Course descriptions

TABLE OF CONTENTS

1. 3-FKL-007/22 Ab initio Modelling of Materials.... 3
2. 3-FTM-807/22 Assistance in Conference Organizing Committee.... 5
3. 3-FTM-704/22 Co-Investigator of the Scientific Project.... 6
4. 3-FTM-501/22 Completion of PhD Research Project Stage (1).... 7
5. 3-FTM-502/22 Completion of PhD Research Project Stage (2).... 8
6. 3-FTM-503/22 Completion of PhD Research Project Stage (3).... 9
7. 3-MXX-101/15 Course of English for PhD Studies (1).... 10
8. 3-MXX-102/15 Course of English for PhD Studies (1).... 11
9. 3-FTM-805/22 Creation of Teaching Aids and Texts.... 12
10. 3-FTM-201/22 Department Seminar (1).... 13
11. 3-FTM-202/22 Department Seminar (2).... 14
12. 3-FTM-203/22 Department Seminar (3).... 15
13. 3-FTM-204/22 Department Seminar (4).... 16
14. 3-FVM-990/15 Dissertation Thesis Defense **(state exam)**.... 17
15. 3-FTM-302/22 Domestic Journal – Current Content/Registered in WoS Database.... 18
16. 3-FTM-304/22 Domestic Journal – Non-Current Content/Non-Registered in WoS Database.... 19
17. 3-FGF-015/22 Efficient Numerical Methods for Simulation of Seismic Motion.... 20
18. 3-FTM-804/22 Elaboration of the Reviewer's Report on the Final Thesis.... 22
19. 3-FVM-211/15 Exactly Solvable Models in Quantum Mechanics and Statistical Physics.... 23
20. 3-FGF-011/22 Hydrodynamics and Magnetohydrodynamics.... 25
21. 3-FVM-105/15 Individual Study of Research Resources (1).... 27
22. 3-FVM-106/15 Individual Study of Research Resources (2).... 28
23. 3-FVM-107/15 Individual Study of Research Resources (3).... 29
24. 3-FVM-108/15 Individual Study of Research Resources (4).... 30
25. 3-FTM-301/22 International Journal – Current Content/Registered in WoS database.... 31
26. 3-FTM-303/22 International Journal – Non-Current Content/Non-Registered in WoS database.... 32
27. 3-FVM-204/15 Introduction to Quantum Processing of Information.... 33
28. 3-FGF-102/22 Mathematical Methods in Geophysics.... 34
29. 3-FTM-006/22 Mathematical Methods of Theoretical Physics (1).... 36
30. 3-FTM-007/22 Mathematical Methods of Theoretical Physics (2).... 38
31. 3-FVM-210/15 Mathematical Structures of Quantum Theory.... 39
32. 3-FTM-703/22 Obtaining a University Grant.... 41
33. 3-FVM-950/15 Passing Dissertation Examination **(state exam)**.... 42
34. 3-FGF-016/22 Physical Principles and Probabilistic Methods of Seismic Hazard Analysis.... 43
35. 3-FGF-014/22 Physics of Seismic Source.... 45
36. 3-FTM-402/22 Presentation at Domestic Conference.... 47
37. 3-FTM-401/22 Presentation at International Conference.... 48
38. 3-FEM-111/22 Professional Oral Communication in English.... 49
39. 3-FTM-209/22 Quantum Theory of Gravity.... 51
40. 3-FTM-207/22 Quantum simulations and calculations.... 53
41. 3-FTM-001/22 Relativistic Quantum Field Theory (1).... 55
42. 3-FTM-002/22 Relativistic Quantum Field Theory (2).... 57
43. 3-FVM-301/22 Research Work (1).... 59
44. 3-FVM-302/22 Research Work (2).... 61

45. 3-FVM-303/22 Research Work (3)....63
46. 3-FVM-304/22 Research Work (4)....65
47. 3-FTM-008/22 Selected Chapters from Geomagnetism....67
48. 3-FGF-009/22 Selected Chapters from the Physics of the Ionosphere and Magnetosphere....68
49. 3-FGF-103/22 Selected Experimental and Observational Methods of Geophysics....70
50. 3-FVM-212/15 Selected Topics in Quantum Theory of Information....72
51. 3-FGF-013/22 Signal and Image Analysis....73
52. 3-FTM-403/22 Study Stay Abroad....75
53. 3-FTM-803/22 Supervision of a Bachelor Thesis....76
54. 3-FTM-806/22 Supervision of a Student at the Student Science Conference....77
55. 3-FVM-801/10 Teaching Activities (1)....78
56. 3-FVM-802/10 Teaching Activities (2)....79
57. 3-FVM-803/10 Teaching Activities (3)....80
58. 3-FVM-804/10 Teaching Activities (4)....81
59. 3-FVM-805/10 Teaching Activities (5)....82
60. 3-FVM-806/10 Teaching Activities (6)....83
61. 3-FVM-807/10 Teaching Activities (7)....84
62. 3-FKL-006/22 Theory of Condensed Matter....85
63. 3-FTM-003/22 Theory of Gravitation and Cosmology (1)....87
64. 3-FTM-004/22 Theory of Gravitation and Cosmology (2)....88

COURSE DESCRIPTION

Academic year: 2022/2023	
University: Comenius University Bratislava	
Faculty: Faculty of Mathematics, Physics and Informatics	
Course ID: FMFI.KEF/3-FKL-007/22	**Course title:** 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, distance learning

Number of credits: 10

Recommended semester: 2.

Educational level: III.

Prerequisites:

Recommended prerequisites:
The course requires knowledge of standard classical MD/MC simulation methods on the level of the course 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 score will be based on the evaluation of the report. Minimal score: 50%
Scale of assessment (preliminary/final): 0/100

Learning outcomes:
The course provides an introduction to current methods of materials modeling based on ab initio approaches. It focuses on static and dynamical simulations (ab initio molecular dynamics) based on the density functional theory (DFT) for electrons and their applications to various condensed matter systems. Quantum Monte Carlo methods for electrons (Diffusion Monte Carlo) and ions (Path Integral Monte Carlo) will be mentioned too. Besides that new approaches to force-field generation based on machine learning will be shown, as well as other possible applications of machine learning in materials simulations. The methods will be illustrated on a number of examples and in the exercises the student will learn to use the freely available ab initio code Quantum Espresso.

Class syllabus:
materials modeling, structural prediction, calculation of properties
density functional theory (DFT), Hohenberg - Kohn theorems
Kohn - Sham method and equations
approximate DFT functionals - LDA, GGA, hybrid
practical approach to solving Kohn-Sham equations - plane-wave basis expansion of wavefunctions, pseudopotentials
ab initio molecular dynamics
evolutionary algorithms and crystal structure prediction
Diffusion Quantum Monte Carlo approach (DMC)
Path Integral Monte Carlo methods

machine-learning-based methods of generating force-fields
further applications of machine learning in materials simulations

Recommended literature:

F. Giustino, Materials Modelling using Density Functional Theory, Oxford University Press 2014
D.S. Sholl, J.A. Steckel, Density functional theory (A practical introduction), John Wiley & sons, 2009
Wolfram Koch, Max C. Holthausen, A Chemist's Guide to Density Functional Theory, 2001 Wiley#VCH Verlag GmbH

Languages necessary to complete the course:
Slovak, English

Notes:

Past grade distribution
Total number of evaluated students: 21

A	ABS	B	C	D	E	FX	NEABS
66,67	23,81	4,76	4,76	0,0	0,0	0,0	0,0

Lecturers: prof. Ing. Roman Martoňák, DrSc.

Last change: 01.02.2022

Approved by:

COURSE DESCRIPTION

Academic year: 2022/2023

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KTF+KAFZM/3-FTM-807/22	Assistance in Conference Organizing Committee

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

Number of credits: 5

Recommended semester:

Educational level: III.

Prerequisites:

Course requirements:

Learning outcomes:

Class syllabus:

Recommended literature:

Languages necessary to complete the course:

Notes:

Past grade distribution
Total number of evaluated students: 0

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

Lecturers:

Last change:

Approved by:

COURSE DESCRIPTION

Academic year: 2022/2023

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KTF+KAFZM/3-FTM-704/22	Co-Investigator of the Scientific Project

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

Number of credits: 15

Recommended semester:

Educational level: III.

Prerequisites:

Course requirements:

Learning outcomes:

Class syllabus:

Recommended literature:

Languages necessary to complete the course:

Notes:

Past grade distribution
Total number of evaluated students: 2

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

Lecturers: prof. RNDr. Peter Moczo, DrSc., doc. RNDr. Vladimír Balek, CSc., doc. RNDr. Marián Fecko, PhD., doc. RNDr. Tomáš Blažek, PhD., doc. Mgr. Jozef Kristek, DrSc.

Last change:

Approved by:

COURSE DESCRIPTION

Academic year: 2022/2023

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KTF+KAFZM/3-FTM-501/22	Completion of PhD Research Project Stage (1)

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

Number of credits: 10

Recommended semester: 2.

Educational level: III.

Prerequisites:

Course requirements:

Learning outcomes:

Class syllabus:

Recommended literature:

Languages necessary to complete the course:

Notes:

Past grade distribution
Total number of evaluated students: 3

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

Lecturers: prof. RNDr. Peter Moczo, DrSc., doc. RNDr. Vladimír Balek, CSc., doc. RNDr. Marián Fecko, PhD., doc. RNDr. Tomáš Blažek, PhD., doc. Mgr. Jozef Kristek, DrSc.

Last change:

Approved by:

COURSE DESCRIPTION

Academic year: 2022/2023

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KTF+KAFZM/3-FTM-502/22	Completion of PhD Research Project Stage (2)

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

Number of credits: 10

Recommended semester: 4.

Educational level: III.

Prerequisites:

Course requirements:

Learning outcomes:

Class syllabus:

Recommended literature:

Languages necessary to complete the course:

Notes:

Past grade distribution
Total number of evaluated students: 1

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

Lecturers: prof. RNDr. Peter Moczo, DrSc., doc. RNDr. Vladimír Balek, CSc., doc. RNDr. Marián Fecko, PhD., doc. RNDr. Tomáš Blažek, PhD., doc. Mgr. Jozef Kristek, DrSc.

Last change:

Approved by:

COURSE DESCRIPTION

Academic year: 2022/2023

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KTF+KAFZM/3-FTM-503/22	Completion of PhD Research Project Stage (3)

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

Number of credits: 10

Recommended semester: 6.

Educational level: III.

Prerequisites:

Course requirements:

Learning outcomes:

Class syllabus:

Recommended literature:

Languages necessary to complete the course:

Notes:

Past grade distribution
Total number of evaluated students: 0

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

Lecturers: prof. RNDr. Peter Moczo, DrSc., doc. RNDr. Vladimír Balek, CSc., doc. RNDr. Marián Fecko, PhD., doc. RNDr. Tomáš Blažek, PhD., doc. Mgr. Jozef Kristek, DrSc.

Last change:

Approved by:

COURSE DESCRIPTION

Academic year: 2022/2023

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KJP/3-MXX-101/15	Course of English for PhD Studies (1)

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

Number of credits: 5

Recommended semester: 1.

Educational level: III.

Prerequisites:

Course requirements:

Learning outcomes:

Class syllabus:

Recommended literature:

Languages necessary to complete the course:

Notes:

Past grade distribution
Total number of evaluated students: 200

A	ABS	B	C	D	E	FX	NEABS
42,0	53,5	0,5	0,0	0,0	2,0	0,0	2,0

Lecturers: PhDr. Alena Zemanová, Mgr. Simona Tomášková, PhD.

Last change: 20.06.2022

Approved by:

COURSE DESCRIPTION

Academic year: 2022/2023

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KJP/3-MXX-102/15	Course of English for PhD Studies (1)

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

Number of credits: 5

Recommended semester: 2.

Educational level: III.

Prerequisites: FMFI.KJP/3-MXX-101/15 - Course of English for PhD Studies (1)

Course requirements:

Learning outcomes:

Class syllabus:

Recommended literature:

Languages necessary to complete the course:

Notes:

Past grade distribution
Total number of evaluated students: 193

A	ABS	B	C	D	E	FX	NEABS
45,6	48,7	0,0	0,0	0,0	0,0	0,0	5,7

Lecturers: PhDr. Alena Zemanová, Mgr. Simona Tomášková, PhD.

Last change: 20.06.2022

Approved by:

COURSE DESCRIPTION

Academic year: 2022/2023

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KTF+KAFZM/3-FTM-805/22	Creation of Teaching Aids and Texts

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

Number of credits: 5

Recommended semester:

Educational level: III.

Prerequisites:

Course requirements:

Learning outcomes:

Class syllabus:

Recommended literature:

Languages necessary to complete the course:

Notes:

Past grade distribution
Total number of evaluated students: 0

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

Lecturers:

Last change:

Approved by:

COURSE DESCRIPTION

Academic year: 2022/2023

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KTF/3-FTM-201/22	Department Seminar (1)

Educational activities:
Type of activities: seminar
Number of hours:
per week: 1 **per level/semester:** 13
Form of the course: on-site learning, distance learning

Number of credits: 5

Recommended semester: 2.

Educational level: III.

Prerequisites:

Course requirements:
active presence
Scale of assessment (preliminary/final): abs

Learning outcomes:
the student will be acquainted with the results of active research

Class syllabus:
according to the seminar schedule

Recommended literature:
according to the seminar schedule

Languages necessary to complete the course:
SK / EN

Notes:

Past grade distribution
Total number of evaluated students: 1

ABS	NEABS
100,0	0,0

Lecturers: doc. RNDr. Tomáš Blažek, PhD., prof. RNDr. Peter Moczo, DrSc.

Last change: 14.03.2022

Approved by:

COURSE DESCRIPTION

Academic year: 2022/2023

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KTF/3-FTM-202/22	Department Seminar (2)

Educational activities:
Type of activities: seminar
Number of hours:
per week: 1 **per level/semester:** 13
Form of the course: on-site learning, distance learning

Number of credits: 5

Recommended semester: 4.

Educational level: III.

Prerequisites:

Course requirements:
active presence
Scale of assessment (preliminary/final): abs

Learning outcomes:
the student will be acquainted with the results of active research

Class syllabus:
according to the seminar schedule

Recommended literature:

Languages necessary to complete the course:
SK / EN

Notes:

Past grade distribution
Total number of evaluated students: 3

ABS	NEABS
100,0	0,0

Lecturers: doc. RNDr. Tomáš Blažek, PhD., prof. RNDr. Peter Moczo, DrSc.

Last change: 14.03.2022

Approved by:

COURSE DESCRIPTION

Academic year: 2022/2023

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KTF/3-FTM-203/22	Department Seminar (3)

Educational activities:
Type of activities: seminar
Number of hours:
per week: 1 **per level/semester:** 13
Form of the course: on-site learning, distance learning

Number of credits: 5

Recommended semester: 6.

Educational level: III.

Prerequisites:

Course requirements:
active presence
Scale of assessment (preliminary/final): abs

Learning outcomes:

Class syllabus:
the student will be acquainted with the results of active research

Recommended literature:

Languages necessary to complete the course:
SK / EN

Notes:

Past grade distribution
Total number of evaluated students: 1

ABS	NEABS
100,0	0,0

Lecturers: doc. RNDr. Tomáš Blažek, PhD., prof. RNDr. Peter Moczo, DrSc.

Last change: 14.03.2022

Approved by:

COURSE DESCRIPTION

Academic year: 2022/2023

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KTF/3-FTM-204/22	Department Seminar (4)

Educational activities:
Type of activities: seminar
Number of hours:
per week: 1 **per level/semester:** 13
Form of the course: on-site learning, distance learning

Number of credits: 5

Recommended semester: 8.

Educational level: III.

Prerequisites:

Course requirements:
active presence
Scale of assessment (preliminary/final): abs

Learning outcomes:
the student will be acquainted with the results of active research

Class syllabus:
according to the seminar schedule

Recommended literature:

Languages necessary to complete the course:
SK / EN

Notes:

Past grade distribution
Total number of evaluated students: 1

ABS	NEABS
100,0	0,0

Lecturers: doc. RNDr. Tomáš Blažek, PhD., prof. RNDr. Peter Moczo, DrSc.

Last change: 14.03.2022

Approved by:

STATE EXAM DESCRIPTION

Academic year: 2022/2023	
University: Comenius University Bratislava	
Faculty: Faculty of Mathematics, Physics and Informatics	
Course ID: FMFI.KTF/3-FVM-990/15	**Course title:** Dissertation Thesis Defense
Number of credits: 30	
Educational level: III.	
State exam syllabus:	
Last change: 02.06.2015	
Approved by:	

COURSE DESCRIPTION

Academic year: 2022/2023

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KTF+KAFZM/3-FTM-302/22	Domestic Journal – Current Content/Registered in WoS Database

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

Number of credits: 25

Recommended semester:

Educational level: III.

Prerequisites:

Course requirements:

Learning outcomes:

Class syllabus:

Recommended literature:

Languages necessary to complete the course:

Notes:

Past grade distribution
Total number of evaluated students: 0

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

Lecturers: prof. RNDr. Peter Moczo, DrSc., doc. RNDr. Vladimír Balek, CSc., doc. RNDr. Marián Fecko, PhD., doc. RNDr. Tomáš Blažek, PhD., doc. Mgr. Jozef Kristek, DrSc.

Last change:

Approved by:

COURSE DESCRIPTION

Academic year: 2022/2023

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KTF+KAFZM/3-FTM-304/22	Domestic Journal – Non-Current Content/Non-Registered in WoS Database

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

Number of credits: 15

Recommended semester:

Educational level: III.

Prerequisites:

Course requirements:

Learning outcomes:

Class syllabus:

Recommended literature:

Languages necessary to complete the course:

Notes:

Past grade distribution
Total number of evaluated students: 0

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

Lecturers: prof. RNDr. Peter Moczo, DrSc., doc. RNDr. Vladimír Balek, CSc., doc. RNDr. Marián Fecko, PhD., doc. RNDr. Tomáš Blažek, PhD., doc. Mgr. Jozef Kristek, DrSc.

Last change:

Approved by:

COURSE DESCRIPTION

Academic year: 2022/2023

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KAFZM/3-FGF-015/22	Efficient Numerical Methods for Simulation of Seismic Motion

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

Number of credits: 10

Recommended semester: 2.

Educational level: III.

Prerequisites:

Course requirements:
The evaluation of the subject is individual by the supervisor, according to the individual study plan of the doctoral student. The evaluation reflects the sufficient orientation of the student in the subject. The conditions for successful completion of the course are in accordance with the Study Regulations of Faculty of Mathematics, Physics and Informatics.

Learning outcomes:
Upon completion, students will have an overview of alternative effective methods of numerical simulation of seismic wave fields and seismic motion.

Class syllabus:
The problem of solving the equation of motion of a viscoelastic continuum with realistic attenuation for structurally complex models. Models of the whole earth body, regional models, local models. Boundary, domain and hybrid methods. Finite difference method, met. finite elements, met. spectral elements, met. boundary elements, met. finite volumes and their application to the solution of the equation of motion of the viscoelastic continuum and the calculation of crack propagation at the fracture. Discrete wave number method. Hybrid approach combining met. finite elements and finite differences.

Recommended literature:
K. Aki, P.G. Richards: Quantitative seismology – Theory and methods I, II. W.H. Freeman 1980
O.C. Zienkiewicz, R.L. Taylor: The finite element method. McGraw-Hill 1989
G.C. Cohen: Higher-order numerical methods for transient wave equations. Springer 2002
P. Moczo: Introduction to modeling seismic wave propagation by the finite-difference method. Kyoto University 1988.
B.L.N. Kennett: The seismic wavefield I and II. Cambridge University Press 2001 a 2002.
J.M. Carcione: Wave field in real media: Wave propagation in anisotropic, anelastic and porous media. Pergamon 2001
selected articles in Geophysics, Bull. Seism. Soc. Am., Geophys. J. Int., J. Geophys. Res., Wave Motion

Languages necessary to complete the course:

Notes:

Past grade distribution
Total number of evaluated students: 6

A	ABS	B	C	D	E	FX	NEABS
83,33	16,67	0,0	0,0	0,0	0,0	0,0	0,0

Lecturers: prof. RNDr. Peter Moczo, DrSc.

Last change: 28.03.2022

Approved by:

COURSE DESCRIPTION

Academic year: 2022/2023

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KTF+KAFZM/3-FTM-804/22	Elaboration of the Reviewer's Report on the Final Thesis

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

Number of credits: 5

Recommended semester:

Educational level: III.

Prerequisites:

Course requirements:

Learning outcomes:

Class syllabus:

Recommended literature:

Languages necessary to complete the course:

Notes:

Past grade distribution
Total number of evaluated students: 0

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

Lecturers:

Last change:

Approved by:

COURSE DESCRIPTION

Academic year: 2022/2023

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KTF/3-FVM-211/15	Exactly Solvable Models in Quantum Mechanics and Statistical Physics

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

Number of credits: 10

Recommended semester: 4.

Educational level: III.

Prerequisites:

Course requirements:
Continuous assessment: continuous 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 course, students will be able to explain under what circumstances the system of interacting particles (or spins) is exactly solvable.
Solution of several model systems.

Class syllabus:
Bethe ansatz method. Analysis of Bethe equations and determination of ground state energy (free energy) as well as the first excited levels depending on the model parameters. Formalization of Bethe ansatz via Yang-Baxter equations, "inverse method of quantum scattering matrix". Model systems: two-dimensional Ising model, one-dimensional quantum Heisenberg model and Hubbard model.

Recommended literature:
R. J. Baxter, Exactly Solved Models in Statistical Mechanics, Acad. Press, 1982 (rus. Mir, 1985).
L. D. Faddeev, How Algebraic Bethe Ansatz works for integrable model, in "Les Houches lectures" (Elsevier, 1997); arXiv:hep-th/9605187.
T. Deguchi, Introduction to solvable lattice models in statistical and mathematical physics, in "Classical and Quantum Integrable Systems: Theory and Application" (IOP Publishing, 2003); cond-mat/0304309.

Languages necessary to complete the course:
Slovak, English

Notes:

Past grade distribution
Total number of evaluated students: 3

A	ABS	B	C	D	E	FX	NEABS
33,33	33,33	33,33	0,0	0,0	0,0	0,0	0,0

Lecturers: RNDr. Ladislav Šamaj, DrSc.

Last change: 15.03.2022

Approved by:

COURSE DESCRIPTION

Academic year: 2022/2023

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KAMS/3-FGF-011/22	Hydrodynamics and Magnetohydrodynamics

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

Number of credits: 10

Recommended semester: 3.

Educational level: III.

Prerequisites:

Course requirements:

Learning outcomes:
By completing the course, students will master the mechanisms of magnetic field generation in rotating systems based on magnetohydrodynamics, methods of linear analysis of instabilities of various types and the principles of dynamo theory.

Class syllabus:
Basic equations of MHD, Boussinesqu and inelastic approximation, density stratification and conditions for convection. Toroidal and poloidal vectors, decay modes. Dimensionless parameters, scaling. Non-diffusion waves, the effect of diffusion on MHD waves. Boundary layers (Ekman, Hartmann, Stewartson). Magnetoconvection in rotating systems, linear stability theory. Stationary convection and periodic instabilities. Horizontal rotating layer model, stability studies in cylindrical and spherical layers. MAC and MC waves. Finite amplitude convection, nonlinear stability theory. MHD in the middle fields.
Convection and dynamo drive mechanisms. Kinematic dynamos and antidynamic theorems. Alpha-effect and omega-effect, alpha-omega dynamos, dyna models with strong and weak field, dynamo number, Taylor condition, Taylor state. Z-dynamo. Computer dyna models, self-consistent self-exciting dynamo. Numerical implementation and solution methods. Geodynamic inversions and their control and regulation mechanisms.

Recommended literature:
J. A. Jacobs: Geomagnetism, Vol. 2. Academic Press 1987
H. K. Moffatt: Magnetic field generation in electrically conducting fluids. Cambridge University Press 1978
P. H. Roberts: An Introduction to Magnetohydrodynamics. Longman 1967
S. Chandrasekhar: Hydrodynamic and hydromagnetic stability. Clarendon Press 1961
Selected papers in Phys. Earth Planet. Int., Geophys. Astrophys. Fluid Dyn.

Languages necessary to complete the course:

Notes:

Past grade distribution
Total number of evaluated students: 2

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

Lecturers: doc. RNDr. Peter Guba, PhD.

Last change: 28.03.2022

Approved by:

COURSE DESCRIPTION

Academic year: 2022/2023

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KTF/3-FVM-105/15	Individual Study of Research Resources (1)

Educational activities:
Type of activities: independent work
Number of hours:
per week: 4 **per level/semester:** 52
Form of the course: on-site learning, distance learning

Number of credits: 10

Recommended semester: 1.

Educational level: III.

Prerequisites:

Course requirements:

Learning outcomes:

Class syllabus:

Recommended literature:

Languages necessary to complete the course:

Notes:

Past grade distribution
Total number of evaluated students: 36

A	ABS	B	C	D	E	FX	NEABS
66,67	33,33	0,0	0,0	0,0	0,0	0,0	0,0

Lecturers: prof. RNDr. Peter Moczo, DrSc., doc. RNDr. Vladimír Balek, CSc., doc. RNDr. Marián Fecko, PhD., doc. RNDr. Tomáš Blažek, PhD., doc. Mgr. Jozef Kristek, DrSc.

Last change: 02.06.2015

Approved by:

COURSE DESCRIPTION

Academic year: 2022/2023

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KTF/3-FVM-106/15	Individual Study of Research Resources (2)

Educational activities:
Type of activities: independent work
Number of hours:
per week: 4 **per level/semester:** 52
Form of the course: on-site learning, distance learning

Number of credits: 10

Recommended semester: 2.

Educational level: III.

Prerequisites:

Course requirements:

Learning outcomes:

Class syllabus:

Recommended literature:

Languages necessary to complete the course:

Notes:

Past grade distribution
Total number of evaluated students: 31

A	ABS	B	C	D	E	FX	NEABS
70,97	25,81	3,23	0,0	0,0	0,0	0,0	0,0

Lecturers: prof. RNDr. Peter Moczo, DrSc., doc. RNDr. Vladimír Balek, CSc., doc. RNDr. Marián Fecko, PhD., doc. RNDr. Tomáš Blažek, PhD., doc. Mgr. Jozef Kristek, DrSc.

Last change: 02.06.2015

Approved by:

COURSE DESCRIPTION

Academic year: 2022/2023

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KTF/3-FVM-107/15	Individual Study of Research Resources (3)

Educational activities:
Type of activities: independent work
Number of hours:
per week: 4 **per level/semester:** 52
Form of the course: on-site learning, distance learning

Number of credits: 10

Recommended semester: 3.

Educational level: III.

Prerequisites:

Course requirements:

Learning outcomes:

Class syllabus:

Recommended literature:

Languages necessary to complete the course:

Notes:

Past grade distribution
Total number of evaluated students: 31

A	ABS	B	C	D	E	FX	NEABS
67,74	29,03	0,0	3,23	0,0	0,0	0,0	0,0

Lecturers: prof. RNDr. Peter Moczo, DrSc., doc. RNDr. Vladimír Balek, CSc., doc. RNDr. Marián Fecko, PhD., doc. RNDr. Tomáš Blažek, PhD., doc. Mgr. Jozef Kristek, DrSc.

Last change: 02.06.2015

Approved by:

COURSE DESCRIPTION

Academic year: 2022/2023

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KTF/3-FVM-108/15	Individual Study of Research Resources (4)

Educational activities:
Type of activities: independent work
Number of hours:
per week: 4 **per level/semester:** 52
Form of the course: on-site learning, distance learning

Number of credits: 10

Recommended semester: 4.

Educational level: III.

Prerequisites:

Course requirements:

Learning outcomes:

Class syllabus:

Recommended literature:

Languages necessary to complete the course:

Notes:

Past grade distribution
Total number of evaluated students: 28

A	ABS	B	C	D	E	FX	NEABS
75,0	21,43	0,0	0,0	3,57	0,0	0,0	0,0

Lecturers: prof. RNDr. Peter Moczo, DrSc., doc. RNDr. Vladimír Balek, CSc., doc. RNDr. Marián Fecko, PhD., doc. RNDr. Tomáš Blažek, PhD., doc. Mgr. Jozef Kristek, DrSc.

Last change: 02.06.2015

Approved by:

COURSE DESCRIPTION

Academic year: 2022/2023

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KTF+KAFZM/3-FTM-301/22	International Journal – Current Content/Registered in WoS database

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

Number of credits: 40

Recommended semester:

Educational level: III.

Prerequisites:

Course requirements:

Learning outcomes:

Class syllabus:

Recommended literature:

Languages necessary to complete the course:

Notes:

Past grade distribution
Total number of evaluated students: 3

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

Lecturers: prof. RNDr. Peter Moczo, DrSc., doc. RNDr. Vladimír Balek, CSc., doc. RNDr. Marián Fecko, PhD., doc. RNDr. Tomáš Blažek, PhD., doc. Mgr. Jozef Kristek, DrSc.

Last change:

Approved by:

COURSE DESCRIPTION

Academic year: 2022/2023

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KTF+KAFZM/3-FTM-303/22	International Journal – Non-Current Content/Non-Registered in WoS database

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

Number of credits: 20

Recommended semester:

Educational level: III.

Prerequisites:

Course requirements:

Learning outcomes:

Class syllabus:

Recommended literature:

Languages necessary to complete the course:

Notes:

Past grade distribution
Total number of evaluated students: 0

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

Lecturers: prof. RNDr. Peter Moczo, DrSc., doc. RNDr. Vladimír Balek, CSc., doc. RNDr. Marián Fecko, PhD., doc. RNDr. Tomáš Blažek, PhD., doc. Mgr. Jozef Kristek, DrSc.

Last change:

Approved by:

COURSE DESCRIPTION

Academic year: 2022/2023

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KTF/3-FVM-204/15	Introduction to Quantum Processing of Information

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

Number of credits: 10

Recommended semester: 3.

Educational level: III.

Prerequisites:

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

Learning outcomes:
Students will get acquainted with the basic principles of quantum information processing and quantum communication theory.

Class syllabus:
Fundamental concepts of quantum mechanics, basics of computer science, quantum logic networks, quantum Fourier transform, quantum search algorithms, physical implementation of quantum computers, CP maps and quantum processes, open quantum systems and decoherence, quantum communication channels and their capacity.

Recommended literature:
M. Nielsen and I.Chuang: Quantum Computation and Quantum Information (CUP, 2000)
J. Preskill: Quantum Computing (http://www.theory.caltech.edu/people/preskill/ph229/)

Languages necessary to complete the course:

Notes:

Past grade distribution
Total number of evaluated students: 10

A	ABS	B	C	D	E	FX	NEABS
20,0	70,0	0,0	0,0	0,0	10,0	0,0	0,0

Lecturers: prof. RNDr. Vladimír Bužek, DrSc., doc. Mgr. Mário Ziman, PhD.

Last change: 15.03.2022

Approved by:

COURSE DESCRIPTION

Academic year: 2022/2023

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KAFZM/3-FGF-102/22	Mathematical Methods in Geophysics

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

Number of credits: 10

Recommended semester: 1.

Educational level: III.

Prerequisites:

Course requirements:
The evaluation of the subject is individual by the supervisor, according to the individual study plan of the doctoral student. The evaluation reflects the sufficient orientation of the student in the subject. The conditions for successful completion of the course are in accordance with the Study Regulations of Faculty of Mathematics, Physics and Informatics.

Learning outcomes:
After completing the course, students will have knowledge of specific mathematical methods applicable in geophysical research.

Class syllabus:
The equations of mathematical physics (in geophysics) – partial differential equations and the methods to solve them. The methods of potential theory, the Green functions method. Qualitative analysis of ordinary differential equations. Application of integral transforms (in mathematical physics and in the data and signal processing…). The methods of signal processing – linear, non-linear, statistical approaches, wavelet transform and analysis. The method of boundary integral equations. Perturbation and asymptotic methods – their application in solving of nonlinear equations (algebraic, differential). Numerical methods – finite difference method, boundary element method, spectral method. Interpolation and approximation.

Recommended literature:
T. Rikitake, R. Sato, Y. Hagiwara: Applied Mathematics for Earth Scientists. Kluwer 1987
M. Abramowitz, I.A. Stegun: Handbook of mathematical functions. National Bureau of Standards, Applied Mathematics Series, 1964
V.J. Arsenin: Matematická fyzika, Alfa 1977 (in Slovak)
M. Hvoždara, M. Gajdošová (R. Pašteka): Matematické základy teórie geofyzikálnych metód I (II), Lecture notes PriFUK 1998 (2000) (in Slovak)
A. Ralston: Základy numerické matematiky, Academia 1973
A.H. Nayfeh: Introduction to Perturbation Techniques, J. Wiley 1981
A.H. Nayfeh, B.Balachandran: Applied Nonlinear Dynamics, J. Wiley 1995
P. Glendinning: Stability, Instability and Chaos. Cambridge University Press 1994

A. Angot: Užitá matematika pro elektrotechnické inženýry. SNTL 1971, (in Czech)
P.M. Morse, H. Feshbach: Methods of Theoretical Physics. McGraw-Hill 1953
H. Jeffreys, B. Swirles: Methods of Mathematical Physics. Cambridge University Press 1966

Languages necessary to complete the course:

Notes:

Past grade distribution
Total number of evaluated students: 10

A	ABS	B	C	D	E	FX	NEABS
90,0	10,0	0,0	0,0	0,0	0,0	0,0	0,0

Lecturers: doc. Mgr. Jozef Kristek, DrSc.

Last change: 28.03.2022

Approved by:

COURSE DESCRIPTION

Academic year: 2022/2023

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KTF/3-FTM-006/22	Mathematical Methods of Theoretical Physics (1)

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

Number of credits: 10

Recommended semester: 1.

Educational level: III.

Prerequisites:

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

Learning outcomes:

Class syllabus:
Geometric approach to hydrodynamics,
2D vector analysis
energy-momentum tensor
Nöther's theorem
Kaluza-Klein geometry,

Recommended literature:
M.Fecko: Differential Geometry and Lie Groups for Physicists,
Cambridge University Press, 2006, 2011
M.Fecko: Modern geometry in not-so-high echelons of physics: Case studies,
Acta Physica Slovaca 63, No.5, 261 - 359 (2013) (arXiv:1406.0078)
Ch.Misner, Kip S.Thorne, J.A.Wheeler: Gravitation, W.H.Freeman, 1973

Languages necessary to complete the course:
SK, EN

Notes:

Past grade distribution
Total number of evaluated students: 2

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

Lecturers: doc. RNDr. Marián Fecko, PhD.

Last change: 14.03.2022
Approved by:

COURSE DESCRIPTION

Academic year: 2022/2023

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KTF/3-FTM-007/22	Mathematical Methods of Theoretical Physics (2)

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

Number of credits: 10

Recommended semester: 2.

Educational level: III.

Prerequisites:

Course requirements:
Continuous assessment: solving tasks
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 geometry in the areas listed in the Brief syllabus.

Class syllabus:
Einstein-Cartan gravity
Newton-Cartan gravity,
cohomology of Lie algebras
Lie algebroids
quantum dynamics as a ("classical") Hamiltonian system

Recommended literature:

Languages necessary to complete the course:
SK, EN

Notes:

Past grade distribution
Total number of evaluated students: 1

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

Lecturers: doc. RNDr. Marián Fecko, PhD.

Last change: 14.03.2022

Approved by:

COURSE DESCRIPTION

Academic year: 2022/2023

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KTF/3-FVM-210/15	Mathematical Structures of Quantum Theory

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, distance learning

Number of credits: 10

Recommended semester: 4.

Educational level: III.

Prerequisites:

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

Learning outcomes:
The graduate of this course will be able to use mathematical tools and formalism of modern quantum theory.

Class syllabus:
1. Mathematical foundations (Hilbert spaces, transformation groups, convex sets, measure theory) 2. States and effects (density matrix, state space, duality, automorphism groups, Wigner theorem, Gleason's theorem) 3. Quantum observable (POVM, relations between observable , Naimark's theorem) 4. Quantum operations (complete positivity, Stinespring's theorem, Choi-Jamiolkowski isomorphism, quantum channels, Kraus representation) 5. Quantum measurement models (instruments, Luders measurements) 6. Quantum dynamics (control equations, Lindblad's equation)

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

Languages necessary to complete the course:
Slovak, English

Notes:

Past grade distribution
Total number of evaluated students: 11

A	ABS	B	C	D	E	FX	NEABS
36,36	45,45	9,09	9,09	0,0	0,0	0,0	0,0

Lecturers: doc. Mgr. Mário Ziman, PhD.

Last change: 15.03.2022

Approved by:

COURSE DESCRIPTION

Academic year: 2022/2023

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KTF+KAFZM/3-FTM-703/22	Obtaining a University Grant

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

Number of credits: 15

Recommended semester:

Educational level: III.

Prerequisites:

Course requirements:

Learning outcomes:

Class syllabus:

Recommended literature:

Languages necessary to complete the course:

Notes:

Past grade distribution
Total number of evaluated students: 1

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

Lecturers: prof. RNDr. Peter Moczo, DrSc., doc. RNDr. Vladimír Balek, CSc., doc. RNDr. Marián Fecko, PhD., doc. RNDr. Tomáš Blažek, PhD., doc. Mgr. Jozef Kristek, DrSc.

Last change:

Approved by:

STATE EXAM DESCRIPTION

Academic year: 2022/2023	
University: Comenius University Bratislava	
Faculty: Faculty of Mathematics, Physics and Informatics	
Course ID: FMFI.KTF/3-FVM-950/15	**Course title:** Passing Dissertation Examination
Number of credits: 20	
Educational level: III.	
State exam syllabus:	
Last change: 12.10.2016	
Approved by:	

COURSE DESCRIPTION

Academic year: 2022/2023

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KAFZM/3-FGF-016/22	Physical Principles and Probabilistic Methods of Seismic Hazard Analysis

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

Number of credits: 10

Recommended semester: 2.

Educational level: III.

Prerequisites:

Course requirements:
The evaluation of the subject is individual by the supervisor, according to the individual study plan of the doctoral student. The evaluation reflects the sufficient orientation of the student in the subject. The conditions for successful completion of the course are in accordance with the Study Regulations of Faculty of Mathematics, Physics and Informatics.

Learning outcomes:
After completing the course, students will be able to apply current methods of seismic hazard analysis.

Class syllabus:
Seismoactive fault, structure of active focal zone, spatio-temporal mode of focal zone, long-term physical processes of earthquake preparation, fault process - crack initialization and propagation, elements of seismic threat, parameterization of seismoactive fault and focal zone in relation to earthquake probability model, , seismotectonic model, epistemic and aleatoric uncertainties of focal zone parameters, attenuation of seismic hazard characteristics, logical tree of seismic hazard parameters - seismic hazard scenarios, probabilistic calculations of seismic hazard characteristics, probabilistic calculation deagregation.

Recommended literature:
R.K. McGuire: The practice of earthquake hazard assessment. IASPEI/ESC 1993
L. Reiter: Earthquake hazard analysis. Issues and insights.Columbia University Presss 1990
C.A. Cornell: Engineering seismic risk analysis. Bull. Seism. Soc. Am. 58,1538-1606,1968
K.W. Campbell: Near-source attenuation of peak horizontal acceleration. Bull. Seism. Soc. Am.71, 2039-2070, 1981
D.L. Wells, K.J. Coppersmith: New empirical relationships among magnitude, rupture length, rupture width, rupure area, and surface displacement. Bull. Seism. Soc. Am. 84, 974-1002,1994
S.-C. Wu et al: A hybrid recurrence model and its implication on seismic hazard results. Bull. Seism. Soc. Am. 85, 1-16,1995
the whole No: Seism. Res. Lett. 68, No. 1, 1997

selected papers in Bull. Seism. Soc. Am., J. Geophys. Res., J. European Engng., Nat. Haz.

Languages necessary to complete the course:

Notes:

Past grade distribution
Total number of evaluated students: 6

A	ABS	B	C	D	E	FX	NEABS
83,33	16,67	0,0	0,0	0,0	0,0	0,0	0,0

Lecturers: doc. Mgr. Jozef Kristek, DrSc.

Last change: 28.03.2022

Approved by:

COURSE DESCRIPTION

Academic year: 2022/2023

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KAFZM/3-FGF-014/22	Physics of Seismic Source

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

Number of credits: 10

Recommended semester: 3.

Educational level: III.

Prerequisites:

Course requirements:
The evaluation of the subject is individual by the supervisor, according to the individual study plan of the doctoral student. The evaluation reflects the sufficient orientation of the student in the subject. The conditions for successful completion of the course are in accordance with the Study Regulations of Faculty of Mathematics, Physics and Informatics.

Learning outcomes:
By completing the course, students will gain an overview of current models of long-term preparation of the tectonic earthquake, the initiation of the fault process and the fault process itself.

Class syllabus:
Tectonic movements of the lithosphere, stress in the lithosphere, cohesion and internal friction, Coulomb's criterion, Anderson's theory of fracture formation, population of fractures, structure and rheology of fracture zone, stress and deformation in fracture zone, thermodynamics of fracture zone, asseismic movements. Breaking surface, initial stress. Crack initialization and formation, crack propagation modes, spontaneous crack propagation and boundary conditions on the fracture surface. Friction - microscopic and macroscopic view. Results of laboratory measurements. Laws of friction and crack propagation on the fracture surface. The process of stopping crack propagation. Energy balance of crack formation and propagation. Seismic crack propagation efficiency. Influence of initial stress, material inhomogeneity, fracture surface geometry. Influence of fluid pressure in pores. Friction heating. Small and large earthquakes in terms of crack propagation and seismic efficiency.

Recommended literature:
Ch. H. Scholz: The mechanics of earthquakes and faulting. Cambridge Univ. Press 2002
B.V. Kostrov, S. Das: Principles of earthquake source mechanics. Cambridge Univ. Press 1988
J.R. Rice: The mechanics of earthquake rupture. North-Holland 1980
J. Koyama: The complex faulting process of earthquakes. Kluwer 1997.
R. Teisseyre (ed.): Continuum theories in solid earth physics. Elsevier 1986
L.B. Freund: Dynamic fracture mechanics. Cambridge Univ. Press 1998
B. Lawn: Fracture of brittle solids. Cambridge Univ. Press 1998

selected articles in Bull. Seism. Soc. Am., J. Geophys. Res., Geophys. J. Int., Rev. Geophysics

Languages necessary to complete the course:

Notes:

Past grade distribution
Total number of evaluated students: 3

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

Lecturers: doc. Mgr. Martin Gális, PhD.

Last change: 28.03.2022

Approved by:

COURSE DESCRIPTION

Academic year: 2022/2023

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KTF+KAFZM/3-FTM-402/22	Presentation at Domestic Conference

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

Number of credits: 15

Recommended semester:

Educational level: III.

Prerequisites:

Course requirements:

Learning outcomes:

Class syllabus:

Recommended literature:

Languages necessary to complete the course:

Notes:

Past grade distribution
Total number of evaluated students: 6

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

Lecturers: prof. RNDr. Peter Moczo, DrSc., doc. RNDr. Vladimír Balek, CSc., doc. RNDr. Marián Fecko, PhD., doc. RNDr. Tomáš Blažek, PhD., doc. Mgr. Jozef Kristek, DrSc.

Last change:

Approved by:

COURSE DESCRIPTION

Academic year: 2022/2023

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KTF+KAFZM/3-FTM-401/22	Presentation at International Conference

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

Number of credits: 20

Recommended semester:

Educational level: III.

Prerequisites:

Course requirements:

Learning outcomes:

Class syllabus:

Recommended literature:

Languages necessary to complete the course:

Notes:

Past grade distribution
Total number of evaluated students: 5

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

Lecturers: prof. RNDr. Peter Moczo, DrSc., doc. RNDr. Vladimír Balek, CSc., doc. RNDr. Marián Fecko, PhD., doc. RNDr. Tomáš Blažek, PhD., doc. Mgr. Jozef Kristek, DrSc.

Last change:

Approved by:

COURSE DESCRIPTION

Academic year: 2022/2023

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KAFZM/3-FEM-111/22	Professional Oral Communication in English

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

Number of credits: 5

Recommended semester: 3.

Educational level: III.

Prerequisites:

Course requirements:
Regular and active presence at the seminars, student's professional presentations in various formats. The course will be classified provided that the PhD 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.

Learning outcomes:
The aim of the course is to help the student improve his/her communication and presentation skills and stimulate discussion in a simulated scientific conference/symposium setting.

Class syllabus:
The students will be trained to deliver various formats of professional communication tools: Elevator talk (1 min). Brief poster talk (3-5 min overview of the student's research topic and key achievements), flash (3 min) and full (15-45 min) oral presentation. Technique and delivery of a good (scientific) presentation. Asking questions and adding comments, addressing peers' questions and comments. The students' topics for presentation: their current research activities or other related topics to the student's field of study. By the end of the course the student will be able to present and discuss their topic effectively in English with using a variety of tools and tips.

Recommended literature:
Armer, T.: Cambridge English for Scientists

Languages necessary to complete the course:
English

Notes:
Knowledge of English minimum at B1 level.

Past grade distribution
Total number of evaluated students: 13

ABS	NEABS
100,0	0,0

Lecturers: prof. RNDr. Zdenko Machala, DrSc.
Last change: 14.04.2022
Approved by:

COURSE DESCRIPTION

Academic year: 2022/2023

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KTF/3-FTM-209/22	Quantum Theory of Gravity

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

Number of credits: 10

Recommended semester: 1.

Educational level: III.

Prerequisites:

Recommended prerequisites:
2-FTF-117 General Theory of Relativity

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, students will know the success to date on the way to combine quantum mechanics with general theory of relativity.

Class syllabus:
Hawking radiation (scalar field modes against a black hole, Hawking temperature), wave function of the universe (ADM formalism, diffeomorphism and Hamiltonian coupling, Hawking - Hartl boundary condition, minispace).

Recommended literature:
S. W. Hawking, Comm. Math. Phys. 43, 199 (1975);
J. B. Hartle, S. W. Hawking, Phys. Rev. D 28, 2960 (1983)

Languages necessary to complete the course:
Slovak, English

Notes:

Past grade distribution
Total number of evaluated students: 5

A	ABS	B	C	D	E	FX	NEABS
60,0	40,0	0,0	0,0	0,0	0,0	0,0	0,0

Lecturers: doc. RNDr. Vladimír Balek, CSc.

Last change: 28.03.2022

Approved by:

COURSE DESCRIPTION

Academic year: 2022/2023

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KTF/3-FTM-207/22	Quantum simulations and calculations

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

Number of credits: 10

Recommended semester: 3.

Educational level: III.

Prerequisites:

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

Learning outcomes:
Students will learn about current theories of tensor networks, which are used to obtain very accurate descriptions of quantum states of fermion and boson strongly correlated systems. They will learn to analyze systems using renoralization methods based on decomposition into singular values by maximizing the quantum entropy of coupling.

Class syllabus:
Interacting systems written by the matrix formalism of the second quantization. Reduced density matrix and von Neumann entropy of quantum coupling. Renormalization group in real space. Matrix product states. Decompositions into singular values. Quantum-classical correspondence. Phase transition theory. Classification of universality classes. Fractal systems of interacting spins. Hyperbolic systems (Anti-de Sitter space) of interacting spins. Quantum gravity.

Recommended literature:
Roman Orus, A practical Introduction to Tensor Networks: Matrix Product States and Projected Entangled Pair States, Annals of Physics 349 (2014) 117-158

Languages necessary to complete the course:
Slovak, English

Notes:

Past grade distribution
Total number of evaluated students: 9

A	ABS	B	C	D	E	FX	NEABS
22,22	77,78	0,0	0,0	0,0	0,0	0,0	0,0

Lecturers: Mgr. Andrej Gendiar, PhD.

Last change: 15.03.2022
Approved by:

COURSE DESCRIPTION

Academic year: 2022/2023

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KTF/3-FTM-001/22	Relativistic Quantum Field Theory (1)

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, distance learning

Number of credits: 10

Recommended semester: 1.

Educational level: III.

Prerequisites:

Recommended prerequisites:
2-FTF-116/00 Kvantová elektrodynamika

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

Learning outcomes:
Students completing the course will be able to use the material covered by the course - as listed below.

Class syllabus:
Relativistic quantum fields: bosons and fermions. Examples of tree-level processes, Feynman diagrams and details of perturbation theory. Regularization and renormalization. Example of calculation at the level of one loop.

Recommended literature:
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 The quantum theory of fields : Volume 2 : Modern applications / Steven Weinberg. Cambridge : Cambridge University Press, 2005

Languages necessary to complete the course:
Slovak, English

Notes:

Past grade distribution
Total number of evaluated students: 4

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

Lecturers: prof. RNDr. Peter Prešnajder, DrSc., doc. RNDr. Tomáš Blažek, PhD.

Last change: 14.03.2022
Approved by:

COURSE DESCRIPTION

Academic year: 2022/2023

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KTF/3-FTM-002/22	Relativistic Quantum Field Theory (2)

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, distance learning

Number of credits: 10

Recommended semester: 2.

Educational level: III.

Prerequisites:

Recommended prerequisites:
2-FTF-116/00 Kvantová elektrodynamika

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

Learning outcomes:
Students completing the course will be able to use the material covered by the course - as listed below.

Class syllabus:
Relativistic quantum fields, bosons and fermions in non-abelian gauge theory. Aspects of renormalization: beta function in non-abelian gauge theory and running of gauge coupling constants in the standard model.

Recommended literature:
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 The quantum theory of fields : Volume 2 : Modern applications / Steven Weinberg. Cambridge : Cambridge University Press, 2005

Languages necessary to complete the course:
Slovak, English

Notes:

Past grade distribution
Total number of evaluated students: 2

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

Lecturers: prof. RNDr. Peter Prešnajder, DrSc., doc. RNDr. Tomáš Blažek, PhD.

Last change: 14.03.2022
Approved by:

COURSE DESCRIPTION

Academic year: 2022/2023

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KTF/3-FVM-301/22	Research Work (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, distance learning

Number of credits: 3

Recommended semester: 5.

Educational level: III.

Prerequisites:

Course requirements:
Ongoing evaluation based on homework
Approximate marking: A 90%, B 80%, C 70%, D 60%, E 50%
Scale of assessment (preliminary/final): 100/0

Learning outcomes:
The student will learn to work individually and in a team on a research project in the following areas: 1. Publishing activities, 2. Active presentation of results, 3. Grants, responses and others

Class syllabus:
independent active scientific activity based on the recommendation of the advisor
1. Work on a publication sent to a professional journal, conference proceedings, contribution to a collaborative note. Development of a new software product related to the dissertation. 2. Presentation at a conference, summer school, professional event, presentation of preliminary results at a departmental seminar or equivalent event for the named events. 3. Submission of a UK grant, participation of at least 20% in the submission of other research grants. The percentage will be confirmed by the advisor.

Recommended literature:
Selection of recent papers from the field relevant to the PhD work

Languages necessary to complete the course:
Slovak, English

Notes:

Past grade distribution
Total number of evaluated students: 26

A	ABS	B	C	D	E	FX	NEABS
76,92	23,08	0,0	0,0	0,0	0,0	0,0	0,0

Lecturers: prof. RNDr. Peter Moczo, DrSc., doc. RNDr. Vladimír Balek, CSc., doc. RNDr. Marián Fecko, PhD., doc. RNDr. Tomáš Blažek, PhD., doc. Mgr. Jozef Kristek, DrSc.

Last change: 01.04.2022
Approved by:

COURSE DESCRIPTION

Academic year: 2022/2023

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KTF/3-FVM-302/22	Research Work (2)

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

Number of credits: 3

Recommended semester: 6.

Educational level: III.

Prerequisites:

Course requirements:
Ongoing evaluation based on homework Approximate marking: A 90%, B 80%, C 70%, D 60%, E 50%
Scale of assessment (preliminary/final): 100/0

Learning outcomes:
The student will learn to work individually and in a team on a research project in the following areas: 1. Publishing activities, 2. Active presentation of results, 3. Grants, responses and others

Class syllabus:
independent active scientific activity based on the recommendation of the advisor
1. Work on a publication sent to a professional journal, conference proceedings, contribution to a collaborative note. Development of a new software product related to the dissertation. 2. Presentation at a conference, summer school, professional event, presentation of preliminary results at a departmental seminar or equivalent event for the named events. 3. Submission of a UK grant, participation of at least 20% in the submission of other research grants. The percentage will be confirmed by the advisor.

Recommended literature:
Selection of recent papers from the field relevant to the PhD work

Languages necessary to complete the course:
Slovak, English

Notes:

Past grade distribution
Total number of evaluated students: 24

A	ABS	B	C	D	E	FX	NEABS
79,17	20,83	0,0	0,0	0,0	0,0	0,0	0,0

Lecturers: prof. RNDr. Peter Moczo, DrSc., doc. RNDr. Vladimír Balek, CSc., doc. RNDr. Marián Fecko, PhD., doc. RNDr. Tomáš Blažek, PhD., doc. Mgr. Jozef Kristek, DrSc.

Last change: 01.04.2022
Approved by:

COURSE DESCRIPTION

Academic year: 2022/2023

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KTF/3-FVM-303/22	Research Work (3)

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

Number of credits: 3

Recommended semester: 7.

Educational level: III.

Prerequisites:

Course requirements:
Ongoing evaluation based on homework Approximate marking: A 90%, B 80%, C 70%, D 60%, E 50%
Scale of assessment (preliminary/final): 100/0

Learning outcomes:
The student will learn to work individually and in a team on a research project in the following areas: 1. Publishing activities, 2. Active presentation of results, 3. Grants, responses and others

Class syllabus:
independent active scientific activity based on the recommendation of the advisor
1. Work on a publication sent to a professional journal, conference proceedings, contribution to a collaborative note. Development of a new software product related to the dissertation. 2. Presentation at a conference, summer school, professional event, presentation of preliminary results at a departmental seminar or equivalent event for the named events. 3. Submission of a UK grant, participation of at least 20% in the submission of other research grants. The percentage will be confirmed by the advisor.

Recommended literature:
Selection of recent papers from the field relevant to the PhD work

Languages necessary to complete the course:
Slovak, English

Notes:

Past grade distribution
Total number of evaluated students: 24

A	ABS	B	C	D	E	FX	NEABS
70,83	29,17	0,0	0,0	0,0	0,0	0,0	0,0

Lecturers: prof. RNDr. Peter Moczo, DrSc., doc. RNDr. Vladimír Balek, CSc., doc. RNDr. Marián Fecko, PhD., doc. RNDr. Tomáš Blažek, PhD., doc. Mgr. Jozef Kristek, DrSc.

Last change: 01.04.2022
Approved by:

COURSE DESCRIPTION

Academic year: 2022/2023

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KTF/3-FVM-304/22	Research Work (4)

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

Number of credits: 3

Recommended semester: 8.

Educational level: III.

Prerequisites:

Course requirements:
Ongoing evaluation based on homework Approximate marking: A 90%, B 80%, C 70%, D 60%, E 50%
Scale of assessment (preliminary/final): 100/0

Learning outcomes:
The student will learn to work individually and in a team on a research project in the following areas: 1. Publishing activities, 2. Active presentation of results, 3. Grants, responses and others

Class syllabus:
independent active scientific activity based on the recommendation of the advisor
1. Work on a publication sent to a professional journal, conference proceedings, contribution to a collaborative note. Development of a new software product related to the dissertation. 2. Presentation at a conference, summer school, professional event, presentation of preliminary results at a departmental seminar or equivalent event for the named events. 3. Submission of a UK grant, participation of at least 20% in the submission of other research grants. The percentage will be confirmed by the advisor.

Recommended literature:
Selection of recent papers from the field relevant to the PhD work

Languages necessary to complete the course:

Notes:

Past grade distribution
Total number of evaluated students: 18

A	ABS	B	C	D	E	FX	NEABS
66,67	33,33	0,0	0,0	0,0	0,0	0,0	0,0

Lecturers: prof. RNDr. Peter Moczo, DrSc., doc. RNDr. Vladimír Balek, CSc., doc. RNDr. Marián Fecko, PhD., doc. RNDr. Tomáš Blažek, PhD., doc. Mgr. Jozef Kristek, DrSc.

Last change: 01.04.2022
Approved by:

COURSE DESCRIPTION

Academic year: 2022/2023

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KAFZM/3-FTM-008/22	Selected Chapters from Geomagnetism

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

Number of credits: 10

Recommended semester: 2.

Educational level: III.

Prerequisites:

Course requirements:

Learning outcomes:

Class syllabus:

Recommended literature:

Languages necessary to complete the course:

Notes:

Past grade distribution
Total number of evaluated students: 0

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

Lecturers: RNDr. Róbert Kysel, PhD.

Last change:

Approved by:

COURSE DESCRIPTION

Academic year: 2022/2023	
University: Comenius University Bratislava	
Faculty: Faculty of Mathematics, Physics and Informatics	
Course ID: FMFI.KAFZM/3-FGF-009/22	**Course title:** Selected Chapters from the Physics of the Ionosphere and Magnetosphere
Educational activities: **Type of activities:** lecture **Number of hours:** **per week:** 3 **per level/semester:** 39 **Form of the course:** on-site learning, distance learning	
Number of credits: 10	
Recommended semester: 3.	
Educational level: III.	
Prerequisites:	
Course requirements: The evaluation of the subject is individual by the supervisor, according to the individual study plan of the doctoral student. The evaluation reflects the sufficient orientation of the student in the subject. The conditions for successful completion of the course are in accordance with the Study Regulations of Faculty of Mathematics, Physics and Informatics.	
Learning outcomes: After completing the course, students will be able to work on a dissertation. The lecture covers the study of a wide range of processes in the ionosphere and magnetosphere induced by solar activity. The dominant focus will reflect the focus of the dissertation	
Class syllabus: Dynamics of middle atmosphere, QBO, NAO, ENSO, ionization, interaction of solar radiation with neutral atmosphere. Chemical processes in the lower ionosphere. Variations of solar activity and their influence on changes in ionosphere and middle atmosphere. Earth's magnetosphere and selected processes, solar wind interaction with magnetosphere. Time and space structure of wave processes in magnetosphere, non-linear character of geomagnetic pulsations development, resonance phenomena. Energy transfer. Processes in magnetosphere on micro- and macro scales, processes of self-organisation and synergism. Fractal dimensions and chaos, scaling. Turbulence. Intermittence and coherence. Non-linear analysis of time series. Method of neuron networks. Cosmic weather. Space satellite research. Propagation of electromagnetic waves along the curved surface and between the surface and ionosphere, eigenmodes of Earth-ionosphere resonator. Schumann resonances. Observatory measurements, analysis and processing of time records and interpretation.	
Recommended literature: W. Baumjohann, R.A. Treumann: Basic space plasma physics. Imperial College Press 1996 H.M. Hastings, G. Sugihara: Fractals: a Users Guide for the Natural Scientists. Oxford University Press 1993 M.G. Kivelson, Ch.T. Russel: Introduction to space physics. Cambridge University Press 1995	

J. Galejs: Terrestrial propagation of long electromagnetic waves. Pergamon Press 1972
J. R. Wait: Electromagnetic waves in stratified media. Pergamon Press 1962
Selected articles from J.Geophys. Res., Planet. Space Sci., Geophys. Res. Lett., Nonl. Proc.Geophys.

Languages necessary to complete the course:

Notes:

Past grade distribution
Total number of evaluated students: 0

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

Lecturers: Mgr. Dávid Gregor, PhD.

Last change: 28.03.2022

Approved by:

COURSE DESCRIPTION

Academic year: 2022/2023

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KAFZM/3-FGF-103/22	Selected Experimental and Observational Methods of Geophysics

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

Number of credits: 10

Recommended semester: 4.

Educational level: III.

Prerequisites:

Course requirements:

Learning outcomes:
After completing the course, students will be able to perform and evaluate their own observatory and experimental measurements according to the focus of the dissertation.

Class syllabus:
Physical principles of geophysical measurement systems in gravimetry, seismology, geomagnetism, paleomagnetism and electromagnetic sounding. Sensors, calibration, analog-digital conversion, time marks and synchronization, DCF and GPS time marks. Precision and sensitivity of apparatus. Absolute and relative measurements, data acquisition by computer, international rules, requirements and standards for data formatting and archivation. Data postprocessing, transfer of data to the local, regional and international collecting centers.
Protection of analog and digital data lines against overvoltages and their attendant problems in geophysical observatories. Disturbances, noise and electromagnetic smog. Elimination of antropogeneous influences by electronic and/or computational postprocessing, digital filtration. The selection of a locality for continual and temporary measurements, the analysis of a suitable locality for recording.

Recommended literature:
Selected articles in the geophysical journals.

Languages necessary to complete the course:

Notes:

Past grade distribution
Total number of evaluated students: 8

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

Lecturers: doc. Mgr. Jozef Kristek, DrSc.

Last change: 28.03.2022
Approved by:

COURSE DESCRIPTION

Academic year: 2022/2023

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KTF/3-FVM-212/15	Selected Topics in Quantum Theory of Information

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

Number of credits: 10

Recommended semester: 4.

Educational level: III.

Prerequisites:

Course requirements:

Learning outcomes:

Class syllabus:

Recommended literature:

Languages necessary to complete the course:

Notes:

Past grade distribution
Total number of evaluated students: 11

A	ABS	B	C	D	E	FX	NEABS
27,27	63,64	9,09	0,0	0,0	0,0	0,0	0,0

Lecturers: doc. Mgr. Mário Ziman, PhD., Mgr. Daniel Nagaj, PhD.

Last change: 02.06.2015

Approved by:

COURSE DESCRIPTION

Academic year: 2022/2023

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KAFZM/3-FGF-013/22	Signal and Image Analysis

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

Number of credits: 10

Recommended semester: 3.

Educational level: III.

Prerequisites:

Course requirements:
The evaluation of the subject is individual by the supervisor, according to the individual study plan of the doctoral student. The evaluation reflects the sufficient orientation of the student in the subject. The conditions for successful completion of the course are in accordance with the Study Regulations of Faculty of Mathematics, Physics and Informatics.

Learning outcomes:
After completing the course, students will be able to use advanced nonFourier methods of time-frequency analysis (TFA) signals and methods used in image processing and analysis.

Class syllabus:
Time-frequency analysis, Heisenberg-Gabor uncertainty principle, windows Fourier transform, continuous wavelet transform, marginal distributions (Wigner-Ville) for real seismic signals and their discrete versions, adaptive pursuit methods-orthogonal/non-orthogonal matching pursuit. Discrete wavelet transform, definition of multi-resolution analysis (MRA). Approximation spaces, scaling function, and the dilation equation, detail spaces. Mother wavelet and the wavelet equation. A view from the frequency domain. Orthogonal wavelets, Daubechies wavelets, Daubechies' least asymmetric filters, coiflets, biorthogonal wavelets. Local trigonometric bases and transforms - discrete sine and cosine transforms. Wavelet packet transform (WPT) and local sine and cosine packet transform. Shift-invariant wavelet transform (MODWT) and WPT's algorithms for pattern recognition. Image segmentation, signal detection and edge identification in seismic signals and images.
Wavelet threshold and noise reduction, the minimum squared error threshold. General cross validation (GCV) methods and their applicability for seismic signals. The Bayesian approach for denoising signals and images. Wavelet packet and best basis methods for compression of seismic signals.
Algorithms and methods for identification and clustering methods in automated identification of seismic phases, phase and group delay, polarization analysis, locally earthquakes effects.

Recommended literature:
S. Mallat: A Wavelet Tour of Signal Processing. Academic Press 1999

P. Flandrin: Time-Frequency / Time-Scale Analysis. Academic Press 1999
R. Carmona, W.L. Hwang, B. Torésani: Practical Time-Frequency Analysis. Academic Press 1998
R.C. Gonzales, R.E. Woods: Digital Image Processing. Addison-Wesley Publishing Co. 1993

Languages necessary to complete the course:

Notes:

Past grade distribution
Total number of evaluated students: 4

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

Lecturers: Mgr. Miriam Kristeková, PhD., prof. RNDr. Peter Moczo, DrSc.

Last change: 28.03.2022

Approved by:

COURSE DESCRIPTION

Academic year: 2022/2023

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KTF+KAFZM/3-FTM-403/22	Study Stay Abroad

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

Number of credits: 5

Recommended semester:

Educational level: III.

Prerequisites:

Course requirements:

Learning outcomes:

Class syllabus:

Recommended literature:

Languages necessary to complete the course:

Notes:

Past grade distribution
Total number of evaluated students: 1

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

Lecturers: prof. RNDr. Peter Moczo, DrSc., doc. RNDr. Vladimír Balek, CSc., doc. RNDr. Marián Fecko, PhD., doc. RNDr. Tomáš Blažek, PhD., doc. Mgr. Jozef Kristek, DrSc.

Last change:

Approved by:

COURSE DESCRIPTION

Academic year: 2022/2023

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KTF+KAFZM/3-FTM-803/22	Supervision of a Bachelor Thesis

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

Number of credits: 10

Recommended semester:

Educational level: III.

Prerequisites:

Course requirements:

Learning outcomes:

Class syllabus:

Recommended literature:

Languages necessary to complete the course:

Notes:

Past grade distribution
Total number of evaluated students: 0

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

Lecturers:

Last change:

Approved by:

COURSE DESCRIPTION

Academic year: 2022/2023

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KTF+KAFZM/3-FTM-806/22	Supervision of a Student at the Student Science Conference

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

Number of credits: 5

Recommended semester:

Educational level: III.

Prerequisites:

Course requirements:

Learning outcomes:

Class syllabus:

Recommended literature:

Languages necessary to complete the course:

Notes:

Past grade distribution
Total number of evaluated students: 0

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

Lecturers:

Last change:

Approved by:

COURSE DESCRIPTION

Academic year: 2022/2023

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KTF/3-FVM-801/10	Teaching Activities (1)

Educational activities:
Type of activities: other
Number of hours:
per week: 4 **per level/semester:** 52
Form of the course: on-site learning, distance learning

Number of credits: 10

Recommended semester: 1.

Educational level: III.

Prerequisites:

Course requirements:

Learning outcomes:

Class syllabus:

Recommended literature:

Languages necessary to complete the course:

Notes:

Past grade distribution
Total number of evaluated students: 17

A	ABS	B	C	D	E	FX	NEABS
82,35	17,65	0,0	0,0	0,0	0,0	0,0	0,0

Lecturers: prof. RNDr. Peter Moczo, DrSc., doc. RNDr. Vladimír Balek, CSc., doc. RNDr. Marián Fecko, PhD., doc. RNDr. Tomáš Blažek, PhD., doc. Mgr. Jozef Kristek, DrSc.

Last change: 02.06.2015

Approved by:

COURSE DESCRIPTION

Academic year: 2022/2023

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KTF/3-FVM-802/10	Teaching Activities (2)

Educational activities:
Type of activities: other
Number of hours:
per week: 4 **per level/semester:** 52
Form of the course: on-site learning, distance learning

Number of credits: 10

Recommended semester: 2.

Educational level: III.

Prerequisites:

Course requirements:

Learning outcomes:

Class syllabus:

Recommended literature:

Languages necessary to complete the course:

Notes:

Past grade distribution
Total number of evaluated students: 15

A	ABS	B	C	D	E	FX	NEABS
93,33	6,67	0,0	0,0	0,0	0,0	0,0	0,0

Lecturers: prof. RNDr. Peter Moczo, DrSc., doc. RNDr. Vladimír Balek, CSc., doc. RNDr. Marián Fecko, PhD., doc. RNDr. Tomáš Blažek, PhD., doc. Mgr. Jozef Kristek, DrSc.

Last change: 02.06.2015

Approved by:

COURSE DESCRIPTION

Academic year: 2022/2023

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KTF/3-FVM-803/10	Teaching Activities (3)

Educational activities:
Type of activities: other
Number of hours:
per week: 4 **per level/semester:** 52
Form of the course: on-site learning, distance learning

Number of credits: 10

Recommended semester: 3.

Educational level: III.

Prerequisites:

Course requirements:

Learning outcomes:

Class syllabus:

Recommended literature:

Languages necessary to complete the course:

Notes:

Past grade distribution
Total number of evaluated students: 16

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

Lecturers: prof. RNDr. Peter Moczo, DrSc., doc. RNDr. Vladimír Balek, CSc., doc. RNDr. Marián Fecko, PhD., doc. RNDr. Tomáš Blažek, PhD., doc. Mgr. Jozef Kristek, DrSc.

Last change: 02.06.2015

Approved by:

COURSE DESCRIPTION

Academic year: 2022/2023

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KTF/3-FVM-804/10	Teaching Activities (4)

Educational activities:
Type of activities: other
Number of hours:
per week: 4 **per level/semester:** 52
Form of the course: on-site learning, distance learning

Number of credits: 10

Recommended semester: 4.

Educational level: III.

Prerequisites:

Course requirements:

Learning outcomes:

Class syllabus:

Recommended literature:

Languages necessary to complete the course:

Notes:

Past grade distribution
Total number of evaluated students: 15

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

Lecturers: prof. RNDr. Peter Moczo, DrSc., doc. RNDr. Vladimír Balek, CSc., doc. RNDr. Marián Fecko, PhD., doc. RNDr. Tomáš Blažek, PhD., doc. Mgr. Jozef Kristek, DrSc.

Last change: 02.06.2015

Approved by:

COURSE DESCRIPTION

Academic year: 2022/2023

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KTF/3-FVM-805/10	Teaching Activities (5)

Educational activities:
Type of activities: other
Number of hours:
per week: 4 **per level/semester:** 52
Form of the course: on-site learning, distance learning

Number of credits: 10

Recommended semester: 5.

Educational level: III.

Prerequisites:

Course requirements:

Learning outcomes:

Class syllabus:

Recommended literature:

Languages necessary to complete the course:

Notes:

Past grade distribution
Total number of evaluated students: 10

A	ABS	B	C	D	E	FX	NEABS
90,0	10,0	0,0	0,0	0,0	0,0	0,0	0,0

Lecturers: prof. RNDr. Peter Moczo, DrSc., doc. RNDr. Vladimír Balek, CSc., doc. RNDr. Marián Fecko, PhD., doc. RNDr. Tomáš Blažek, PhD., doc. Mgr. Jozef Kristek, DrSc.

Last change: 02.06.2015

Approved by:

COURSE DESCRIPTION

Academic year: 2022/2023

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KTF/3-FVM-806/10	Teaching Activities (6)

Educational activities:
Type of activities: other
Number of hours:
per week: 4 **per level/semester:** 52
Form of the course: on-site learning, distance learning

Number of credits: 10

Recommended semester: 6.

Educational level: III.

Prerequisites:

Course requirements:

Learning outcomes:

Class syllabus:

Recommended literature:

Languages necessary to complete the course:

Notes:

Past grade distribution
Total number of evaluated students: 9

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

Lecturers: prof. RNDr. Peter Moczo, DrSc., doc. RNDr. Vladimír Balek, CSc., doc. RNDr. Marián Fecko, PhD., doc. RNDr. Tomáš Blažek, PhD., doc. Mgr. Jozef Kristek, DrSc.

Last change: 02.06.2015

Approved by:

COURSE DESCRIPTION

Academic year: 2022/2023

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KTF/3-FVM-807/10	Teaching Activities (7)

Educational activities:
Type of activities: other
Number of hours:
per week: 4 **per level/semester:** 52
Form of the course: on-site learning, distance learning

Number of credits: 10

Recommended semester: 7.

Educational level: III.

Prerequisites:

Course requirements:

Learning outcomes:

Class syllabus:

Recommended literature:

Languages necessary to complete the course:

Notes:

Past grade distribution
Total number of evaluated students: 7

A	ABS	B	C	D	E	FX	NEABS
57,14	42,86	0,0	0,0	0,0	0,0	0,0	0,0

Lecturers: prof. RNDr. Peter Moczo, DrSc., doc. RNDr. Vladimír Balek, CSc., doc. RNDr. Marián Fecko, PhD., doc. RNDr. Tomáš Blažek, PhD., doc. Mgr. Jozef Kristek, DrSc.

Last change: 02.06.2015

Approved by:

COURSE DESCRIPTION

Academic year: 2022/2023

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KEF/3-FKL-006/22	Theory of Condensed Matter

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

Number of credits: 10

Recommended semester: 1.

Educational level: III.

Prerequisites:

Recommended prerequisites:
2-FTL-107 Structure and mechanical properties of solids
2-FTL-108 Electronic and optical properties of solids
2-FTL-205 Many body physics

Course requirements:
seminars, homeworks + oral exam
minimal score: 50%
Scale of assessment (preliminary/final): 55/45

Learning outcomes:
The students will be able to formulate the many-body problems in the language of quantum field theory. They will know the basic principles of selected theoretical techniques used in condensed matter theory and they will know in which circumstances they can be applied.

Class syllabus:
Linear response theory and correlation functions. Green's functions: relation to observables, formal properties. Perturbation theory and Feynman diagrams. Adiabatic continuity, renormalization group, and effective Hamiltonians. Variational methods. Upon agreement with the students, these notions and methods will be illustrated in the context of quantum magnetism, superfluidity and superconductivity, disordered systems, correlated electrons, and/or coupled electron-phonon problems.

Recommended literature:
http://www.st.fmph.uniba.sk/~hlubina1/
Green’s functions and condensed matter / G. Rickayzen. Academic Press, 1980
Fundamentals of the Physics of Solids, Vols. 1-3 / J. Sólyom. Springer 2007 - 2010
Principles of condensed matter physics / P. M. Chaikin, T. C. Lubensky. Cambridge Univ. Press, 1995
Basic notions of condensed matter physics / P. W. Anderson. Addison Wesley, 1984

Languages necessary to complete the course:

english

Notes:

Past grade distribution
Total number of evaluated students: 16

A	ABS	B	C	D	E	FX	NEABS
37,5	50,0	0,0	0,0	0,0	0,0	0,0	12,5

Lecturers: doc. RNDr. Richard Hlubina, DrSc.

Last change: 01.02.2022

Approved by:

COURSE DESCRIPTION

Academic year: 2022/2023

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KTF/3-FTM-003/22	Theory of Gravitation and Cosmology (1)

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

Number of credits: 10

Recommended semester: 1.

Educational level: III.

Prerequisites:

Course requirements:
Continuous assessment: solving problems
Completion: 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 have a detailed knowledge of the applications of general theory of relativity in astrophysics

Class syllabus:
Kerr metric (dragging of inertial frames, Penrose process, ring siingularity), disks around black holes

Recommended literature:
Ch.W.Misner, K.S.Thorne, J.A.Wheeler: Gravitation, W.H.Freeman, 2003, New York
I.D.Novikov, K.S.Thorne: Astrophysics of Black Holes, in Black Holes,
eds. C. DeWitt, B. DeWitt, Paris : Gordon and Breach, 1973

Languages necessary to complete the course:
SK, EN

Notes:

Past grade distribution
Total number of evaluated students: 3

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

Lecturers: doc. RNDr. Vladimír Balek, CSc., doc. RNDr. Tomáš Blažek, PhD.

Last change: 14.03.2022

Approved by:

COURSE DESCRIPTION

Academic year: 2022/2023

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KTF/3-FTM-004/22	Theory of Gravitation and Cosmology (2)

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

Number of credits: 10

Recommended semester: 2.

Educational level: III.

Prerequisites:

Course requirements:
Continuous assessment: solving problems
Completion: 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 have a detailed knowledge of the applications of general theory of relativity in cosmology.

Class syllabus:
generation and propagation of gravitational waves, theory of cosmological perturbations

Recommended literature:
L.D.Landau, E.M.Lifschitz: The Classical Theory of Fields, Oxford, Butterworth-Heinemann, 1980
A.R.Liddle, D.H.Lyth: Cosmological Inflation and Large-Scale Structure, Cambridge, Cambridge University Press, 2000

Languages necessary to complete the course:
SK, EN

Notes:

Past grade distribution
Total number of evaluated students: 0

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

Lecturers: doc. RNDr. Vladimír Balek, CSc., doc. RNDr. Tomáš Blažek, PhD.

Last change: 14.03.2022

Approved by: