Course descriptions

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COURSE DESCRIPTION

Academic year: 2026/2027

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KAI/2-AIN-127/15	Advanced Computer Graphics

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

Number of credits: 6

Recommended semester: 2.

Educational level: II.

Prerequisites:

Antirequisites: FMFI.KAG/2-MPG-101/00 and FMFI.KAG/2-MPG-102/00

Course requirements:
Attend lessons. One missed +0 points. 2 missed 0 points, 3 missed 0 points, 4 and more is Fx.
Project and exercise (mandatory).
Solve all homework problems (mandatory each one >=30%)
Pass final term (mandatory) You will need to solve several problems discussed during lessons.
Pass oral/written exam: (mandatory)
For the semester, the student can get 50% for exercises, 10% bonus, 10% for homework, the final exam consists of a test with weights of 20% and the oral exam is for 20%. The student must solve at least 30% of each homework in order to pass the final written exam. Grading: 92-100 A, 84-91 B, 76-83 C, 68-75 D, 60-67 E. Details on the subject page.
Scale of assessment (preliminary/final): 60/40

Learning outcomes:
After completing the course students will know techniques of photorealistic computer graphics. Will be able to solve color calculation, shadow computation and render views of a scene from the input images. Students learn the basics of graphical programming in C #.

Class syllabus:
LECTURE01 "INTRODUCTION TO COMPUTER GRAPHICS"
LECTURE02 "RAY TRACING 1."
TayTracong Pipeline
LECTURE03 "RAY TRACING 2."
Ray Intersections
LECTURE04 "RAY TRACING 3."
Ray Tracing Acceleration, Data structure: grids, BVH, Kd-tree, Directional Partitioning, Dynamic Scenes, Beam and Cone Tracing, Packet Tracing
LECTURE05 "LIGHT TRASPORT."
Physics behind ray tracing, Physical light quantities, Visual perception of light, Light sources, Light transport simulation: Rendering Equation

LECTURE06 "RADIOSITY."
Diffuse reflectance function, Radiative equilibrium between emission and absorption, escape, System of linear equations, Iterative solution Neuman series
LECTURE07 "BRDF."
Bidirectional Reflectance Distribution Function (BRDF), Reflection models, Projection onto spherical basis functions, Shading Phong model, Blin-Phong model
Physical BRDF, Ward Reflection Model, Cook-Torrance model
LECTURE08 "SHADOWS."
LECTURE09 "TEXTURING 1, 2."
Texture parameterization, Procedural methods, Procedural textures, Fractal landscapes, Surface reality techniques
LECTURE10 "IMAGE BASED RENDERING 1."
Plenopticfunction, Panoramas, Concentric Mosaics, Light Field Rendering, The Lumigraph
LECTURE11 "IMAGE BASED RENDERING 2."
Layered Depth Images, View-dependent Texture Mapping, Surface Light Fields, View Morphing
LECTURE12 "ASK ME ANYTHING."
Test problem introduction

Recommended literature:
Moderní počítačová grafika / Jiří Žára ... [et al.]. Brno : Computer Press, 2010
Realistic image synthesis using photon mapping / Henrik Wann Jensen ; Foreword by Pat Hanrahan. Natick : A K Peters, 2001
http://www.sccg.sk/~durikovic/classes/CG2/cg2_syllabus.html

Languages necessary to complete the course:
Slovak, English

Notes:

Past grade distribution
Total number of evaluated students: 18

A	B	C	D	E	FX
27,78	16,67	27,78	5,56	11,11	11,11

Lecturers: prof. RNDr. Roman Ďurikovič, PhD., Mgr. Andrej Mihálik, PhD.

Last change: 20.06.2022

Approved by: prof. RNDr. Roman Ďurikovič, PhD.

COURSE DESCRIPTION

Academic year: 2026/2027

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KAI/2-AIN-112/15	Advanced Image Processing

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

Number of credits: 6

Recommended semester: 1.

Educational level: II.

Prerequisites:

Course requirements:
It is necessary to obtain at least 90% of the points to obtain A grade, at least 80% of points to grade B, at least 70% of points to grade C, at least 60% to grade D and at least 50% to grade E.
The course assessment consists of three parts: exercises (30%), project (20%) and final exam (50%). Students should get at least 30 points (out of 50) from exercises and project to meet the minimum condition for admission to the final written exam.
Scale of assessment (preliminary/final): 50/50

Learning outcomes:
Graduates will know the advanced image processing techniques, such as image transformation, filtering, image improvement, advanced segmentation techniques (using active contours - snakes, flood segmentation) etc.

Class syllabus:
Image capture.
Features digital image.
Picture transformation
Methods of image preprocessing, Hough transform
Fourier Transform - DFT, FFT, filters detail
noise Reduction
Mathematical Morphology BW and grayscale
Segmentation. Snake watershed, clustering
improving the image
processing textures

Recommended literature:
Computer Vision: Algorithms and Applications, Richard Szeliski, The University of Washington, 2nd ed. 2021
Image processing, analysis, and machine vision / Milan Sonka, Vaclav Hlavac, Roger Boyle. [Stamford] : Cengage Learning, 2008

Digital image processing / Rafael C. Gonzalez, Richard E. Woods. Beijing : PEARSON; 4th edition, 2018
Image processing : The fundamentals / Maria Petrou, Costas Petrou. Chichester : John Wiley, 2010

Languages necessary to complete the course:
Slovak, English

Notes:

Past grade distribution
Total number of evaluated students: 108

A	B	C	D	E	FX
11,11	24,07	32,41	12,96	3,7	15,74

Lecturers: doc. RNDr. Zuzana Černeková, PhD., Ing. Viktor Kocur, PhD.

Last change: 23.06.2022

Approved by: prof. RNDr. Roman Ďurikovič, PhD.

COURSE DESCRIPTION

Academic year: 2026/2027

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KAI+KI/2-AIN-205/15	Algorithmics for Hard Problems

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

Number of credits: 6

Recommended semester: 2.

Educational level: II.

Prerequisites:

Recommended prerequisites:
1-AIN-105 Efficient algorithms and compexity OR 1-INF-310 Design of efficient algorithms

Course requirements:
homeworks (28%), midterm (22%), written exam and oral consultation (50%)
To pass the exam, student has to achieve at least 50% on the exam.
Scale: A 90%, B 80%, C 70%, D 60%, E 50%
Scale of assessment (preliminary/final): 50/50

Learning outcomes:
After completing the course students will be able to use methods for solving hard algorithmic tasks, particularly approximation algorithms, probabilistic algorithms, and integer linear programming. Students will be able to work with advanced methods for analysis of algorithms.

Class syllabus:
Introduction to approximation algorithms. Inapproximability. Probabilistic algorithms and their complexity. Las Vegas and Monte Carlo. Integer linear programming. Hierarchy of complexity classes. Examples.

Recommended literature:
Introduction to algorithms / Thomas H. Cormen ... [et al.]. Cambridge, Mass. : MIT Press, 2001
Approximation algorithms / Vijay V. Vazirani. Berlin : Springer, 2001
Randomized algorithms / Rajeev Motwani, Prabhakar Raghavan. New York : Cambridge University Press, 1995

Languages necessary to complete the course:
Slovak, English

Notes:

Past grade distribution
Total number of evaluated students: 80

A	B	C	D	E	FX
23,75	12,5	16,25	20,0	17,5	10,0

Lecturers: doc. Mgr. Tomáš Vinař, PhD., RNDr. Jozef Šiška, PhD.

Last change: 24.06.2022

Approved by: prof. RNDr. Roman Ďurikovič, PhD.

COURSE DESCRIPTION

Academic year: 2026/2027

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KAI/2-AIN-140/20	Architectures of Software Systems

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

Number of credits: 6

Recommended semester: 2.

Educational level: II.

Prerequisites: FMFI.KAI/2-AIN-156/22 - Agile Software Development in Teams

Course requirements:
Continuous assessment: midterm
Examination: oral or written examination
Indicative assessment scale: A 90%, B 80%, C 70%, D 60%, E 50%
Scale of assessment (preliminary/final): 40/60

Learning outcomes:
Deeper knowledge of software engineering, architectural styles and patterns, design patterns, creating models and modeling the architectures. After this course students will be able to study and implement styles and patterns, use prefactoring and refactoring to optimize software design.

Class syllabus:
Stručná osnova predmetu:
1. Architectural styles I. (Garlan & Shaw: Abstract Machine, Pipes and Filters, Client-Server, Object Model, Repository, Blackboard)
2. Architectural styles II. (Interpreter, Modern Canonical Compiler, Rule-Based System, Aspect Oriented Architectures, MVC, Mickrokernel)
3. Distributed architectures, CORBA, Service Oriented Architectures.
4. Architectural patterns I (Buschmann: POSA IV: Pattern Oriented Software Architecture for Distributed Computing).
5. Architectural patterns II. (Reactor, Proactor, Requestor, Invoker, Acceptor, Connector, ACT, Facade, Master-Slave, ...)
6. Architectural patterns III (Memento, Context Object, DTO, Adapter, Iterator, Interceptor, ...)
7. Design patterns I (model and source code level, Gamma et al.).
Creational Patterns (Builder, Abstract Factory, Factory method, ...).
8. Design patterns II. Structural Patterns (Bridge, Decorator, Composite, Proxy, ...)
9. Design patterns III. Behavioral Patterns. (Command, Mediator, State, Strategy, Visitor, Observer, ...)
10. From Refactoring to Patterns (Kerievsky).
11. Refactoring and Prefactoring (Fowler, Pugh).

12. UML and its new features. Superstructure, Infrastructure, meta-models, and Object Constraint Language. Consistency and interconnection of models. XMI, HUTN and PlantUML. 3DUML and xDUML.
13. Agile Modeling and development process. Lean Architecture (Coplien).

Recommended literature:

1. Buschmann F. et al.: Pattern-oriented software architecture: a pattern language for distributed computing, Vol. 4. New York : John Wiley & Sons, 2007. BUSCHMANN, F. -- HENNEY, K. -- SCHMIDT, D. Pattern-oriented software architecture: a pattern language for distributed computing, vol. 4. New York : John Wiley & Sons, 2007.
2. Shaw M L., Garlan D.: Software architecture: Perspectives on an emerging discipline. Prentice Hall, 1996. SHAW, M L. -- GARLAN, D. Software architecture: Perspectives on an emerging discipline.
Upper Saddle River : Prentice Hall, 1996.
3. Arlow J., Neustadt I. UML 2 and the Unified Process: Practical Object-Oriented Analysis and Design. Addison-Wesley, 2006.
4. Kerievsky J.: Refactoring to Patterns. Addison Wesley, 2008.
5. Gamma E. et al.: Design Patterns. Elements of Reusable Object-Oriented Software. Addison Wesley, 1994.
6. Fowler M.: Refactoring. Improving the Design of Existing Code. Wesley Longmann, 2000.
7. Pugh K.: Prefactoring, O'Reilly, 2005
8. Coplien O. J., Bjornvig G.: Lean Architecture for Agile Software Development. J. Wiley, 2014.
9.
SOMMERVILLE, I. Software engineering. Harlow : Pearson Education Limited, 2004.
ARLOW, J. -- NEUSTADT, I. UML 2 and the Unified Process: Practical Object-Oriented Analysis and Design. New Jersey : Addison-Wesley, 2006. 592 p. ISBN 0-321-32127-8.KERIEVSKY, J. Refactoring to Patterns. Boston: Addison Wesley, 2008.
GAMMA, E. -- HELM, R. -- JOHNSON, R. -- VLISSIDES, J. Design Patterns. Elements of Reusable Object-Oriented Software. Boston : Addison Wesley, 1994. 395 p. ISBN 0-201-63361-2.
FOWLER, M. Refactoring. Improving the Design of Existing Code. Boston: Wesley Longmann, 2000.
Pugh K.:Prefactoring, O'Reilly, 2005

Languages necessary to complete the course:
Slovak, English

Notes:

Past grade distribution
Total number of evaluated students: 81

A	B	C	D	E	FX
27,16	33,33	23,46	4,94	0,0	11,11

Lecturers: doc. Ing. Ivan Polášek, PhD.

Last change: 18.11.2021

Approved by: prof. RNDr. Roman Ďurikovič, PhD.

COURSE DESCRIPTION

Academic year: 2026/2027

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

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

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

Number of credits: 6

Recommended semester:

Educational level: I.II., II.

Prerequisites:

Course requirements:

Learning outcomes:

Class syllabus:

Recommended literature:

Languages necessary to complete the course:

Notes:

Past grade distribution
Total number of evaluated students: 22

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

Lecturers: prof. Ing. Igor Farkaš, Dr.

Last change:

Approved by: prof. RNDr. Roman Ďurikovič, PhD.

COURSE DESCRIPTION

Academic year: 2026/2027

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KAI/2-AIN-113/22	Computational Fuzzy Logic, Modeling and Systems

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

Number of credits: 6

Recommended semester: 1.

Educational level: II.

Prerequisites:

Course requirements:
Examination: examination is in written and oral form, two programming tasks and one theoretical question
Continuous assessment:
Approximate evaluation scale: A 90%, B 80%, C 70%, D 60%, E 50%
Scale of assessment (preliminary/final): 0/100

Learning outcomes:
Theoretical and practical foundations of computational fuzzy logic, modelling, and systems.

Class syllabus:
1) Rule-based systems, the DPLL-procedure, binary resolution, hyper-resolution.
2) Uncertainty and its formalisation, triangular (co-)norms, continuity.
3) Many-valued (fuzzy) logics and computational formalisms (Lukasiewicz, Goedel, Product ones).
4) Fuzzy sets.
5) Fuzzy numbers and arithmetic.
6) Modifiers of fuzzy sets (hedges).
7) Fuzzy approximation models, F-transform, fuzzy cluster analysis.
8) Fuzzy inference, the compositional rule of inference (CRI).
9) Fuzzy rules - a Mamdani’s type.
10) Fuzzy rules - a Sugeno-Takagi's type.
11) The linguistic variable, a Zadeh’s approach.
12) Fuzzification.
13) Defuzzification.
14) Fuzzy inference systems, fuzzy controllers.

Recommended literature:
[1] Hájek, P. (1998). Metamathematics of fuzzy logic. Trends in Logic, vol. 4, Kluwer Academic Publishers.
[2] Klement, E. P., Mesiar, R., (2005). Logical, Algebraic, Analytic and Probabilistic Aspects of Triangular Norms, Elsevier.

[3] U. Schoening, J. Toran (2013), The Satisfiability Problem: Algorithms and Analyses, ser. Mathematik fuer Anwendungen. Lehmanns Media.
[4] Jantzen J. (2013). Foundations of Fuzzy Control: A Practical Approach, 2nd Edition, Wiley. ISBN: 978-1-118-50622-6.
[5] Novák, V., Perfilieva, I., & Dvorak, A. (2016). Insight into fuzzy modeling. John Wiley & Sons.
[6] Guller D. (2019). Hyperresolution for Goedel Logic with Truth Constants. Fuzzy Sets and Systems. 363: 1-65.

Languages necessary to complete the course:
Slovak, English

Notes:

Past grade distribution
Total number of evaluated students: 94

A	B	C	D	E	FX
55,32	31,91	7,45	0,0	0,0	5,32

Lecturers: doc. RNDr. Dušan Guller, PhD.

Last change: 29.06.2022

Approved by: prof. RNDr. Roman Ďurikovič, PhD.

COURSE DESCRIPTION

Academic year: 2026/2027

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KAI/2-AIN-147/19	Computer Vision

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

Number of credits: 6

Recommended semester: 2.

Educational level: II.

Prerequisites:

Antirequisites: FMFI.KAI+KAG/2-MPG-125/15

Course requirements:
Assessment: evaluation Preliminary assessment: Continuous assessment projects Final assessment: assessment examination A 90%; B 80%; C 70%; D 60%; E 50%
Scale of assessment (preliminary/final): 40/60

Learning outcomes:
Graduates will know the advance techniques of machine vision, image recognition and processing, such as feature extraction from images, face detection and tracking, identification of significant areas in the image, etc.

Class syllabus:
Image Features extraction (Low, Medium and High level features)
Feature categories and application(Shape, Color, Texture...)
Object detection (Template matching, histogram of oriented gradients, Face detection and classification)
Local features (detectors, descriptors, matching, Ransac, Bag of visual words)
Dynamic Range of images, Tone Mapping a Gamut mapping
Image Quality metrics (SSIM and modifications)
Eye tracking (methods and applications)
Machine Vision and industry applications of computer vision (Laser line triangulation sensors, multispectral imaging)
Object Tracking (Tracking by detection, Optical flow)

Recommended literature:
Feature extraction : Foundations and applications / Isabelle Guyon ... [et al.] (eds.). Berlin : Springer, 2006 Algorithms for image processing and computer vision / J. R. Parker. New York : Wiley, 1997 Shape classification and analysis : Theory and practice / Luciano da Fontoura Costa, Roberto Marcondes Cesar, Jr.. Boca Raton, Fla. : CRC Press, 2009 Elena Šikudová, Zuzana Černeková, Vanda Benešová, Zuzana Haladová, Júlia Kučerová: Počítačové videnie. Detekcia a rozpoznávanie objektov, vydavateľstvo Wikina, Praha, ISBN: 978-80-87925-06-5

Languages necessary to complete the course:
Slovak and English

Notes:

Past grade distribution
Total number of evaluated students: 45

A	B	C	D	E	FX
26,67	13,33	15,56	17,78	24,44	2,22

Lecturers: RNDr. Zuzana Berger Haladová, PhD.

Last change: 27.11.2021

Approved by: prof. RNDr. Roman Ďurikovič, PhD.

COURSE DESCRIPTION

Academic year: 2026/2027

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KAI/2-AIN-233/00	Computer Vision Applications

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

Number of credits: 3

Recommended semester: 3.

Educational level: II.

Prerequisites:

Recommended prerequisites:
2-AIN-112/15
or
2-MPG-125/15

Course requirements:
Presentations and activity on lectures
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 discover, develop and analyze the latest practices of successful projects in the field of computer vision and apply new trends in computer vision to create their own applications.

Class syllabus:
1. Case studies of successful applications.
2. Industrial applications.
3. Medical applications.
3. Other applications.
4. Results of departmental research projects.
5. New trends in application of computer vision methods and techniques.

Recommended literature:
Computer Vision and Image Understanding, Elsevier Inc., http://www.sciencedirect.com/science/journal/10773142
International Journal of Computer Vision Springer http://www.springerlink.com/content/0920-5691
IET Computer Vision http://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=4159597
CVPR - Computer Vision and Pattern Recognition Workshops http://ieeexplore.ieee.org/xpl/mostRecentIssue.jsp?punumber=5521877

Languages necessary to complete the course:
Slovak, English

Notes:

Past grade distribution
Total number of evaluated students: 348

A	B	C	D	E	FX
50,57	21,84	11,21	2,01	4,89	9,48

Lecturers: doc. RNDr. Zuzana Černeková, PhD.

Last change: 23.06.2022

Approved by: prof. RNDr. Roman Ďurikovič, PhD.

COURSE DESCRIPTION

Academic year: 2026/2027

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KAI/2-AIN-226/22	Deep Learning for Computer Vision

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

Number of credits: 6

Recommended semester: 3.

Educational level: II.

Prerequisites:

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

Learning outcomes:
Upon completion the student will have a good understanding of the theoretical background of various types of neural networks used in computer vision for classification, localization and object detection tasks as well as generative models. The student will also be able to create, implement, train and evaluate such networks with the use of hardware on PCs or in the cloud.

Class syllabus:
Introduction - machine learning basics, classical approaches to feature extraction, data splits and model evaluation, image manipulation basics
Classification - k-nearest neighbors method, linear classifier, loss functions, gradient optimization, regularization
Fully-connected NNs - computational graphs, vectorized computation, backpropagation, loss functions, automatic differentiation software, augmentation, dropout, stochastic optimization
Convolutional NNs - convolution, pooling, vanishing gradients, batch normalization, weight initialization, transfer learning, architectures
Recurrent NNs - sequential data, hidden states, LSTM, GRU, training regimes
Transformers - self-attention, transformers in NLP tasks, combinations with CNNs, transformers in computer vision
Object detection and segmentation - one and two stage object detectors, expansion of object detectors to segmentation, segmentation architectures, data annotation
Generative models - GAN, VAE
CNN visualization and understanding - learned features, style transfer, deep dream, adversarial examples, activation maps

Scientific and ethical problems of computer vision - data collection, privacy issues, computational dominance, method interpretability, safety, undesirable social effects, model bias, illusion of algorithmic objectivity

Recommended literature:

Ian Goodfellow and Yoshua Bengio and Aaron Courville: Deep learning, MIT Press, Online for free, http://www.deeplearningbook.org/

Michael Nielsen: Neural networks and deep learning, Online for free, http://neuralnetworksanddeeplearning.com/

Adrian Rosebrock: Computer Vision and deep learning, Resource guide

Languages necessary to complete the course:

Slovak, English

Notes:

Past grade distribution

Total number of evaluated students: 41

A	B	C	D	E	FX
9,76	12,2	24,39	26,83	9,76	17,07

Lecturers: doc. RNDr. Zuzana Černeková, PhD., Ing. Viktor Kocur, PhD.

Last change: 18.11.2021

Approved by: prof. RNDr. Roman Ďurikovič, PhD.

COURSE DESCRIPTION

Academic year: 2026/2027

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KAI/2-AIN-276/24	Digital Twin Development

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

Number of credits: 6

Recommended semester: 3.

Educational level: II.

Prerequisites:

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

Learning outcomes:
Upon completion, students will have mastered the theoretical foundations and practical skills for authoring (both individually and in teams) digital twins.

Class syllabus:
Digital Twins: Definitions and Basic Concepts, Applications in Industry, Manufacturing, and Research (Digital
Model, Digital Shadow, Digital Thread, Digital Twin)
Definition of Basic Terms and Principles of Computer Graphics and Vision
3D Reconstruction of Static Objects for Digital Twins
3D Reconstruction of Dynamic Objects and Motion Capture of Objects and People
Data Capture (IoT, RTLS), Tracking, Streaming, and Fusion
Modeling and Simulation Techniques – Agents, Dynamic and Discrete Simulations
Case Study of Digital Twins (3D Reconstruction of an Office, Process Simulation in a Factory, Optimization of
an Automated Warehouse, etc.)
API and Commercial Software (UE, Omniverse, OpenUSD, Reality Capture, etc.)
Modeling, Simulation, and Visualization of a Project for a Digital Twin

Recommended literature:
Digital Twins in Industry / A.Y.C. Nee and S.K. Ong: MDPI, 2021, ISBN 978-3-0365-1799-5
Digital Twins: Basics and Applications / Zhihan Lv, Elena Fersman, Springer 2022, ISBN 978-3-031-11400-7
Digital Twin in manufacturing: A categorical literature review and classification / Werner Kritzinger et al. 2018, IFAC PapersOnLine 51-11 (2018) 1016–1022

Digital Twin: Origin to Future / Singh, M.; Fuenmayor, E.; Hinchy, E.P.; Qiao, Y.; Murray, N.; Devine, Appl. Syst. Innov. 2021, 4, 36.
Digital twin modeling method based on IFC standards for building construction processes / Dai C, Cheng K, Liang B, Zhang X, Liu Q and Kuang Z, 2024, Front. Energy Res.

Languages necessary to complete the course:
Slovak, English

Notes:

Past grade distribution
Total number of evaluated students: 10

A	B	C	D	E	FX
20,0	30,0	30,0	10,0	10,0	0,0

Lecturers: doc. RNDr. Martin Madaras, PhD.

Last change: 18.06.2024

Approved by: prof. RNDr. Roman Ďurikovič, PhD.

STATE EXAM DESCRIPTION

Academic year: 2026/2027

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KAI/2-AIN-991/22	Diploma Thesis

Number of credits: 15

Educational level: II.

Prerequisites: (FMFI.KAI/2-AIN-923/22 - Project Seminar (1) or FMFI.KAI/2-AIN-923/15 - Project Seminar (1)) and (FMFI.KAI/2-AIN-924/22 - Project Seminar (2) or FMFI.KAI/2-AIN-924/15 - Project Seminar (2))

Course requirements:

Interim evaluation: Written report - diploma thesis, which is assessed by the project leader and one opponent, its defense is a state exam. By enrolling in the subject of Diploma Thesis Defense, the student also registers for the state exam in the given academic year. If the student has not submitted the diploma thesis by the given deadline, the state examination is classified with the classification grade "FX".
Exam: State exam defense of diploma thesis
Scale of assessment (preliminary/final): 0/100

Learning outcomes:

The result is a written diploma thesis defended before the state commission.
1. Problem specification and its analysis.
2. Overview of the issue.
3. Methodology of problem solving.
4. Project decisions.
5. Work plan and its control.
6. Specification of software work.
7. Computational experiments and their evaluation.
8. Defense of the diploma thesis text.

Class syllabus:

Writing, preparing a presentation and defending a thesis.
The diploma thesis is taken into account when evaluating the subject of the state examination
- submitted diploma thesis and the level of achieved results with emphasis on creativity and implementation results (based on the opinions of the project leader and the opponent),
- work on the project during its solution (based on the opinion of the project leader),
- presentation and defense of the diploma thesis,
- statements and opinions in a wider professional debate.

State exam syllabus:

The result is a written diploma thesis defended before the state commission with the following structure
1. Problem specification and its analysis.
2. Overview of the issue.
3. Methodology of problem solving.
4. Project decisions.

5. Work plan and its control.
6. Specification of software work.
7. Computational experiments and their evaluation.
8. Defense of the diploma thesis text.
`

Writing, preparing a presentation and defending a thesis.
The diploma thesis is taken into account when evaluating the subject of the state examination
- submitted diploma thesis and the level of achieved results with emphasis on creativity and implementation results (based on the opinions of the project leader and the opponent),
- work on the project during its solution (based on the opinion of the project leader),
- presentation and defense of the diploma thesis,
- statements and opinions in a wider professional debate.

Recommended literature:

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

http://dl.acm.org/dl.cfm?CFID=412417535&CFTOKEN=50913605

Languages necessary to complete the course:

Slovak, English

Last change: 18.11.2021

Approved by: prof. RNDr. Roman Ďurikovič, PhD.

COURSE DESCRIPTION

Academic year: 2026/2027

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KAI/2-AIN-138/16	Discrete Structures in Informatics and Computer Graphics

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

Number of credits: 6

Recommended semester: 2.

Educational level: II.

Prerequisites:

Course requirements:
Examination: an examination consisting of a written and an oral part
Continuous assessment: project, test The student must obtain at least 55% of points from the semester in order to take the final exam.
Indicative rating scale: A 90%, B 80%, C 70%, D 60%, E 50%
Weight of the mid-term / final evaluation: 50/50
Scale of assessment (preliminary/final): 50/50

Learning outcomes:
Theoretical foundations, methods and tools from Algebra and Discrete structures used in Informatics and Computer Graphics with examples and practical applications.

Class syllabus:
1) Selected chapters from elementary number theory, primality tests.
2) Modular arithmetic, congruences, Fermat's Little Theorem, Euler's Theorem
3) Algebraic structures: groups, rings, finite fields - practical examples
4) Orders of an element and of a group, primitive roots
6) Number systems: congruences, fast modular exponentiation,
7) Chinese Remainder Theorem, solving systems of linear congruences, application: error detecting and error-correcting codes
8) Pseudo-random numbers: the linear congruential generator
9) Matrix algebra, linear transformations
5) Quaternions
10) Modular matrices, application: Hill's cryptosystem
11) Determinants, application: Vandermond's determinant – secret sharing
12) One-way functions, discrete logarithm, one-way functions in algebraic structures
13) Applications of groups, finite fields, congruences: RSA cryptosystem, Knapsack cryptosystem,
14) Mathematical concept of symmetry: groups of automorphisms, isomorphisms, permutations

Recommended literature:
[1] Stanoyevitch, A. (2011) Discrete Structures with Contemporary Applications, CRC Press.

[2] Gersting, J.L. (2007) Mathematical Structures for Computer Science, 6th edition, W.H.Freeman and Company, NY.
[3] Gallian, J.A. (2012) Contemporary Abstract Algebra, 8th edition, Brooks/Cole, Boston
[4] Cormen, T.H. - Leiserson, C.E. - Rivest, R.L.- Stein,C. (2009) Introduction to Algorithms, 3nd edition, The MIT Press.
[5] Yamamura, A. - Jajcayová, T. - Kurokawa, T. (2005) Oblivious transfer and private information retrieval using homomorphic encryption functions, In: Proceedings of the 2005 Symposium on Cryptography and Information Security, Vol. 1. - Tokyo
[6] Jajcayová, T. (2019): Representations of permutation groups and semigroups on combinatiorial structures
In: Fifth Russian Finnish Symposium on Discrete Mathematics. S. 137-145. - ISBN 978-5-89896-704-8

Languages necessary to complete the course:
Slovak, English

Notes:

Past grade distribution
Total number of evaluated students: 67

A	B	C	D	E	FX
32,84	28,36	16,42	5,97	8,96	7,46

Lecturers: doc. RNDr. Tatiana Jajcayová, PhD.

Last change: 26.06.2022

Approved by: prof. RNDr. Roman Ďurikovič, PhD.

COURSE DESCRIPTION

Academic year: 2026/2027

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

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

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

Number of credits: 2

Recommended semester: 2., 8.

Educational level: I.II., II.

Prerequisites:

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

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

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

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

Languages necessary to complete the course:
Slovak or English

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

Past grade distribution
Total number of evaluated students: 95

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

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

COURSE DESCRIPTION

Academic year: 2026/2027

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

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

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

Number of credits: 2

Recommended semester: 1., 7.

Educational level: I.II., II.

Prerequisites:

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

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

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

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

Languages necessary to complete the course:
Slovak or English

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

Past grade distribution
Total number of evaluated students: 95

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

Lecturers: doc. RNDr. Mária Markošová, PhD.

Last change: 22.08.2021
Approved by: prof. RNDr. Roman Ďurikovič, PhD.

COURSE DESCRIPTION

Academic year: 2026/2027

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

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

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

Number of credits: 2

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

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

Prerequisites:

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

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

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

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

Languages necessary to complete the course:

Notes:

Past grade distribution
Total number of evaluated students: 318

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

Lecturers: Mgr. Aneta Barnes

Last change: 11.04.2024
Approved by: prof. RNDr. Roman Ďurikovič, PhD.

COURSE DESCRIPTION

Academic year: 2026/2027

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

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

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

Number of credits: 2

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

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

Prerequisites:

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

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

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

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

Languages necessary to complete the course:

Notes:

Past grade distribution
Total number of evaluated students: 201

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

Lecturers: Mgr. Aneta Barnes

Last change: 11.04.2024
Approved by: prof. RNDr. Roman Ďurikovič, PhD.

COURSE DESCRIPTION

Academic year: 2026/2027

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KAI/2-AIN-185/22	Formal Methods of Software Development

Educational activities:
Type of activities: lecture / practicals
Number of hours:
per week: 3 / 1 **per level/semester:** 39 / 13
Form of the course: on-site learning

Number of credits: 5

Recommended semester: 4.

Educational level: II.

Prerequisites:

Course requirements:
exercises, exams
A 90%, B 80%, C 70%, D 60%, E 50%
Scale of assessment (preliminary/final): 40/60

Learning outcomes:
Graduates of this subject will know the basic models, the formalisms and techniques used in formal specification and verification of methods.

Class syllabus:
Students will learn some basic models exploited in formal specifications of systems (Process Algebras, Petri nets, Timed Automata ..), their syntax and semantics which are suitable for different applications in formal specifications. Also some modal and temporal logics which are exploited in systems specifications will be tought together with some basics on model checking.

Recommended literature:
Milner, R.: Communication and concurrency. Prentice-Hall
International, New York, 1989.
Reisig, W.: A Primer in Petri Net Design. Springer-Verlag, 1992
Jan A. Bergstra, Alban Ponse, and Scott A. Smolka, Editors. Handbook of Process Algebra, Elsevier, 2001.
Stirling C.: Modal and Temporal Properties of Processes, Springer (Texts in Computer Science), 2001

Languages necessary to complete the course:
Slovak, English

Notes:

Past grade distribution Total number of evaluated students: 558					
A	B	C	D	E	FX
22,04	13,8	19,35	24,19	18,82	1,79
Lecturers: doc. RNDr. Damas Gruska, PhD.					
Last change: 23.11.2021					
Approved by: prof. RNDr. Roman Ďurikovič, PhD.					

COURSE DESCRIPTION

Academic year: 2026/2027

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

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

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

Number of credits: 2

Recommended semester: 1., 7.

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

Prerequisites:

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

Learning outcomes:

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

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

Languages necessary to complete the course:

Notes:

Past grade distribution
Total number of evaluated students: 499

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

Lecturers: Mgr. Ľubomíra Kožehubová

Last change: 20.06.2022

Approved by: prof. RNDr. Roman Ďurikovič, PhD.

COURSE DESCRIPTION

Academic year: 2026/2027

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

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

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

Number of credits: 2

Recommended semester: 2., 8.

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

Prerequisites:

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

Learning outcomes:

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

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

Languages necessary to complete the course:

Notes:

Past grade distribution
Total number of evaluated students: 307

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

Lecturers: Mgr. Ľubomíra Kožehubová

Last change: 20.06.2022

Approved by: prof. RNDr. Roman Ďurikovič, PhD.

COURSE DESCRIPTION

Academic year: 2026/2027

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

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

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

Number of credits: 2

Recommended semester: 3., 9.

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

Prerequisites:

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

Learning outcomes:

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

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

Languages necessary to complete the course:

Notes:

Past grade distribution
Total number of evaluated students: 128

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

Lecturers: Mgr. Ľubomíra Kožehubová

Last change: 20.06.2022

Approved by: prof. RNDr. Roman Ďurikovič, PhD.

COURSE DESCRIPTION

Academic year: 2026/2027

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

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

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

Number of credits: 2

Recommended semester: 4., 10.

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

Prerequisites:

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

Learning outcomes:

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

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

Languages necessary to complete the course:

Notes:

Past grade distribution
Total number of evaluated students: 79

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

Lecturers: Mgr. Ľubomíra Kožehubová

Last change: 20.06.2022

Approved by: prof. RNDr. Roman Ďurikovič, PhD.

COURSE DESCRIPTION

Academic year: 2026/2027

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KAI/2-AIN-134/14	Geometric modelling in graphics

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

Number of credits: 6

Recommended semester: 2.

Educational level: II.

Prerequisites:

Course requirements:
Projects, oral exam
For the semester, the student can get 50% for exercises, the final exam in the form of a presentation of a chapter from the book has a weight of 50%. The student must solve each task in the exercises at least 30% in order to pass the final exam. Grading: 92-100 A, 84-91 B, 76-83 C, 68-75 D, 60-67 E. Details on the subject page.
Scale of assessment (preliminary/final): 50/50

Learning outcomes:
After completing the course, students will be able to distinguish between the current methods and options for creating, modeling and digital representation of three-dimensional objects. He will be able to implement these structures and procedures to use and modify them under the existing modeling tools.

Class syllabus:
1. Polygonal networks - describes the structure for polygonal representation networks, simplification, smoothing compression and networking, computing over networks (earth, normal, curvature), parameterization and triangularizácia, interactive techniques for modeling networks 2. Parametric curves and surfaces - polynomial and spline representation, design and modeling, tessellation, redistribution curves and surfaces 3. implicit FREP a volumetric representation - classification, modeling, set operations, conversion to the polygonal network 4. point clouds - representation of unorganized set of points, nearest neighbor search set of points, proximity graphs, surface reconstruction, multiview geometry 5. Procedural modeling - L-systems, generating terrain procedurally buildings and cities

Recommended literature:
Curves and Surfaces for computer-Aided geometric design : A practical Guide / Gerald E. Farin. San Diego : Academic Press, 1997

Languages necessary to complete the course:
Slovak, English

Notes:

Past grade distribution
Total number of evaluated students: 25

A	B	C	D	E	FX
40,0	16,0	20,0	8,0	12,0	4,0

Lecturers: prof. RNDr. Roman Ďurikovič, PhD.

Last change: 20.06.2022

Approved by: prof. RNDr. Roman Ďurikovič, PhD.

COURSE DESCRIPTION

Academic year: 2026/2027

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

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

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

Number of credits: 2

Recommended semester: 1., 7.

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

Prerequisites:

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

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

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

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

Languages necessary to complete the course:

Notes:

Past grade distribution
Total number of evaluated students: 874

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

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

Last change: 05.09.2025

Approved by: prof. RNDr. Roman Ďurikovič, PhD.

COURSE DESCRIPTION

Academic year: 2026/2027

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

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

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

Number of credits: 2

Recommended semester: 2., 8.

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

Prerequisites:

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

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

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

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

Languages necessary to complete the course:

Notes:

Past grade distribution
Total number of evaluated students: 542

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

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

Last change: 05.09.2025

Approved by: prof. RNDr. Roman Ďurikovič, PhD.

COURSE DESCRIPTION

Academic year: 2026/2027

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

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

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

Number of credits: 2

Recommended semester: 3., 9.

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

Prerequisites:

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

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

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

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

Languages necessary to complete the course:

Notes:

Past grade distribution
Total number of evaluated students: 191

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

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

Last change: 05.09.2025

Approved by: prof. RNDr. Roman Ďurikovič, PhD.

COURSE DESCRIPTION

Academic year: 2026/2027

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

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

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

Number of credits: 2

Recommended semester: 4., 10.

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

Prerequisites:

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

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

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

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

Languages necessary to complete the course:

Notes:

Past grade distribution
Total number of evaluated students: 104

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

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

Last change: 05.09.2025

Approved by: prof. RNDr. Roman Ďurikovič, PhD.

COURSE DESCRIPTION

Academic year: 2026/2027

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

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

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

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

Number of credits: 3

Recommended semester: 1., 7.

Educational level: I.II., II.

Prerequisites:

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

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

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

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

Languages necessary to complete the course:
Slovak

Notes:

Past grade distribution
Total number of evaluated students: 0

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

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

Last change: 13.03.2026

Approved by: prof. RNDr. Roman Ďurikovič, PhD.

COURSE DESCRIPTION

Academic year: 2026/2027

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

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

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

Number of credits: 5

Recommended semester: 1., 7.

Educational level: I.II., II.

Prerequisites:

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

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

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

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

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

Languages necessary to complete the course:
English

Notes:

Past grade distribution
Total number of evaluated students: 10

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

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

Last change: 22.06.2022

Approved by: prof. RNDr. Roman Ďurikovič, PhD.

COURSE DESCRIPTION

Academic year: 2026/2027

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KAI/2-INF-150/15	Machine Learning

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

Number of credits: 6

Recommended semester: 1.

Educational level: II.

Prerequisites:

Recommended prerequisites:
(1-INF-115 Algebra (1) OR 1-AIN-152 Linear Algebra) AND 2-INF-175 Probability and Statistics

Course requirements:
homework assignments (30%), project (30%), final exam (40%)
To pass the exam, a student has to get at least half of the points on the exam.
A 90%, B 80%, C 70%, D 60%, E 50%
Scale of assessment (preliminary/final): 60/40

Learning outcomes:
Students will be familiar with basic machine learning techniques, and they will be able to use these techniques in practical applications.

Class syllabus:
Supervised machine learning (linear and generalized linear regression, neural networks, classification with support vector machines, kernel methods, discrete classifiers). Machine learning theory (statistical model of machine learning, bias-variance trade-off, overfitting and underfitting, PAC learning, VC dimension estimates). Unsupervised machine learning (clustering, self-organizing maps, principal component analysis). Reinforcement learning. Ensemble learning (bagging, boosting).

Recommended literature:
The elements of statistical learning : Data mining, inference, and prediction / Trevor Hastie, Robert Tibshirani, Jerome Friedman. New York : Springer, 2009
Pattern recognition and machine learning / Christopher M. Bishop. New York : Springer, 2006
Machine learning / T. M. Mitchell. New York : McGraw Hill, 1997
Biological sequence analysis : Probabilistic models of proteins and nucleic acids / Richard Durbin ... [et al.]. Cambridge : Cambridge University Press, 1998

Languages necessary to complete the course:
Slovak, English

Notes:

Past grade distribution
Total number of evaluated students: 367

A	B	C	D	E	FX
47,41	14,44	11,17	7,63	7,63	11,72

Lecturers: Mgr. Vladimír Boža, PhD., Mgr. Marek Šuppa, doc. Mgr. Tomáš Vinař, PhD.

Last change: 24.06.2022

Approved by: prof. RNDr. Roman Ďurikovič, PhD.

STATE EXAM DESCRIPTION

Academic year: 2026/2027

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KAI/2-AIN-953/22	Methods of Applied Informatics

Number of credits: 6

Educational level: II.

Learning outcomes:
The student consolidates the knowledge and skills acquired during the master's study and understands their interrelationships and the context in which they act.

Class syllabus:
The syllabi of the exam, which are published in advance, are based on the content of the profile subjects, but are not linked to them. List of recommended subjects:
Mathematical modeling and computer animation of physical processes; Formal software development methods; Discrete structures in informatics; Computational fuzzy logic, modeling and systems; Machine learning.

State exam syllabus:
The syllabi of the exam, which are published in advance, are based on the content of the profile subjects, but are not linked to them. List of recommended subjects:
Mathematical modeling and computer animation of physical processes; Formal software development methods; Discrete structures in informatics; Computational fuzzy logic, modeling and systems; Machine learning.
9.2.9 Syllabuses of state examinations of the master's study program
Applied Informatics
a
Applied informatics (conversion program)
State subject 2-AIN-991/15 Master's thesis defense
State subject 2-AIN-953/15 Methods of Applied Informatics
The student pulls one question at random.
2-AIN-185/00 Formal methods of software development - D. Gruska
1. Explain the principle of bisimulation and its use to verify the properties of programs.
2. Modal and temporal logics and their use for verification of program properties.
3. Process algebras, syntax, semantics, usage.
4. Time automata, principles, properties and uses.
5. Petri nets, types, properties and uses.
2-AIN-206/15 Mathematical Modeling and Computer Animation of Physical Processes - R. Ďurikovič
6. Animations of motion and orientation, nearest neighbor, linear interpolation, interpolation spline for motion animation, Cubic Bézier interpolation curve, C1 continuity of curve composition.
7. Quaternion and orientation, axis of rotation and angle, representation by quaternions, rotation in space by quaternions, inverse quaternion, composition of rotation of two quaternions, interpolation SLERP (Spherical Linear Interpolation), interpolation of two or more quaternions, Catmull-Rom interpolation.

8. Collision detection, necessary and sufficient condition when there are no two bodies in collision, dividing plane, broad phase (hierachical grid), mid phase (envelope hierarchy, Voronoi areas in collision, explain on the example of collision ball x capsule, decomposition of a body on convex parts), narrow phase (Minkowski space and proximity of convex bodies).
9. Numerical solution of differential equations, ODE first order separable, Equations of motion first order velocity, acceleration, Euler's method, MidPoint method, Runge-Kuta method, stability condition for time step selection.
10. Dynamics of rigid bodies, problem definition, position, center of gravity and orientation of a body, equation of motion (4 ODE), velocity, acceleration, angular velocity and angular acceleration, momentum matrix (inertia matrix) momentum matrix for a sphere, fixed block, displaced block.
2-INF-150/15 Machine learning - V. Boža, M. Šuppa, T. Vinař
11. Regression. Linear regression, solution using normal equations and gradient method, generalized linear regression, regularization.
12. Neural networks. Differences between logistic regression and simple perceptron. Hidden layers in neural networks. Convolutional neural networks. Back promotion method.
13. Support vector machines. Basic formulation, dual formulation. Kernel method.
14. Voting schemes. Bagging and boosting. Application to decision trees. Random forests.
15. Theory of machine learning. Mathematical model of machine learning. Deviation and variance. Holdout testing. PAC (probably approximately correct) learning, VC (Vapnik-Cervonenkis) dimension.
2-AIN-113/22 Computational fuzzy logic, modeling and systems - D. Guller
16. Residual unions - basic properties, triangular (co-) norms, residuals, continuity, manyvalued (MV), Goedel (G), product (P) algebras / varieties.
17. Fuzzy logics and computational formalisms (Lukasiewicz, Goedel, product), Davis – Putnam – Logemann – Loveland (DPLL) procedure, binary resolution, hyper-resolution.
18. Fuzzy sets, fuzzy numbers and arithmetic, discrete fuzzy sets, fuzzy set modifiers (hedges).
19. Fuzzy approximation models, fuzzy (F) transform, fuzzy cluster analysis.
20. Fuzzy inference, compositional rule of inference (CRI), fuzzy rules - Mamdani type, Sugeno-Takagi type, linguistic variable, Zadeh approach, fuzzification / defuzzification, fuzzy inference systems, fuzzy controllers (linear fuzzy proportional-integral-derivative (PID) and incremental control).
2-AIN-138/16 Discrete Structures in Informatics and Computer Graphics - T. Jajcayová
21. Groups, cyclic groups, modular arithmetic, primitive root, application to pseudorandom number generator, linear congruent generator.
22. One-way functions, discrete logarithm, application to Diffie-Helman key exchange protocol, use in crypto systems with public key.
23. Matrix algebra, modular matrices, applications, determinants, linear transformations.
24. Quaternions and their basic operations, Quaternion group, connections to linear transformations and rotations in three dimensions, comparing properties of the fields of Real, Complex, and Quaterion numbers.
25. Number theory, prime tests (also probabilistic), extended Euclidean algorithm - applications, fast modular exponentiation (even with complexities), small Fermat's theorem, Euler's theorem, applications to RSA crypto system.

Recommended literature:

Image processing, analysis, and machine vision / Milan Sonka, Vaclav Hlavac, Roger Boyle. [Stamford] : Cengage Learning, 2008
Artificial intelligence : A modern approach / Stuart J. Russell, Peter Norvig. Englewood Cliffs : Prentice-Hall, 1995

Parallel program design : A Foundation / K. Mani Chandy , Jayadev Misra. Reading : Addison-Wesley, 1988
Hughes et al. 2013. Computer Graphics Principles and Practice. > ISBN-13: > 978-0321399526. Addison-Wesley Professional. 3 edition (July 20, 2013)

Languages necessary to complete the course:
Slovak, English

Last change: 18.03.2026

Approved by: prof. RNDr. Roman Ďurikovič, PhD.

COURSE DESCRIPTION

Academic year: 2026/2027

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KAI/2-AIN-132/15	Neural Networks

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

Number of credits: 6

Recommended semester: 2.

Educational level: II.

Prerequisites:

Antirequisites: FMFI.KAI/1-AIN-480/00

Course requirements:
individual projects during the semester.
Final written-oral exam
Scale: A 90%, B 80%, C 70%, D 60%, E 50%
Scale of assessment (preliminary/final): 70/30

Learning outcomes:
After completing the course will student understands the basic principles of connectionism (neural networks) know the basic models of neural networks and know their usefulness when solving various tasks (eg. Pattern recognition, classification, time series prediction, memorizing patterns and others). Lectures are combined with computer simulations exercises in Python.

Class syllabus:
Introduction, inspiration from biology, brief history, NS with logical neurons.
Binary / continuous perceptron: the concept of learning with the teacher, classification of patterns.
Single-layer NS: linear self-association, classification, error functions.
Multilayer perceptron: error backpropagation method, training and test set, generalization, model selection, validation.
Modifications of gradient methods, second order optimization, regularization. Optimization problems.
Unsupervised learning, feature extraction, principal component analysis, self-organizing map, data visualization.
Sequence data modeling: forward NS, relation to n-grams, partially and completely recurrent models, SRN model, BPTT algorithms, RTRL.
Expansion of hidden representation: NS with radial basis functions (RBF), echo state network (ESN).
Deep learning, convolutional neural networks: introduction.
Modern recurrent NS: autoencoders, GRU, LSTM.
Hopfield model: deterministic dynamics, attractors, autoassociative memory.

Stochastic recurrent NS models: basics of probability theory and statistical mechanics, Boltzmann machine, RBM model, Deep Belief Network.
The recent trends in NS.

Recommended literature:

Neural networks and learning machines / Simon Haykin. Upper Saddle River : Pearson education, 2009
Úvod do teórie neurónových sietí / Vladimír Kvasnička ... [et al.]. Bratislava : Iris, 1997
Neural networks (slajdy k prednáškam), Igor Farkaš, Knižničné a edičné centrum FMFI UK v Bratislave, 2011.
Goodfellow I., Bengio Y., Courville A. (2016). Deep Learning. MIT Press.
Zhang A. et al. (2020). Dive into Deep Learning. An interactive deep learning book with code, math, and discussions, based on the NumPy interface.

Languages necessary to complete the course:
Slovak, English

Notes:

Past grade distribution
Total number of evaluated students: 223

A	B	C	D	E	FX
26,91	18,39	15,7	10,31	12,56	16,14

Lecturers: prof. Ing. Igor Farkaš, Dr.

Last change: 18.11.2021

Approved by: prof. RNDr. Roman Ďurikovič, PhD.

COURSE DESCRIPTION

Academic year: 2026/2027

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

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

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

Number of credits: 2

Recommended semester: 2., 8.

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

Prerequisites:

Course requirements:

Learning outcomes:

Class syllabus:

Recommended literature:

Languages necessary to complete the course:

Notes:

Past grade distribution
Total number of evaluated students: 202

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

Lecturers: Mgr. Xenia Daniela Poslon, PhD.

Last change: 06.09.2023

Approved by: prof. RNDr. Roman Ďurikovič, PhD.

COURSE DESCRIPTION

Academic year: 2026/2027

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

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

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

Number of credits: 2

Recommended semester: 1., 7.

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

Prerequisites:

Course requirements:

Learning outcomes:

Class syllabus:

Recommended literature:

Languages necessary to complete the course:

Notes:

Past grade distribution
Total number of evaluated students: 202

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

Lecturers: Mgr. Xenia Daniela Poslon, PhD.

Last change: 06.09.2023

Approved by: prof. RNDr. Roman Ďurikovič, PhD.

COURSE DESCRIPTION

Academic year: 2026/2027

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

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

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

Number of credits: 2

Recommended semester: 1., 7.

Educational level: I.II., II.

Prerequisites:

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

Learning outcomes:

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

Recommended literature:

Languages necessary to complete the course:
Slovak, English

Notes:

Past grade distribution
Total number of evaluated students: 2007

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

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

Last change: 15.03.2022

Approved by: prof. RNDr. Roman Ďurikovič, PhD.

COURSE DESCRIPTION

Academic year: 2026/2027

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

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

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

Number of credits: 2

Recommended semester: 2., 8.

Educational level: I.II., II.

Prerequisites:

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

Learning outcomes:

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

Recommended literature:

Languages necessary to complete the course:
Slovak, English

Notes:

Past grade distribution
Total number of evaluated students: 1797

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

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

Last change: 15.03.2022

Approved by: prof. RNDr. Roman Ďurikovič, PhD.

COURSE DESCRIPTION

Academic year: 2026/2027

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

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

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

Number of credits: 2

Recommended semester: 3., 9.

Educational level: I.II., II.

Prerequisites:

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

Learning outcomes:

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

Recommended literature:

Languages necessary to complete the course:
Slovak, English

Notes:

Past grade distribution
Total number of evaluated students: 1525

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

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

Last change: 15.03.2022

Approved by: prof. RNDr. Roman Ďurikovič, PhD.

COURSE DESCRIPTION

Academic year: 2026/2027

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

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

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

Number of credits: 2

Recommended semester: 4., 10.

Educational level: I.II., II.

Prerequisites:

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

Learning outcomes:

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

Recommended literature:

Languages necessary to complete the course:
Slovak, English

Notes:

Past grade distribution
Total number of evaluated students: 1267

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

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

Last change: 15.03.2022

Approved by: prof. RNDr. Roman Ďurikovič, PhD.

COURSE DESCRIPTION

Academic year: 2026/2027

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KAI/2-AIN-206/15	Physical-based Animations and Mathematical Modeling

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

Number of credits: 6

Recommended semester: 1.

Educational level: II.

Prerequisites:

Course requirements:
Evaluation: assignments, homeworks,
Exam: final exam, oral exam
Evaluation scale: A 92%, B 84%, C 76%, D 68%, E 60%
For the semester, the student can get 10% for exercises, 60% for homework, final written exam with a weight of 30% oral final exam is voluntary with a weight of 20%. The student must solve at least 30% of each homework in order to pass the final written exam. Grading: 92-100 A, 84-91 B, 76-83 C, 68-75 D, 60-67 E. Details on the course page.
Scale of assessment (preliminary/final): 40/60

Learning outcomes:
Students will learn the basic techniques of simulation particle systems, solving systems of ordinary differential equations numerically, the object collision detection. Understand the principles of dynamics of rigid bodies and the principle of the creation of computer animation and camera movement. Understand how to construct physics engine for games or video animation.

Class syllabus:
Particle systems, motion equations of first order integration methods to calculate the speed and position, state vector system, external forces, restrictive conditions - constraints, response forces, particle collisions - plane.
Numerical solution of differential equations, Euler method, Runge-Kuta method, stability criteria to select the time step.
Lagrange method without networks, modeling and animation point cloud, SPH, deformation
Animation mobility, spline interpolation to animate movement, reparametrisation spline curves by length, and orientation quaternion interpolation of two or more quaternion.
Collision detection, Z buffer algorithm, necessary and sufficient conditions when there are two bodies in a collision, parting line, hierarchy envelopes force response (Response Forces). Three phase detection wide, medium and narrow.
Dynamics of rigid bodies, equations of motion, velocity, acceleration, angular velocity and angular acceleration, inertia matrix.
Procedurárne animation, systems and methods for creating computer animation liquids, fire, smoke.

Computer animation in games and in the film industry. Other applications of computer animation with further developments in the field of computer animation using physical effects.

Recommended literature:

Visual Quantum mechanics : Selected Topics with Computer/Generated animations of Quantum-Mechanical phenomena / Bernd Thaller. New York : Springer, 2000

Computer facial animation / Frederic I. Parke, Keith Waters. Wellesley : A. K. Peters , 1996

SIGGRAPH tutorialy dostupné na http://dl.acm.org/dl.cfm?CFID=412417535&CFTOKEN=50913605

Dostupné texty k prednáške. https://dai.fmph.uniba.sk/w/Physical-based_Animations_and_Mathematical_Modeling_Material

Languages necessary to complete the course:

Slovak, English

Notes:

Past grade distribution

Total number of evaluated students: 572

A	B	C	D	E	FX
28,85	18,53	16,08	14,69	9,97	11,89

Lecturers: prof. RNDr. Roman Ďurikovič, PhD.

Last change: 20.06.2022

Approved by: prof. RNDr. Roman Ďurikovič, PhD.

COURSE DESCRIPTION

Academic year: 2026/2027

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KAI/2-AIN-290/15	Practice

Educational activities:
Type of activities: practice
Number of hours:
per week: **per level/semester:** 150s
Form of the course: on-site learning

Number of credits: 6

Recommended semester: 4.

Educational level: II.

Prerequisites:

Course requirements:
Continuous assessment: Attendance, activity report
Scale of assessment (preliminary/final): 100/0

Learning outcomes:
The student will find a suitable company or scientific institution that works in the field of information technology, acquire basic work habits and gain experience in the field of informatics, which is necessary for easier job search. Completing a course with a good recommendation will allow the student to work after graduation.

Class syllabus:
924 / 5000
Translation results
The student will find a suitable company or scientific institution that works in the field of information technology and submit his proposal for approval to the guarantor. The student completes the course according to the instructions of the institution.
The aim of the course is for students to get acquainted with new IT technologies, devices, learn to work with them, operate and operate them.
As a condition for obtaining the evaluation, the student prepares and submits a written report confirmed by the responsible leader in the institution consisting of:
1. Confirmations of attendance of at least 150 hours lasting 9 weeks, i. attendance sheets
2. Activity report or statement sheets with a precise description of the activities
The evaluation for the internship, the minimum duration of which is 9 weeks (150 hours), is recorded by the guarantor after its completion. The internship can be completed at any time during the 1st and 2nd year of the master's study, but no later than the deadline set by the end of the examination period of the given semester.

Recommended literature:

Languages necessary to complete the course:
Slovak, English

Notes:

Past grade distribution
Total number of evaluated students: 221

A	B	C	D	E	FX
50,23	8,14	33,03	3,17	0,45	4,98

Lecturers: prof. RNDr. Roman Ďurikovič, PhD.

Last change: 18.11.2021

Approved by: prof. RNDr. Roman Ďurikovič, PhD.

COURSE DESCRIPTION

Academic year: 2026/2027

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KAI/2-AIN-109/22	Programming of Parallel and Distributed Systems

Educational activities:
Type of activities: lecture / practicals
Number of hours:
per week: 3 / 1 **per level/semester:** 39 / 13
Form of the course: on-site learning

Number of credits: 5

Recommended semester: 2.

Educational level: II.

Prerequisites:

Course requirements:
all homeworks as well as two written test during semester has to be completed
A 90%, B 80%, C 70%, D 60%, E 50%
Scale of assessment (preliminary/final): 80/20

Learning outcomes:
Graduates of the course will be acquainted with the issues of parallel and distributed programming. They will get acquainted with the basic algorithms used in practice, as well as with methods how to prove the correctness or effectiveness of algorithms. They will gain an overview of basic parallel and distributed architectures, a brief overview of various paradigms and programming languages.

Class syllabus:
At the beginning, students will be introduced to a simple way to write algorithms for parallel and distributed computing, so that these notations are applicable to different types of architectures. They will also gain the basics of logic that will be used to express and prove the properties of programs. Then they will get acquainted with the basic architectures of parallel and distributed systems. The core of the course consists of selected basic algorithms of parallel and distributed systems (eg Shortest path, Reader-problémWriters problem, Evening philosophers, Meeting coordination, Drinking philosophers, Sorting, Faulty channels, Global snapshots, Stable feature detection, Byzantine agreement). Alternatively, their zones may expand in line with developments in the field. At the end of the course there will be an overview of different programming languages and paradigms and logics.

Recommended literature:
Parallel program design : A Foundation / K. Mani Chandy , Jayadev Misra. Reading : Addison-Wesley, 1988 An introduction to parallel algorithms / Joseph Jájá. Boston : Addison-Wesley, 1992 C. Stirling: Modal and Temporal Properties of Processes, Springer 2001 Elektronické poznámky k prednáške, http://ii.fmph.uniba.sk/~gruska/udpp/Beziacaudppprednaska2014.pdf

Languages necessary to complete the course:
Slovak, English

Notes:

Past grade distribution
Total number of evaluated students: 387

A	B	C	D	E	FX
26,87	16,28	22,74	21,45	8,79	3,88

Lecturers: doc. RNDr. Damas Gruska, PhD.

Last change: 20.06.2022

Approved by: prof. RNDr. Roman Ďurikovič, PhD.

COURSE DESCRIPTION

Academic year: 2026/2027

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KAI/2-AIN-923/22	Project Seminar (1)

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

Number of credits: 5

Recommended semester: 2.

Educational level: II.

Prerequisites:

Course requirements:
The necessary condition for enrolling in the course is the enrollment of the diploma topic and the supervisor.
Interim evaluation: 1. Presentation of their progress on the topic of the diploma thesis and a conference of results within the course. 2. Demonstration of either partially functional implementation or the solution proposed by the graduate and the proposed method of validation (in the case of theoretical, review papers). 3. Evaluation of key studied articles and satisfactory answer to the question from the knowledge of the read literature.
Exam: A: Prototype demonstration, studied basics of the issue. B: A simple example of a partial solution to one of the goals. C: Detailed study of the problem and the procedure of solving the goals, knowledge of the limitations of the studied methods, number of articles (& gt; 4). D: Studied tutorials, new libraries needed to solve the goal. E: The researcher has an idea of how he will specifically solve the goals of the work, he knows which libraries he will use. Fx: remaining options (missing presentation, non-participation)
Indicative assessment scale: A 92%, B 84%, C 76%, D 68%, E 60%
Scale of assessment (preliminary/final): 100/0

Learning outcomes:
Student will gain habits and experience for individual and collective professional work on a larger scale. They will learn to quickly extract essential ideas from scientific articles. The theoretical part of the diploma thesis will be mastered and will focus on the implementation of the work.

Class syllabus:
1. Presentation of their progress on the topic of the diploma thesis and a conference of results within the subject will take place.
2. Demonstration of either partially functional implementation or the solution proposed by the graduate and the proposed method of validation (in the case of theoretical, review papers).
3. Evaluation of key studied articles and satisfactory answer to the question from the knowledge of the read literature.

Recommended literature:

LATEX : Podrobný průvodce / Helmut Kopka, Patrick W. Daly ; překlad Jan Gregor. Brno : Computer Press, 2004
LATEX : A Document preparation system / Leslie Lamport. Reading : Addison-Wesley, 1986

Languages necessary to complete the course:
Slovak, English

Notes:

Past grade distribution
Total number of evaluated students: 395

A	B	C	D	E	FX
61,01	14,68	11,39	2,78	2,78	7,34

Lecturers: prof. RNDr. Roman Ďurikovič, PhD.

Last change: 18.11.2021

Approved by: prof. RNDr. Roman Ďurikovič, PhD.

COURSE DESCRIPTION

Academic year: 2026/2027

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KAI/2-AIN-924/22	Project Seminar (2)

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

Number of credits: 5

Recommended semester: 3.

Educational level: II.

Prerequisites: FMFI.KAI/2-AIN-923/22 - Project Seminar (1)

Recommended prerequisites:
2-AIN-924 Projektový seminár (1)

Course requirements:
Interim evaluation: 1. Presentation in the form of pre-defense and a conference of results will take place. 2. Written report on the solution in the form of a written comprehensive chapter of the diploma thesis, agreed with the supervisor, front sheets and a list of literature (according to the standard), including documentation (min. 10 pages). 3. Demonstration of either implementation with tests or examples illustrating the solution proposed by the graduate. 4. Study of key articles read and a satisfactory answer to a question from the knowledge of the literature read.
Exam: Rating E and better requires to meet each of the following points.
Indicative assessment scale: A 92%, B 84%, C 76%, D 68%, E 60%
Scale of assessment (preliminary/final): 100/0

Learning outcomes:
He will gain habits and experience for individual and collective professional work on a larger scale. They will learn to quickly extract essential ideas from scientific articles. The theoretical part of the diploma thesis will be mastered and will focus on the implementation of the work.

Class syllabus:
Information on large-scale professional work technology. Customs for writing professional computer texts. The second stage of the project is a diploma thesis. Papers of graduates on the issue of diploma thesis. Project work and implementation so that it results in a diploma thesis.

Recommended literature:
LATEX : Podrobný průvodce / Helmut Kopka, Patrick W. Daly ; překlad Jan Gregor. Brno : Computer Press, 2004
LATEX : A Document preparation system / Leslie Lamport. Reading : Addison-Wesley, 1986

Languages necessary to complete the course:
Slovak, English

Notes:

Past grade distribution Total number of evaluated students: 422					
A	B	C	D	E	FX
56,16	16,35	11,14	3,55	5,21	7,58
Lecturers: prof. RNDr. Roman Ďurikovič, PhD.					
Last change: 18.11.2021					
Approved by: prof. RNDr. Roman Ďurikovič, PhD.					

COURSE DESCRIPTION

Academic year: 2026/2027

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KAI/2-AIN-128/15	Real-time Graphics and GPU Computations

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

Number of credits: 6

Recommended semester: 2.

Educational level: II.

Prerequisites:

Antirequisites: FMFI.KAG/2-MPG-101/00 and FMFI.KAG/2-MPG-102/00

Course requirements:
The student can get 70% of the evaluation for the project. The student must elaborate the project of at least 50% in order to pass the final oral exam. Grading: 92-100 A, 84-91 B, 76-83 C, 68-75 D, 60-67 E. More detailed informations on the course page.
Scale of assessment (preliminary/final): 70/30

Learning outcomes:
The course represents the key themes, principles and techniques used in the rendering of virtual scenes in real time. This procedure is most commonly used in making 3D games, but also in various scientific vizualizations, such as visualization of medical data. After the course the students will be able to analyze and implement current procedures, algorithms, programming effects for graphics cards and the create the visualization applications. The subjects students will be able to develop gaming applications on different platforms, applications in virtual and mixed reality and create visualizations of medical data.

Class syllabus:
1. Graphic display channel - description of the graphics hardware architectures, programming of graphics cards, coordinate systems, programmable parts of the display channel, description and formats of virtual scene during the rendering, OpenGL API
2. Animation - a description of the object pose representation (position, rotation, scale), nuts and Quaternions, linear and cubic interpolation for animation
3. Light - description of lighting models and their implementation using shaders, textures in lighting model, direct and defferred lighting, use rendering to texture and shadows, approximation of global illumination methods
4. Post-process Effects - description of algorithms to improve the quality of the final output image, motion blur, depth of field, SSAO, reflections and refractions, HDRI, bloom, toon shading
5. Image-based rendering - use of texture to speed up calculations of lighting, textures for backgrounds to represent complex objects (bilboarding), image processing algorithms on the GPU, volumetric graphics

6. Accelerating algorithms - algorithms and structures to accelerate rendering complex scenes, trimming techniques, level of detail, collision detection
7. GPGPU - description of the graphics card performance for general computing, CUDA and OpenCL language, image and video processing, physical simulation of phenomena on the GPU, ray tracing on the GPU

Recommended literature:
Real-time rendering / Tomas Akenine-Möller, Eric Haines, Naty Hoffman. Wellesley : A. K. Peters, 2008

Languages necessary to complete the course:
Slovak, English

Notes:

Past grade distribution
Total number of evaluated students: 46

A	B	C	D	E	FX
36,96	28,26	8,7	6,52	8,7	10,87

Lecturers: Mgr. Andrej Mihálik, PhD.

Last change: 22.06.2022

Approved by: prof. RNDr. Roman Ďurikovič, PhD.

COURSE DESCRIPTION

Academic year: 2026/2027

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KAI/2-IKVa-194/21	Reinforcement Learning

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

Number of credits: 5

Recommended semester: 2., 4.

Educational level: II.

Prerequisites:

Course requirements:
Work on exercises (50%)
Exam: test (50%)
Grade A: 90% , B: 80% , C 70%, D 60% and grade E at minimum 50%

Learning outcomes:
The graduate will gain an overview of the methods and techniques used in reinforcement learning. Will gain practical experience with analysis, design and implementation of reinforcement learning problems.

Class syllabus:
1. Introduction to reinforcement learning
2. Markov decision process
3. Dynamic programming
4. Monte Carlo methods
5. Temporal-Difference learning
6. Exploration and exploitation
7. Value function approximation
8. Policy gradient methods
9. Actor-critic methods
10. Deep reinforcement learning

Recommended literature:
Sutton, Richard S., and Andrew G. Barto. Reinforcement learning: An introduction. MIT press, 2018.
Goodfellow, Ian, Yoshua Bengio, and Aaron Courville. Deep learning. MIT press, 2016.

Languages necessary to complete the course:
Slovak, English

Notes:

Past grade distribution
Total number of evaluated students: 26

A	B	C	D	E	FX
38,46	30,77	11,54	3,85	7,69	7,69

Lecturers: doc. Ing. Peter Lacko, PhD.

Last change: 12.11.2021

Approved by: prof. RNDr. Roman Ďurikovič, PhD.

COURSE DESCRIPTION

Academic year: 2026/2027

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

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

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

Number of credits: 2

Recommended semester: 1., 7.

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

Prerequisites:

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

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

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

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

Languages necessary to complete the course:

Notes:

Past grade distribution
Total number of evaluated students: 746

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

Lecturers: Viktoria Mirsalova

Last change: 20.06.2022

Approved by: prof. RNDr. Roman Ďurikovič, PhD.

COURSE DESCRIPTION

Academic year: 2026/2027

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

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

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

Number of credits: 2

Recommended semester: 2., 8.

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

Prerequisites:

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

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

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

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

Languages necessary to complete the course:

Notes:

Past grade distribution
Total number of evaluated students: 435

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

Lecturers: Viktoria Mirsalova

Last change: 20.06.2022

Approved by: prof. RNDr. Roman Ďurikovič, PhD.

COURSE DESCRIPTION

Academic year: 2026/2027

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

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

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

Number of credits: 2

Recommended semester: 3., 9.

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

Prerequisites:

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

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

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

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

Languages necessary to complete the course:

Notes:

Past grade distribution
Total number of evaluated students: 215

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

Lecturers: Viktoria Mirsalova

Last change: 20.06.2022

Approved by: prof. RNDr. Roman Ďurikovič, PhD.

COURSE DESCRIPTION

Academic year: 2026/2027

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

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

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

Number of credits: 2

Recommended semester: 4., 10.

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

Prerequisites:

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

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

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

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

Languages necessary to complete the course:

Notes:

Past grade distribution
Total number of evaluated students: 153

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

Lecturers: Viktoria Mirsalova

Last change: 20.06.2022

Approved by: prof. RNDr. Roman Ďurikovič, PhD.

COURSE DESCRIPTION

Academic year: 2026/2027

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KAI/2-AIN-211/22	Shader Programming

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

Number of credits: 3

Recommended semester: 4.

Educational level: II.

Prerequisites:

Course requirements:
To obtain an A rating it is necessary to obtain at least 90% of points, to obtain a B rating at least 80% of points, for rating C at least 70% of points, for rating D at least 60% of pointsand for rating E at least 50% of the points.
Scale of assessment (preliminary/final): Weight of the course work / exam: Weight of the intermediate / final evaluation: 100/0

Learning outcomes:
Students will learn to program the shader programs used in computer graphics to create a variety of effects in image rendering. Student will be able to use the learned principles during programming of the graphics effects in game engines or interfaces such as Vulkan or OpenGL.

Class syllabus:
Learning in online editor Shadertoy.
2D and 3D transformations.
Procedural modeling.
Parametric equations.
Procedural textures.
Fractal generation.
Particle systems.
Team work on a project in a PC room, brainstorming

Recommended literature:
Graphics Shaders: Theory and Practice, Second Edition / Mike Bailey, Steve Cunningham : CRC Press, 2016

Languages necessary to complete the course:
Slovak, English

Notes:

Past grade distribution
Total number of evaluated students: 2

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

Lecturers: Mgr. Andrej Mihálik, PhD.

Last change: 18.11.2021

Approved by: prof. RNDr. Roman Ďurikovič, PhD.

COURSE DESCRIPTION

Academic year: 2026/2027

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

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

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

Number of credits: 2

Recommended semester: 1., 7.

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

Prerequisites:

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

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

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

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

Languages necessary to complete the course:

Notes:

Past grade distribution
Total number of evaluated students: 155

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

Lecturers: Mgr. Aneta Barnes

Last change: 21.06.2022

Approved by: prof. RNDr. Roman Ďurikovič, PhD.

COURSE DESCRIPTION

Academic year: 2026/2027

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

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

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

Number of credits: 2

Recommended semester: 2., 8.

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

Prerequisites:

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

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

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

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

Languages necessary to complete the course:

Notes:

Past grade distribution
Total number of evaluated students: 87

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

Lecturers: Mgr. Aneta Barnes

Last change: 21.06.2022

Approved by: prof. RNDr. Roman Ďurikovič, PhD.

COURSE DESCRIPTION

Academic year: 2026/2027

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

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

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

Number of credits: 2

Recommended semester: 3., 9.

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

Prerequisites:

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

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

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

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

Languages necessary to complete the course:

Notes:

Past grade distribution
Total number of evaluated students: 32

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

Lecturers: Mgr. Aneta Barnes

Last change: 21.06.2022

Approved by: prof. RNDr. Roman Ďurikovič, PhD.

COURSE DESCRIPTION

Academic year: 2026/2027

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

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

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

Number of credits: 2

Recommended semester: 4., 10.

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

Prerequisites:

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

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

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

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

Languages necessary to complete the course:

Notes:

Past grade distribution
Total number of evaluated students: 25

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

Lecturers: Mgr. Aneta Barnes

Last change: 21.06.2022

Approved by: prof. RNDr. Roman Ďurikovič, PhD.

COURSE DESCRIPTION

Academic year: 2026/2027

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

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

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

Number of credits: 2

Recommended semester: 1., 7.

Educational level: I.II., II.

Prerequisites:

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

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

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

Recommended literature:

Languages necessary to complete the course:
Slovak

Notes:
KTVŠ does not rent ski equipment.

Past grade distribution
Total number of evaluated students: 186

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

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

Last change: 16.06.2022
Approved by: prof. RNDr. Roman Ďurikovič, PhD.

COURSE DESCRIPTION

Academic year: 2026/2027

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

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

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

Number of credits: 2

Recommended semester: 2., 8.

Educational level: I.II., II.

Prerequisites:

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

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

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

Recommended literature:

Languages necessary to complete the course:
Slovak

Notes:
KTVŠ will provide sports equipment.

Past grade distribution
Total number of evaluated students: 109

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

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

COURSE DESCRIPTION

Academic year: 2026/2027

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KAI/2-AIN-137/24	Statistical Methods in Artificial Intelligence

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

Number of credits: 6

Recommended semester: 2.

Educational level: II.

Prerequisites:

Antirequisites: FMFI.KAI/2-AINa-137/20

Course requirements:
projects, written exam
Scale: A 95%, B 88%, C 79%, D 68%, E 55%
Scale of assessment (preliminary/final): 30/70

Learning outcomes:
After completing the course, students should have a good overview of the theoretical methods used in artificial intelligence. They should be able to use these methods in practice in programming intelligent systems, they should be able to enrich and creatively exploit.

Class syllabus:
1. Short repetition of basic technics in AI: agent, searching, CSP problem, logical agents.
2. Planning I: Basic planning (STRIPS, POP, TOP, graphplan, critical path method), scheduling.
3. Planning II: Planning problems (hierarchical planning, senzorless planning, incremental planning, planning in a case of nondeterministic actions.)
4. Probabilistic methods in UI I: necessary basic concepts (short summary), introduction to Monte Carlo methods, basic examples. Sampling methods in MC, MC in AI (sampling and artificial data, Monte Carlo tree search)
5. Probabilistic methods in UI II: bayesian networks, bayesian inference, examples. Exact and probabilistic inference in bayesian networks: derect and rejection sampling, likehood weighting, how to use bayesian networks in UI (classification, diagnosis)
6. Time series I . Classical time series analysis, trend and periodicity analysis, spectral analysis, stationary time series, nonlinear time series.
7. Time series II. Box Jenkins time series analysis (AR, MA, ARMA models), time series with uncertainity, introduction.
8. Time series III. Time series with uncertainity, markovian processes, filtration, prediction, Vitterbi algorithm, real problem examples, Kálman filter.
9. Decision theory I. Introduction, simple and complex decisions (lottery examples) utility functions. Markov decision problem, optimal policy, value iteration algorithm, Belman equation.

10. Decision theory II. Decision in games, dominant strategy , Nash equilibrium, repeated games, grim trigger a tit for tat analysis. Cooperation in games.
11. Theory of learning I : supervised and unsupervised learning, Learning decision trees, PAC learning, linear models, regression and classification.
12. Theory of learning II : Bayesian learning , naive models, maximum likehood learning and continuous models, Bayesian learning with hidden parameters.

Recommended literature:

Artificial intelligence : A modern approach / Stuart J. Russell, Peter Norvig. Englewood Cliffs : Prentice-Hall, 1995
Artificial intelligence a new synthesis / Nils J. Nilsson. San Francisco : Morgan Kaufmann, 1998

Languages necessary to complete the course:
Slovak, English

Notes:

Past grade distribution
Total number of evaluated students: 15

A	B	C	D	E	FX
6,67	20,0	20,0	26,67	26,67	0,0

Lecturers: doc. RNDr. Mária Markošová, PhD.

Last change: 28.05.2024

Approved by: prof. RNDr. Roman Ďurikovič, PhD.

COURSE DESCRIPTION

Academic year: 2026/2027

University: Comenius University Bratislava

Faculty: Faculty of Mathematics, Physics and Informatics

Course ID:	**Course title:**
FMFI.KAI+KDMFI/2-AIN-111/24	Web Design Methodology

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

Number of credits: 6

Recommended semester: 1.

Educational level: I., II.

Prerequisites:

Antirequisites: FMFI.KAI+KDMFI/2-AINa-111/20

Course requirements:
Semester: project 60pts, final test 15pts (minimum 50%)
Exam: oral exam 25pts (admittance requirement: 60pts from the semester)
Passing the course: 50pts altogether and 50% from the final test
Scale: A 90%, B 80%, C 70%, D 60%, E 50%
Scale of assessment (preliminary/final): 75/25

Learning outcomes:
An overview of web technologies and their applications for various purposes. Principles and methodologies of web applications, web user interfaces, and web content design.

Class syllabus:
- Overview of web technologies and web architecture
- Information architecture, types of websites, web applications, components and interfaces
- Client platforms (mobile, tablet, desktop) and implications for web design and development
- Methodologies of website and web application development (waterfall model, agile methodologies)
- Interaction design methodologies (user research and modelling, iterative prototype-based design, prototype testing)
- Principles and methodologies of web content curation
- Testing, optimization and maintenance of web applications and web content
- Website and web application quality measures

Recommended literature:
Web Style Guide, 4th ed. / P.J. Lynch, S. Horton. Yale University Press, 2016. Dostupné online: http://webstyleguide.com/
Mobile First. L. Wroblewski, A Book Apart, 2011

Languages necessary to complete the course:

Slovak, English

Notes:

Past grade distribution
Total number of evaluated students: 29

A	B	C	D	E	FX
6,9	20,69	17,24	24,14	17,24	13,79

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

Last change: 28.05.2024

Approved by: prof. RNDr. Roman Ďurikovič, PhD.