colleagues, prepare a scientific article suitable for publication

Class syllabus:
- Research methodology
- Design and implementation of a research project in an international group (preferably interdisciplinary)
- Methods and tools for collaboration in virtual space, collaboration in science and practice
- Academic writing, presentation of research results through scientific articles; objectives, content and structure of scientific articles; forms of academic publication, publication forums and evaluation of their quality
- Quality assurance and feedback - peer review
- Communication of results through posters or conference presentations

Recommended literature:
- Teachers' own electronic study materials published on the course website or in the Moodle system
- Gavora, Peter a kol. 2010. Elektronická učebnica pedagogického výskumu. [online]. Bratislava : Univerzita Komenského, 2010. Dostupné na: http://www.e-metodologia.fedu.uniba.sk/ ISBN 978–80–223–2951–4.

- Tharenou, P., Donohue, R. and Cooper, B., 2007. Management research methods. Cambridge University Press.
- Topping, A., 2015: The Quantitative-Qualitative Continium. In: Gerrish, K. and Lathlean, J., The Research Process in Nursing, p. 159-172
- Williamson, K. and Johanson, G. eds., 2017. Research methods: Information, systems, and contexts. Chandos Publishing.

Languages necessary to complete the course:
English

Notes:

Past grade distribution
Total number of evaluated students: 10

A	B	C	D	E	FX
70,0	0,0	0,0	0,0	30,0	0,0

Lecturers: prof. RNDr. Zuzana Kubincová, PhD., doc. RNDr. Martin Homola, PhD.

Last change: 22.06.2022

Approved by: prof. RNDr. Fedor Šimkovic, CSc.

COURSE DESCRIPTION

Academic year: 2026/2027

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KTF/2-FTF-135/10	Introduction to Elementary Particle Physics

Educational activities:
Type of activities: lecture
Number of hours:
per week: 3 **per level/semester:** 39
Form of the course: on-site learning

Number of credits: 5

Recommended semester: 1.

Educational level: II.

Prerequisites:

Course requirements:
Scale of assessment (preliminary/final): 20/80

Learning outcomes:
By completing the course, the student will understand how we classify elementary particles on the basis of experiment, and learn their categorization by symmetries. The student will also understand at the appropriate introductory level the basics of the standard model and the roles played in it by the gauge symmetries and spontaneous electroweak symmetry breaking.

Class syllabus:
Introduction to elementary particles, quantum numbers (additive and multiplicative), leptons, hadrons, mesons, baryons. SU (2) and isospin, SU (3) and flavor, SU (3) and color. Forming higher irreducible representations of both groups. Feynman diagrams and perturbation theory - philosophy. Fermions and Dirac equation, fermion - fermion interactions in quantum electrodynamics: estimates of amplitude, cross section and decay width using Feynman diagrams. Mandelstam variables. Quantum chromodynamics, asymptotic freedom and confinement of quarks. Standard model and gauge symmetry of its Lagragian. Spontaneous breaking of electroweak gauge symmetry. Higgs boson and particle masses.

Recommended literature:
F.Halzen, A.D.Martin: Quarks and Leptons. Wiley, 1984
M. Peskin, D.V. Schroeder: An Introduction to Quantum Field Theory, Westview Press, 1995
J.F.Donoghue, E.Golowicz, B.Holstein: Dynamics of the Standard Model, CUP, 2ed, 2014
S.Raby, Introduction to the Standard Model and Beyond, Cambridge University Press, 2021

Languages necessary to complete the course:
Slovak, English

Notes:

Past grade distribution
Total number of evaluated students: 35

A	B	C	D	E	FX
97,14	2,86	0,0	0,0	0,0	0,0

Lecturers: doc. RNDr. Tomáš Blažek, PhD., Mgr. Zuzana Kučerová, PhD.

Last change: 25.02.2022

Approved by: prof. RNDr. Fedor Šimkovic, CSc.

COURSE DESCRIPTION

Academic year: 2026/2027

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KTF/2-FTF-128/24	Introduction to String Theory

Educational activities:
Type of activities: lecture / practicals
Number of hours:
per week: 2 / 1 **per level/semester:** 26 / 13
Form of the course: on-site learning

Number of credits: 4

Recommended semester: 2.

Educational level: II.

Prerequisites:

Course requirements:
Exam: final work
Indicative assessment scale: A 90%, B 80%, C 70%, D 60%, E 50%
Scale of assessment (preliminary/final): 100/0

Learning outcomes:
After completing the course, the students will have an idea of the theory in which the smallest building blocks of matter are considered to be linear objects - strings.

Class syllabus:
- free bosonic string - action, equations of motion, constraints
- light-cone gauge
- mass spectrum of the string and the constraint on the number of dimensions

Recommended literature:
B. Zwiebach: A First Course in String Theory, Cambridge University Press, Cambridge (2004)
M. B. Green, J. H. Schwartz, E. Witten: Superstring Theory, vol. 1, Cambridge University Press, Cambridge (2012)

Languages necessary to complete the course:
Slovak, English

Notes:

Past grade distribution
Total number of evaluated students: 1

A	B	C	D	E	FX
100,0	0,0	0,0	0,0	0,0	0,0

Lecturers: doc. Mgr. Juraj Tekel, PhD.

Last change: 24.05.2024

Approved by: prof. RNDr. Fedor Šimkovic, CSc.

COURSE DESCRIPTION

Academic year: 2026/2027

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KEF/2-FTL-203/22	Magnetic Properties of Solids and Superconductivity

Educational activities:
Type of activities: lecture / practicals
Number of hours:
per week: 4 / 2 **per level/semester:** 52 / 26
Form of the course: on-site learning

Number of credits: 8

Recommended semester: 3.

Educational level: II.

Prerequisites:

Course requirements:
Continuous: Homework, 20%
Final: Project, 80%
The course will be classified provided that the student proves the fulfilment of obligations at the level of at least 51 %. The conditions for successful completion of the course are in accordance with the Study Regulations of the Faculty of Mathematics, Physics and Informatics.
Scale of assessment (preliminary/final): 20/80

Learning outcomes:
Students acquire essential knowledge of the theory of magnetic phenomena and superconductivity, and their applications as well.

Class syllabus:
Phase transitions in solids. Electronic structure of atoms. Diamagnetism and paramagnetism. Ferromagnetism and other types of magnetic ordering. Properties of hard magnetics. Magnetic resonances. Basics of spintronics. Phenomenological theories of superconductivity. Microscopic theory of superconductivity. Type II superconductivity. Josephson phenomena. Applications of magnetism and superconductivity.

Recommended literature:
Magnetizačné procesy / Vladimír Hajko, Ladislav Potocký, Anton Zentko. Bratislava : Alfa, 1982
Solid state physics / Neil W. Ashcroft, N. David Mermin. Fort Worth : Harcourt Brace, 1976
Supravodivosť / Pavol Valko. Zlín : Kniha Zlín, 2011
Introduction to superconductivity / Michael Tinkham, Gordon McKay. Mineola : Dover, 2004

Languages necessary to complete the course:
Slovak in combination with English (suggested readings in English)

Notes:

Past grade distribution Total number of evaluated students: 41					
A	B	C	D	E	FX
65,85	4,88	7,32	9,76	12,2	0,0
Lecturers: doc. RNDr. Michal Maheľ, CSc.					
Last change: 09.02.2022					
Approved by: prof. RNDr. Fedor Šimkovic, CSc.					

COURSE DESCRIPTION

Academic year: 2026/2027

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KEF/2-FTL-205/22	Many-body Physics

Educational activities:
Type of activities: lecture / practicals
Number of hours:
per week: 4 / 2 **per level/semester:** 52 / 26
Form of the course: on-site learning

Number of credits: 8

Recommended semester: 3.

Educational level: II.

Prerequisites: FMFI.KEF/2-FTL-108/22 - Electronic and Optical Properties of Solids

Recommended prerequisites:
2-FTL-107 Structure and mechanical properties of solids

Course requirements:
homeworks and oral exam: A 90%, B 80%, C 70%, D 60%, E 50%
Scale of assessment (preliminary/final): 55/45

Learning outcomes:
The students will be acquainted with the notions of effective model and renormalization group. They will have a deeper understanding of the notions of the physical vacuum and elementary excitation. They will also understand how spontaneous symmetry breaking and its defects determine physical properties of condensed matter. They will gain basic information about the role of topology in modern condensed matter physics.

Class syllabus:
Effective models. Symmetries and conservation laws. Heisenberg model: exact results, spontaneous symmetry breaking. Goldstone modes. Generalized rigidity. XY model and the quantum spin liquid. Kosterlitz-Thouless transition. Superfluid helium: basic experimental facts, Josephson equations, Bogoliubov theory. Superconductivity: basic experimental facts, effective model, Cooper instability and renormalization group. BCS theory. Thermodynamics and spectroscopy of superconductors. Topological defects. Topological insulators.

Recommended literature:
http://www.st.fmph.uniba.sk/~hlubina1/
Statistical mechanics : Entropy, order parameters, and complexity / James P. Sethna. Oxford University Press, 2006
Condensed matter physics : Corrected printing / Michael P. Marder. John Wiley, 2000
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: 19					
A	B	C	D	E	FX
68,42	10,53	15,79	0,0	5,26	0,0
Lecturers: doc. RNDr. Richard Hlubina, DrSc.					
Last change: 31.01.2022					
Approved by: prof. RNDr. Fedor Šimkovic, CSc.					

COURSE DESCRIPTION

Academic year: 2026/2027

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KTF/2-FTF-112/15	Mathematical Physics (2)

Educational activities:
Type of activities: lecture / practicals
Number of hours:
per week: 4 / 2 **per level/semester:** 52 / 26
Form of the course: on-site learning

Number of credits: 8

Recommended semester: 1.

Educational level: II.

Prerequisites:

Antirequisites: FMFI.KTFDF/2-FTF-112/00

Course requirements:
Continuous assessment: referring homework for exercises
Exam: exam
Indicative assessment scale: A 90%, B 80%, C 70%, D 60%, E 50%
Scale of assessment (preliminary/final): 20/80

Learning outcomes:
After completing the course, students will be able to use modern differential geometry in the context of contemporary theoretical physics.

Class syllabus:
English
Apparatus of differential forms.
Symplectic geometry and Hamiltonian dynamics.
Linear connection - parallel translation, covariant derivatives.
Field theory and form theory.

Recommended literature:
Differential geometry and Lie groups for physicists / Marián Fecko. Cambridge : Cambridge University Press, 2006
Crampin, Pirani: Applicable differential geometry, CUP 1986

Languages necessary to complete the course:
Slovak, English

Notes:

Past grade distribution
Total number of evaluated students: 43

A	B	C	D	E	FX
90,7	6,98	0,0	0,0	2,33	0,0

Lecturers: doc. RNDr. Marián Fecko, PhD.
Last change: 25.02.2022
Approved by: prof. RNDr. Fedor Šimkovic, CSc.

COURSE DESCRIPTION

Academic year: 2026/2027

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KTF/2-FTF-233/18	Matrix Models in Theoretical Physics

Educational activities:
Type of activities: lecture
Number of hours:
per week: 2 **per level/semester:** 26
Form of the course: on-site learning

Number of credits: 3

Recommended semester: 4.

Educational level: II.

Prerequisites:

Course requirements:
Mid-term evaluation: homework assignments
Scale of assessment (preliminary/final): 100/0

Learning outcomes:
By completing the course, students will acquire basic skills and tools in working with matrix models and get acquainted with modern applications of these methods in various areas of theoretical physics.

Class syllabus:
Random matrix sets, saddle point method, orthogonal polynomials, 1 / N development in calibration theories, 2D gravity and random surfaces, M-theory and non-perturbative formulations of string theory, noncommutative field theories, numerical methods in matrix models.

Recommended literature:
Freely accessible electronic materials:
Random matrices / Eynard, Kimura, Ribault; arxiv:1510.04430 [math-ph].
Phase structure of fuzzy field theories and multitrace matrix models / Tekel; arXiv:1512.00689 [hep-th].
2D Gravity and Random Matrices / Di Francesco, Ginsparg, Zinn-Justin; Phys.Rept. 254 (1995) 1-133.

Languages necessary to complete the course:
Slovak, English

Notes:

Past grade distribution
Total number of evaluated students: 8

A	B	C	D	E	FX
87,5	12,5	0,0	0,0	0,0	0,0

Lecturers: doc. Mgr. Juraj Tekel, PhD.

Last change: 25.02.2022
Approved by: prof. RNDr. Fedor Šimkovic, CSc.

COURSE DESCRIPTION

Academic year: 2026/2027

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KEF/2-FTL-224/22	Mesoscopic Physics and Quantum Electronics

Educational activities:
Type of activities: lecture / practicals
Number of hours:
per week: 4 / 1 **per level/semester:** 52 / 13
Form of the course: on-site learning

Number of credits: 7

Recommended semester: 3.

Educational level: II.

Prerequisites:

Course requirements:
written test during the course – weight 30 %,
written and oral exam – weight 70 %.
Evaluation A – at least 90 %, B – at least 80 %, C – at least 70 %, D – at least 60 %, E – at least 50 %.
Scale of assessment (preliminary/final): 30/70

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 systems. He/she will be able to understand physical principles of nanoelectronics devices at the edge of miniaturization.

Class syllabus:
Definition of mesoscopic system. Two-terminal conductance of disordered mesoscopic system – Landauer formula. Fundamental quantization of ballistic conductance. Coherent conductance of disordered one-dimensional wire – strong localization, giant conductance fluctuations, conductance distribution. Weak localization and universal conductance fluctuations. Multiterminal conductance of disordered mesoscopic system – Büttiker equations, effect of measurement on the measured coherent conductance. Quantum Hall effect. Mesoscopic ring connected to leads, electronic Bohm-Aharonov effect and parallel connection of quantum resistors in the scattering matrix formalism. Single-electron tunneling through a weak link and through a series of weak links, Coulomb blockade, single-electron transistor.

Recommended literature:
S. Datta, Electronic Transport in Mesoscopic Systems (Cambridge University Press, Cambridge, UK, 1995)
Y. Imry, Introduction to Mesoscopic Physics (Oxford University Press, Oxford, UK, 2002)
M. Moško a A. Mošková , Introduction into mesoscopic physics (in Slovak language), 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: 27

A	B	C	D	E	FX
59,26	22,22	14,81	0,0	3,7	0,0

Lecturers: doc. RNDr. Martin Moško, DrSc.

Last change: 01.02.2022

Approved by: prof. RNDr. Fedor Šimkovic, CSc.

COURSE DESCRIPTION

Academic year: 2026/2027

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KTF/2-FTF-132/10	Methods in Computer Physics

Educational activities:
Type of activities: lecture
Number of hours:
per week: 3 **per level/semester:** 39
Form of the course: on-site learning

Number of credits: 5

Recommended semester: 1.

Educational level: II.

Prerequisites:

Course requirements:
Continuous assessment: numerical solution of assigned homework problems
Exam: written
Indicative assessment scale: A 90%, B 80%, C 70%, D 60%, E 50%
Scale of assessment (preliminary/final): 100/0

Learning outcomes:
Students are able to create programs for numerical solution of selected physical problems.

Class syllabus:
Representation of numbers in the computer, errors in numerical computations, solving nonlinear equations, solving systems of linear equations, iterative methods, finding eigenvalues of matrices, approximation and interpolation of functions, Chebyshev polynomials, cubic spline, least squares method

Recommended literature:
R.W.Hamming: Numerical methods for scientists and engineers, 1987;
W.H.Press, S.A.Teukolsky, W.T.Weterling, B.P.Flannery: Numerical recipes 3.ed., 2007;
A.Ralston, P.Rabinowitz: A first course in numerical analysis, 2001;

Languages necessary to complete the course:
Slovak or English

Notes:

Past grade distribution
Total number of evaluated students: 34

A	B	C	D	E	FX
88,24	5,88	2,94	0,0	0,0	2,94

Lecturers: RNDr. Eduard Masár, PhD.

Last change: 25.02.2022

Approved by: prof. RNDr. Fedor Šimkovic, CSc.

COURSE DESCRIPTION

Academic year: 2026/2027

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KTF/2-FTF-121/00	Methods of Functional Integral in Physics

Educational activities:
Type of activities: lecture
Number of hours:
per week: 2 **per level/semester:** 26
Form of the course: on-site learning

Number of credits: 3

Recommended semester: 1.

Educational level: II.

Prerequisites:

Course requirements:
Continuous assessment: solving tasks
Exam: exam
Indicative assessment scale: A 90%, B 80%, C 70%, D 60%, E 50%
Scale of assessment (preliminary/final): 100/0

Learning outcomes:
After completing the course, students will be able to use the functional integral as a unifying mathematical method in classical stochastic processes, quantum field theory and quantum statistics.

Class syllabus:
Functional integral in stochastic processes, quantum mechanics, quantum field theories with bosons and fermions and in quantum statistics.

Recommended literature:
M. Chaichian, P. Demichev, Path integrals in physics (Inst. of Physics, Bristol, 2002)
L:D: Faddeev, A.A. Slavnov, Introduction to quantum theory of gauge fields (Benjamin-Cummings, Reading, Mass. 1980)
V. N. Popov, Functional integrals in quantum field theory and statistical Physics (Gordon and Breach, Amsterdam, (1988)

Languages necessary to complete the course:
Slovak, English

Notes:

Past grade distribution
Total number of evaluated students: 75

A	B	C	D	E	FX
86,67	10,67	1,33	0,0	0,0	1,33

Lecturers: Mgr. Peter Mészáros, PhD.

Last change: 25.02.2022
Approved by: prof. RNDr. Fedor Šimkovic, CSc.

COURSE DESCRIPTION

Academic year: 2026/2027

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KJFB/2-FJF-125/00	Modelling Experimental Set-Ups

Educational activities:
Type of activities: lecture
Number of hours:
per week: 2 **per level/semester:** 26
Form of the course: on-site learning

Number of credits: 3

Recommended semester: 2.

Educational level: II.

Prerequisites:

Course requirements:
Interim evaluation: homeworks
Exam: oral
Indicative evaluation scale: A 90%, B 80%, C 70%, D 60%, E 50%
Scale of assessment (preliminary/final): 50/50

Learning outcomes:
Students will understand how to model random variables in general, and how to apply the general principles to the task of simulating interaction of particles with material. They will gain basic understanding of probability theory, estimators and hypothesis testing. They will learn how to use machine learning models to solve classification problems in physics and how to use unfolding to estimate true distributions from observations smeared by experimental measurement.

Class syllabus:
1. Introduction to C++ and ROOT software.
2. Introduction to probability theory and statistics. Uncertainty propagation, Central Limit Theorem.
3. Random distributions occuring in physics, computer-based random number generation.
4. Estimators, statistical tests, estimation of confidence intervals.
5. Stochastic processes and Markov chains.
6. Modelling of particle interaction with material and the transport equation.
7. Introduction to Bayesian statistics and Fisher discriminant.
8. p-value and statistical significance of a measurement.
9. Machine learning and its application for signal/background classification in physics.
10. Deconvolution (unfolding). Issues with a naive approach to unfolding. Parametrized unfolding approach.
11. Hypothesis testing. Quantification of agreement of data and a model. Chi-square and likelihood approaches.
12. Maximum likelihood fit and uncertainties estimation.

Recommended literature:

Data Analysis in High Energy Physics: A Practical Guide to Statistical Methods, Olaf Behnke, Kevin Kröninger, Grégory Schott, and Thomas Schörner-Sadenius, 2013
Statistics, a guide to the use of statistical methods in the physical sciences, R. J. Barlow, John Wiley and Sons, 1989
Introduction to Statistics and Data Analysis for Physicists, Gerhard Bohm, Günter Zech, 2010

Languages necessary to complete the course:
Slovak, English

Notes:

Past grade distribution
Total number of evaluated students: 40

A	B	C	D	E	FX
87,5	5,0	5,0	0,0	0,0	2,5

Lecturers: prof. RNDr. Stanislav Tokár, DrSc., Mgr. Michal Dubovský, PhD.

Last change: 22.06.2022

Approved by: prof. RNDr. Fedor Šimkovic, CSc.

COURSE DESCRIPTION

Academic year: 2026/2027

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KJFB/2-FJF-153/22	Neutrino Physics

Educational activities:
Type of activities: lecture
Number of hours:
per week: 2 **per level/semester:** 26
Form of the course: on-site learning

Number of credits: 3

Recommended semester: 3.

Educational level: II.

Prerequisites:

Recommended prerequisites:
quantum mechanics, quantum field theory

Course requirements:
preliminary evaluation: -; final evaluation: test plus oral exam
The scale of assessment (preliminary/final): 0/100

Learning outcomes:
By addressing the urgent tasks of neutrino physics, students will gain the knowledge and understanding of the evolution of the Universe, processes in stars, nuclear reactors, Earth's atmosphere, and core, as well as about the formulation of the Grand Unified Theories.

Class syllabus:
1. Brief History of the Neutrino
2. Neutrino within the Standard Model, Neutrino Interactions
3. Neutrino Scattering Theory
4. Natural Neutrino Sources (Sun, Atmosphere, Earth, Cosmic Accelerators, Supernova)
5. Artificial Neutrino Sources (Accelerators, Reactors)
6. Physics Beyond the SM: Neutrino Masses and Mixing, See-Saw Mechanism
7. Neutrino Oscillations in Vaccum
8. Neutrino Oscillations in Matter (MSW)
9. Solar, atmpheric, accelerator and reactor neutrino oscillations
10. Laboratory Experiments to directly measure Neutrino Mass
11. Lepton Flavor/Number Non-conservation, Neutrinoless Double Beta Decay
12. Neutrino Cosmology, Relic Neutrinos
13. Sterile Neutrinos

Recommended literature:
Zhi-Zhong Xing and Shun Zhuo: Neutrinos in Particle Physics, Astronomy and Cosmology, Springer, 2010
Samoil Bilenky: Introduction to the Physics of Massive and Mixed Neutrinos, Springer, 2010

Frank F. Deppisch: A modern Introduction to Neutrino Physics, Morgan & Claypool Publishers, 2019

Languages necessary to complete the course:

Notes:

Past grade distribution
Total number of evaluated students: 14

A	B	C	D	E	FX
64,29	35,71	0,0	0,0	0,0	0,0

Lecturers: prof. RNDr. Fedor Šimkovic, CSc., Mgr. Eliška Eckerová, PhD., Mgr. Zuzana Beňušová, PhD.

Last change: 28.02.2022

Approved by: prof. RNDr. Fedor Šimkovic, CSc.

COURSE DESCRIPTION

Academic year: 2026/2027

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KAI/2-MXX-132/23	Participation in Empirical Research

Educational activities:
Type of activities: course
Number of hours:
per week: 2 **per level/semester:** 26
Form of the course: on-site learning

Number of credits: 2

Recommended semester: 1., 7.

Educational level: I., I.II., II.

Prerequisites:

Course requirements:

Learning outcomes:

Class syllabus:

Recommended literature:

Languages necessary to complete the course:

Notes:

Past grade distribution
Total number of evaluated students: 202

A	B	C	D	E	FX
89,6	1,49	1,49	0,0	2,97	4,46

Lecturers: Mgr. Xenia Daniela Poslon, PhD.

Last change: 06.09.2023

Approved by: prof. RNDr. Fedor Šimkovic, CSc.

COURSE DESCRIPTION

Academic year: 2026/2027

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KAI/2-MXX-132/23	Participation in Empirical Research

Educational activities:
Type of activities: course
Number of hours:
per week: 2 **per level/semester:** 26
Form of the course: on-site learning

Number of credits: 2

Recommended semester: 2., 8.

Educational level: I., I.II., II.

Prerequisites:

Course requirements:

Learning outcomes:

Class syllabus:

Recommended literature:

Languages necessary to complete the course:

Notes:

Past grade distribution
Total number of evaluated students: 202

A	B	C	D	E	FX
89,6	1,49	1,49	0,0	2,97	4,46

Lecturers: Mgr. Xenia Daniela Poslon, PhD.

Last change: 06.09.2023

Approved by: prof. RNDr. Fedor Šimkovic, CSc.

COURSE DESCRIPTION

Academic year: 2026/2027

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KJFB/2-FJF-132/00	Particle Accelerators

Educational activities:
Type of activities: lecture
Number of hours:
per week: 2 **per level/semester:** 26
Form of the course: on-site learning

Number of credits: 3

Recommended semester: 1.

Educational level: II.

Prerequisites:

Course requirements:
Examination: written test / oral examination, 70/30
Indicative assessment scale: A 90%, B 80%, C 70%, D 60%, E 50%

Learning outcomes:
The course will cover the physics of particle accelerators. It will introduce the techniques used in particle accelerators, and describe the layout and functionality of modern accelerators and acceleration systems.

Class syllabus:
1. Linear accelerators – electrostatic, Linear resonant accelerators
2. Linear accelerators of relativistic particles, Resonators
3. Accelerators with running and standing wave, Principe of self-phasing
4. Cyclic accelerators – Cyclotron, Phazotron
5. Relativistic isochronic cyclotron, Microtron, Betatron
6. Stationary trajectory of accelerator
7. Synchrotron, Synchrophazotron
8. Weak and Strong focusation
9. Equation of motion for particle in acceleration
10. Compactness of beam momentum, Criterion of stability
11. Fix target accelerators
12. Quality and cooling of beam

Recommended literature:
E. Wilson, An Introduction to Particle Accelerators, Oxford Univ. Press, 2001, s. 252
K. Wille, The Physics of Particle Accelerators : An Introduction, Oxford University Press, 2001, s. 330
S. Bernal, A Practical Introduction to Beam Physics and Particle Accelerators, Morgan & Claypool Publishers, 2016,

Languages necessary to complete the course:
slovak, english

Notes:

Past grade distribution
Total number of evaluated students: 91

A	B	C	D	E	FX
53,85	28,57	16,48	0,0	0,0	1,1

Lecturers: doc. Mgr. Michal Mereš, PhD., doc. Mgr. Pavol Bartoš, PhD.

Last change: 20.06.2022

Approved by: prof. RNDr. Fedor Šimkovic, CSc.

COURSE DESCRIPTION

Academic year: 2026/2027

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KTV/2-MXX-110/00	Physical Education and Sport (1)

Educational activities:
Type of activities: practicals
Number of hours:
per week: 2 **per level/semester:** 26
Form of the course: on-site learning

Number of credits: 2

Recommended semester: 1., 7.

Educational level: I.II., II.

Prerequisites:

Course requirements:
Scale of assessment (preliminary/final): 100/0

Learning outcomes:

Class syllabus:
Practicing of the students´ game skills in collective sports: basketball, volleyball, football, floorball and hockey. Mastering of the basic technique of a particular sport discipline in other sports. In paddling, basic training on still and slightly flowing water. Development of coordination skills, improvement of articular mobility and cardiovascular system.

Recommended literature:

Languages necessary to complete the course:
Slovak, English

Notes:

Past grade distribution
Total number of evaluated students: 2007

A	B	C	D	E	FX
97,41	0,6	0,1	0,0	0,0	1,89

Lecturers: PaedDr. Dana Mašlejová, Mgr. Ladislav Mókus, Mgr. Jana Leginusová, Mgr. Tomáš Kuchár, PhD., PaedDr. Mikuláš Ortutay, Mgr. Martin Dovičák, PhD., Mgr. Júlia Raábová, PhD., Mgr. Branislav Nedbálek, PhD., Mgr. Tomáš Lovecký, Mgr. Martina Maheľová, PaedDr. Lucia Ondrušová

Last change: 15.03.2022

Approved by: prof. RNDr. Fedor Šimkovic, CSc.

COURSE DESCRIPTION

Academic year: 2026/2027

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KTV/2-MXX-120/00	Physical Education and Sport (2)

Educational activities:
Type of activities: practicals
Number of hours:
per week: 2 **per level/semester:** 26
Form of the course: on-site learning

Number of credits: 2

Recommended semester: 2., 8.

Educational level: I.II., II.

Prerequisites:

Course requirements:
Scale of assessment (preliminary/final): 100/0

Learning outcomes:

Class syllabus:
Practicing of offensive and defensive game combinations and playing with modified rules in collective sports such as basketball, volleyball, football, floorball, hockey. Command of elements of higher difficulty in locomotion skills (swimming - crawl stroke, breast stroke, butterfly stroke, trampoline jumping and aerobics – practicing of areobics compositions, bodybuilding – development of the main muscle groups, paddling on running water. Testing of the level of physical fitness and coordination skills.

Recommended literature:

Languages necessary to complete the course:
Slovak, English

Notes:

Past grade distribution
Total number of evaluated students: 1797

A	B	C	D	E	FX
98,44	0,33	0,06	0,06	0,06	1,06

Lecturers: Mgr. Martin Dovičák, PhD., Mgr. Tomáš Kuchár, PhD., Mgr. Jana Leginusová, PaedDr. Dana Mašlejová, Mgr. Ladislav Mókus, Mgr. Branislav Nedbálek, PhD., PaedDr. Mikuláš Ortutay, Mgr. Júlia Raábová, PhD., Mgr. Tomáš Lovecký, Mgr. Martina Maheľová, PaedDr. Lucia Ondrušová

Last change: 15.03.2022

Approved by: prof. RNDr. Fedor Šimkovic, CSc.

COURSE DESCRIPTION

Academic year: 2026/2027

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KTV/2-MXX-210/00	Physical Education and Sport (3)

Educational activities:
Type of activities: practicals
Number of hours:
per week: 2 **per level/semester:** 26
Form of the course: on-site learning

Number of credits: 2

Recommended semester: 3., 9.

Educational level: I.II., II.

Prerequisites:

Course requirements:
Scale of assessment (preliminary/final): 100/0

Learning outcomes:

Class syllabus:
To improve offensive and defensive game combinations in collective sports. Practicing of tactical and technical elements in individual sports. Compensatory exercises to correct wrong body posture. Stretching. Competition rules in sport disciplines.

Recommended literature:

Languages necessary to complete the course:
Slovak, English

Notes:

Past grade distribution
Total number of evaluated students: 1525

A	B	C	D	E	FX
98,36	0,39	0,07	0,0	0,07	1,11

Lecturers: PaedDr. Dana Mašlejová, Mgr. Ladislav Mókus, Mgr. Jana Leginusová, Mgr. Tomáš Kuchár, PhD., PaedDr. Mikuláš Ortutay, Mgr. Martin Dovičák, PhD., Mgr. Júlia Raábová, PhD., Mgr. Branislav Nedbálek, PhD., Mgr. Tomáš Lovecký, Mgr. Martina Maheľová, PaedDr. Lucia Ondrušová

Last change: 15.03.2022

Approved by: prof. RNDr. Fedor Šimkovic, CSc.

COURSE DESCRIPTION

Academic year: 2026/2027

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KTV/2-MXX-220/00	Physical Education and Sport (4)

Educational activities:
Type of activities: practicals
Number of hours:
per week: 2 **per level/semester:** 26
Form of the course: on-site learning

Number of credits: 2

Recommended semester: 4., 10.

Educational level: I.II., II.

Prerequisites:

Course requirements:
Scale of assessment (preliminary/final): 100/0

Learning outcomes:

Class syllabus:
Sport training for Faculty Championships in a selected sport with modified rules. Selection of sport-talented students into teams of the Faculty Sport League, University League of Bratislava Faculties, and participation in sport events of the Faculty and University.

Recommended literature:

Languages necessary to complete the course:
Slovak, English

Notes:

Past grade distribution
Total number of evaluated students: 1267

A	B	C	D	E	FX
98,34	0,39	0,08	0,08	0,08	1,03

Lecturers: PaedDr. Dana Mašlejová, Mgr. Ladislav Mókus, Mgr. Jana Leginusová, Mgr. Tomáš Kuchár, PhD., PaedDr. Mikuláš Ortutay, Mgr. Martin Dovičák, PhD., Mgr. Branislav Nedbálek, PhD., Mgr. Júlia Raábová, PhD., Mgr. Tomáš Lovecký, Mgr. Martina Maheľová, PaedDr. Lucia Ondrušová

Last change: 15.03.2022

Approved by: prof. RNDr. Fedor Šimkovic, CSc.

COURSE DESCRIPTION

Academic year: 2026/2027

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KTF/2-FTF-224/10	Physics Beyond the Standard Model

Educational activities:
Type of activities: lecture
Number of hours:
per week: 3 **per level/semester:** 39
Form of the course: on-site learning

Number of credits: 5

Recommended semester: 3.

Educational level: II.

Prerequisites:

Recommended prerequisites:
2-FTF-116/00 Kvantová elektrodynamika
(Quantum Electrodynamics Course)

Course requirements:
Continuous assessment: continuous test
Indicative assessment scale: A 70%, B 60%, C 50%, D 40%, E 33%
Scale of assessment (preliminary/final): 100/0

Learning outcomes:
After completing the course, students will be able to explain trends in contemporary high energy physics and offer an understanding of modern topics in particle physics.

Class syllabus:
Standard model as an effective theory
Lessons from the standard model
Introduction to supersymmetry
Superfield formalism
Minimal supersymmetric standard model

Recommended literature:
Stephen Martin: Supersymmetry Primer, version 7, lecture notes freely available on the Internet, e.g., https://www.niu.edu/spmartin/primer/
S.Raby: Introduction to the Standard Model and Beyond, Cambridge University Press, 2021

Languages necessary to complete the course:
Slovak, English

Notes:

Past grade distribution
Total number of evaluated students: 31

A	B	C	D	E	FX
100,0	0,0	0,0	0,0	0,0	0,0

Lecturers: doc. RNDr. Tomáš Blažek, PhD.

Last change: 08.03.2022

Approved by: prof. RNDr. Fedor Šimkovic, CSc.

COURSE DESCRIPTION

Academic year: 2026/2027

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KTF/2-FTF-116/00	Quantum Electrodynamics

Educational activities:
Type of activities: lecture / practicals
Number of hours:
per week: 4 / 2 **per level/semester:** 52 / 26
Form of the course: on-site learning

Number of credits: 8

Recommended semester: 2.

Educational level: II.

Prerequisites:

Recommended prerequisites:
2-FTF-113/00 Kvantová teória poľa
(Quantum Field Theory Course)

Course requirements:
Continuous assessment: solving problems
Exam: exam
Indicative assessment scale: A 70%, B 60%, C 50%, D 40%, E 33%
Scale of assessment (preliminary/final): 40/60

Learning outcomes:
After completing the course, students will be able to actively use the material listed in the Brief syllabus of the course.

Class syllabus:
- theory of free electron-positron and electromagnetic fields
- quantum theory of electromagnetic interactions
- Feynman diagrams in QED
- electron-positron anihilation to muons and Compton scattering

Recommended literature:
V. B. Beresteckii, E. M. Lifshitz, L. P. Pitajevskii: Kvantovaia elektrodinamika, Nauka, Moskva (1980) [English translation: Oxford, Pergamon Press (1982)]
J. Formánek: Kvantová teorie I, II, III, UK, Praha (1986)
An introduction to quantum field theory / Michael E. Peskin, Daniel V. Schroeder. Boulder : Westview Press, 1995
The quantum theory of fields : Volume 1 : Foundations / Steven Weinberg. Cambridge : Cambridge University Press, 2005
Lectures on Quantum Field Theory / Ashok Das, 2ed, World Scientific, 2021

Languages necessary to complete the course:
Slovak, English

Notes:

Past grade distribution
Total number of evaluated students: 82

A	B	C	D	E	FX
87,8	9,76	1,22	0,0	1,22	0,0

Lecturers: doc. RNDr. Tomáš Blažek, PhD.

Last change: 08.03.2022

Approved by: prof. RNDr. Fedor Šimkovic, CSc.

COURSE DESCRIPTION

Academic year: 2026/2027

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KTF/2-FTF-113/00	Quantum Field Theory

Educational activities:
Type of activities: lecture / practicals
Number of hours:
per week: 4 / 2 **per level/semester:** 52 / 26
Form of the course: on-site learning

Number of credits: 8

Recommended semester: 1.

Educational level: II.

Prerequisites:

Course requirements:
Examination: written, with possible oral part
Indicative assessment scale: A 90%, B 80%, C 70%, D 60%, E 50%
Scale of assessment (preliminary/final): 0/100

Learning outcomes:
After completing this course, students should 1. understand the basic principles of relativistic quantum field theory 2. be able to calculate the transition amplitude for zero-spin particles using Feynman diagrams

Class syllabus:
1. Introduction
2. Free field
3. Interacting fields
4. Functional methods

Recommended literature:
M. Mojžiš, Quantum Field Theory (electronic study materials)
An introduction to quantum field theory / Michael E. Peskin, Daniel V. Schroeder. Boulder : Westview Press, 1995

Languages necessary to complete the course:
Slovak, English

Notes:

Past grade distribution
Total number of evaluated students: 133

A	B	C	D	E	FX
66,92	17,29	7,52	2,26	6,02	0,0

Lecturers: doc. RNDr. Martin Mojžiš, PhD.

Last change: 25.02.2022
Approved by: prof. RNDr. Fedor Šimkovic, CSc.

COURSE DESCRIPTION

Academic year: 2026/2027

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KTF/2-FTF-228/15	Quantum Theory of Information

Educational activities:
Type of activities: lecture / practicals
Number of hours:
per week: 2 / 1 **per level/semester:** 26 / 13
Form of the course: on-site learning

Number of credits: 5

Recommended semester: 3.

Educational level: II.

Prerequisites:

Antirequisites: FMFI.KTFDF/2-FTF-228/12

Course requirements:
Continuous assessment: solving homework
Exam: exam
Indicative rating scale: A 85%, B 70%, C 55%, D 40%, E 20%.
Scale of assessment (preliminary/final): 100/0

Learning outcomes:
The student will gain a comprehensive overview of quantum information processing and will also learn to read with understanding scientific articles in this field.

Class syllabus:
1. Quantum communication (quantum sources, von Neuman entropy, quantum information compression, quantum noise model, quantum transmission capacities) 2. Quantum coupling (LOCC operations, coupling rates, quantum coupling testing, coupling-assisted transmission capacities, quantum coupling distillation, distribution quantum coupling, dynamics of quantum coupling) 3. Quantum calculations and complexity (quantum steps, adiabatic quantum computing, simulations of quantum systems) 4. Quantum cryptography (multi-user cryptographic protocols, quantum anonymity)

Recommended literature:
Quantum computation and quantum information / Michael A. Nielsen and Isaac L. Chuang. Cambridge: Cambridge University Press, 2000
Review articles from the area
Own electronic texts delivered to students by e-mail, including relevant references.

Languages necessary to complete the course:
Slovak, English

Notes:

Past grade distribution Total number of evaluated students: 5					
A	B	C	D	E	FX
80,0	20,0	0,0	0,0	0,0	0,0
Lecturers: doc. Mgr. Mário Ziman, PhD., Mgr. Daniel Nagaj, PhD.					
Last change: 23.02.2022					
Approved by: prof. RNDr. Fedor Šimkovic, CSc.					

COURSE DESCRIPTION

Academic year: 2026/2027

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KTF/2-FTF-227/15	Quantum Theory of Measurement

Educational activities:
Type of activities: lecture / practicals
Number of hours:
per week: 2 / 1 **per level/semester:** 26 / 13
Form of the course: on-site learning

Number of credits: 5

Recommended semester: 1.

Educational level: II.

Prerequisites:

Antirequisites: FMFI.KTFDF/2-FTF-227/12

Course requirements:
Mid-term evaluation: homework assignments
Examination: written test and oral examination
Indicative assessment scale: A 85%, B 70%, C 55%, D 40%, E 20%
Scale of assessment (preliminary/final): 100/0

Learning outcomes:
The student will learn to use the extended mathematical formalism of modern quantum theory in solving problems in the fields of quantum measurement and estimation, quantum dynamics of open systems and quantum information processing.

Class syllabus:
1. Quantum experiment (states and effects, density matrix, state space, convexity, Gleason's theorem) 2. Quantum observable (POVM, relations between observable, Naimark's theorem, estimates, state differentiation) 3. Quantum processes (complete positivity, Stinespring's theorem, Choi-Jamiolkowski isomorphism, Kraus representation) 4. Quantum measurement models (instruments, Luders measurements, measurement repeatability) 5. Quantum measurement problem (time evolution, Lindblad equation, objectification, interpretation)

Recommended literature:
T.Heinosaari, M.Ziman: The Mathematical Language of Quantum theory (Cambridge, 2012)
T.Heinosaari, M.Ziman: Guide to mathematical concepts of quantum theory, Acta Physica Slovaca 58, 487-674 (2008)

Languages necessary to complete the course:
Slovak, English

Notes:

Past grade distribution Total number of evaluated students: 14					
A	B	C	D	E	FX
64,29	21,43	14,29	0,0	0,0	0,0
Lecturers: doc. Mgr. Mário Ziman, PhD.					
Last change: 23.02.2022					
Approved by: prof. RNDr. Fedor Šimkovic, CSc.					

COURSE DESCRIPTION

Academic year: 2026/2027

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KTF/2-FTF-127/00	Renormalization

Educational activities:
Type of activities: lecture
Number of hours:
per week: 3 **per level/semester:** 39
Form of the course: on-site learning

Number of credits: 5

Recommended semester: 2.

Educational level: II.

Prerequisites:

Course requirements:
Continuous assessment: test
Indicative assessment scale: A 90%, B 80%, C 70%, D 60%, E 50%
Scale of assessment (preliminary/final): 100/0

Learning outcomes:
After completing the lecture, students should be able to compute the processes in quantum field theory in the loop approximation, and understand why it is done the way it is done.

Class syllabus:
I. renormalization without infinities
1. tree level summary
2. loop effects
propagators
vertices
II. renormalization and infinities
1. caclulation of loop integrals
2. applications

Recommended literature:
M.Mojžiš, Renormalization (electronic study materials)
An introduction to quantum field theory / Michael E. Peskin, Daniel V. Schroeder. Boulder : Westview Press, 1995

Languages necessary to complete the course:
Slovak, English

Notes:

Past grade distribution Total number of evaluated students: 68					
A	B	C	D	E	FX
89,71	5,88	2,94	0,0	1,47	0,0
Lecturers: doc. RNDr. Martin Mojžiš, PhD.					
Last change: 25.02.2022					
Approved by: prof. RNDr. Fedor Šimkovic, CSc.					

COURSE DESCRIPTION

Academic year: 2026/2027

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KTF/2-FTF-111/16	Representations of Groups

Educational activities:
Type of activities: lecture / practicals
Number of hours:
per week: 4 / 1 **per level/semester:** 52 / 13
Form of the course: on-site learning

Number of credits: 7

Recommended semester: 2.

Educational level: II.

Prerequisites:

Course requirements:
Homework and exam.
Scale of assessment (preliminary/final): 40/60

Learning outcomes:
Upon completion, students will understand the basics of the representation theory of finite and Lie groups and applications in theoretical physics.

Class syllabus:
Representations of finite groups, characters, Pontryagin's dual, Fourier analysis on finite groups, Frobeni's theory of representations of semi-direct products, representations of symmetric groups. Representations of Lie groups, linearization, structure of Lie algebras, representations of simple Lie algebras, Clifford algebras, BCH formula, local and global integration of representations of Lie algebras, Peter-Weyl theorem and non-abelian Fourier analysis, Wigner theorem, projective representations, representations of Poincaré group, mass, spin, helicity, relationship of quantum fields and particles.

Recommended literature:
Fulton, Harris - Representation Theory, A First Course, Springer, 1991.
Simon - Representations of Finite and Compact Groups, AMS, 1996.
Hall - Lie Groups, Lie Algebras, and Representations, Springer, 2003.

Languages necessary to complete the course:

Notes:

Past grade distribution
Total number of evaluated students: 35

A	B	C	D	E	FX
65,71	5,71	17,14	2,86	5,71	2,86

Lecturers: Mgr. Martin Kršśák, Dr.rer.nat.

Last change: 25.02.2022
Approved by: prof. RNDr. Fedor Šimkovic, CSc.

COURSE DESCRIPTION

Academic year: 2026/2027

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KJP/1-MXX-161/00	Russian Language (1)

Educational activities:
Type of activities: practicals
Number of hours:
per week: 2 **per level/semester:** 26
Form of the course: on-site learning

Number of credits: 2

Recommended semester: 1., 7.

Educational level: I., I.II., II.

Prerequisites:

Course requirements:
Scale of assessment (preliminary/final): 100/0

Learning outcomes:
Basic communication in Russian, developing other Russian language skills - listening comprehension, reading and writing.

Class syllabus:
To master the fundamentals of general Russian. The language level is A1.
Learning the Cyrillic (Russian) alphabet, gaining basic language competence, building up skills and confidence in dealing with unfamiliar authentic and semi-authentic texts.
The subject provides a course in Russian language for beginners.

Recommended literature:
The textbook: : Точка Ру A1 (Ольга Долматова, Екатерина Новачац), pracovné karty Падежи 1 (Л.С. Безкоровайная, В.Е. Штыленко).

Languages necessary to complete the course:

Notes:

Past grade distribution
Total number of evaluated students: 746

A	B	C	D	E	FX
57,77	16,62	11,13	4,16	1,74	8,58

Lecturers: Viktoria Mirsalova

Last change: 20.06.2022

Approved by: prof. RNDr. Fedor Šimkovic, CSc.

COURSE DESCRIPTION

Academic year: 2026/2027

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KJP/1-MXX-162/00	Russian Language (2)

Educational activities:
Type of activities: practicals
Number of hours:
per week: 2 **per level/semester:** 26
Form of the course: on-site learning

Number of credits: 2

Recommended semester: 2., 8.

Educational level: I., I.II., II.

Prerequisites:

Course requirements:
Scale of assessment (preliminary/final): 100/0

Learning outcomes:
Basic communication in Russian, developing other Russian language skills - listening comprehension, reading and writing.

Class syllabus:
To master the fundamentals of general Russian.
Learning the Cyrillic (Russian) alphabet, gaining basic language competence, building up skills and confidence in dealing with unfamiliar authentic and semi-authentic texts.
The subject continues the program of Russian language (1) and provides a course of Russian for beginners.

Recommended literature:
Textbook: Точка Ру A1 (Ольга Долматова, Екатерина Новачац), pracovné karty Падежи 1 (Л.С. Безкоровайная, В.Е. Штыленко).

Languages necessary to complete the course:

Notes:

Past grade distribution
Total number of evaluated students: 435

A	B	C	D	E	FX
63,91	16,09	8,97	3,91	0,92	6,21

Lecturers: Viktoria Mirsalova

Last change: 20.06.2022

Approved by: prof. RNDr. Fedor Šimkovic, CSc.

COURSE DESCRIPTION

Academic year: 2026/2027

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KJP/1-MXX-261/00	Russian Language (3)

Educational activities:
Type of activities: practicals
Number of hours:
per week: 2 **per level/semester:** 26
Form of the course: on-site learning

Number of credits: 2

Recommended semester: 3., 9.

Educational level: I., I.II., II.

Prerequisites:

Course requirements:
Scale of assessment (preliminary/final): 100/0

Learning outcomes:
Basic communication in Russian, developing other Russian language skills - listening comprehension, reading and writing.

Class syllabus:
Learning the handwritten Russian (Russian Cursive Cyrillic), developing further language skills, gaining knowledge of Russian culture, history and way of life, pre-intermediate to intermediate grammar and vocabulary.
The course "Russian for Intermediate Students" is a follow-up to "Russian for Beginners". The subject of the course is general Russian in the range appropriate to the given level.

Recommended literature:
Точка Ру A2 (Ольга Долматова, Екатерина Новачац) a Short Stories in Russian (Olly Richards, Alex Rowlings)

Languages necessary to complete the course:

Notes:

Past grade distribution
Total number of evaluated students: 215

A	B	C	D	E	FX
68,84	17,67	9,3	2,33	0,0	1,86

Lecturers: Viktoria Mirsalova

Last change: 20.06.2022

Approved by: prof. RNDr. Fedor Šimkovic, CSc.

COURSE DESCRIPTION

Academic year: 2026/2027

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KJP/1-MXX-262/00	Russian Language (4)

Educational activities:
Type of activities: practicals
Number of hours:
per week: 2 **per level/semester:** 26
Form of the course: on-site learning

Number of credits: 2

Recommended semester: 4., 10.

Educational level: I., I.II., II.

Prerequisites:

Course requirements:
Scale of assessment (preliminary/final): 100/0

Learning outcomes:
Learning the handwritten Russian (Russian Cursive Cyrillic), developing further language skills, gaining knowledge of Russian culture, history and way of life, pre-intermediate to intermediate grammar and vocabulary.

Class syllabus:
Learning the handwritten Russian (Russian Cursive Cyrillic), developing further language skills, gaining knowledge of Russian culture, history and way of life, pre-intermediate to intermediate grammar and vocabulary.
The course "Russian for Intermediate Students" is a follow-up to "Russian for Beginners". The subject of the course is general Russian in the range appropriate to the given level.

Recommended literature:
Точка Ру A2 (Ольга Долматова, Екатерина Новачац) a Short Stories in Russian (Olly Richards, Alex Rowlings)

Languages necessary to complete the course:

Notes:

Past grade distribution
Total number of evaluated students: 153

A	B	C	D	E	FX
74,51	14,38	7,19	2,61	0,65	0,65

Lecturers: Viktoria Mirsalova

Last change: 20.06.2022

Approved by: prof. RNDr. Fedor Šimkovic, CSc.

COURSE DESCRIPTION

Academic year: 2026/2027

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KTF/2-FTF-133/10	Selected Methods in Computer Physics

Educational activities:
Type of activities: seminar
Number of hours:
per week: 3 **per level/semester:** 39
Form of the course: on-site learning

Number of credits: 5

Recommended semester: 2.

Educational level: II.

Prerequisites:

Course requirements:
Continuous assessment: numerical solution of assigned homework problems Exam: written
Indicative assessment scale: A 90%, B 80%, C 70%, D 60%, E 50%
Scale of assessment (preliminary/final): 100/0

Learning outcomes:
Students are able to create programs for numerical solution of selected physical problems.

Class syllabus:
Orthogonal polynomials, numerical quadrature, numerical differentiation, numerical solution of the initial value problem, adaptive methods, Richardson extrapolation, numerical solution of selected boundary value problems.

Recommended literature:
R.W.Hamming: Numerical methods for scientists and engineers, 1987;
W.H.Press, S.A.Teukolsky, W.T.Weterling, B.P.Flannery: Numerical recipes 3.ed, 2007;
A.Ralston, P.Rabinowitz: A first course in numerical analysis, 2001;

Languages necessary to complete the course:
Slovak or English

Notes:

Past grade distribution
Total number of evaluated students: 15

A	B	C	D	E	FX
86,67	6,67	0,0	0,0	6,67	0,0

Lecturers: RNDr. Eduard Masár, PhD.

Last change: 23.02.2022

Approved by: prof. RNDr. Fedor Šimkovic, CSc.

COURSE DESCRIPTION

Academic year: 2026/2027

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KTF/2-FTF-114/00	Selected Parts of Advanced Statistical Physics

Educational activities:
Type of activities: lecture / practicals
Number of hours:
per week: 4 / 2 **per level/semester:** 52 / 26
Form of the course: on-site learning

Number of credits: 8

Recommended semester: 2.

Educational level: II.

Prerequisites:

Course requirements:
Continuous assessment: homeworks
Exam: oral exam
A: 100-90, B: 89-80, C: 79-70, D: 69-60, E: 59-50, Fx: 49-0.
Scale of assessment (preliminary/final): 80/20

Learning outcomes:
Acquire advanced techniques of statistical physics. Namely
- probability theory techniques related to normal distribution
- elements of hypothesis testing
- the relationship between quantum and classical statistical physics
- the relationship between thermodynamics and statistical physics
- basic knowledge of phase transitions
- orientation in techniques of physical kinetics

Class syllabus:
Mathematical statistics, elements of information theory, general formalism of quantum statistical physics, numerical methods, variation principles, phase transitions, spin models, kinetic equations, transport phenomena, theory of fluctuations, random processes.

Recommended literature:
L. E. Reichl, A modern course in statistical physics
David Tong, Statistical Physics
V.Černý, M.Medo: Selected topics from statistical physics, elektronický text na web stránke predmetu

Languages necessary to complete the course:

Notes:

Past grade distribution Total number of evaluated students: 117					
A	B	C	D	E	FX
62,39	30,77	2,56	1,71	2,56	0,0
Lecturers: doc. Mgr. Samuel Kováčik, PhD.					
Last change: 15.06.2022					
Approved by: prof. RNDr. Fedor Šimkovic, CSc.					

COURSE DESCRIPTION

Academic year: 2026/2027

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KTF/2-FTF-137/24	Selected Topics in General Relativity

Educational activities:
Type of activities: lecture
Number of hours:
per week: 3 **per level/semester:** 39
Form of the course: on-site learning

Number of credits: 5

Recommended semester: 2.

Educational level: II.

Prerequisites:

Course requirements:
Homework assignments,
Indicative assessment scale: A 90%, B 80%, C 70%, D 60%, E 50%
Scale of assessment (preliminary/final): 100/0

Learning outcomes:
Students will become familiar with advanced topics in General Relativity.

Class syllabus:
1. Rotating and charged black holes.
2. Conservation laws in general relativity, definitions of gravitational energy.
3. Mechanics and thermodynamics of black holes.
4. Hypersurfaces and extrinsic curvature.
5. 3+1 splitting and ADM formalism.
6. Hamiltonian formulation of general relativity.
7. Tetrad formalism.
8. Extended/modified theories of gravity.

Recommended literature:
1. C. W. Misner, K. S. Thorne, and J. A. Wheeler, Gravitation. W. H. Freeman, San Francisco, 1973.
2. R. Wald, General Relativity, University of Chicago Press, 1984.
3. E. Poisson, A Relativist's Toolkit: The Mathematics of Black-Hole Mechanics. Cambridge University Press, 2009.
4. T. Padmanabhan, Gravitation: Foundations and frontiers. Cambridge University Press, 2014.
5. P. K. Townsend, Black Holes, ArXiv:gr-qc/9707012

Languages necessary to complete the course:
Slovak and English.

Notes:

Past grade distribution
Total number of evaluated students: 4

A	B	C	D	E	FX
100,0	0,0	0,0	0,0	0,0	0,0

Lecturers: Mgr. Martin Kršśák, Dr.rer.nat., Mgr. Peter Mészáros, PhD.

Last change: 24.05.2024

Approved by: prof. RNDr. Fedor Šimkovic, CSc.

COURSE DESCRIPTION

Academic year: 2026/2027

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KTF/2-FTF-225/10	Selected Topics in Quantum Physics

Educational activities:
Type of activities: lecture
Number of hours:
per week: 3 **per level/semester:** 39
Form of the course: on-site learning

Number of credits: 5

Recommended semester: 4.

Educational level: II.

Prerequisites:

Recommended prerequisites:
1-FYZ-365 Kvantová teória (2)

Course requirements:
Continuous assessment: continuous test
Indicative assessment scale: A 70%, B 60%, C 50%, D 40%, E 33%
Scale of assessment (preliminary/final): 100/0

Learning outcomes:
After completing the course, students will gain an overview of the connection between quantum theory and particle physics, with various applications, including applications from group theory.

Class syllabus:
electromagnetic, strong and weak forces and their quantum description, the role of symmetries and the Standard Model of Elementary Particles, tensor products in simple groups SU (2) and SU (3), higher groups and Dynkin's formalism, tensor products in higher groups, large unification of forces based on SU (5) and SO (10) gauge symmetries, experimental indications in favor of great unification

Recommended literature:
Úvod do kvantovej mechaniky / Ján Pišút, Ladislav Gomolčák, Vladimír Černý. Bratislava : Alfa, 1983
Quantum Mechanics: Symmetries / Greiner W., Muller B. Springer, 2001.
B.H.Bransden, C.J.Joachain: Quantum Mechanics, 2ed, Pearson Education Ltd, 2000.
S.Raby: Introduction to the Standard Model and Beyond, Cambridge University Press, 2021.

Languages necessary to complete the course:
Slovak, English

Notes:

Past grade distribution
Total number of evaluated students: 16

A	B	C	D	E	FX
93,75	0,0	0,0	0,0	0,0	6,25

Lecturers: doc. RNDr. Tomáš Blažek, PhD.

Last change: 10.03.2022

Approved by: prof. RNDr. Fedor Šimkovic, CSc.

COURSE DESCRIPTION

Academic year: 2026/2027

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KTF/2-FTF-136/17	Selected Topics in Theory of Relativity

Educational activities:
Type of activities: lecture
Number of hours:
per week: 2 **per level/semester:** 26
Form of the course: on-site learning

Number of credits: 3

Recommended semester: 1.

Educational level: I., II.

Prerequisites:

Course requirements:
During the semester, students receive homework that is not evaluated, but at the beginning of each lecture there will be a short paper with a similar assignment. To complete the course, it is necessary to obtain at least 50% of points.
Scale of assessment (preliminary/final): 100/0

Learning outcomes:
After completing the course, the student should understand in detail the basic concepts of the special theory of relativity.

Class syllabus:
experiments leading to special theories of relativity, coordinate systems, relativity in classical mechanics, Minkowski space-time and space-time intervals, space-time diagrams, four-vectors and Lorentz transformations, theory of relativity and electromagnetism;

Recommended literature:
Special Relativity (Springer Undergraduate Mathematics Series) / Nicholas.M.J.Woodhouse, Springer-Verlag Berlin Heidelberg 1992;
Dynamics and relativity (University of Cambridge Part IA Mathematical Tripos), David Tong 2013;

Languages necessary to complete the course:
Slovak, English

Notes:

Past grade distribution
Total number of evaluated students: 67

A	B	C	D	E	FX
47,76	17,91	14,93	16,42	0,0	2,99

Lecturers: Mgr. Peter Maták, PhD.

Last change: 18.05.2022
Approved by: prof. RNDr. Fedor Šimkovic, CSc.

COURSE DESCRIPTION

Academic year: 2026/2027

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KJP/1-MXX-171/20	Slovak Language for Foreign Students (1)

Educational activities:
Type of activities: practicals
Number of hours:
per week: 2 **per level/semester:** 26
Form of the course: on-site learning

Number of credits: 2

Recommended semester: 1., 7.

Educational level: I., I.II., II., III.

Prerequisites:

Course requirements:
tests
Course prerequisites:
https://fmph.uniba.sk/microsites/kjp/katedra-jazykovej-pripravy/poziadavky-na-udelenie-priebezneho-hodnotenia-aj1aj2aj3-ostatne-kurzy/
Scale of assessment (preliminary/final): 100/0

Learning outcomes:
This course is aimed for foreign students to learn the fundamentals of the Slovak language with the focus on basic communication as well as all other language skills- listening comprehension,reading and writing.

Class syllabus:
The sylabus is targeted at the comprehension of the basics of the Slovak language for the absolute beginners (A1).

Recommended literature:
Krížom- Krážom Slovenčina 1, additional material to further support the covered topics.

Languages necessary to complete the course:

Notes:

Past grade distribution
Total number of evaluated students: 155

A	ABS	B	C	D	E	FX	NEABS
40,65	21,29	7,1	4,52	0,65	1,29	21,29	3,23

Lecturers: Mgr. Aneta Barnes

Last change: 21.06.2022

Approved by: prof. RNDr. Fedor Šimkovic, CSc.

COURSE DESCRIPTION

Academic year: 2026/2027

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KJP/1-MXX-172/20	Slovak Language for Foreign Students (2)

Educational activities:
Type of activities: practicals
Number of hours:
per week: 2 **per level/semester:** 26
Form of the course: on-site learning

Number of credits: 2

Recommended semester: 2., 8.

Educational level: I., I.II., II., III.

Prerequisites:

Course requirements:
tests
Course prerequisites:
https://fmph.uniba.sk/microsites/kjp/katedra-jazykovej-pripravy/poziadavky-na-udelenie-priebezneho-hodnotenia-aj1aj2aj3-ostatne-kurzy/
Scale of assessment (preliminary/final): 100/0

Learning outcomes:
This course is aimed for foreign students to learn the fundamentals of the Slovak language with the focus on basic communication as well as all other language skills- listening comprehension,reading and writing.

Class syllabus:
The sylabus is targeted at the comprehension of the basics of the Slovak language for the absolute beginners (A1) and this course is a follow up course to the Slovak language course 1.

Recommended literature:
Krížom- Krážom Slovenčina 1, additional material to further support the covered topics

Languages necessary to complete the course:

Notes:

Past grade distribution
Total number of evaluated students: 87

A	ABS	B	C	D	E	FX	NEABS
63,22	18,39	1,15	1,15	0,0	0,0	9,2	6,9

Lecturers: Mgr. Aneta Barnes

Last change: 21.06.2022

Approved by: prof. RNDr. Fedor Šimkovic, CSc.

COURSE DESCRIPTION

Academic year: 2026/2027

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KJP/1-MXX-271/20	Slovak Language for Foreign Students (3)

Educational activities:
Type of activities: practicals
Number of hours:
per week: 2 **per level/semester:** 26
Form of the course: on-site learning

Number of credits: 2

Recommended semester: 3., 9.

Educational level: I., I.II., II., III.

Prerequisites:

Course requirements:
tests
Course prerequisites:
https://fmph.uniba.sk/microsites/kjp/katedra-jazykovej-pripravy/poziadavky-na-udelenie-priebezneho-hodnotenia-aj1aj2aj3-ostatne-kurzy/
Scale of assessment (preliminary/final): 100/0

Learning outcomes:
This course is aimed for foreign students to better comprehend all the language skills important to enable correct usage of the Slovak language – listening comprehension, reading, writing and speaking.

Class syllabus:
The sylabus is targeted at the comprehension of all the language skills of the Slovak language , and it is a follow up course to the Slovak language course 2.

Recommended literature:
Krížom-Krážom Slovenčina 2, additional material to further support the covered topics.

Languages necessary to complete the course:

Notes:

Past grade distribution
Total number of evaluated students: 32

A	ABS	B	C	D	E	FX	NEABS
59,38	3,13	18,75	3,13	3,13	0,0	12,5	0,0

Lecturers: Mgr. Aneta Barnes

Last change: 21.06.2022

Approved by: prof. RNDr. Fedor Šimkovic, CSc.

COURSE DESCRIPTION

Academic year: 2026/2027

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KJP/1-MXX-272/20	Slovak Language for Foreign Students (4)

Educational activities:
Type of activities: practicals
Number of hours:
per week: 2 **per level/semester:** 26
Form of the course: on-site learning

Number of credits: 2

Recommended semester: 4., 10.

Educational level: I., I.II., II., III.

Prerequisites:

Course requirements:
tests
Course prerequisites:
https://fmph.uniba.sk/microsites/kjp/katedra-jazykovej-pripravy/poziadavky-na-udelenie-priebezneho-hodnotenia-aj1aj2aj3-ostatne-kurzy/
Scale of assessment (preliminary/final): 100/0

Learning outcomes:
This course is aimed for foreign students to better comprehend all the language skills important to enable correct usage of the Slovak language – listening comprehension, reading, writing and speaking.

Class syllabus:
The sylabus is targeted at the comprehension of all the language skills of the Slovak language , and it is a follow up course to the Slovak language course 3.

Recommended literature:
Krížom-Krážom Slovenčina 2, additional material to further support the covered topics.

Languages necessary to complete the course:

Notes:

Past grade distribution
Total number of evaluated students: 25

A	ABS	B	C	D	E	FX	NEABS
84,0	0,0	4,0	4,0	0,0	0,0	8,0	0,0

Lecturers: Mgr. Aneta Barnes

Last change: 21.06.2022

Approved by: prof. RNDr. Fedor Šimkovic, CSc.

COURSE DESCRIPTION

Academic year: 2026/2027

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KTV/2-MXX-115/17	Sports in Natur (1)

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., 7.

Educational level: I.II., II.

Prerequisites:

Course requirements:
Grades: A 90%, B 80%, C 70%, D 60%, E 50%
The condition for the award of 1 or 2 credits is the completion of a multi-day course in its full scope, or the completion of one-day courses in the scope of 4 days. Candidates can apply to the leaders of individual courses. From the presented offer of courses, you can choose the one that suits your interests, abilities and deadlines.

Learning outcomes:
Acquisition and development of basic motor skills and abilities in selected sports: skiing and snowboarding. Mastering the correct technique of performing individual movements, which are necessary for skiing and snowboarding.

Class syllabus:
The student can sign up for the outdoor sports courses offered by the department: skiing, snowboarding. The lessons in the courses are focused on the development of basic and special movement skills and mastering the techniques needed for the sports.

Recommended literature:

Languages necessary to complete the course:
Slovak

Notes:
KTVŠ does not rent ski equipment.

Past grade distribution
Total number of evaluated students: 186

A	B	C	D	E	FX
98,92	0,0	0,0	0,0	0,0	1,08

Lecturers: Mgr. Martin Dovičák, PhD., Mgr. Tomáš Kuchár, PhD., Mgr. Jana Leginusová, PaedDr. Dana Mašlejová, Mgr. Ladislav Mókus, PaedDr. Mikuláš Ortutay, Mgr. Júlia Raábová, PhD., Mgr. Tomáš Lovecký

Last change: 16.06.2022
Approved by: prof. RNDr. Fedor Šimkovic, CSc.

COURSE DESCRIPTION

Academic year: 2026/2027

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KTV/2-MXX-116/18	Sports in Natur (2)

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., 8.

Educational level: I.II., II.

Prerequisites:

Course requirements:
Grades: A 90%, B 80%, C 70%, D 60%, E 50%.
The condition for the award of 1 or 2 credits is the completion of a multi-day course in its full scope, or the completion of one-day courses in the scope of 4 days. Candidates can apply to the leaders of individual courses. From the presented offer of courses, you can choose the one that suits your interests, abilities and deadlines.

Learning outcomes:
Creating a positive and lasting relationship with physical activity. Acquisition and mastery of basic motor skills and abilities in outdoor sports: windsurfing, beach volleyball, water tourism - river rafting, hiking and other sports according to interest. Training and improving the technique needed for the sports.

Class syllabus:
The student can sign up for the outdoor sports courses offered by the department: water tourism - river rafting, windsurfing, beach volleyball, hiking and other hobby sports. The lessons in the courses are focused on the development of basic and special movement skills and, mastering the techniques needed for the sports.

Recommended literature:

Languages necessary to complete the course:
Slovak

Notes:
KTVŠ will provide sports equipment.

Past grade distribution
Total number of evaluated students: 109

A	B	C	D	E	FX
95,41	0,0	0,0	0,0	0,0	4,59

Lecturers: Mgr. Martin Dovičák, PhD., Mgr. Tomáš Kuchár, PhD., Mgr. Jana Leginusová, PaedDr. Dana Mašlejová, Mgr. Ladislav Mókus, PaedDr. Mikuláš Ortutay, Mgr. Júlia Raábová, PhD., Mgr. Tomáš Lovecký
Last change: 16.06.2022
Approved by: prof. RNDr. Fedor Šimkovic, CSc.

COURSE DESCRIPTION

Academic year: 2026/2027

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KTF/2-FTF-212/16	Standard Model

Educational activities:
Type of activities: lecture / practicals
Number of hours:
per week: 4 / 1 **per level/semester:** 52 / 13
Form of the course: on-site learning

Number of credits: 7

Recommended semester: 3.

Educational level: II.

Prerequisites:

Recommended prerequisites:
2-FTF-116/00 Kvantová elektrodynamika
(Quantum Electrodynamics Course)

Course requirements:
Continuous assessment: homework and midterm exam
Exam: written
Indicative assessment scale: A 70%, B 60%, C 50%, D 40%, E 33%
Weight of the intermediate / final evaluation: 40/60
Scale of assessment (preliminary/final): 40/60

Learning outcomes:
By completing the course, the student will understand the basics of the standard model and the roles played in it by gauge symmetries, various particle fields and spontaneous breaking of electroweak symmetry. As a result, the student will be able to solve scattering and decay problems at least at the tree level.

Class syllabus:
The concept of effective field theory. Standard model at low energies. Stable particles. Leptons, mesons, baryons. Allowed (weak) decays. Quantum electrodynamics as an abelian gauge theory based on U(1) symmetry. Annihilation of e+e- into muon antimuon or a calculation of a different QED observable (e.g., the electron magnetic dipole moment) that was not covered in the QED course. Evidence for the existence of colored charge. SU (3)c gauge symmetry. Asymptotic freedom. Quark confinement. Standard model at energies ~ 100 GeV and at energies higher than 100 GeV by many orders of magnitude. Electroweak SU(2)L x U(1)y gauge symmetry. Higgs boson and masses of W and Z bosons from spontaneous breaking of electroweak symmetry. The key role of electroweak symmetry in cancelling the incorrect high-energy amplitude behavior.

Recommended literature:
F.Halzen, A.D.Martin: Quarks and Leptons. Wiley, 1984
Michael E. Peskin, Daniel V. Schroeder: An Introduction to Quantum Field Theory, Westview Press, 1995

S.Weinberg: The quantum theory of fields, Vol.1 a 2, Cambridge University Press, 2005
S.Raby: Introduction to the Standard Model and Beyond, Cambridge University Press, 2021

Languages necessary to complete the course:
Slovak, English

Notes:

Past grade distribution
Total number of evaluated students: 33

A	B	C	D	E	FX
90,91	9,09	0,0	0,0	0,0	0,0

Lecturers: doc. RNDr. Martin Mojžiš, PhD., doc. RNDr. Tomáš Blažek, PhD.

Last change: 17.10.2022

Approved by: prof. RNDr. Fedor Šimkovic, CSc.

COURSE DESCRIPTION

Academic year: 2026/2027

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KEF/2-FTL-107/22	Structure and Mechanical Properties of Solids

Educational activities:
Type of activities: lecture / practicals
Number of hours:
per week: 4 / 2 **per level/semester:** 52 / 26
Form of the course: on-site learning

Number of credits: 8

Recommended semester: 1.

Educational level: II.

Prerequisites:

Recommended prerequisites:
knowledge of the basic concepts of solid state physics on the level of the course 2-FOL-117 Introduction to solid state physics

Course requirements:
Homework during semester
Written exam
Grades: A 90%, B 80%, C 70%, D 60%, E 50%
Scale of assessment (preliminary/final): 20/80

Learning outcomes:
The course provides deeper insight into the structure of a broad spectrum of forms of condensed matter, from ideal crystals to defective crystals to quasicrystals to liquid crystals to liquids and amorphous structures. Besides description of structure the course focuses on understanding of relations between structure, energy and entropy as well as phase transitions among structural phases.

Class syllabus:
Thermodynamic potentials and phase diagrams
Lattice vibrations in harmonic approximation - dynamical matrix, phonons
Anharmonic effects in crystals - thermal expansion
Quasicrystals and incommensurate structures
Defects in crystals - point defects, dislocations
Order/disorder transition in alloys
Structure of surfaces - reconstruction
Mechanical properties of solids - strain and stress tensors, elastic constants in crystals, plasticity, fracture
Structure of liquids, glasses and amorphous solids
Soft matter
Polymers and their properties
Liquid crystals, isotropic-nematic transition, Frederiks transition
2D systems - graphene

Recommended literature:

Solid state physics / Neil W. Ashcroft, N. David Mermin. Fort Worth : Harcourt Brace, 1976

Úvod do fyziky pevných látek / Charles Kittel ; přeložili Miloš Matyáš ... [et al.]. Praha : Academia, 1985

Condensed matter physics : Corrected printing / Michael P. Marder. New York : John Wiley, 2000

Languages necessary to complete the course:

Slovak, English

Notes:

Past grade distribution

Total number of evaluated students: 60

A	B	C	D	E	FX
60,0	11,67	10,0	10,0	8,33	0,0

Lecturers: prof. Ing. Roman Martoňák, DrSc.

Last change: 19.01.2022

Approved by: prof. RNDr. Fedor Šimkovic, CSc.

STATE EXAM DESCRIPTION

Academic year: 2026/2027	
University: Comenius University Bratislava	
Faculty: Faculty of Mathematics, Physics and Informatics	
Course ID: FMFI.KTF/2-FTF-954/22	**Course title:** Theoretical Physics
Number of credits: 6	
Educational level: II.	
Course requirements: Interim evaluation: the state final exam does not have an interim evaluation Examination: state final examination before the commission Indicative assessment scale: A 90%, B 80%, C 70%, D 60%, E 50% Scale of assessment (preliminary/final): 0/100	
Learning outcomes: The result of successful completion of the course will be the completion of the final state examination in the course of the SS Theoretical Physics	
Class syllabus: According to the choice of compulsory elective courses and the focus of the diploma thesis, the student will answer two selected questions from two selected areas from the following three areas: 1. Mathematical physics and gravity 2. Elementary particles 3. Theory of condensed matter	
State exam syllabus:	
Languages necessary to complete the course: Slovak, English	
Last change: 25.02.2022	
Approved by: prof. RNDr. Fedor Šimkovic, CSc.	

COURSE DESCRIPTION

Academic year: 2026/2027

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KTF/2-FTF-232/18	Topological Quantum Field Theory

Educational activities:
Type of activities: lecture
Number of hours:
per week: 3 **per level/semester:** 39
Form of the course: on-site learning

Number of credits: 4

Recommended semester: 4.

Educational level: II.

Prerequisites:

Course requirements:
Mid-term evaluation: homework assignments
Examination: oral examination
Indicative assessment scale: A 90%, B 80%, C 70%, D 60%, E 50%
Scale of assessment (preliminary/final): Weight of the intermediate / final evaluation: 40/60

Learning outcomes:
After completing the course, students will know the basic topological quantum theories of the field.

Class syllabus:
Morse theory as a supersymmetric sigma model, N = 2 super Yang-Mills theory, Seiberg-Witten invariants, Donaldson-Witten theory, Floer homology, Atiyah's definition of TQFT

Recommended literature:
Differential Topology and Quantum Field Theory / Nash, Academic Press 1991.
Wild World of 4-Manifolds / Scorpan, AMS 2005.
Morse Theory and Floer Homology / Audin, Damian, Springer 2014.

Languages necessary to complete the course:
Slovak, English

Notes:

Past grade distribution
Total number of evaluated students: 4

A	B	C	D	E	FX
75,0	25,0	0,0	0,0	0,0	0,0

Lecturers: Mgr. Peter Mészáros, PhD., doc. Mgr. Juraj Tekel, PhD.

Last change: 25.02.2022

Approved by: prof. RNDr. Fedor Šimkovic, CSc.