CONTENT

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚMV/ dPTGa/25	**Course name:** Advanced graph theory I

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

Number of ECTS credits: 7

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

Course level: III.

Prerequisities:

Conditions for course completion:
To complete the course, it is necessary to demonstrate the ability to formulate definitions and theorems from the lectured material together with their proofs, and to present an understanding of the connections between particular concepts and results.
The evaluation of the subject is based on the results of an oral exam (consisting of two theoretical questions).

Learning outcomes:
After completing the course, the student is acquainted with other advanced topics of graph theory in the form of selected modules, which are not covered by basic courses in discrete mathematics during the bachelor or master degree study.

Brief outline of the course:
Minors, topological minors and and forbidden subgraphs.
Groups and graphs, automorphisms of graphs, Cayley and Schreier graphs, Frucht theorem.
Methods of linear algebra in graph theory.
Nowhere-zero flows.
Domination in graphs.
Graph reconstruction.

Recommended literature:
J. A. Bondy and U.S.R. Murty, Graph Theory, Springer-Verlag, 2008
J.Bang-Jensen and G. Gutin: Digraphs: Theory, Algorithms and Applications, Springer-Verlag London, 2001
R. Diestel: Graph Theory, Springer-Verlag, New York, 1997
scientific journal publications

Course language:
Slovak and English

Notes:
Knowledge of graph theory within the scope of the discrete mathematics course (which is standardly provided within the framework of a bachelor's or master's mathematics-oriented study programme) is required.

Course assessment
Total number of assessed students: 51

N	P
0.0	100.0

Provides: prof. RNDr. Tomáš Madaras, PhD., RNDr. Igor Fabrici, Dr. rer. nat., doc. RNDr. Roman Soták, PhD.

Date of last modification: 12.12.2024

Approved: prof. RNDr. Tomáš Madaras, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚMV/ dPTGb/25	**Course name:** Advanced graph theory II

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

Number of ECTS credits: 7

Recommended semester/trimester of the course: 2., 4.

Course level: III.

Prerequisities:

Conditions for course completion:
To complete the course, it is necessary to demonstrate the ability to formulate definitions and theorems from the lectured material together with their proofs, and to present an understanding of the relationships between particular concepts and results.
The evaluation of the subject is based on the results of an oral exam (consisting of two theoretical questions).

Learning outcomes:
After completing the course, the student is acquainted with other specific topics of graph theory which are not covered by basic or advanced courses in discrete mathematics during the bachelor or master degree study, and which are the subject of research of teams, whose members contribute to supervision of the doctoral program Mathematics.

Brief outline of the course:
The Discharging Method in graph theory.
3-colourability of graphs - sufficient conditions, algorithmic aspects.
Graph colourings with constraints on colour neighbourhoods of vertices.
Long cycles in graphs.
1-planar graphs, other concepts of nonplanarity of graphs.
Social / complex network analysis - centrality indices, community structure, scale-free networks.

Recommended literature:
Recent publications from international scientific journals.

Course language:
Slovak and English

Notes:
The completion of the subject dPTGa Advanced graph theory I is assumed.

Course assessment
Total number of assessed students: 25

N	P
0.0	100.0

Provides: doc. RNDr. Roman Soták, PhD., prof. RNDr. Tomáš Madaras, PhD., RNDr. Igor Fabrici, Dr. rer. nat.

Date of last modification: 09.01.2025

Approved: prof. RNDr. Tomáš Madaras, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚMV/ dPMS/10	**Course name:** Advanced statistical methods

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

Number of ECTS credits: 8

Recommended semester/trimester of the course: 2., 4.

Course level: III.

Prerequisities:

Conditions for course completion:
Exam or public lecture.

Learning outcomes:
Understanding the current state of the research area.

Brief outline of the course:
Study of journal articles and scientific monographs according to specific research direction of students.

Recommended literature:
Recent journal literature.

Course language:
Slovak and English

Notes:

Course assessment
Total number of assessed students: 6

N	P
0.0	100.0

Provides: prof. RNDr. Ivan Žežula, CSc.

Date of last modification: 28.03.2022

Approved: prof. RNDr. Tomáš Madaras, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚMV/ dPNP/25	**Course name:** Advanced stochastic processes

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

Number of ECTS credits: 8

Recommended semester/trimester of the course: 2., 4.

Course level: III.

Prerequisities:

Conditions for course completion:
Based on written tests and oral exam.

Learning outcomes:
Student should obtain the knowledge about special discrete and continuous stochastic processes and their applications.

Brief outline of the course:
Poisson process and its application in special queueing systems.
Martingales with discrete and continuous time - definition, properties, applications.
Brownian motion (Wiener process) - properties, modifications, applications.

Recommended literature:
1. Beichelt F.: Applied Probability and Stochastic Processes, 2nd ed., Chapman and Hall, 2018.
2. Ross S. M.: Introduction to Probability Models, 13th ed., Elsevier, 2023
3. Gallager R. G.: Stochastic Processes: Theory for Applications, Cambridge University Press, 2014.
4. Stirzaker D.: Stochastic Processes and Models, Oxford University Press, Oxford, 2005.
5. Časopisecká literatúra.

Course language:
Slovak or English

Notes:

Course assessment
Total number of assessed students: 7

N	P
0.0	100.0

Provides: doc. RNDr. Martina Hančová, PhD.

Date of last modification: 09.01.2025

Approved: prof. RNDr. Tomáš Madaras, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚMV/ dATH/22	**Course name:** Algorithmic game theory
Course type, scope and the method: **Course type:** Lecture **Recommended course-load (hours):** **Per week:** 4 **Per study period:** 56 **Course method:** present	
Number of ECTS credits: 7	
Recommended semester/trimester of the course: 2., 4.	
Course level: III.	
Prerequisities:	
Conditions for course completion:	
Learning outcomes: Broader relation of game theory and other disciplines. Understanding of the difference between existential and constructive results in mathematics. Undestanding of a new complexity class.	
Brief outline of the course: The notion of Nash equilibrium in bimatrix games. Nash existence theorem for games with finite number of pure strategies. Lemke-Howson algorithm for computing Nash equilibrium. Some NP-complete problems connected with Nash equilibrium. The PPAD complexity class. Proof of PPAD completeness of NASH problem. Brouwers fixed point theorem and Sperner lemma. Voting games - various voting systems and their shortcommings. Arrows theorem on dictators and Gibbart-Sattertwaithe theorem on election manipulability. Various forms of election manipulation and their complexity.	
Recommended literature: 1. N. Nisan, T. Roughgarden, E. Tardos, V.V. Vazirani: Algorithmic Game Theory, Cambridge University Press, 2007 2. C. Daskalakis, P.W. Goldberg, Ch. H. Papadimitriou: The complexity of computing a Nash equilibrium, Comm. ACM, Vol. 52, 89-97, 2009 3. Ch.H. Papadimitriou: On the complexity of the parity argument and other inefficient proofs of existence, J. of Computer and System Sciences, Vol. 48, 498-532, 1994 4. Bierman, Fernandez: Game theory with economic applications, Addison Wesley, 1998 5. J. Geanakoplos: Three brief proofs of Arrow's Impossibility Theorem, Economic Theory26, 211–215 (2005) 6. P. Faliszewski, E. Hemaspaandra, L. Hemaspaandra, J. Rothe: A RICHER UNDERSTANDING OF THE COMPLEXITY OF ELECTION SYSTEMS, S.S. Ravi, S.K. Shukla (eds.), Fundamental Problems in Computing, Springer 2009	
Course language: Slovak or English	
Notes:	

Course assessment Total number of assessed students: 0	
N	P
0.0	0.0
Provides: prof. RNDr. Katarína Cechlárová, DrSc.	
Date of last modification: 24.01.2022	
Approved: prof. RNDr. Tomáš Madaras, PhD.	

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚINF/ ZSUD/22	**Course name:** Basics of machine learning
Course type, scope and the method: **Course type:** Lecture / Practice **Recommended course-load (hours):** **Per week:** 2 / 2 **Per study period:** 28 / 28 **Course method:** present	
Number of ECTS credits: 7	
Recommended semester/trimester of the course: 1., 3.	
Course level: III.	
Prerequisities:	
Conditions for course completion: Creating a project focused on the application of machine learning algorithms in a selected application domain. Continuous written work focused on the preparation, processing and interpretation of data using machine learning methods. Successful completion of an oral exam focused on selected machine learning methods.	
Learning outcomes: Theoretical knowledge in the area of machine learning. Basic concepts of machine learning. Basic machine learning algorithms.	
Brief outline of the course: 1. Basic concepts of machine learning, basic characteristics of data, types of attributes, characteristics for individual attributes, dependence between attributes. 2. Data sources and their acquisition. Determining the target task, preparation and cleaning of data, missing values, incorrect inputs. 3. Classification tasks, selected classification methods, evaluation of models, classification accuracy indicators. 4. Cluster analysis. Association rules. 5. Prediction tasks and selected prediction methods, prediction accuracy indicators.	
Recommended literature: 1. AGGARWAL, Charu C. Data mining: a textbook. Cham: Springer, 2015. ISBN 978-3-319-14141-1. 2. ALPAYDIN, Ethem. Introduction to machine learning. 3rd ed. Massachusetts: MIT Press, 2014. ISBN 978-0-262-02818-9. 3. RASCHKA, Sebastian, Mirjalili, Vahid. Python Machine Learning: Machine Learning and Deep Learning with Python, scikit-learn, and TensorFlow 2, 3rd Edition, Packt Publishing Ltd., 2019. ISBN 978-1789955750.	
Course language:	
Notes:	

Course assessment Total number of assessed students: 2	
N	P
0.0	100.0
Provides: doc. RNDr. Ľubomír Antoni, PhD.	
Date of last modification: 01.10.2021	
Approved: prof. RNDr. Tomáš Madaras, PhD.	

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚMV/ dCOK/24	**Course name:** Certified training course
Course type, scope and the method: **Course type:** **Recommended course-load (hours):** **Per week: Per study period:** **Course method:** present	
Number of ECTS credits: 4	
Recommended semester/trimester of the course:	
Course level: III.	
Prerequisities:	
Conditions for course completion: Completion of a certified professional/training course.	
Learning outcomes: The PhD student acquires up-to-date scientific knowledge, develops the capabilities of scientific work and familiarizes himself with the methodologies of making scientific knowledge available. He confronts his own knowledge and skills with other course participants, develops the abilities of peer discussion in the given scientific field.	
Brief outline of the course:	
Recommended literature:	
Course language:	
Notes:	
Course assessment Total number of assessed students: 0	

abs	n
0.0	0.0

Provides:
Date of last modification: 05.03.2024
Approved: prof. RNDr. Tomáš Madaras, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚMV/ dCTG/25	**Course name:** Chromatic graph theory

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

Number of ECTS credits: 7

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

Course level: III.

Prerequisities:

Conditions for course completion:
Oral exam.

Learning outcomes:

Brief outline of the course:
Proper vertex coloring of graphs. Coloring of planar graphs. Perfect graphs.
List colorings.
Edge coloring of graphs and multigraphs.
Distance graphs and their chromatic number.
Coloring of hyergraphs.
Acyclic coloring.
Strong edge coloring. Star edge coloring.
Non-repetitive coloring.

Recommended literature:
1. L.W. Beineke, R.J. Wilson: Topics in Chromatic Graph Theory, Cambridge University Press 2015.
2. J.A. Bondy, U.S.R. Murty: Graph Theory, Springer 2008.
3. G. Chartrand, P. Zhang: Chromatic graph theory, Chapman and Hall/CRC 2008.

Course language:
Slovak or English

Notes:

Course assessment
Total number of assessed students: 0

N	P
0.0	0.0

Provides: doc. RNDr. Roman Soták, PhD.

Date of last modification: 13.01.2025

Approved: prof. RNDr. Tomáš Madaras, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚMV/ dCDC/22	**Course name:** Citation in Slovak scientific journal
Course type, scope and the method: **Course type:** **Recommended course-load (hours):** **Per week: Per study period:** **Course method:** present	
Number of ECTS credits: 2	
Recommended semester/trimester of the course:	
Course level: III.	
Prerequisities:	
Conditions for course completion: Citation in a national scientific journal	
Learning outcomes: Obtaining a citation demonstrates broad and very well-founded scientific knowledge in the researched field, based on the ability to formulate research questions, to reflect on a scientific problem in such a way that generates new knowledge. At the same time, a citation in an indexed source demonstrates the competence to communicate new knowledge, which is a significant contribution to scientific knowledge, at the highest expert level.	
Brief outline of the course:	
Recommended literature:	
Course language:	
Notes:	
Course assessment Total number of assessed students: 0	

abs	n
0.0	0.0

Provides:
Date of last modification: 08.11.2022
Approved: prof. RNDr. Tomáš Madaras, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚMV/ dCZC/22	**Course name:** Citation in international scientific journal
Course type, scope and the method: **Course type:** **Recommended course-load (hours):** **Per week: Per study period:** **Course method:** present	
Number of ECTS credits: 4	
Recommended semester/trimester of the course:	
Course level: III.	
Prerequisities:	
Conditions for course completion: Obtained citation in a foreign scientific journal.	
Learning outcomes: Obtaining a citation demonstrates broad and very well-founded scientific knowledge in the researched field, based on the ability to formulate research questions, to reflect on a scientific problem in such a way that generates new knowledge. At the same time, a citation in an indexed source demonstrates the competence to communicate new knowledge, which is a significant contribution to scientific knowledge, at the highest expert level	
Brief outline of the course:	
Recommended literature:	
Course language:	
Notes:	
Course assessment Total number of assessed students: 0	

abs	n
0.0	0.0

Provides:
Date of last modification: 08.11.2022
Approved: prof. RNDr. Tomáš Madaras, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚMV/ dCMG/22	**Course name:** Citation in monograph
Course type, scope and the method: **Course type:** **Recommended course-load (hours):** **Per week: Per study period:** **Course method:** present	
Number of ECTS credits: 8	
Recommended semester/trimester of the course:	
Course level: III.	
Prerequisities:	
Conditions for course completion: Obtained citation registered in SCI or Scopus.	
Learning outcomes: Obtaining a citation demonstrates broad and very well-founded scientific knowledge in the researched field, based on the ability to formulate research questions, to reflect on a scientific problem in such a way that generates new knowledge. At the same time, a citation in an indexed source demonstrates the competence to communicate new knowledge, which is a significant contribution to scientific knowledge, at the highest expert level.	
Brief outline of the course:	
Recommended literature:	
Course language:	
Notes:	
Course assessment Total number of assessed students: 0	

abs	n
0.0	0.0

Provides:
Date of last modification: 08.11.2022
Approved: prof. RNDr. Tomáš Madaras, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚMV/ dSPA/24	**Course name:** Co-investigator of applied research project
Course type, scope and the method: **Course type:** **Recommended course-load (hours):** **Per week: Per study period:** **Course method:** present	
Number of ECTS credits: 5	
Recommended semester/trimester of the course:	
Course level: III.	
Prerequisities:	
Conditions for course completion: Co-investigator of the applied research project	
Learning outcomes: The PhD student demonstrates the ability to participate in teamwork, to bring his own contribution to the solution of the project objective of applied research and to take responsibility for assigned tasks. By solving an applied research project, he acquires the ability to implement the project objective according to the established procedure, to follow the project schedule, to coordinate his own activities with colleagues, to participate in the creation of applied research outputs. The PhD student gains valuable experience from the practical course of a grant project with a focus on applied research	
Brief outline of the course:	
Recommended literature:	
Course language:	
Notes:	
Course assessment Total number of assessed students: 0	

abs	n
0.0	0.0

Provides:
Date of last modification: 05.03.2024
Approved: prof. RNDr. Tomáš Madaras, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚMV/ dSVG/24	**Course name:** Co-investigator of internal grant (VVGS)

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

Number of ECTS credits: 5

Recommended semester/trimester of the course:

Course level: III.

Prerequisities:

Conditions for course completion:
Co-worker of project supported by internal grant schemes (VVGS)

Learning outcomes:
The PhD student demonstrates the ability to participate in teamwork, to bring his own contribution to the solution of the project objective within the internal grant system at UPJŠ. By solving the internal VVGS grant, he acquires the ability to implement the project plan according to the established procedure, adhere to the project schedule, coordinate his own activities with colleagues, and participate in the creation of outputs. The PhD student gains valuable experience from the practical course of the grant project.

Brief outline of the course:

Recommended literature:

Course language:

Notes:

Course assessment
Total number of assessed students: 0

abs	n
0.0	0.0

Provides:

Date of last modification: 05.03.2024

Approved: prof. RNDr. Tomáš Madaras, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚMV/ dSMP/22	**Course name:** Co-investigator of international project

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

Number of ECTS credits: 15

Recommended semester/trimester of the course:

Course level: III.

Prerequisities:

Conditions for course completion:
Membership in the research team of an international project.

Learning outcomes:
Active involvement by solving a specific task within a team of international project solvers. The PhD student demonstrates the ability to work in a team, take responsibility for the assigned task, adhere to the time schedule and fulfill the project outputs. The PhD student gains personal experience from the implementation of an international project, participation in its key stages, creation of measurable outputs, grant funding of science.

Brief outline of the course:

Recommended literature:

Course language:

Notes:

Course assessment
Total number of assessed students: 2

abs	n
100.0	0.0

Provides:

Date of last modification: 08.11.2022

Approved: prof. RNDr. Tomáš Madaras, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚMV/ dSDP/24	**Course name:** Co-investigator of national project

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

Number of ECTS credits: 10

Recommended semester/trimester of the course:

Course level: III.

Prerequisities:

Conditions for course completion:
Co-investigator of the domestic project

Learning outcomes:
The PhD student demonstrates the ability to participate in teamwork, to bring his own contribution to the solution of the project objective and to take responsibility for the assigned tasks. By solving the domestic project, he acquires the ability to implement the project intention according to the established procedure, to follow the project schedule, to coordinate his own activities with colleagues, to participate in the creation of outputs. The PhD student gains valuable experience from the practical course of the grant project.

Brief outline of the course:

Recommended literature:

Course language:

Notes:

Course assessment
Total number of assessed students: 1

abs	n
100.0	0.0

Provides:

Date of last modification: 05.03.2024

Approved: prof. RNDr. Tomáš Madaras, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚMV/dKOA/25	**Course name:** Combinatorial algorithms

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

Number of ECTS credits: 7

Recommended semester/trimester of the course: 2., 4.

Course level: III.

Prerequisities:

Conditions for course completion:
The evaluation consists of a project (30 points) and an oral exam (70 points). The semester project consists of the elaboration of a computer program that returns the optimal solution or a acceptable approximation of the optimal solution, respectively, of a selected graph problem given by a suitable representation.

Learning outcomes:
Practice of graph algorithms. Understanding the close relationship between the theoretical and algorithmic aspects of discrete mathematics. Ability to understand how selected algorithms can be derived from mathematical statements. Ability to prove the correctness of algorithms.

Brief outline of the course:

Recommended literature:
1. G. Chartrand, O.R. Oellermann: Applied and Algorithmic Graph Theory, McGraw-Hill 1993.
2. J.L. Gross, J. Yellen: Graph Theory and Its Applications, Chapman & Hall/CRC 2006.
3. D. Jungnickel: Graphs, Networks, and Algorithms, Springer 2005.

Course language:
Slovak and English

Notes:

Course assessment
Total number of assessed students: 2

N	P
0.0	100.0

Provides: doc. RNDr. Roman Soták, PhD.

Date of last modification: 13.01.2025

Approved: prof. RNDr. Tomáš Madaras, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚINF/VYMD/15	**Course name:** Computational complexity and models

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

Number of ECTS credits: 9

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

Course level: III.

Prerequisities:

Conditions for course completion:
Written test combined with an oral examination.

Learning outcomes:
Providing an extended backgroung in the area of efficient computations, computational complexity of algorithms, fundamental time and space complexity classes, hardest complete problems, and about reducibility among problems.

Brief outline of the course:
1. Measuring time and space complexity, basic computational models: single- and multi-tape Turing machines, RAM and RASP models, unit and logarithmic costs.
2. Basic complexity classes: L, NL, P, NP, PSPACE, NPSPACE, EXPTIME, NEXPTIME, EXPSPACE.
3. P versus NP, L versus NL. Examples of complete problems in these classes.
4. Polynomial time and logarithmic space reducibilities, definition and basic properties of complete problems.
5. NP-completenss of the Boolean formula satisfiability (SAT).
6. Variants of SAT, problems related to graph coloring.
7. Other NP-complete problems: vertex cover, Hamiltionian paths, subset sum, balancing, traveling salesman problem.
8. Subexponential deterministic solutions for selected NP-complete problems: planar 3-colorability, balancing. Restricted variants with more efficient solutions.
9. Space complexity classes: Savitch theorem, inductive counting.
10. Problems complete for NL, P, and PSPACE: graph accessibily (GAP), circuit-value, quantified Boolean formulas (QBF).
11. Hierarchy and translation theorems for time and space.
12. Relativized complexity classes.
13. Alternating complexity classes.
14. Polynomial time hierarchy.
15. Alternating logarithmic space hierarchy.

Recommended literature:

J.E. Hopcroft, R.Motwani, J.D. Ullman: Introduction to automata theory, languages, and computation, Addison-Wesley, 2007.
M. Sipser: Introduction to the Theory of Computation, Thomson, 2nd edition, 2006.
S. Arora, B. Barak: Computational Complexity: A Modern Approach, Cambridge Univ. Pess, 2009.
C. Calude and J. Hromkovič: Complexity: A Language-Theoretic Point of View, in G. Rozenberg and A. Salomaa, Handbook of Formal Languages II, Springer, 1997.
G.Brassard, P.Bradley: Fundamentals of algorithmics, Prentice Hall, 1996.
Ch. H. Papadimitriou: Computational Complexity, Addison-Wesley, 1994.
D.P.Bovet, P.Crescenzi: Introduction to the theory of complexity, Prentice Hall, 1994.

Course language:
Slovak or english

Notes:
Content prerequisity: Basic knowlegde in the area of formal languages, automata theory, and programming.

Course assessment
Total number of assessed students: 30

N	P
0.0	100.0

Provides: prof. RNDr. Viliam Geffert, DrSc.

Date of last modification: 23.11.2021

Approved: prof. RNDr. Tomáš Madaras, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚMV/ dDIR/14	**Course name:** Differential and integral equations

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

Number of ECTS credits: 8

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

Course level: III.

Prerequisities:

Conditions for course completion:
Overall evaluation is given by written and oral part of the exam.

Learning outcomes:
Understanding of the basic rigorous ideas of differential and integral equations and their applications.

Brief outline of the course:
Boundary Value Problems and Sturm–Liouville Theory. Green's Functions. Self-adjoint Problems. Nonhomogeneous Boundary Value Problems. Nonlinear Differential Equations and Stability. Volterra Integral Equations. The Fredholm Alternative. Degenerate Operators and Kernels.

Recommended literature:
M. Greguš, M. Švec, V. Šeda: Obyčajné diferenciálne rovnice, Bratislava 1985.
V. V. Stepanov: Kurs diferenciálních rovnic, Praha, 1950.
M. Švec: Integrálne rovnice, Bratislava, 1983.
W. E. Boyce, R. C. DiPrima: Elementary Differential Equations and Boundary Value Problems, John Willey & Sons, Inc. 2001.
R. Kress: Linear Integral Equations, Springer, 2014.

Course language:
Slovak and English

Notes:
Basic knowledge of functional analysis is required.

Course assessment
Total number of assessed students: 3

N	P
0.0	100.0

Provides: doc. Mgr. Jozef Kiseľák, PhD.

Date of last modification: 14.04.2022

Approved: prof. RNDr. Tomáš Madaras, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚMV/ dDME/10	**Course name:** Discrete models of mathematical economics

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

Number of ECTS credits: 8

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

Course level: III.

Prerequisities:

Conditions for course completion:
Active study of journal publications, solving exercises, ability to formulate and analyze algorithms.

Learning outcomes:
Knowledge of approaches to modelling fairness in resource division. Ability to formulate algorithms and analyze their properties.

Brief outline of the course:
The cake cutting problem. Fairness criteria and their relations. Algorithms for proportional division. Division into unequal parts, Ramsey partitions. Algorithms for envy-free division. Lower bounds for numbers of cuts. Impossibility results. Approximate algorithms.

Recommended literature:
1. J. Robertson, W. Web: Cake-cutting algorithms, A.K. Peters, 1998
2. S. Brams, A.D. Taylor: Fair Division, Cambridge University Press, 1996

Course language:
Slovak and English

Notes:

Course assessment
Total number of assessed students: 8

N	P
0.0	100.0

Provides: prof. RNDr. Katarína Cechlárová, DrSc.

Date of last modification: 26.01.2022

Approved: prof. RNDr. Tomáš Madaras, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚMV/ dDZS/24	**Course name:** Dissertation exam

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

Number of ECTS credits: 20

Recommended semester/trimester of the course:

Course level: III.

Prerequisities:

Conditions for course completion:
Obtaining the required number of credits in the prescribed composition according to the UPJŠ study regulations, preparation and defense of the thesis, successfully completed dissertation examination.

Learning outcomes:
The PhD student demonstrated the prerequisites for successful continuation of the study by fulfilling the conditions prescribed by the study regulations for the study and scientific part of the doctoral study related to the topic of the dissertation.

Brief outline of the course:

Recommended literature:

Course language:

Notes:

Course assessment
Total number of assessed students: 38

N	P
0.0	100.0

Provides:

Date of last modification: 08.03.2024

Approved: prof. RNDr. Tomáš Madaras, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚMV/ dVOP/24	**Course name:** Elaboration of reviewer report

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

Number of ECTS credits: 3

Recommended semester/trimester of the course:

Course level: III.

Prerequisities:

Conditions for course completion:
Elaboration of reviewer report

Learning outcomes:
The PhD student demonstrates broad and scientifically based knowledge in the field of study, as well as knowledge of a wide range of methods and approaches. Demonstrates the ability to critically assess a professional problem and its proposed solution, as well as to evaluate it and possibly recommend another solution. He applies knowledge and skills from the field of pedagogical sciences to his own field.

Brief outline of the course:

Recommended literature:

Course language:

Notes:

Course assessment
Total number of assessed students: 1

abs	n
100.0	0.0

Provides:

Date of last modification: 05.03.2024

Approved: prof. RNDr. Tomáš Madaras, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: CJP/ AJD1/07	**Course name:** English Language for PhD Students 1
Course type, scope and the method: **Course type:** Practice **Recommended course-load (hours):** **Per week:** 2 **Per study period:** 28 **Course method:** distance, present	
Number of ECTS credits: 2	
Recommended semester/trimester of the course: 1.	
Course level: III.	
Prerequisities:	
Conditions for course completion: Completion of e-course English for PhD Students (lms.upjs.sk), consultations (1-3). Written assignments - Professional/Academic CV, Short Academic Biography.	
Learning outcomes: The development of students´ language skills - reading, writing, listening, speaking; improvement of their linguistic competence - students acquire knowledge of selected phonological, lexical and syntactic aspects; development of pragmatic competence - students acquire skills for effective and purposeful communication, with focus on Academic English and English for specific/professional purposes, level B2.	
Brief outline of the course: Specific aspects of academic and professional English with focus on correct pronunciation, vocabulary development (noun and verb collocations, phrasal verbs, prepositional phrases, word-formation, formal/informal language, etc.), selected aspects of English grammar (prepositions, grammar tenses, passive voice, etc.), academic writing (professional/academic CV, Short Academic Biography).	
Recommended literature: Moore, J.: Oxford Academic Vocabulary Practice. OUP, 2017. Kolaříková, Z., Petruňová, H., Timková, R.: Angličtina v akademickom prostredí – cvičebnica. Košice, Vydavateľstvo ŠafárikPress, 2021. Tomaščíková, S., Rozenfeld, J. Developing Academic English in Speaking and Writing. Vydavateľstvo ŠafárikPress, 2021. McCarthy, M., O´Dell, F.: Academic Vocabulary in Use. CUP, 2008. Štepánek, L., J. De Haff a kol.: Academic English-Akademická angličtina. Grada Publishing, a.s., 2011. Armer, T.: Cambridge English for Scientists. CUP, 2011. lms.upjs.sk	
Course language: English, level B2 according to CEFR	
Notes:	

Course assessment
Total number of assessed students: 813

N	Ne	P	Pr	abs	neabs
0.0	0.0	43.79	0.0	56.09	0.12

Provides: Mgr. Zuzana Kolaříková, PhD., Mgr. Ivana Kupková, PhD.

Date of last modification: 06.09.2024

Approved: prof. RNDr. Tomáš Madaras, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: CJP/ AJD2/07	**Course name:** English Language for PhD Students 2
Course type, scope and the method: **Course type:** Practice **Recommended course-load (hours):** **Per week:** 2 **Per study period:** 28 **Course method:** distance, present	
Number of ECTS credits: 3	
Recommended semester/trimester of the course: 2.	
Course level: III.	
Prerequisities:	
Conditions for course completion: Test, oral exam in accordance with the exam requirements (available at the web-site of the LTC and in MS TEAMS)	
Learning outcomes: The development of students´ language skills - reading, writing, listening, speaking, improvement of their linguistic competence - students acquire knowledge of selected phonological, lexical and syntactic aspects, development of pragmatic competence - students can efectively use the language for a given purpose, with focus on Academic English and English for specific/professional purposes, level B2.	
Brief outline of the course: Academic communication (self-presentation, presenting at scientific meetings and conferences). Specific aspects of academic and professional English with focus on vocabulary development (formality, academic word-list), English grammar (passive voice, nominalisatio), language functions (expressing opinion, cause/effect, presenting arguments, giving examples, describing graphs/charts/schemes, etc.). Cross-language interference.	
Recommended literature: Moore, J.: Oxford Academic Vocabulary Practice. OUP, 2017. Kolaříková, Z., Petruňová, H., Timková, R.: Angličtina v akademickom prostredí (cvičebnica). UPJŠ Košice, 2021. Tomaščíková, S., Rozenfeld, J. Developing Academic English in Speaking and Writing. Vydavateľstvo ŠafárikPress, 2021. McCarthy, M., O´Dell, F.: Academic Vocabulary in Use. CUP, 2008. Štepánek, L., J. De Haff a kol.: Academic English-Akademická angličtina. Grada Publishing, a.s., 2011. Armer, T.: Cambridge English for Scientists. CUP, 2011.	
Course language: B2 level according to CEFR	
Notes:	

Course assessment
Total number of assessed students: 776

N	Ne	P	Pr	abs	neabs
0.26	0.0	94.07	1.03	4.51	0.13

Provides: Mgr. Zuzana Kolaříková, PhD.

Date of last modification: 03.02.2025

Approved: prof. RNDr. Tomáš Madaras, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚMV/ dEKO/10	**Course name:** Enumeration of combinatorial objects

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

Number of ECTS credits: 7

Recommended semester/trimester of the course: 2., 4.

Course level: III.

Prerequisities:

Conditions for course completion:
A student is evaluated according to an oral examination.

Learning outcomes:
Student gets acquainted with Pólya's enumeration theory and on special examples sees how to use it when determining the number of some mathematical objects.

Brief outline of the course:
Cycle index of a permutation group. Burnside's Lemma. Pólya's Enumeration Theorem. Enumeration of injective functions. Enumeration of trees. Enumeration of graphs of given order and size. Enumeration of oriented graphs. Generalisations of Pólya's Enumeration Theorem.

Recommended literature:
F. Harary, E. M. Palmer: Graphical Enumeration, Academic Press, 1973

Course language:
Slovak and English

Notes:

Course assessment
Total number of assessed students: 1

N	P
0.0	100.0

Provides: RNDr. Igor Fabrici, Dr. rer. nat.

Date of last modification: 17.03.2022

Approved: prof. RNDr. Tomáš Madaras, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚMV/ dFAN/10	**Course name:** Functional analysis

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

Number of ECTS credits: 8

Recommended semester/trimester of the course: 2., 4.

Course level: III.

Prerequisities:

Conditions for course completion:
An exam consisting of demonstrating basic knowledge of function spaces and their applications in solving differential and integral equations.

Learning outcomes:
Understanding the basic methods of Applied Functional Analysis, the principles of mathematical analysis in infinite-dimensional spaces with an emphasis on the completeness of function spaces within which differential and integral equations are solved.

Brief outline of the course:
Linear spaces. Algebraic base and dimension. Linear operators and functionals. Algebraic dual spaces. Linear topological space. Locally convex space. Normed space. L(p) spaces. Dual spaces of L(p) spaces. Hilbert space. Applications of Baire category theorem. Open mapping theorem. Closed graph theorem. Hahn-Banach theorem. Spectrum of linear compact operator. Lebesgue spaces, Sobolov spaces and their use in solving differential and integral equations.

Recommended literature:
Bryan P. Rynne and Martin A. Youngson: Linear Functional Analysis, 2008.
Kösaku Yosida: Functional Analysis (Springer Classics in Mathematics) 6th ed. 1995.

Course language:
Slovak and English

Notes:

Course assessment
Total number of assessed students: 16

N	P
0.0	100.0

Provides: prof. RNDr. Jozef Doboš, CSc.

Date of last modification: 09.01.2025

Approved: prof. RNDr. Tomáš Madaras, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚMV/ dTGP/25	**Course name:** Group theory

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

Number of ECTS credits: 7

Recommended semester/trimester of the course: 2., 4.

Course level: III.

Prerequisities:

Conditions for course completion:
written and oral exam

Learning outcomes:
The students learn basic concepts and methods of group theory and their applications in various parts of mathematics.

Brief outline of the course:
Groups of symmetries, abstract groups. Subgroups, orders of elements, cyclic groups. Normal subgroups, factorization. Classification of finitely generated Abelian groups. Groups of permutations, cyclic index, Burnside´s lemma, Pólya´s theorem. Sylow´s subgroups, p-groups. Groups in linear algebra.

Recommended literature:
S. MacLane, G. Birkhoff: Algebra, Alfa Bratislava, 1973
L. Beran: Grupy a svazy, SNTL Praha, 1974
D.A.R. Wallace: Groups,rings and fields, Springer 1998
J. J. Rotman: Advanced Modern Algebra, Amer. Math. Soc., Providence 2010

Course language:
Slovak or English

Notes:

Course assessment
Total number of assessed students: 22

N	P
0.0	100.0

Provides: doc. RNDr. Miroslav Ploščica, CSc.

Date of last modification: 09.01.2025

Approved: prof. RNDr. Tomáš Madaras, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚMV/ dISLa/14	**Course name:** Individual study of scientific literature I
Course type, scope and the method: **Course type:** **Recommended course-load (hours):** **Per week: Per study period:** **Course method:** present	
Number of ECTS credits: 12	
Recommended semester/trimester of the course: 1., 2..	
Course level: III.	
Prerequisities:	
Conditions for course completion:	
Learning outcomes:	
Brief outline of the course:	
Recommended literature:	
Course language: Slovak and English	
Notes:	
Course assessment Total number of assessed students: 42	

abs	n
100.0	0.0

Provides:
Date of last modification: 03.05.2015
Approved: prof. RNDr. Tomáš Madaras, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚMV/ dISLb/14	**Course name:** Individual study of scientific literature II
Course type, scope and the method: **Course type:** **Recommended course-load (hours):** **Per week: Per study period:** **Course method:** present	
Number of ECTS credits: 12	
Recommended semester/trimester of the course: 3., 4..	
Course level: III.	
Prerequisities:	
Conditions for course completion:	
Learning outcomes:	
Brief outline of the course:	
Recommended literature:	
Course language: Slovak and English	
Notes:	
Course assessment Total number of assessed students: 41	

abs	n
100.0	0.0

Provides:
Date of last modification: 03.05.2015
Approved: prof. RNDr. Tomáš Madaras, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚMV/ dZSP2/24	**Course name:** International study stay over 30 days

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

Number of ECTS credits: 10

Recommended semester/trimester of the course:

Course level: III.

Prerequisities:

Conditions for course completion:
Completion of a foreign study stay lasting more than 30 days.

Learning outcomes:
By completing the study stay, the PhD student demonstrates the ability to reflect on research problems and work critically with sources at an expert level and in an interdisciplinary context, while being able to generate new knowledge. He is able to actively communicate at an expert level in more than one language. He acts as a responsible independent scientist, works independently and in a group with the aim of pushing the boundaries of knowledge and transferring them to other areas of research, to practice and to the wider public. He can competently argue and explain his ideas

Brief outline of the course:

Recommended literature:

Course language:

Notes:

Course assessment
Total number of assessed students: 0

abs	n
0.0	0.0

Provides:

Date of last modification: 05.03.2024

Approved: prof. RNDr. Tomáš Madaras, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚMV/ dZSP1/24	**Course name:** International study stay up to 30 days
Course type, scope and the method: **Course type:** **Recommended course-load (hours):** **Per week: Per study period:** **Course method:** present	
Number of ECTS credits: 5	
Recommended semester/trimester of the course:	
Course level: III.	
Prerequisities:	
Conditions for course completion: Completion of a foreign study stay lasting at most 30 days.	
Learning outcomes: By completing a shorter study stay, the PhD student demonstrates the ability to reflect on research problems and work critically with sources at an expert level and in an interdisciplinary context, while being able to generate new knowledge. He is able to actively communicate at an expert level in more than one language. He acts as a responsible independent scientist, works independently and in a group with the aim of pushing the boundaries of knowledge and transferring them to other areas of research, to practice and to the wider public. He can competently argue and explain his ideas.	
Brief outline of the course:	
Recommended literature:	
Course language:	
Notes:	
Course assessment Total number of assessed students: 0	

abs	n
0.0	0.0

Provides:
Date of last modification: 13.01.2025
Approved: prof. RNDr. Tomáš Madaras, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚMV/ dTZV/25	**Course name:** Lattice theory

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

Number of ECTS credits: 7

Recommended semester/trimester of the course: 2., 4.

Course level: III.

Prerequisities:

Conditions for course completion:
Awarded according to written and oral exam.

Learning outcomes:
The students learn basic concepts and methods of Lattice theory and gain the ability to apply them in various parts of mathematics.

Brief outline of the course:
Distributive and modular lattices, Boolean algebras. Ideals, reprezentation of distibutive lattices and Boolean algebras. Completeness and completions. Algebraic properties of lattices, congruence relations. Formal concept analysis.

Recommended literature:
G.Grätzer: General Lattice Theory (2nd edition), Birkhäuser, 1998
B. A. Davey, H. A. Priestley: Introduction to lattices and order, Cambridge University Press 1990
M. Kolibiar: Algebra a príbuzné disciplíny, Alfa Bratislava, 1991

Course language:
Slovak and English

Notes:

Course assessment
Total number of assessed students: 6

N	P
0.0	100.0

Provides: doc. RNDr. Miroslav Ploščica, CSc.

Date of last modification: 20.11.2024

Approved: prof. RNDr. Tomáš Madaras, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚMV/ dPME/14	**Course name:** Matching models in economics

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

Number of ECTS credits: 7

Recommended semester/trimester of the course: 2., 4.

Course level: III.

Prerequisities:

Conditions for course completion:
The assessment is based on the ability to solve problems and on an oral exam in theory.

Learning outcomes:
The knowledge of basic assignment problems in economics and game theory and their computational analysis.

Brief outline of the course:
The problem of stable marriage. Gale-Shapley algorithm. Structure of stable matchings. The hospital-residens problem. Rural hospitals theorem. The assigment problem with couples. Maximum flow approach to assign students to two different places. The stable roommates problem and Irvings algorithm. The stable partition problem.

Recommended literature:
1. D.Gusfield and R.W. Irving, The Stable Marriage Problem: Structure and Algorithms, MIT Press, 1989.
2. A.E. Roth and M.A.O. Sotomayor, Two-sided matching: a study in game-theoretic modeling and analysis, Econometric Society Monographs, Cambridge University Press, 1990.
3. D.F. Manlove, Algorithmics of Matching Under Preferences, World Scientific, 2013.
4. Journal publications

Course language:
Slovak and English

Notes:

Course assessment
Total number of assessed students: 3

N	P
0.0	100.0

Provides: prof. RNDr. Katarína Cechlárová, DrSc.

Date of last modification: 26.01.2022

Approved: prof. RNDr. Tomáš Madaras, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚMV/ dMPS/25	**Course name:** Matrices in statistics

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

Number of ECTS credits: 7

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

Course level: III.

Prerequisities:

Conditions for course completion:
Exam

Learning outcomes:
Mastering modern algebraic methods of applied mathematics.

Brief outline of the course:
Decompositions of matrices.
g-inverses.
Special matrix products.
Operators of vectorization, permutation and commutation matrices.
Foundations of matrix differential calculus.
Matrix integral.

Recommended literature:
Magnus, Neudecker: Matrix differential calculus with applications in statistics and econometrics, Wiley, 1999

Course language:
Slovak and English

Notes:

Course assessment
Total number of assessed students: 6

N	P
0.0	100.0

Provides: prof. RNDr. Ivan Žežula, CSc.

Date of last modification: 09.01.2025

Approved: prof. RNDr. Tomáš Madaras, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚMV/ dTMT/10	**Course name:** Matroid theory

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

Number of ECTS credits: 7

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

Course level: III.

Prerequisities:

Conditions for course completion:
A student is evaluated according to an oral examination.

Learning outcomes:
A student gets acquainted with special parts of matroid theory and with possibilities how to use them in various disciplines of discrete mathematics.

Brief outline of the course:
Restriction, contraction, minor of a matroid. Connected matroids. Whitney's Theorem. Graph homeomorphisms versus matroid minors. Planar graphs and their duals. Representation of a matroid in a vector space. Binary matroids. Block designs versus matroids. Extremal problems in matroids. Greedy algorithm versus matroids.

Recommended literature:
D. J. A. Welsh: Matroid Theory, Academic Press, 1976.
J. G. Oxley, Matroid Theory, Oxford University Press, 2010.

Course language:
Slovak and English

Notes:

Course assessment
Total number of assessed students: 1

N	P
0.0	100.0

Provides: doc. RNDr. Roman Soták, PhD.

Date of last modification: 17.03.2022

Approved: prof. RNDr. Tomáš Madaras, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚMV/ dPOV/24	**Course name:** Membership in conference organising commiittee
Course type, scope and the method: **Course type:** **Recommended course-load (hours):** **Per week: Per study period:** **Course method:** present	
Number of ECTS credits: 3	
Recommended semester/trimester of the course:	
Course level: III.	
Prerequisities:	
Conditions for course completion: Work in the organizing committee of the conference	
Learning outcomes: By working in the organizing committee of the conference, the PhD student demonstrates the abilities and competences to organize a scientific or professional event independently or in a team, to manage the implementation in terms of time and content, to communicate effectively verbally and in writing using various technical means as needed, including in a foreign language at a professional level with various types of people, if necessary, correctly recommend solutions or make independent decisions.	
Brief outline of the course:	
Recommended literature:	
Course language:	
Notes:	
Course assessment Total number of assessed students: 0	
abs	n
0.0	0.0
Provides:	
Date of last modification: 05.03.2024	
Approved: prof. RNDr. Tomáš Madaras, PhD.	

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚMV/ dCFA/14	**Course name:** Methods of time-frequency analysis
Course type, scope and the method: **Course type:** Lecture **Recommended course-load (hours):** **Per week:** 4 **Per study period:** 56 **Course method:** present	
Number of ECTS credits: 7	
Recommended semester/trimester of the course: 2., 4.	
Course level: III.	
Prerequisities:	
Conditions for course completion: individual oral exam	
Learning outcomes: The purpose of the course is to provide introductory knowledge in time-frequency methods of functional analysis. Present possibilities of their usage in various areas of signal processing.	
Brief outline of the course: 1. Basic notions of functional analysis: linear spaces, metrics, norm, inner product, Hilbert space, bases, linear operators and their basic properties. 2. Laplace transform and Fourier transform: definitions, basic properties, convolution, inverse Laplace and Fourier transform. 3. Window functions, short-time Fourier transform: basic properties and usage. 4. Wavelets: basic constructions, ortonormal bases, continuous wavelet transform (CWT), signal reconstruction using CWT, applications of CWT. 5. Localization operators (LO's) and time-frequency analysis: Gabor and Calderón reproducing formula, symbol of an operator, basic properties of LO's and its usage in signal processing in the time-frequency (resp. time-scale) plane.	
Recommended literature: 1. Gröchenig, K.: Foundations of Time-Frequency Analysis. Birkhäuser, Boston, 2001. 2. Führ, H.: Abstract Harmonic Analysis of Continuous Wavelet Transforms. Lecture Notes in Mathematics 1863, Springer Verlag, 2005. 3. Walker, J. S.: A Primer on Wavelets and Their Scientific Applications (Second Edition). Chapman & Hall, Boca Raton, 2008.	
Course language: Slovak and English	
Notes:	

Course assessment Total number of assessed students: 5	
N	P
0.0	100.0
Provides: prof. RNDr. Ondrej Hutník, PhD.	
Date of last modification: 14.04.2022	
Approved: prof. RNDr. Tomáš Madaras, PhD.	

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚMV/ dNMI/11	**Course name:** Non-additive measures and integrals

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

Number of ECTS credits: 7

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

Course level: III.

Prerequisities:

Conditions for course completion:

Learning outcomes:
The purpose of the course is to provide introductory knowledge in non-additive set functions, measures and integrals. Present possibilities of their usage in various areas of human knowledge.

Brief outline of the course:
Basic notions: set systems, set functions, measurable spaces, measurable mappings. Additive and σ-additive measures, Lebesgue's integral. Non-additive mesaures, fuzzy measures, belief and plausability, comonotone functions. Choquet and Sugeno integral and their discrete forms. Pseudo-operations, pseudo-additive integrals, applications of non-additive integrals.

Recommended literature:
1. Denneberg, D.: Non-additive Measure and Integral. Kluwer Academic Publishers, Dordrecht, 1997.
2. Neubrunn, T. - Riečan, B.: Integral, Measure and Ordering, Kluwer Academic Publishers, Dordrecht, 1997.
3. Pap, E.: Null-additive Set Functions. Kluwer Academic Publishers, Boston-Bratislava-Dordrecht, 1995.
4. Wang, Z. - Klir, G. J.: Generalized Measure Theory. Springer, 2009.

Course language:
Slovak and English

Notes:
Student has to have a basic knowledge from measure theory and Lebesgue integral.

Course assessment
Total number of assessed students: 13

N	P
0.0	100.0

Provides: prof. RNDr. Ondrej Hutník, PhD.

Date of last modification: 14.04.2022

Approved: prof. RNDr. Tomáš Madaras, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚMV/ dTOR/25	**Course name:** Optimal control theory

Course type, scope and the method:
Course type: Lecture / Practice
Recommended course-load (hours):
Per week: 3 / 2 **Per study period:** 42 / 28
Course method: present

Number of ECTS credits: 7

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

Course level: III.

Prerequisities:

Conditions for course completion:
Demonstrate the ability of solving problems, to be able to understand the theoretical analysis, use individual study to prepare and present a chosen application model.

Learning outcomes:
To obtain basic knowledge of methods, theoretical foundations and applications of control theory for continuous systems.

Brief outline of the course:
Controllable system - notions. Examples of physical, mechanical, electrical and economic systems. Controllable set and conditions of controllability. Pontrjagin's maximum principle and its variants, transversality conditions. Linear systems, bang-bang controls, switching points, singular controls. Applications of theoretical in practical tasks and models in mechanics, ecology, economics.

Recommended literature:
1. J. Macki, A. Strauss, Introduction to Optimal Control Theory, Springer, 1980.
2. L.M. Hocking, Optimal Control, An Introduction to the Theory with Applications, Oxford University Press, 1991.
3. G. Feichtinger, R.F. Hartl, Optimale Kontrolle oeonomischer Prozesse, de Gruyter, 1986.
4. A. Seierstad, K. Sydsaeter, Optimal Control Theory with Economic Applications, North-Holland, 1987.
5. ST S.P. Sethi, G.L. Thompson, Optimal Control Theory, Applications to Management Science and Economics, Springer, 2006.

Course language:
Slovak and English

Notes:

Course assessment
Total number of assessed students: 9

N	P
0.0	100.0

Provides: prof. RNDr. Katarína Cechlárová, DrSc.
Date of last modification: 13.01.2025
Approved: prof. RNDr. Tomáš Madaras, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: KPE/ PgVU/17	**Course name:** Pedagogy for University Teachers

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

Number of ECTS credits: 5

Recommended semester/trimester of the course:

Course level: III.

Prerequisities:

Conditions for course completion:
1. Development of a teaching diary—100%
2. Compulsory active participation and attendance in accordance with the Study Regulations.

Learning outcomes:
After completing the course, the student will acquire knowledge, skills, and competencies, i.e., will be able to:
Knowledge
Define and apply basic didactic principles, methods, forms, and tools in the teaching process of university-level professional subjects. Identify and specify educational procedures of a university teacher aimed at effective teaching management, pedagogical diagnostics, and assessment of learning outcomes. Recognize different approaches to pedagogical evaluation and their impact on improving the quality of the educational process at the university level.
Skills
Implement effective educational methods and techniques into the teaching of professional subjects, tailored to the needs of university students. Conduct pedagogical diagnostics, assess students' progress, and apply appropriate evaluation methods to improve learning outcomes. Analyze and reflect on one's own teaching process, identify areas for improvement, and enhance the teaching of professional subjects, including the rationalization of the time and content structure of teaching. Present specific proposals for improving the teaching process, including the use of new technologies and innovative pedagogical approaches.
Competencies
Confidently and effectively manage the teaching of university subjects, applying educational competencies that consider the specifics of higher education. Critically reflect on one's own pedagogical practice and the learning outcomes of students to improve teaching methods and achieve a higher quality of the educational process. Apply innovative solutions to streamline and optimize the teaching process, aiming to increase the engagement and success of university students.

Brief outline of the course:
The personality of a university teacher. Teaching styles. Student in university education. Student learning styles. Possibilities of adapting teaching styles and student learning styles. University teacher–student interaction and communication in the teaching process. Pedagogical competencies

of a university teacher. Didactic analysis of the curriculum; teaching materials and textbooks. Forms of university teaching. Methods of university teaching. Verification methods and student assessment. Creation of a didactic test. Designing university teaching process. University teacher self-reflection.

Recommended literature:

Beránek, J. (2023). Moderní pedagogické metody a přístupy. Praha: Portál.
Fiala, M. (2023). Didaktika a metodika v současné škole. Praha: Grada Publishing.
Kováč, M. (2023). Vzdelávanie v 21. storočí: Inovatívne prístupy a metódy. Nitra: Vydavateľstvo UKF v Nitre.
Koudelka, J. (2023). Moderní didaktika a její aplikace. Praha: Karolinum.
Křížová, M., & Šebová, P. (2023). Vzdělávání učitelů: Teoretické a praktické přístupy. Praha: Triton.
Kučerová, M. (2023). Vzdělávání učitelů a profesionální rozvoj. Praha: Triton.
Mocová, M., & Lázňovská, M. (2023). Pedagogika a jej aplikácie v praxi. Bratislava: Vydavateľstvo Spolku slovenských pedagogických pracovníkov.
Novák, J., & Pol, M. (2024). Pedagogické výzkumy a inovace ve vzdělávání. Praha: Portál.
Sikora, J. (2022). Didaktika a metodika vzdelávania: Nové výzvy a trendy. Bratislava: Vydavateľstvo Univerzity Komenského v Bratislave.
Škoda, J. (2022). Efektivní výuka: Praktické strategie a metody. Praha: Grada Publishing.
Švec, J. (2023). Didaktika a školní politika: Teorie a praxe. Praha: Grada Publishing.
Vojtová, K. (2024). Diferenciace a inkluze ve vzdělávání. Praha: Wolters Kluwer.

Course language:
slovak

Notes:

Course assessment
Total number of assessed students: 152

abs	n	neabs
98.03	0.66	1.32

Provides: doc. PaedDr. Renáta Orosová, PhD.

Date of last modification: 14.09.2024

Approved: prof. RNDr. Tomáš Madaras, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚMV/ dODP/24	**Course name:** PhD thesis defence
Course type, scope and the method: **Course type:** **Recommended course-load (hours):** **Per week: Per study period:** **Course method:** present	
Number of ECTS credits: 30	
Recommended semester/trimester of the course:	
Course level: III.	
Prerequisities:	
Conditions for course completion:	
Learning outcomes:	
Brief outline of the course:	
Recommended literature:	
Course language:	
Notes:	

Course assessment
Total number of assessed students: 1

N	P
0.0	100.0

Provides:
Date of last modification: 26.03.2024
Approved: prof. RNDr. Tomáš Madaras, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚMV/ dPPV/24	**Course name:** Popularisation of science

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

Number of ECTS credits: 5

Recommended semester/trimester of the course:

Course level: III.

Prerequisities:

Conditions for course completion:
Active involvement in the popularization of science.

Learning outcomes:
Demonstrated ability to present science to the lay public, use interactive methods of scientific communication, identify the target group and adapt the communication language to the level of professional knowledge. A PhD student is able to arouse interest and motivate specific target groups in the field of his scientific work, but also in the wider context of science.

Brief outline of the course:

Recommended literature:

Course language:

Notes:

Course assessment
Total number of assessed students: 0

abs	n
0.0	0.0

Provides:

Date of last modification: 05.03.2024

Approved: prof. RNDr. Tomáš Madaras, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚMV/ dPZK/24	**Course name:** Presentation of results at international conference

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

Number of ECTS credits: 10

Recommended semester/trimester of the course:

Course level: III.

Prerequisities:

Conditions for course completion:
Active participation in an international conference abroad.

Learning outcomes:
By actively participating in an international scientific conference abroad, the phD student demonstrates a high level of ability to identify, evaluate, and apply correct scientific methods or research methodology in his scientific field. He demonstrates the ability to reflect on a specific scientific problem by using the latest approaches and applying them critically. Demonstrates competence to use existing theories and concepts in an innovative way, as well as generate new original scientific knowledge and communicate research results to a wider audience by adequate means and through a foreign language.

Brief outline of the course:

Recommended literature:

Course language:

Notes:

Course assessment
Total number of assessed students: 0

abs	n
0.0	0.0

Provides:

Date of last modification: 05.03.2024

Approved: prof. RNDr. Tomáš Madaras, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚMV/ dPDK/24	**Course name:** Presentation of results at local conference

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

Number of ECTS credits: 2

Recommended semester/trimester of the course:

Course level: III.

Prerequisities:

Conditions for course completion:
Active participation in the home conference.

Learning outcomes:
By actively participating in the national scientific conference, the PhD student demonstrates a high degree of ability to identify, evaluate, and apply correct scientific methods or research methodology in his scientific field. He demonstrates the ability to reflect on a specific scientific problem by using the latest approaches and applying them critically. Demonstrates competence in using existing theories and concepts in an innovative way, as well as generating new original scientific knowledge and communicating research results to a wider audience using adequate means and through the Slovak language.

Brief outline of the course:

Recommended literature:

Course language:

Notes:

Course assessment
Total number of assessed students: 0

abs	n
0.0	0.0

Provides:

Date of last modification: 05.03.2024

Approved: prof. RNDr. Tomáš Madaras, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚMV/ dPDZ/24	**Course name:** Presentation of results at local conference with international participation

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

Number of ECTS credits: 5

Recommended semester/trimester of the course:

Course level: III.

Prerequisities:

Conditions for course completion:
Active participation in a national conference with foreign participation.

Learning outcomes:
By actively participating in a scientific conference, the PhD student demonstrates a high degree of ability to identify, evaluate, and apply correct scientific methods or research methodology in his scientific field. He demonstrates the ability to reflect on a specific scientific problem by using the latest approaches and applying them critically. Demonstrates competence to use existing theories and concepts in an innovative way, as well as generate new original scientific knowledge and communicate research results to a wider audience by adequate means and through Slovak or a foreign language.

Brief outline of the course:

Recommended literature:

Course language:

Notes:

Course assessment
Total number of assessed students: 2

abs	n
100.0	0.0

Provides:

Date of last modification: 05.03.2024

Approved: prof. RNDr. Tomáš Madaras, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚMV/ dPSM/24	**Course name:** Presentation of results in seminar

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

Number of ECTS credits: 5

Recommended semester/trimester of the course:

Course level: III.

Prerequisities:

Conditions for course completion:
Presentation at the seminar

Learning outcomes:
By actively participating in the seminar, the PhD student demonstrates the ability to identify, evaluate, and apply correct scientific methods or research methodology in his field of study. He demonstrates the ability to reflect on a specific scientific problem by using the latest approaches and applying them critically. Demonstrates competence in using existing theories and concepts in an innovative way, as well as generating new original scientific knowledge and communicating research results by adequate means and through Slovak or a foreign language.

Brief outline of the course:

Recommended literature:

Course language:

Notes:

Course assessment
Total number of assessed students: 2

abs	n
100.0	0.0

Provides:

Date of last modification: 05.03.2024

Approved: prof. RNDr. Tomáš Madaras, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚMV/ dZVG/24	**Course name:** Principal investigator of internal grant (VVGS)

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

Number of ECTS credits: 10

Recommended semester/trimester of the course:

Course level: III.

Prerequisities:

Conditions for course completion:
Principal investigator of an internal grant (VVGS)

Learning outcomes:
The PhD student demonstrates the ability to process a successful application for his own research problem within the internal grant system at UPJŠ. Acquires skills with the design of research stages, their time schedule, measurable outputs and adequate distribution of funds. The very solution of the internal VVGS grant acquires the ability to implement the project intention according to the established procedure, to be responsible for achieving the set outputs. As a responsible researcher, the PhD student acquires competencies in project management, its administration, and presentation of results.

Brief outline of the course:

Recommended literature:

Course language:

Notes:

Course assessment
Total number of assessed students: 1

abs	n
100.0	0.0

Provides:

Date of last modification: 05.03.2024

Approved: prof. RNDr. Tomáš Madaras, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚINF/ PAHD/15	**Course name:** Probabilistic and approximate algorithms

Course type, scope and the method:
Course type: Lecture / Practice
Recommended course-load (hours):
Per week: 2 / 1 **Per study period:** 28 / 14
Course method: present

Number of ECTS credits: 9

Recommended semester/trimester of the course: 2., 4.

Course level: III.

Prerequisities:

Conditions for course completion:
Written test combined with an oral examination.

Learning outcomes:
Providing en extended backgroung in the area of probabilistic and approximation algorithms, with respect to their classification, efficiency, and probability of error.

Brief outline of the course:
1. Elementary probability theory. Basic probabilistic computational models.
2. Las Vegas algorithms, One-sided error Monte Carlo algorithms.
3. Two-sided error Monte Carlo algorithms, with bounded and unbounded-error.
4. Probabilistic classes with polynomial time.
5. Foiling the adversary
6. Hashing.
7. Fingerprinting.

Recommended literature:
1. HROMKOVIČ, J.: Design and analysis of ranodmized algorithms. Springer-Verlag, 2005. ISBN 3-540-23949-9.
2. MOTWANI, R. and RAGHAVAN, P.: Randomized Algorithms. Cambridge University Press 1995. ISBN 0-521-47465-5
3. MITZEMANCHER, M. and UPFAL, E.: Probability and Computing: Randomized Algorithms and Probabilistic Analysis. Cambridge University Press 2005. ISBN 0-521-83540 2
4. HROMKOVIČ, J.: Communication Protocols - An Exemplary Study of the Power of Randomness. In: Handbook on Randomized Computing, P.Pardalos, S.Rajasekaran, J.Reif, J.Rolim, Eds., Kluwer Publ., 2001.

Course language:
Slovak or English

Notes:
Content prerequisities: Basic knowlegde of in the area of probability theory, computational complexity, and programming.

Course assessment Total number of assessed students: 11	
N	P
0.0	100.0
Provides: prof. RNDr. Viliam Geffert, DrSc., prof. RNDr. Gabriel Semanišin, PhD.	
Date of last modification: 23.11.2021	
Approved: prof. RNDr. Tomáš Madaras, PhD.	

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚMV/ dPMK/10	**Course name:** Probability method in combinatorics

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

Number of ECTS credits: 7

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

Course level: III.

Prerequisities:

Conditions for course completion:
In the covered areas of the probabilistic method, the ability to formulate definitions and statements, to present proofs of statements, to explain the individual steps in proofs and to mention possibilities of application is required.
The evaluation is based on an oral exam.

Learning outcomes:
Introduction to the randomness in graph theory and applications of the probabilistic method in combinatorics and graph theory. The obtained overview of the ways of using basic results of probability in proving the existence of objects with the required properties, understanding of various forms of this method and knowledge of possible applications.

Brief outline of the course:
1. Probability Theory (probability space, event, probability, random variable, expectation, random graph)
2. Probabilistic Method - First Moment Principle (Ramsey numbers, hypergraph coloring, intersecting sets system/Kneser graph, pairs of sets)
3. Linearity of Expectation (Hamiltonian graphs, splitting graphs)
4. Alterations (Markov's inequality, independent sets, high girth and high chromatic number)
5. The Second Moment (Chebyshev’s inequality, threshold functions, the clique number)
6. The Lovász Local Lemma (hypergraph coloring again, directed cycles)
7. Chernoff bound

Recommended literature:
1. N. Alon, J. Spencer: The Probabilistic Method, John Wiley, 1991
2. M. Molloy, B. Reed: Graph Colourings and the Probabilistic Method, Springer, 2002
3. J. Matoušek, J. Vondrák: The Probabilistic Method, Lecture Notes, 2002

Course language:
Slovak

Notes:

Course assessment Total number of assessed students: 12	
N	P
0.0	100.0
Provides: RNDr. Igor Fabrici, Dr. rer. nat.	
Date of last modification: 19.10.2021	
Approved: prof. RNDr. Tomáš Madaras, PhD.	

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: KPPaPZ/PsVU/17	**Course name:** Psychology for University Lecturers

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

Number of ECTS credits: 5

Recommended semester/trimester of the course:

Course level: III.

Prerequisities:

Conditions for course completion:
Case study, micro-output, its analysis
Current modifications of the course are listed in the electronic bulletin board of the course.

Learning outcomes:
After completing the course, students will gain knowledge that allows them to understand, summarize and explain selected psychological knowledge from cognitive psychology, emotion and motivation psychology, personality psychology, developmental, social, educational psychology and health psychology. They will acquire skills to apply the above psychological knowledge necessary for the professional, competent performance of university teaching practice of doctoral students to create and implement the teaching of a professional topic with applied psychological knowledge and develop the competences to create and implement teaching of a professional topic with the application of psychological knowledge, as well as to evaluate their performance and the performance of their classmates in the form of constructive feedback.

Brief outline of the course:
The content of the course is based on selected psychological knowledge of cognitive psychology, psychology of emotions and motivation, personality psychology, developmental, social, educational psychology and health psychology. Teaching is realized by a combination of lectures with interactive, experiential methods, discussion, open communication with mutual respect, support of independence, activity and motivation of students. Syllabus: University teacher and his work in the teaching process with a focus on: teachers in relation to themselves (cognitive, personal, social and competencies in the use of methods), in relation to students and as part of the teacher-student relationship on the basis of selected areas of cognitive psychology, psychology of emotions and motivation, developmental psychology, social psychology, educational psychology and health psychology with application to the university environment

Recommended literature:
Alexitch, L. R. (2005). Applying social psychology to education. Social Psychology.–Ed.: Schneider F., Gruman J., Coutts L.–Sage Publications, Inc, 205-228.
Fry, H., Ketteridge, S., & Marshall, S. (2008). A handbook for teaching and learning in higher education: Enhancing academic practice. Routledge.
Mareš, J.: Pedagogická psychologie. Portál, 2013.

Kniha psychologie. Universum, 2014
Čáp, J., Mareš, J.: Psychologie pro učitele. Praha: Portál 2007.
Vágnerová, M.: Školní poradenská psychológie pro pedagogy. Praha: Karolínum 2005.
Cuevas, J. A., Childers, G., & Dawson, B. L. (2023). A rationale for promoting cognitive science in teacher education: Deconstructing prevailing learning myths and advancing research-based practices. Trends in neuroscience and education, 100209.

Course language:
slovak

Notes:

Course assessment
Total number of assessed students: 87

abs	n	neabs
98.85	0.0	1.15

Provides: PhDr. Anna Janovská, PhD.

Date of last modification: 09.12.2024

Approved: prof. RNDr. Tomáš Madaras, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚMV/ dPDC/24	**Course name:** Publication in local journal
Course type, scope and the method: **Course type:** **Recommended course-load (hours):** **Per week: Per study period:** **Course method:** present	
Number of ECTS credits: 6	
Recommended semester/trimester of the course:	
Course level: III.	
Prerequisities:	
Conditions for course completion: Publication accepted in a national journal as author/co-author.	
Learning outcomes: By publishing in a national journal as an author/co-author, the PhD student demonstrates a high level of ability to identify, evaluate, and apply correct scientific methods or research methodology. He demonstrates the ability to reflect on a scientific problem by using the latest approaches and applying them critically. He demonstrates the competence to use existing theories and concepts in an innovative way, as well as to generate new original scientific knowledge, which he can publish according to the highest qualitative and ethical standards of the field. The PhD student demonstrates the ability to critically evaluate and respond to reviewers' suggestions, to finalize his own ideas.	
Brief outline of the course:	
Recommended literature:	
Course language:	
Notes:	
Course assessment Total number of assessed students: 0	

abs	n
0.0	0.0

Provides:
Date of last modification: 12.03.2024
Approved: prof. RNDr. Tomáš Madaras, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚMV/ dPNZ/24	**Course name:** Publication in non-reviewed proceedings

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

Number of ECTS credits: 2

Recommended semester/trimester of the course:

Course level: III.

Prerequisities:

Conditions for course completion:
A publication published in a non-reviewed foreign or national journal as an author/co-author.

Learning outcomes:
By publishing in a non-reviewed foreign or national journal as an author/co-author, the PhD student demonstrates the ability to identify, evaluate, and apply correct scientific methods or research methodology. He demonstrates the ability to reflect on a scientific problem by using the latest approaches and applying them critically. He demonstrates the competence to use existing theories and concepts in an innovative way, as well as to generate new original scientific knowledge, which he can publish according to the highest qualitative and ethical standards of the field. The phD student demonstrates the ability to finalize his own thoughts in a written speech.

Brief outline of the course:

Recommended literature:

Course language:

Notes:

Course assessment
Total number of assessed students: 0

abs	n
0.0	0.0

Provides:

Date of last modification: 05.03.2024

Approved: prof. RNDr. Tomáš Madaras, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚMV/ dTRF/10	**Course name:** Real functions theory

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

Number of ECTS credits: 8

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

Course level: III.

Prerequisities:

Conditions for course completion:
exam

Learning outcomes:
Understanding of the basic rigorous ideas of Real Functions Theory.

Brief outline of the course:
Properties of real functions: continuity, gneralized continuity, quasi-uniform convergence, set of points of discontinuity, stationary sets, determining sets, metric preserving functions.

Recommended literature:
B. S. Thomson: Real Functions, Springer-Verlag, 1985, ISBN 3-540-16058-2.
J. Doboš: Metric preserving functions, Štroffek, Košice, 1998, ISBN 80-88896-30-4.

Course language:
Slovak or English

Notes:

Course assessment
Total number of assessed students: 1

N	P
0.0	100.0

Provides: prof. RNDr. Jozef Doboš, CSc.

Date of last modification: 14.09.2021

Approved: prof. RNDr. Tomáš Madaras, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚMV/ dTRH/10	**Course name:** Risk and extreme value theory

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

Number of ECTS credits: 8

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

Course level: III.

Prerequisities:

Conditions for course completion:
Based on written tests and oral exam.

Learning outcomes:
To give theoretical knowledge in stochastic modelling of insurance risk process and the elements of ruin theory. To provide a grounding in extreme value theory with applications to insurance and finance.

Brief outline of the course:
Individual and collective risk models. Probability distributions of individual claims. Distribution of the total number and of the hight of aggregated claims. Compound distributions, their characteristics and moment generating functions. The risk process as special random process. Cramér- Lundberg model and its modification. Risk reserves and ruin probability approximations.
The elements of extreme value theory. Probability distributions of extremes, heavy-tailed, subexponential and stable distributions. The frequency of claim occurence and waiting times for extremes. Methods for registration of extremes. Limit distributions for block-maxima, excesses-over-threshold an records. Methods of statistical analysis of extremes.

Recommended literature:
1. Beirlant at al:: Statistics of extremes. Wiley, New York. 2004
2. Daykin at al.: Practical risk theory for actuarial. Chapman and Hall, 1994
3. Cipra T.: Teorie rizika v pojistné matematice. MFF UK, Praha, 1991
4. Embrechts at al.: Modelling extremal events. Springer, Berlin, 1997
5. Mikosch T.M.: Non-life Insurance Mathematics, Springer, Berlin, 2009.
6. Časopisecká literatúra

Course language:
Slovak and English

Notes:

Course assessment Total number of assessed students: 3	
N	P
0.0	100.0
Provides: doc. RNDr. Martina Hančová, PhD., Mgr. Katarína Lučivjanská, PhD.	
Date of last modification: 15.04.2022	
Approved: prof. RNDr. Tomáš Madaras, PhD.	

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚMV/ dCSC/24	**Course name:** SCI or Scopus citation

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

Number of ECTS credits: 8

Recommended semester/trimester of the course:

Course level: III.

Prerequisities:

Conditions for course completion:
Obtained citation registered in SCI or Scopus.

Learning outcomes:
Obtaining a citation demonstrates broad and very well-founded scientific knowledge in the researched field, based on the ability to formulate research questions, to reflect on a scientific problem in such a way that generates new knowledge. At the same time, a citation in an indexed source demonstrates the competence to communicate new knowledge, which is a significant contribution to scientific knowledge, at the highest expert level.

Brief outline of the course:

Recommended literature:

Course language:

Notes:

Course assessment
Total number of assessed students: 0

abs	n
0.0	0.0

Provides:

Date of last modification: 05.03.2024

Approved: prof. RNDr. Tomáš Madaras, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚMV/ dQ1M/24	**Course name:** Scientific publication in Q1 journal

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

Number of ECTS credits: 30

Recommended semester/trimester of the course:

Course level: III.

Prerequisities:

Conditions for course completion:
Publication accepted in a journal of category Q1 as co-author.

Learning outcomes:
By publishing in a journal of category Q1 as a co-author, the PhD student demonstrates a high degree of ability to identify, evaluate, and apply correct scientific methods or research methodology. He demonstrates the ability to reflect on a scientific problem by using the latest approaches and applying them critically. He demonstrates the competence to use existing theories and concepts in an innovative way, as well as to generate new original scientific knowledge, which he can publish according to the highest qualitative and ethical standards of the field. The PhD student demonstrates the ability to critically evaluate and respond to reviewers' suggestions, to finalize his own ideas.

Brief outline of the course:

Recommended literature:

Course language:

Notes:

Course assessment
Total number of assessed students: 0

abs	n
0.0	0.0

Provides:

Date of last modification: 11.03.2024

Approved: prof. RNDr. Tomáš Madaras, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚMV/dQ1V/24	**Course name:** Scientific publication in Q1 journal with significant author's contribution

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

Number of ECTS credits: 40

Recommended semester/trimester of the course:

Course level: III.

Prerequisities:

Conditions for course completion:
Publication accepted in a journal of category Q1 with author's share at least 25%.

Learning outcomes:
By publishing in a journal of category Q1 as the first or corresponding author, the PhD student demonstrates a high degree of ability to identify, evaluate, and apply correct scientific methods or research methodology. He demonstrates the ability to reflect on a scientific problem by using the latest approaches and applying them critically. He demonstrates the competence to use existing theories and concepts in an innovative way, as well as to generate new original scientific knowledge, which he can publish according to the highest qualitative and ethical standards of the field. The PhD student demonstrates the ability to critically evaluate and respond to reviewers' suggestions, to finalize his own ideas. A significant author's share will have a substantial impact on the number and quality of the publication results, on the implementation of software support for research, and on the formal processing of the publication itself in terms of content and graphics.

Brief outline of the course:

Recommended literature:

Course language:

Notes:

Course assessment
Total number of assessed students: 0

abs	n
0.0	0.0

Provides:

Date of last modification: 13.01.2025

Approved: prof. RNDr. Tomáš Madaras, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚMV/ dQ2M/24	**Course name:** Scientific publication in Q2 journal

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

Number of ECTS credits: 20

Recommended semester/trimester of the course:

Course level: III.

Prerequisities:

Conditions for course completion:
Publication accepted in a journal of category Q2 as co-author.

Learning outcomes:
By publishing in a journal of category Q2 as a co-author, the PhD student demonstrates a high degree of ability to identify, evaluate, and apply correct scientific methods or research methodology. He demonstrates the ability to reflect on a scientific problem by using the latest approaches and applying them critically. He demonstrates the competence to use existing theories and concepts in an innovative way, as well as to generate new original scientific knowledge, which he can publish according to the highest qualitative and ethical standards of the field. The PhD student demonstrates the ability to critically evaluate and respond to reviewers' suggestions, to finalize his own ideas.

Brief outline of the course:

Recommended literature:

Course language:

Notes:

Course assessment
Total number of assessed students: 0

abs	n
0.0	0.0

Provides:

Date of last modification: 11.03.2024

Approved: prof. RNDr. Tomáš Madaras, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚMV/dQ2V/24	**Course name:** Scientific publication in Q2 journal with significant author's contribution

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

Number of ECTS credits: 30

Recommended semester/trimester of the course:

Course level: III.

Prerequisities:

Conditions for course completion:
Publication accepted in a journal of category Q2 with author's share at least 25%.

Learning outcomes:
By publishing in a journal of category Q2 as the first or corresponding author, the PhD student demonstrates a high degree of ability to identify, evaluate, and apply correct scientific methods or research methodology. He demonstrates the ability to reflect on a scientific problem by using the latest approaches and applying them critically. He demonstrates the competence to use existing theories and concepts in an innovative way, as well as to generate new original scientific knowledge, which he can publish according to the highest qualitative and ethical standards of the field. The PhD student demonstrates the ability to critically evaluate and respond to reviewers' suggestions, to finalize his own ideas. A significant author's share will have a substantial impact on the number and quality of the publication results, on the implementation of software support for research, and on the formal processing of the publication itself in terms of content and graphics.

Brief outline of the course:

Recommended literature:

Course language:

Notes:

Course assessment
Total number of assessed students: 0

abs	n
0.0	0.0

Provides:

Date of last modification: 13.01.2025

Approved: prof. RNDr. Tomáš Madaras, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚMV/ dQ3M/24	**Course name:** Scientific publication in Q3 journal

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

Number of ECTS credits: 15

Recommended semester/trimester of the course:

Course level: III.

Prerequisities:

Conditions for course completion:
Publication accepted in a journal of category Q3 as co-author.

Learning outcomes:
By publishing in a journal of category Q3 as a co-author, the PhD student demonstrates a high degree of ability to identify, evaluate, and apply correct scientific methods or research methodology. He demonstrates the ability to reflect on a scientific problem by using the latest approaches and applying them critically. He demonstrates the competence to use existing theories and concepts in an innovative way, as well as to generate new original scientific knowledge, which he can publish according to the highest qualitative and ethical standards of the field. The PhD student demonstrates the ability to critically evaluate and respond to reviewers' suggestions, to finalize his own ideas.

Brief outline of the course:

Recommended literature:

Course language:

Notes:

Course assessment
Total number of assessed students: 0

abs	n
0.0	0.0

Provides:

Date of last modification: 11.03.2024

Approved: prof. RNDr. Tomáš Madaras, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚMV/ dQ3V/24	**Course name:** Scientific publication in Q3 journal with significant author's contribution

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

Number of ECTS credits: 25

Recommended semester/trimester of the course:

Course level: III.

Prerequisities:

Conditions for course completion:
Publication accepted in a journal of category Q3 with author's share at least 25%.

Learning outcomes:
By publishing in a journal of category Q3 as the first or corresponding author, the PhD student demonstrates a high degree of ability to identify, evaluate, and apply correct scientific methods or research methodology. He demonstrates the ability to reflect on a scientific problem by using the latest approaches and applying them critically. He demonstrates the competence to use existing theories and concepts in an innovative way, as well as to generate new original scientific knowledge, which he can publish according to the highest qualitative and ethical standards of the field. The PhD student demonstrates the ability to critically evaluate and respond to reviewers' suggestions, to finalize his own ideas. A significant author's share will have a substantial impact on the number and quality of the publication results, on the implementation of software support for research, and on the formal processing of the publication itself in terms of content and graphics.

Brief outline of the course:

Recommended literature:

Course language:

Notes:

Course assessment
Total number of assessed students: 0

abs	n
0.0	0.0

Provides:

Date of last modification: 13.01.2025

Approved: prof. RNDr. Tomáš Madaras, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚMV/ dQ4M/24	**Course name:** Scientific publication in Q4 journal

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

Number of ECTS credits: 10

Recommended semester/trimester of the course:

Course level: III.

Prerequisities:

Conditions for course completion:
Publication accepted in a journal of category Q4 as co-author.

Learning outcomes:
identify, evaluate, and apply correct scientific methods or research methodology. He demonstrates the ability to reflect on a scientific problem by using the latest approaches and applying them critically. He demonstrates the competence to use existing theories and concepts in an innovative way, as well as to generate new original scientific knowledge, which he can publish according to the highest qualitative and ethical standards of the field. The PhD student demonstrates the ability to critically evaluate and respond to reviewers' suggestions, to finalize his own ideas.

Brief outline of the course:

Recommended literature:

Course language:

Notes:

Course assessment
Total number of assessed students: 0

abs	n
0.0	0.0

Provides:

Date of last modification: 11.03.2024

Approved: prof. RNDr. Tomáš Madaras, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚMV/ dQ4V/24	**Course name:** Scientific publication in Q4 journal with significant author's contribution

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

Number of ECTS credits: 20

Recommended semester/trimester of the course:

Course level: III.

Prerequisities:

Conditions for course completion:
Publication accepted in a journal of category Q4 with author's share at least 25%.

Learning outcomes:
By publishing in a journal of category Q4 as the first or corresponding author, the PhD student demonstrates a high degree of ability to identify, evaluate, and apply correct scientific methods or research methodology. He demonstrates the ability to reflect on a scientific problem by using the latest approaches and applying them critically. He demonstrates the competence to use existing theories and concepts in an innovative way, as well as to generate new original scientific knowledge, which he can publish according to the highest qualitative and ethical standards of the field. The PhD student demonstrates the ability to critically evaluate and respond to reviewers' suggestions, to finalize his own ideas. A significant author's share will have a substantial impact on the number and quality of the publication results, on the implementation of software support for research, and on the formal processing of the publication itself in terms of content and graphics.

Brief outline of the course:

Recommended literature:

Course language:

Notes:

Course assessment
Total number of assessed students: 0

abs	n
0.0	0.0

Provides:

Date of last modification: 13.01.2025

Approved: prof. RNDr. Tomáš Madaras, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚMV/ dPZC/24	**Course name:** Scientific publication in international journal

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

Number of ECTS credits: 8

Recommended semester/trimester of the course:

Course level: III.

Prerequisities:

Conditions for course completion:
Publication accepted in a foreign journal as an author/co-author.

Learning outcomes:
By publishing in a foreign journal as an author/co-author, the PhD student demonstrates a high level of ability to identify, evaluate, and apply correct scientific methods or research methodology. He demonstrates the ability to reflect on a scientific problem by using the latest approaches and applying them critically. He demonstrates the competence to use existing theories and concepts in an innovative way, as well as to generate new original scientific knowledge, which he can publish according to the highest qualitative and ethical standards of the field. The PhD student demonstrates the ability to critically evaluate and respond to reviewers' suggestions, to finalize his own ideas.

Brief outline of the course:

Recommended literature:

Course language:

Notes:

Course assessment
Total number of assessed students: 0

abs	n
0.0	0.0

Provides:

Date of last modification: 12.03.2024

Approved: prof. RNDr. Tomáš Madaras, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚMV/ dPRZ/24	**Course name:** Scientific publication in peer-reviewed proceedings

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

Number of ECTS credits: 5

Recommended semester/trimester of the course:

Course level: III.

Prerequisities:

Conditions for course completion:
A publication published in a peer-reviewed foreign or national proceedings as an author/co-author.

Learning outcomes:
By publishing in a peer-reviewed foreign or national journal as an author/co-author, the PhD student demonstrates a high degree of ability to identify, evaluate, and apply correct scientific methods or research methodology. He demonstrates the ability to reflect on a scientific problem by using the latest approaches and applying them critically. He demonstrates the competence to use existing theories and concepts in an innovative way, as well as to generate new original scientific knowledge, which he can publish according to the highest qualitative and ethical standards of the field. The PhD student demonstrates the ability to critically evaluate and respond to reviewers' suggestions, to finalize his own ideas.

Brief outline of the course:

Recommended literature:

Course language:

Notes:

Course assessment
Total number of assessed students: 0

abs	n
0.0	0.0

Provides:

Date of last modification: 05.03.2024

Approved: prof. RNDr. Tomáš Madaras, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚMV/ dSVU/24	**Course name:** Software in public repository
Course type, scope and the method: **Course type:** **Recommended course-load (hours):** **Per week: Per study period:** **Course method:** present	
Number of ECTS credits: 5	
Recommended semester/trimester of the course:	
Course level: III.	
Prerequisities:	
Conditions for course completion: A created software product stored in a public repository.	
Learning outcomes: The PhD student demonstrates the ability to create a stand-alone or supporting software product in a form that can be used by other researchers.	
Brief outline of the course:	
Recommended literature:	
Course language:	
Notes:	
Course assessment Total number of assessed students: 0	

abs	n
0.0	0.0

Provides:	
Date of last modification: 13.01.2025	
Approved: prof. RNDr. Tomáš Madaras, PhD.	

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: Dek. PF UPJŠ/JSD/14	**Course name:** Spring School for PhD Students

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

Number of ECTS credits: 2

Recommended semester/trimester of the course:

Course level: III.

Prerequisities:

Conditions for course completion:
Active participation in the Spring School of PhD students of UPJŠ.

Learning outcomes:
By actively participating in the Spring School of PhD Students of UPJŠ, the PhD student demonstrates a high level of ability to process the issues of his dissertation for a multidisciplinary audience with an emphasis on clarifying the motivation, scientific problem, processing methodology and own contribution to the solution of the selected topic. The PhD student demonstrates the ability to professionally discuss various research topics, present his own positions and accept a plurality of opinions. Demonstrates the ability to communicate research results to a wider professional audience with adequate means and through the Slovak language.

Brief outline of the course:
1. Interdisciplinary lectures from the fields of medicine, natural sciences, law, public affairs, humanities. Lecturers - top foreign or national experts from the mentioned fields.
2. Scientific lectures in sections created within related disciplines. Lecturers - top experts from UPJŠ from the mentioned fields.
3. Scientific contributions of PhD students in sections of related fields.
4. Panel discussions on the issue of PhD studies and current trends in the development of scientific disciplines at UPJŠ.

Recommended literature:
Proceedings of the Spring School of Doctoral Students.

Course language:

Notes:

Course assessment
Total number of assessed students: 203

abs	n
100.0	0.0

Provides: doc. RNDr. Marián Kireš, PhD.

Date of last modification: 08.11.2022
Approved: prof. RNDr. Tomáš Madaras, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚMAT/ dSAA/25	**Course name:** Stochastic analysis and applications

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

Number of ECTS credits: 7

Recommended semester/trimester of the course: 2., 4.

Course level: III.

Prerequisities:

Conditions for course completion:
The final assessment is given on the basis of the written and oral part of the exam

Learning outcomes:
Students obtain knowledge from the modern theory of stochastic analysis and interrelations among disciplines like probability theory, mathematical analysis, functional analysis and random processes.
Using the Wiener process and diffusion processes, the student will become familiar with the basic principles and methods of stochastic analysis and modeling of real events in economics, financial mathematics, biology, and engineering. In the theoretical part of the course, students will learn how to calculate stochastic integrals, solve stochastic differential equations, use martingales and realize the connection between diffusion processes and partial differential equations. In the practical part, the student will learn to simulate diffusion processes, estimate their parameters and model real events (e.g. the development of the price of a quality indicator or the membrane potential of a neuron).

Brief outline of the course:
Continuous-time random processes and their properties, L2 space, Hilbert space, linear and quadratic variation, filtering and Markov times, optimal stopping time theorem, continuous-time martingales, Local martingales, Continuous semimartingales, martingale representation theorem (Doob, Meyer), Stochastic Itô and Stratonovich integral and Itô formula, product rule, per-partes integration, Itô process, Itô isometry, stochastic differential equations, Radon-Nikodym derivative, Cameron-Martin theorem, Girsanov theorem, Black-Scholes model, options, geometric Brownian motion, continuous-time Markov processes, diffusion, Ornstein-Uhlenbeck process, stochastic interpretation of diffusion equation and Laplace equation , Feynman-Kac theorem and Fokker-Planck equation, Clark-Ocone theorem.

Recommended literature:
• KARATZAS Ioannis, SHREVE Steven E., Brownian motion and stochastic calculus, Springer, 1988
• ØKSENDAL Bernt, Stochastic differential equations : an introduction with applications. 6th ed., Springer, 2005

• KLOEDEN Peter E., PLATEN Eckhard, SCHURZ Henri, Numerical solution of SDE through computer experiments, Springer, 1994
• MELICHERČÍK Igor, OLŠAROVÁ Ladislava, ÚRADNÍČEK Vladimír, Kapitoly z finančnej matematiky, Epos, 2005

Course language:
Slovak and English

Notes:
Knowledge of mathematical analysis and probability and statistics and basic knowledge of functional analysis are required.

Course assessment
Total number of assessed students: 0

N	P
0.0	0.0

Provides: doc. Mgr. Jozef Kiseľák, PhD.

Date of last modification: 11.01.2025

Approved: prof. RNDr. Tomáš Madaras, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚMV/dPZR/24	**Course name:** Submitted scientific work

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

Number of ECTS credits: 10

Recommended semester/trimester of the course:

Course level: III.

Prerequisities:

Conditions for course completion:
Scientific work after being sent to the editorial office as an author/co-author.

Learning outcomes:
By sending a manuscript to the editors of a scientific journal as an author/co-author, the PhD student demonstrates a high degree of ability to identify, evaluate, and apply correct scientific methods or research methodology. He demonstrates the ability to reflect on a scientific problem by using the latest approaches and applying them critically. He demonstrates the competence to use existing theories and concepts in an innovative way, as well as to generate new original scientific knowledge, which he can publish according to the highest qualitative and ethical standards of the field. The PhD student demonstrates the ability to formulate his own ideas in a structured form.

Brief outline of the course:

Recommended literature:

Course language:

Notes:

Course assessment
Total number of assessed students: 1

abs	n
100.0	0.0

Provides:

Date of last modification: 05.03.2024

Approved: prof. RNDr. Tomáš Madaras, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚMV/ dVSS/24	**Course name:** Supervision of student scientific work
Course type, scope and the method: **Course type:** **Recommended course-load (hours):** **Per week: Per study period:** **Course method:** present	
Number of ECTS credits: 8	
Recommended semester/trimester of the course:	
Course level: III.	
Prerequisities:	
Conditions for course completion: Supervision of Student's Scientific Activity	
Learning outcomes: By guiding a student within the SOČ or ŠVOČ, the PhD student demonstrates broad and scientifically based knowledge in the field of study, as well as knowledge of a wide range of methods and approaches. Demonstrates the ability to critically assess a professional problem and its proposed solution, as well as to evaluate it and possibly propose another solution. He applies knowledge and skills from the field of pedagogical sciences to his own field.	
Brief outline of the course:	
Recommended literature:	
Course language:	
Notes:	
Course assessment Total number of assessed students: 0	

abs	n
0.0	0.0

Provides:
Date of last modification: 05.03.2024
Approved: prof. RNDr. Tomáš Madaras, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚMV/ dPPC1/24	**Course name:** Teaching activities 1 h/s
Course type, scope and the method: **Course type:** **Recommended course-load (hours):** **Per week: Per study period:** **Course method:** present	
Number of ECTS credits: 2	
Recommended semester/trimester of the course:	
Course level: III.	
Prerequisities:	
Conditions for course completion: Direct teaching activity 1 semester hour	
Learning outcomes: Through pedagogical activity, the PhD student demonstrates the ability to transfer and integrate knowledge from his own field of study into education. He is able to select and apply the right techniques and strategies of study group management, higher education and evaluation of learning outcomes. He is capable of designing and implementing part of the educational process in accordance with current trends in higher education and the requirements placed on the level of communication and digital competencies.	
Brief outline of the course:	
Recommended literature:	
Course language:	
Notes:	
Course assessment Total number of assessed students: 0	

abs	n
0.0	0.0

Provides:
Date of last modification: 05.03.2024
Approved: prof. RNDr. Tomáš Madaras, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚMV/ dPPC2/24	**Course name:** Teaching activities 2 h/s
Course type, scope and the method: **Course type:** **Recommended course-load (hours):** **Per week: Per study period:** **Course method:** present	
Number of ECTS credits: 4	
Recommended semester/trimester of the course:	
Course level: III.	
Prerequisities:	
Conditions for course completion: Direct teaching activity 2 semester hours	
Learning outcomes: Through pedagogical activity, the PhD student demonstrates the ability to transfer and integrate knowledge from his own field of study into education. He is able to select and apply the right techniques and strategies of study group management, higher education and evaluation of learning outcomes. He is capable of designing and implementing part of the educational process in accordance with current trends in higher education and the requirements placed on the level of communication and digital competencies.	
Brief outline of the course:	
Recommended literature:	
Course language:	
Notes:	
Course assessment Total number of assessed students: 0	

abs	n
0.0	0.0

Provides:
Date of last modification: 05.03.2024
Approved: prof. RNDr. Tomáš Madaras, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚMV/ dPPC3/24	**Course name:** Teaching activities 3 h/s
Course type, scope and the method: **Course type:** **Recommended course-load (hours):** **Per week: Per study period:** **Course method:** present	
Number of ECTS credits: 6	
Recommended semester/trimester of the course:	
Course level: III.	
Prerequisities:	
Conditions for course completion: Direct teaching activity 3 semester hours	
Learning outcomes: Through pedagogical activity, the PhD student demonstrates the ability to transfer and integrate knowledge from his own field of study into education. He is able to select and apply the right techniques and strategies of study group management, higher education and evaluation of learning outcomes. He is capable of designing and implementing part of the educational process in accordance with current trends in higher education and the requirements placed on the level of communication and digital competencies.	
Brief outline of the course:	
Recommended literature:	
Course language:	
Notes:	
Course assessment Total number of assessed students: 0	

abs	n
0.0	0.0

Provides:
Date of last modification: 05.03.2024
Approved: prof. RNDr. Tomáš Madaras, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚMV/ dPPC4/24	**Course name:** Teaching activities 4 h/s
Course type, scope and the method: **Course type:** **Recommended course-load (hours):** **Per week: Per study period:** **Course method:** present	
Number of ECTS credits: 8	
Recommended semester/trimester of the course:	
Course level: III.	
Prerequisities:	
Conditions for course completion: Direct teaching activity 4 semester hours	
Learning outcomes: Through pedagogical activity, the PhD student demonstrates the ability to transfer and integrate knowledge from his own field of study into education. He is able to select and apply the right techniques and strategies of study group management, higher education and evaluation of learning outcomes. He is capable of designing and implementing part of the educational process in accordance with current trends in higher education and the requirements placed on the level of communication and digital competencies.	
Brief outline of the course:	
Recommended literature:	
Course language:	
Notes:	
Course assessment Total number of assessed students: 0	

abs	n
0.0	0.0

Provides:
Date of last modification: 05.03.2024
Approved: prof. RNDr. Tomáš Madaras, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚMV/ dTPG/14	**Course name:** Theory of planar graphs

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

Number of ECTS credits: 7

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

Course level: III.

Prerequisities:

Conditions for course completion:
To complete the course, it is necessary to demonstrate the ability to formulate definitions and theorems from the lectured material together with their proofs, and to present an understanding of the relationships between particular concepts and results.
The evaluation of the subject is based on the results of an oral exam (consisting of two theoretical questions).

Learning outcomes:
After completing the course, the student will be acquainted with basic and advanced topics related to planar and plane graphs.

Brief outline of the course:
Fundamentals of topology of the plane.
Planar and planar graphs, outerplanar graphs.
Characterization theorems for planarity.
Euler's formula and its consequences.
Local structure of planar and plane graphs, the discharging method method.
Separators in planar graphs.

Recommended literature:
T. Nishizeki, N. Chiba: Planar graphs: Theory and Algorithms, Dover Publications, 2008.
S. Jendrol', H-J. Voss: Light subgraphs of graphs embedded in the plane - A survey, Discrete Mathematics Vol. 313, no. 4 (2013) 406-421.

Course language:
Slovak and English

Notes:

Course assessment
Total number of assessed students: 0

N	P
0.0	0.0

Provides: prof. RNDr. Tomáš Madaras, PhD.
Date of last modification: 09.01.2025
Approved: prof. RNDr. Tomáš Madaras, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚMV/ dKZP/24	**Course name:** Thesis consultant
Course type, scope and the method: **Course type:** **Recommended course-load (hours):** **Per week: Per study period:** **Course method:** present	
Number of ECTS credits: 4	
Recommended semester/trimester of the course:	
Course level: III.	
Prerequisities:	
Conditions for course completion: Final thesis consultant.	
Learning outcomes: By consulting the final thesis, the PhD student demonstrates broad and scientifically based knowledge in the field of study, as well as knowledge of a wide range of methods and approaches. Demonstrates the ability to critically assess a professional problem and its proposed solution, as well as to evaluate it and possibly propose another solution. He applies knowledge and skills from the field of pedagogical sciences to his own field.	
Brief outline of the course:	
Recommended literature:	
Course language:	
Notes:	
Course assessment Total number of assessed students: 0	

abs	n
0.0	0.0

Provides:
Date of last modification: 05.03.2024
Approved: prof. RNDr. Tomáš Madaras, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚMV/ dVZP/24	**Course name:** Thesis supervising

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

Number of ECTS credits: 8

Recommended semester/trimester of the course:

Course level: III.

Prerequisities:

Conditions for course completion:
Supervisor of the final thesis.

Learning outcomes:
By supervising the final thesis, the PhD student demonstrates broad and scientifically based knowledge in the field of study, as well as knowledge of a wide range of methods and approaches. Demonstrates the ability to critically assess a professional problem and its proposed solution, as well as to evaluate it and possibly propose another solution. He applies knowledge and skills from the field of pedagogical sciences to his own field.

Brief outline of the course:

Recommended literature:

Course language:

Notes:

Course assessment
Total number of assessed students: 0

abs	n
0.0	0.0

Provides:

Date of last modification: 05.03.2024

Approved: prof. RNDr. Tomáš Madaras, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚMV/ dTTG/10	**Course name:** Topological graph theory

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

Number of ECTS credits: 7

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

Course level: III.

Prerequisities:

Conditions for course completion:
Exam

Learning outcomes:
To obtain knowledge on basic methods and results of Topological Graph Theory.

Brief outline of the course:
Planar graphs. Surfaces. Embeddings. Voltage graphs and covering spaces. The genus of a graph. The genus of a group. Colorings of embedded graphs. Unavoidable configurations. Representativity of embedded graphs. Treewidth of graphs. Minors. Forbidden configurations for surfaces.

Recommended literature:
1. G. Gross, T.W. Tucker: Topological Graph Theory, John Wiley and Sons, New York, 1987
2. B. Mohar, C., Thomassen: Graphs on Surfaces,The Johns Hopkins University Press, Baltimore, 2001
3. G. Ringel: Map Color Theorem, Springer-Verlag, Berlin, 1974
4. Journal articles

Course language:
Slovak or English

Notes:

Course assessment
Total number of assessed students: 19

N	P
0.0	100.0

Provides: doc. RNDr. Roman Soták, PhD.

Date of last modification: 09.01.2025

Approved: prof. RNDr. Tomáš Madaras, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚMV/ dTOP/25	**Course name:** Topology

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

Number of ECTS credits: 7

Recommended semester/trimester of the course: 2., 4.

Course level: III.

Prerequisities:

Conditions for course completion:
Exam focused on the knowledge of the notions and relations among them

Learning outcomes:
The knowledge of selected results of point-set and algebraic topology.

Brief outline of the course:
Notions and results of point-set topology.
Compactness and compactification.
Metric and separable space.
Homotopy, homology, and fundamental group.
Basics of topological data analysis.

Recommended literature:
R. Engelking, General Topology, Heldermann, 1989.
J.L. Kelley, General Topology, Springer, 1955.
I.M. Singer, J.A. Thorpe, Lecture Notes on Elementary Topology and Geometry, Springer, 1967.
A. Hatcher, Algebraic topology, Cambridge University Press, 2002.

Course language:
Slovak or English

Notes:

Course assessment
Total number of assessed students: 9

N	P
0.0	100.0

Provides: doc. Mgr. Jozef Kiseľák, PhD., RNDr. Jaroslav Šupina, PhD.

Date of last modification: 13.01.2025

Approved: prof. RNDr. Tomáš Madaras, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚMV/ dVKO/25	**Course name:** Variance components

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

Number of ECTS credits: 7

Recommended semester/trimester of the course: 2., 4.

Course level: III.

Prerequisities:

Conditions for course completion:
Exam

Learning outcomes:
Mastering the technique of estimation and testing of variance components in linear models.

Brief outline of the course:
For mastering the course, student has to pass a basic course of the theory of linear models.
Contents:
1. Model of one-way ANOVA (equation of the model, first moments, second moments)
2. Matrix form of the model, variance matrices in the balanced and unbalanced model
3. Estimation of random effects
4. Prediction of random effects
5. ANOVA-type estimators in the balanced model
a. Mean values of sums of squares and ANOVA-estimators
b. Distributions of statistics in the case of normality, confidence intervals and tests of hypotheses, probability of negative estimates
6. ANOVA-type estimators in the unbalanced model
a. Mean values of sums of squares and ANOVA-estimators
b. Distributions of statistics in the case of normality, confidence intervals
7. Maximum likelihood estimators (ML), the balanced and unbalanced model, solutions of likelihood equations and ML-estimators, mean values and variances of ML-estimators
8. Residual maximum likelihood estimators (REML)
a. The balanced model, solutions of REML equations and REML-estimators, comparison of REML, ML, and ANOVA-estimators, mean values and variances of REML-estimators
b. The unbalanced model
9. MINQE-type estimators, the balanced and unbalanced model, the problem of fixed effects estimation
10. Bayesian estimators, the problem of Bayesian estimation in the general case, solution in the balanced model

Recommended literature:
• Kubáček, Kubáčková, Volaufová: Statistical Models with Linear Structures, Veda, 1995

• Searle, Casella, McCulloch: Variance components, Wiley, 2004
• Rao, Kleffe: Estimation of variance components, in: Handbook of statistics, Vol.1, Elsevier - North Holland, 1980, s.1-40
• Christensen: Plane answers to complex questions, Springer, 1987
• Pinheiro, Bates: Mixed-effects models in S and S+, Springer, 2000

Course language:
Slovak and English

Notes:

Course assessment
Total number of assessed students: 4

N	P
0.0	100.0

Provides: doc. RNDr. Daniel Klein, PhD., prof. RNDr. Ivan Žežula, CSc.

Date of last modification: 09.01.2025

Approved: prof. RNDr. Tomáš Madaras, PhD.