CONTENT

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚMV/ALA/10	**Course name:** Applied linear algebra

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: 5

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

Course level: II.

Prerequisities:

Conditions for course completion:
According to tests and to the exam.

Learning outcomes:
To deepen and expand your knowledge of linear algebra, to get acquainted with selected calculation methodologies and to be able to apply them to specific problems and mathematical problems. Demonstrate knowledge of mathematical content in context. Completion of the course significantly completes the profile of the graduate.

Brief outline of the course:
Matrices over Euclidean rings, canonical forms. Polynomial matrices.
Similar matrices. Jordan normal form.
Functions of matrices, sequences, series.
Inversion of singular matrices, pseudoinverse matrices and their application.

Recommended literature:
M. Fiedler: Speciálni matice a jejich použití v numerické matematice, SNTL Praha, 1981.
H.E.Rose: Linear Algebra, A Pure Mathematical Approach, Birkhäuser Verlag, 2002.
D.Serre: Matrices, Theory and applications, Springer Verlag, 2002.

Course language:
Slovak

Notes:

Course assessment
Total number of assessed students: 51

A	B	C	D	E	FX
29.41	9.8	23.53	5.88	31.37	0.0

Provides: prof. RNDr. Danica Studenovská, CSc.

Date of last modification: 19.04.2022

Approved: prof. RNDr. Tomáš Madaras, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚMV/ APS/10	**Course name:** Applied statistics

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: 6

Recommended semester/trimester of the course: 2.

Course level: II.

Prerequisities:

Conditions for course completion:
Given at the basis of statistical processing of real data. Final evaluation is given at the basis of partial examination, computing part, and oral part of the exam.

Learning outcomes:
Learning most frequently applied statistical methods.

Brief outline of the course:
o Matrices and linear spaces, g-inversions, projections
o Normal distribution and related distributions
o Hotelling's test
o Probability foundations of regression and correlation
o General linear model with full rank
o Model with incomplete rank
o Submodels testing
o Regression analysis, basic models
o Assesing the quality of a model
o Analysis of variance
o One-way ANOVA, multiple comparison procedures, problem of heteroskedasticity
o Balanced factorial models, hierarchical models
o Analysis of covariance
o Statistical software for linear modeling

Recommended literature:
• Rao: Linear statistical inference and its applications, Wiley, 1973
• Seber: Linear regression analysis, Wiley, 1977
• Searle: Linear models, Wiley, 1997
• Sen, Srivastava: Regression analysis (Theory, Methods, and Applications), Springer, 1990
• Christensen: Plane answers to complex questions (The Theory of Linear Models), Springer, 1987

Course language:
Slovak

Notes:

Course assessment
Total number of assessed students: 60

A	B	C	D	E	FX
3.33	8.33	18.33	15.0	31.67	23.33

Provides: prof. RNDr. Ivan Žežula, CSc.

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/ VMO/22	**Course name:** Calculus of variations in optimization

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: 6

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

Course level: II.

Prerequisities:

Conditions for course completion:
EN
Ongoing evaluation takes the form of a written test during the semester and attendance in lectures or exercises. The overal evaluation is based on a result of mid-term evaluation (60%) and the result of final written and oral examination (40%).

Learning outcomes:
Students will learn to find local extremes of functionals, especially to derive variational integrals. They will be able to verify the necessary and sufficient conditions for the existence of global and local extrema for specific functionals, find extremals in the case of one-dimensional integrals, and determine whether they are weak or strong extremes. Use theoretical results for examples from geometry, physics, chemistry or financial mathematics.

Brief outline of the course:
Abstract variational calculus in Banach space - critical points, extremals, sufficient conditions for the existence of a (global) minimizer and its uniqueness. Differentiability in Banach spaces (Gateaux and Fréchet derivative, variation of functionals). Euler's necessary condition (Beltrami's identity) and Lagrange's sufficient condition of local extremes. Lagrange’s multipliers method. Courant-Weinstein principle and Rayleigh's quotient. Ekeland's principle of variation. Rayleigh-Ritz method. The mountain pass theorem. Least squares method in spaces with infinite dimension. Bayesian variational methods. Discrete variational calculus. Du Bois-Reymond, Legendre and Weierstrass necessary conditions. Lavrentiev phenomenon. Conjugate points method. Sufficient conditions for weak and strong extremes. Hamilton-Jacobi equation. Geometric and physical aspects of calculus of variations (minimum areas, harmonic representations, central tendency measures, curvature equations, isoperimetric problem, geodetic calculation, Lagrange and Hamiltonian formulation of mechanics, Legendre transform, Fermat's principle).

Recommended literature:
1. K. Rektorys: Variační metody, Academia - nakladatelství, ISBN: 80-200-0714-8, 602 s.,1999.
2. J. Bouchala: Variační metody, https://mi21.vsb.cz/sites/mi21.vsb.cz/files/unit/variacni_metody.pdf, 2012.
3. Cassel, Kevin W.: Variational Methods with Applications in Science and Engineering, Cambridge University Press, 2013.

4. Elsgolc, L.E.: Calculus of Variations, Courier Corporation, ISBN 9780486457994, 2007.

Course language:
Slovak

Notes:

Course assessment
Total number of assessed students: 4

A	B	C	D	E	FX
25.0	75.0	0.0	0.0	0.0	0.0

Provides: doc. Mgr. Jozef Kiseľák, PhD.

Date of last modification: 19.04.2022

Approved: prof. RNDr. Tomáš Madaras, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚMV/ CTG/22	**Course name:** Chromatic graph theory

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: 4

Recommended semester/trimester of the course: 1.

Course level: II.

Prerequisities:

Conditions for course completion:
Oral exam.

Learning outcomes:
Basic knowledge concerning methods how new discoveries in matematics. Deeper knowledge on selected topics in graph theory.

Brief outline of the course:
Proper vertex coloring of graphs. Coloring of planar graphs. Perfect graphss.
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

Notes:

Course assessment
Total number of assessed students: 43

A	B	C	D	E	FX
60.47	11.63	16.28	9.3	2.33	0.0

Provides: doc. RNDr. Roman Soták, PhD., RNDr. Igor Fabrici, Dr. rer. nat., univerzitný docent

Date of last modification: 15.11.2021
Approved: prof. RNDr. Tomáš Madaras, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚINF/ KKV1/21	**Course name:** Classical and quantum computations

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: 6

Recommended semester/trimester of the course: 3.

Course level: II., N

Prerequisities:

Conditions for course completion:
Successful completion of the subject is conditioned by proper acquisition of basic concepts, algorithms and models and demonstrating the ability to apply them creatively. The acquisition of knowledge takes place:
- continuously during the semester in the form of partial assignments,
- a written test during the semester,
- a written test at the exam,
- oral exam.

In order to receive an evaluation, it is necessary to obtain at least 50% of points from each of the three parts (assignments during the semester, written part of the exam, oral part of the exam). The detailed evaluation method is published in the AIS.

Learning outcomes:
By completing the subject, the student will get:
- knowledge of the classification and design of probabilistic algorithms,
- basic knowledge of the principles of quantum computers and their differences compared to classical computing models,
- knowledge and skills about the design and functioning of quantum computing and become familiar with the most well-known algorithms,

= basic quantum computer programming skills.

Brief outline of the course:
1. Introduction to quantum quantum computers. Basics of classical complexity theory.
2. Boolean circuits and their basic properties.
3. Probability algorithms.
4. BPP class and probability testing.
5. Basic properties of circuits and Fermat's test.
6. Miller - Rabin's test and the position of the BPP class in the hierarchy of complexity models.
7. Introduction to quantum computing and mathematical foundations of quantum theory.
8. Spectral representation of self-adjoint operators.
9. Quantum states and Hilbert vector spaces.
10. Basic quantum operators and basic quantum algorithms.

11. Quantum teleportation, superdense coding and Grover's algorithm.
12. Fourier transformation.
13. Shor's algorithm.

Recommended literature:

1. BERMAN,G.P., DOOLEN,G.D., MAINIERI, R., TSIFRINOVIC, V.I. Introduction to Quantum Computers. World Scientific, 2003.
2. GRUSKA, J. Quantum Computing. McGraw-Hill, 1999.
3. JOHNSON, G. A Shortcut Through Time: The Path to the Quantum Computer, Knopf 2003.
4. KITAEV, A.Y., SHEN, A.H., VYALYI, M.N. Classical and Quantum Computation. American Mathematical Society, 2002.
5. NIELSEN, M.A., CHUANG, I.L. Quantum Computation and Quantum Information. Cambridge University Press, 2000.
6. HIRVENSALO, M., Quantum Computing, Springer 2004

Course language:
Slovak or english

Notes:
Content prerequisites:
Linear algebra, Group theory, Probability theory, Theory of algorithms, Introduction to quantum computers.

Course assessment
Total number of assessed students: 93

A	B	C	D	E	FX
27.96	38.71	16.13	5.38	4.3	7.53

Provides: prof. RNDr. Gabriel Semanišin, PhD., Mgr. Viktor Olejár

Date of last modification: 25.07.2022

Approved: prof. RNDr. Tomáš Madaras, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚMV/ KDZ/10	**Course name:** Combinatorial designs

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: 4

Recommended semester/trimester of the course: 3.

Course level: II.

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, to present the proofs of theorems and to solve selected problems based on theory of combinatorial designs.
The exam itakes written form by elaborating a test containing three questions of a theoretical nature and two questions of a practical / computational nature; the maximum number of points that can be obtained for answering each question is 20. To pass the exam, it is necessary to obtain more than half of the maximum number of 100 points (otherwise the exam is evaluated by FX), while the rating E is given in the case of point range 51-59, D in case of 60-69, C in case of 70-79, B in case of 80-89 and A in case of more than 90 points.

Learning outcomes:
After completing the course, the student is acquainted with the basics of the theory of combinatorial designs, its applications in the natural sciences and relations to other parts of mathematics.

Brief outline of the course:
Week 1: Motivational problems using combinatorial designs, definition and basic properties of BIBDs.
Week 2: Incidence matrix of a design and its properties.
Week 3: Constructions of BIBDs.
Week 4: Symmetrical BIBDs, derived and residual design.
Week 5: Order of symmetric BIBD, its relation to the number of points.
Week 6: Finite projective planes.
Week 7: Hadamard designs and Hadamard matrices.
Week 8: Conditions for the existence of symmetric BIBDs, Lagrange's four-square theorem.
Week 9: Bruck-Ryser-Chowla theorem and its consequences.
Week 10 and 11: Steiner triple systems and their constructions.
Week 12: Orthogonal Latin squares, orthogonal arrays.
Week 13: Strongly regular graphs.
Week 14: Selected applications of combinatorial designs (group testing of samples, sharing of secret information).

Recommended literature:

I. Anderson, I. Honkala: A short course in combinatorial designs, http://www.utu.fi/~honkala/cover.html
D.R. Stinson: Combinatorial Designs: Constructions and Analysis, Springer 2004
W.D. Wallis: Combinatorial designs, Marcel Dekker 1988

Course language:
Slovak or English

Notes:
Basic knowledge of arithmetic, linear algebra and graph theory is required, as well as basic knowledge of working with the Maple computer algebra system.

Course assessment
Total number of assessed students: 75

A	B	C	D	E	FX
30.67	20.0	24.0	20.0	5.33	0.0

Provides: prof. RNDr. Tomáš Madaras, 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/ KOO/10	**Course name:** Combinatorial optimization

Course type, scope and the method:
Course type: Lecture / Practice
Recommended course-load (hours):
Per week: 3 / 1 **Per study period:** 42 / 14
Course method: present

Number of ECTS credits: 6

Recommended semester/trimester of the course: 2.

Course level: II.

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:
Understanding of basic graph algorithm, the close connection 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:
Basic notions from graph theory.
Introduction to algorithms and complexity. Basic types of algorithms - sorting algorithms, search algorithms, greedy algorithms. NP-completeness.
Trees, spanning trees and rooted trees. Depth first search, breadth first search. Generating of all spanning trees of a graph, number of spanning trees. Minimum spanning tree problem (Kruskal, Prim, and Boruvka´s algorithms).
Distance in graphs. Shortest path problem in (non)oriented (weighted) graphs (various types of algorithms) and other variations of this problem.
Introduction to network analysis, critical path method.
Flows in networks, the max-flow min-cut theorem and related concepts.
Matchings, maximum matchings in bipartite and general graphs, finding a matching with maximum weight in bipartite graphs.
Location of centers in graphs, finding a center, absolute center, and a median of a graph.
Eulerian graphs and Chinese postman's problem.
Hamiltonian graphs, Travelling salesman problem and approximation algorithms for TSP.

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

4. J. Plesník: Grafové algoritmy, Veda Bratislava 1983.

Course language:
Slovak

Notes:

Course assessment
Total number of assessed students: 33

A	B	C	D	E	FX
63.64	24.24	3.03	6.06	0.0	3.03

Provides: doc. RNDr. Roman Soták, PhD.

Date of last modification: 19.04.2022

Approved: prof. RNDr. Tomáš Madaras, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: KPPaPZ/KK/07	**Course name:** Communication and Cooperation

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

Number of ECTS credits: 2

Recommended semester/trimester of the course: 3.

Course level: II.

Prerequisities:

Conditions for course completion:
Evaluation:
A condition for student evaluation is his active participation in the seminar. It is expected that the student will actively participate in the discussions and will express their positions and possible solutions.
The output for evaluation will be the development of a project in the form of a Power Point presentation or a video on a selected communication topic.

Learning outcomes:
The goal of the subject Communication, cooperation is the formation and development of students' language and communication skills through experiential activities.
The student can demonstrate an understanding of individual behavior in various communication contexts.
The student can describe, explain and evaluate communication techniques (cooperation, assertiveness, empathy, negotiation, persuasion) in practical contexts.
The student can apply these techniques in common communication schemes.

Brief outline of the course:
Communication
Communication theory
Non-verbal communication and its means
Verbal communication (basic components of communication, language means of communication) about active listening
Empathy
Short conversation and effective communication (principles and principles of effective communication)
Cooperation
About the basics of cooperation
About types, signs, types and factors of cooperation
Characteristics of the team (positions in the team)
Small social group (structure, development, characteristics of a small social group, position of the individual in the group)

About leadership (characteristics of the leader, management, leadership styles)

Recommended literature:

Course language:

Notes:

Course assessment
Total number of assessed students: 281

abs	n	z
98.22	1.78	0.0

Provides: Mgr. Ondrej Kalina, PhD., Mgr. Lucia Barbierik, PhD.

Date of last modification: 31.07.2022

Approved: prof. RNDr. Tomáš Madaras, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚINF/ VYZ1/15	**Course name:** Computational complexity

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: 4

Recommended semester/trimester of the course: 3.

Course level: II., N

Prerequisities:

Conditions for course completion:
Oral examination.

Learning outcomes:
To give students theoretical background in computational complexity and theory of NP-completeness.

Brief outline of the course:
1: Introduction: the notion of computational complexity, computational time, computational model, example - the problem of sorting, computational complexity as an asymptotic function
2: Basic computational models: RAM and RASP computers, the cost of an elementary step on these computers, single-tape Turing machine, multi-tape Turing machine, nondeterministic variants of these computational models, transformations among these models with respect to the time complexity
3: The classes P and NP: basic definitions, presenting (un)undirected graphs on the input, 3COL – the set of all 3-colorable graphs is in NP, 2COL - the set of all 2-colorable graphs is in P, SAT – the set of satisfiable Boolean formulas is in NP, CNF-SAT - Boolean formulas in conjunctive normal form
4: Variants of P and NP: decision problem, the problem of finding a solution, optimization problem, polynomial conversions among different variants
5: NP-completeness: reducibility in polynomial time and its transitivity, definition of the NP-completeness and its basic properties
6: NP-completeness of SAT
7: Variants of SAT: 3CNF-SAT - satisfiability of Boolean formulas in 3-conjunctive normal form, kCNF-SAT, CNF-SAT - satisfiability in k-conjunctive (conjunctive) normal form, 2CNF-SAT is in P
8: 3COL and its variants: 3COL (the problem of coloring vertices of a graph with 3 colors) in NP-complete, consequently: for each k>3, kCOL (the problem of coloring with k colors) is NP-complete as well
9: Colorability of a planar graph with three colors: presenting a planar graph on the input, the proof of NP-completeness, coloring with a larger number of colors
10: Another NP-complete problems: Exact set cover, Clique, Vertex cover

11: Hamiltonian path: Hamiltonian path in a directed and in undirected graph
12: Subset-sum-like problems: Subset Sum - the problem of whether any subset of the integers sum to precisely a target sum, Partition - the problem of whether a given multiset of positive integers can be partitioned into two subsets with equal sums, a "more relaxed" version of Partition - achieving an approximate equality of the sums, distribution of tasks among K parallel processors
13: Beyond P a NP: a review of the basic complexity classes - L, NL, P, NP, PSpace , NPSpace, ExpTime, NExpTime, …, simulation of (non)deterministic space in (non)deterministic time, conversions in opposite directions
14: PSpace: QBF - true quantified Boolean formulas, prenex normal form, Pspace completeness of QBF, PSpace = NPSpace

Recommended literature:

1. J.E. Hopcroft, R.Motwani, J.D. Ullman: Introduction to automata theory, languages, and computation, Addison-Wesley, 2007.
2. M. Sipser: Introduction to the Theory of Computation, Thomson, 2nd edition, 2006.
3. L.A.Hemaspaandra, M.Ogihara: Complexity theory companion, EATCS series, texts in computer science, Springer-Verlag, 2002.
4. S. Arora, B. Barak: Computational Complexity: A Modern Approach, Cambridge Univ. Pess, 2009. 5. G.Brassard, P.Bradley: Fundamentals of algorithmics, Prentice Hall, 1996.
6. D.P.Bovet, P.Crescenzi: Introduction to the theory of complexity, Prentice Hall, 1994.
7. 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.

Course language:
Slovak or english

Notes:
Content prerequisities:
Basic notions from the theory of automata and formal languages.
Basic skills in programming and design of algorithms (in any programming language).
Basics knowledge in mathematical logic, set theory, and graph theory.

Course assessment
Total number of assessed students: 380

A	B	C	D	E	FX
57.11	15.79	13.16	6.84	6.84	0.26

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/ KOP/10	**Course name:** Convex programming

Course type, scope and the method:
Course type: Lecture / Practice
Recommended course-load (hours):
Per week: 3 / 1 **Per study period:** 42 / 14
Course method: present

Number of ECTS credits: 5

Recommended semester/trimester of the course: 2.

Course level: I., II.

Prerequisities: ÚMV/LCO/10 and (ÚMV/MAN1c/22 or ÚMV/MAN2d/22 or ÚMV/FRPb/19)

Conditions for course completion:
To complete the course, it is necessary to demonstrate the ability to formulate definitions and theorems from the lectured material, to demonstrate the proofs of theorems and to solve selected problems of convex resp. nonlinear programming.
The overall evaluation of the course is awarded on the basis of semester evaluation (which includes the completion of two semester tests focusing on problem solving; for each of them, a maximum of 25 points can be obtained) and the results of an oral exam (consisting of three questions of a theoretical nature, with a total of 50 points). To pass the exam, it is necessary to obtain more than half of the maximum number of 100 points (otherwise the test is evaluated by FX), whereby evaluation E is given in case of point gain 51-59, D in case of 60-69, C in case of 70-79, B in the case of 80-89 and A in the case of more than 90 points.

Learning outcomes:
After completing the course, the student is acquainted with the basics of nonlinear programming from both theoretical point of view (the topics include properties of convex sets, properties of convex functions, optimality conditions for nonlinear problems, Karush-Kuhn-Tucker theory, quadratic programming), as well as from practical one (illustrations of real problems with underlying models that use nonlinear programming, and methods of their solution using computer algebra systems and computer technology).

Brief outline of the course:
Week 1: Practical problems leading to nonlinear programs.
Week 2 - 3: Convex sets and their properties.
Week 4 - 6: Convex functions – properties and criteria of convexity.
Week 7 - 8: Necessary and sufficient conditions of optimality. Karush-Kuhn-Tucker conditions.
Week 9 - 10: Quadratic programming. Duality in nonlinear programming.

Recommended literature:
M. Hamala, M. Trnovská: Nelineárne programovanie, Epos, 2012
M.S. Bazaraa, H.D. Sherali, C.M. Shetty: Nonlinear Programming: Theory and Algorithms, 3rd edition, Wiley-Interscience, 2006

Course language:
Slovak or English

Notes:
Knowledge of the basics of differential calculus of functions of one and more variables, linear algebra and linear programming (simplex method) is required.

Course assessment
Total number of assessed students: 92

A	B	C	D	E	FX
15.22	14.13	9.78	13.04	47.83	0.0

Provides: prof. RNDr. Tomáš Madaras, PhD., RNDr. Alfréd Onderko, PhD.

Date of last modification: 19.04.2022

Approved: prof. RNDr. Tomáš Madaras, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚINF/ DBS/15	**Course name:** Database systems for Mathematicians

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: 6

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

Course level: I., II.

Prerequisities:

Conditions for course completion:
Demonstration of adequate mastery of the content standard of the subject in the ongoing and final evaluation, the ability to formulate a problem in the acquired terminology and solve it within a project.
Written works during the semester, project.
Written and oral exam.

Learning outcomes:
After completing the course, the student acquires the principles of relational databases, is able to apply standard data models, design relational databases and formulate filtering queries.

Brief outline of the course:
1) Relational databases. Query language SQL, filtering; Stored procedures.
2) Data types, operators, numerical, string and time functions; System and user functions.
3) JOIN operations; Views. CTE.
4) AGGREGATION AND GROUP BY; Recursion and transitive closure.
5) Data and database models. Relational scheme. RDB principles. Data integrity; Transactions.
6) DB design, ER diagrams; Triggers and integrity.
7) System commands about DB and tables. Cascading deletion and update; Cursors.
8) Nested queries. ROLLUP. CASE expression; Physical organization of data.
9) Three-valued logic. Quantifiers and NOT. Set operations; B-trees and indexes.
10) Data science and knowledge acquisition using R; Functional dependencies.
11) Data warehouses. Data cube. Pivot table.
12) Relational algebra. Normalization of relational databases; The latest normal form - ETNF.

Recommended literature:
- C.J. Date, Database Design and Relational Theory, 2012, O'Reilly Media, Inc., ISBN: 978-1-449-32801-6
- J. Murach, Murach's MySQL, 3rd Edition, 2019, Mike Murach & Associates, Inc., ISBN-10: 1943872368
- R. Ramakrishnan, J. Gehrke, Database Management Systems, 2020, McGraw-Hill, ISBN13 9780071231510
- S. Krajčí: Databázové systémy, UPJŠ, 2005

- I. Ben-Gan, D. Sarka, A. Machanic, K. Farlee, T-SQL Querying, 2015, Microsoft Press, ISBN: 978-0-7356-8504-8
- I. Ben-Gan, T-SQL Fundamentals, Third Edition, 2016, Microsoft Press, ISBN: 978-1-5093-0200-0

Course language:
Slovak or English

Notes:

Course assessment
Total number of assessed students: 736

A	B	C	D	E	FX
12.91	10.05	13.86	20.24	32.88	10.05

Provides: doc. RNDr. Csaba Török, CSc., RNDr. Lukáš Miňo, PhD.

Date of last modification: 08.01.2022

Approved: prof. RNDr. Tomáš Madaras, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚMV/ RPR/22	**Course name:** Decision processes

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: 5

Recommended semester/trimester of the course: 2.

Course level: I., II.

Prerequisities:

Conditions for course completion:
The evaluation is given on the basis of elaboration of individual projects related to the topics covered within the subject.

Learning outcomes:
After completing the course, the student has the knowledge on basics of decision theory (games against nature), selected methods of solving multicriterial optimization problems together with advanced topics in decision-making theory (use of non-additive measures and generalized integrals).

Brief outline of the course:
Weeks 1 -2: Basics of decision theory, games against nature: examples of practical problems, decision criteria.
Week 3: Decision trees and their applications.
Weeks 4 - 8: Multicriterial optimization: examples of practical problems, methods for evaluating the importance of variant assessment criteria, methods for determining compromise and optimal variants.
Week 9: Utility function, decision-making under risk and uncertainty.
Weeks 10 - 11: Non-additive measures, their interpretation and the Choquet integral in the decision-making process, other selected non-additive methods.
Week 12: CEU, RDEU method and the Choquet-Stieltjes integral, paradoxes (Allais and Ellsberg paradox).

Recommended literature:
Grabisch, M.: Set Functions, Games and Capacities in Decision Making. Theory and Decision Library C~46, Springer International Publishing Switzerland, 2016.
Greco, S., Ehrgott, M., Figueira, J.-R.: Multiple Criteria Decision Analysis: State of the Art Surveys, International Series in Operations Research & Management Science, 233, Springer; 2nd ed. 2016.

Course language:
Slovak

Notes:

Course assessment
Total number of assessed students: 8

A	B	C	D	E	FX
62.5	12.5	0.0	12.5	12.5	0.0

Provides: prof. RNDr. Tomáš Madaras, PhD., RNDr. Lenka Halčinová, PhD.

Date of last modification: 19.04.2022

Approved: prof. RNDr. Tomáš Madaras, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚMV/ DPP1a/22	**Course name:** Diploma project 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: 1	
Recommended semester/trimester of the course: 1.	
Course level: II.	
Prerequisities:	
Conditions for course completion:	
Learning outcomes:	
Brief outline of the course:	
Recommended literature:	
Course language:	
Notes:	
Course assessment Total number of assessed students: 9	

abs	n
100.0	0.0

Provides:
Date of last modification: 24.08.2022
Approved: prof. RNDr. Tomáš Madaras, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚMV/ DPP1b/22	**Course name:** Diploma project 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: 2	
Recommended semester/trimester of the course: 2.	
Course level: II.	
Prerequisities:	
Conditions for course completion:	
Learning outcomes:	
Brief outline of the course:	
Recommended literature:	
Course language:	
Notes:	
Course assessment Total number of assessed students: 7	

abs	n
100.0	0.0

Provides:
Date of last modification: 24.08.2022
Approved: prof. RNDr. Tomáš Madaras, PhD.

COURSE INFORMATION LETTER

<table>
<tr><td colspan="2">University: P. J. Šafárik University in Košice</td></tr>
<tr><td colspan="2">Faculty: Faculty of Science</td></tr>
<tr><td>Course ID: ÚMV/ DPP1c/22</td><td>Course name: Diploma project III</td></tr>
<tr><td colspan="2">Course type, scope and the method:
Course type:
Recommended course-load (hours):
Per week: Per study period:
Course method: present</td></tr>
<tr><td colspan="2">Number of ECTS credits: 2</td></tr>
<tr><td colspan="2">Recommended semester/trimester of the course: 3.</td></tr>
<tr><td colspan="2">Course level: II.</td></tr>
<tr><td colspan="2">Prerequisities:</td></tr>
<tr><td colspan="2">Conditions for course completion:</td></tr>
<tr><td colspan="2">Learning outcomes:</td></tr>
<tr><td colspan="2">Brief outline of the course:</td></tr>
<tr><td colspan="2">Recommended literature:</td></tr>
<tr><td colspan="2">Course language:</td></tr>
<tr><td colspan="2">Notes:</td></tr>
<tr><td colspan="2">Course assessment
Total number of assessed students: 15</td></tr>
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<tr><td>abs</td><td>n</td></tr>
<tr><td>100.0</td><td>0.0</td></tr>
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<tr><td colspan="2">Provides:</td></tr>
<tr><td colspan="2">Date of last modification: 24.08.2022</td></tr>
<tr><td colspan="2">Approved: prof. RNDr. Tomáš Madaras, PhD.</td></tr>
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COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚMV/ DPP1d/22	**Course name:** Diploma project IV
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: 4.	
Course level: II.	
Prerequisities:	
Conditions for course completion:	
Learning outcomes:	
Brief outline of the course:	
Recommended literature:	
Course language:	
Notes:	
Course assessment Total number of assessed students: 15	

abs	n
100.0	0.0

Provides:
Date of last modification: 24.08.2022
Approved: prof. RNDr. Tomáš Madaras, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚMV/DPO/22	**Course name:** Diploma thesis and its 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: 16

Recommended semester/trimester of the course:

Course level: II.

Prerequisities:

Conditions for course completion:
The diploma thesis is the result of the student's own work. It must not show elements of academic fraud and must meet the criteria of good research practice defined in the Rector's Decision no. 21/2021, which lays down the rules for assessing plagiarism at Pavol Jozef Šafárik University in Košice and its components. Fulfillment of the criteria is verified mainly in the process of supervision and in the process of thesis defense. Failure to do so is reason for disciplinary action.

Learning outcomes:
The diploma thesis demonstrates mastery of extended theory and professional terminology of the field of study, acquisition of knowledge, skills and competencies in accordance with the declared profile of the graduate of the study program, as well as the ability to apply them creatively in solving selected field problems. Student demonstrates the ability of independent professional work in terms of content, formal and ethical. Further details on the diploma thesis are determined by Directive no. 1/2011 on the basic requirements of final theses and the Study Regulations of UPJŠ in Košice.

Brief outline of the course:
1. Elaboration of the diploma thesis in accordance with the instructions of the supervisor.
2. Presentation of the results of the diploma thesis before the examination commission.
3. Answering questions related to the topic of the diploma thesis within the discussion.

Recommended literature:
The recommended literature is determined individually in accordance with the topic of the diploma thesis.

Course language:
Slovak

Notes:

Course assessment
Total number of assessed students: 8

A	B	C	D	E	FX
87.5	0.0	0.0	0.0	12.5	0.0

Provides:
Date of last modification: 19.04.2022
Approved: prof. RNDr. Tomáš Madaras, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚMV/ FAN/22	**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: 6

Recommended semester/trimester of the course: 1.

Course level: II.

Prerequisities:

Conditions for course completion:
exam

Learning outcomes:
Understanding of the basic rigorous ideas of Applied Functional Analysis.

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.

Recommended literature:
A. M. Bruckner, J. B. Bruckner, B. S. Thomson: Real Analysis, Prentice Hall, 1997.
B. P. Rynne, M. A. Youngson: Linear Functional Analysis, Springer-Verlag, 2008.

Course language:
Slovak

Notes:

Course assessment
Total number of assessed students: 47

A	B	C	D	E	FX
19.15	10.64	10.64	17.02	34.04	8.51

Provides: RNDr. Jaroslav Šupina, PhD.

Date of last modification: 19.04.2022

Approved: prof. RNDr. Tomáš Madaras, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚMV/ THR/22	**Course name:** Game theory

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: 6

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

Course level: II.

Prerequisities:

Conditions for course completion:
Two written exams dring the semester (solving problems), presentation of an interesting model. The final assessment is based on the written tests and oral examination.

Learning outcomes:
Knowledge of basic models of noncooperative and cooperative game theory, solution methods and applications of game-theoretic models in economics and everyday life.

Brief outline of the course:
Examples of games. Extensive form of a game, value of the game. Von Neumann Morgenstern theory of utility. Matrix games and their solution. Bimatrix games.Negotiations theory. n-person games: core, Shapley value. Economic applications of game theory.

Recommended literature:
1. K. Binmore, Fun and games, D.C. Heath, 1992
2. G. Owen, Game Theory, Academic Press (existuje ruský preklad).
3. A.R. Karlin, Y.Peres, Game theory alive, American Mathematical Society, 2017
4. L.C. Thomas, Games, Theory and Applications, Wiley, New York.
5. H.S. Bierman, L. Fernandez, Game Theory with Economic Applications, Addison-Wesley, 1998.

Course language:
Slovak

Notes:
The students should have basic knowledge in probability theory and linear programming (including duality theory and simplex method).

Course assessment
Total number of assessed students: 97

A	B	C	D	E	FX
22.68	21.65	23.71	16.49	13.4	2.06

Provides: prof. RNDr. Katarína Cechlárová, DrSc.

Date of last modification: 19.04.2022
Approved: prof. RNDr. Tomáš Madaras, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚMV/ TGP/10	**Course name:** Group theory

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: 5

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

Course level: II.

Prerequisities:

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

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. Sylow 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: 34

A	B	C	D	E	FX
35.29	20.59	17.65	17.65	8.82	0.0

Provides: doc. RNDr. Miroslav Ploščica, CSc.

Date of last modification: 19.04.2022

Approved: prof. RNDr. Tomáš Madaras, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚMV/ TIN/22	**Course name:** Information theory

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: 4

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

Course level: II.

Prerequisities:

Conditions for course completion:
A student is evaluated according to an oral examination during which he/she answers two questions chosen by him/her at random, one from the group A and one from the group B (both for 50 points at maximum). Evaluation scale: A ... 90-100 p., B ... 80-89 p., C ... 70-79 p., D ... 60-69 p., E ... 50-59 p., FX ... 0-49 p.

Learning outcomes:
A student gets acquainted with a mathematical attempt to solve some problems of computer science.

Brief outline of the course:
A quantitative characteristic of an information. Entropy of a random variable. Mutual information. Inequalities involving mutual information and entropy, respectively. Typical sequence, typical set. Data compression.

Recommended literature:
T. M. Cover, J. A. Thomas, Elements of Information Theory, Wiley, 1991 (2nd ed. 2006)
T. K. Moon, Information Theory (free online course materials), available at the address http://digitalcommons.usu.edu/ocw_ece/3/
S. Palúch, Teória informácie, Žilinská univerzita, Žilina 2007
J. Černý, Entropia a informácia v kybernetike, Alfa, Bratislava 1981

Course language:
Slovak

Notes:

Course assessment
Total number of assessed students: 41

A	B	C	D	E	FX
58.54	4.88	12.2	4.88	19.51	0.0

Provides: prof. RNDr. Ondrej Hutník, PhD.

Date of last modification: 19.04.2022

Approved: prof. RNDr. Tomáš Madaras, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚMV/TZV/10	**Course name:** Lattice theory

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: 5

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

Course level: II.

Prerequisities:

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

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:
Ordered sets and lattices. Distributivity and modularity. Ideals and set-theoretical representation. Completeness and completions. Formal concept analysis.

Recommended literature:
1. G. Grätzer: General Lattice Theory (2nd edition), Birkhäuser, 1998
2. B. A. Davey, H. A. Priestley: Introduction to lattices and order, Cambridge University Press 1990
3. M. Kolibiar: Algebra a príbuzné disciplíny, Alfa Bratislava, 1991
4. S. Roman: Lattices and Ordered Sets, Springer 2008.

Course language:
Slovak

Notes:

Course assessment
Total number of assessed students: 27

A	B	C	D	E	FX
14.81	22.22	37.04	22.22	3.7	0.0

Provides: doc. RNDr. Miroslav Ploščica, CSc.

Date of last modification: 24.03.2023

Approved: prof. RNDr. Tomáš Madaras, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚINF/ STU1/16	**Course name:** 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: 5

Recommended semester/trimester of the course: 2.

Course level: II.

Prerequisities:

Conditions for course completion:
The realization of a project focused on the application of machine solution methods in solving practical tasks. Successful completion of two written tests based on machine learning, probabilistic learning, classification tasks. Successful completion of the written and oral part of the exam based on machine learning, probabilistic learning, classification tasks.

Learning outcomes:
The result of education is an understanding of the basic principles of machine learning. The student will gain the ability to analyze data using selected methods of machine learning and artificial intelligence. Can work with a selected tool for modeling neural networks.

Brief outline of the course:
1. Learning algorithms, concepts, hypotheses. Training and learning, learning by construction and numbering.
2. Boolean formulas and their representation. Learning algorithms for monocells. Hypothesis space representation.
3. Probabilistic learning. An estimate of the number of examples needed to achieve some accuracy and credibility.
4. Probabilistic learning and consistent algorithms.
5. Relationships between attribute sets and predicted variables. Regression. Linear modeling using the least squares method of deviations.
6. Linear modeling, generalization, nonlinear responses from a linear model, data validation. Classification.
7. Linear modeling using probability theory and maximum confidence.
8. VC (Vapnik - Cervonenkis) dimension of its relation to perceptrons.
9. Bayesian approach to learning. SVM.
10. Clustering.
11. Hidden Markov models.

Recommended literature:
1. ANTHONY, Martin a Norman BIGGS. Computational Learning Theory, Cambridge University Press, 1997. ISBN 978-0521599221.
2. BROWNLEE, Jason. Machine Learning Mastery With Python. 2019.

3. WATT, Jeremy, Reza BORHANI a Aggelos K. KATSAGGELOS. Machine learning refined: foundations, algorithms, and applications. Cambridge: Cambridge University Press, 2016. ISBN 978-1-107-12352-6.

Course language:
Slovak language or English language

Notes:

Course assessment
Total number of assessed students: 61

A	B	C	D	E	FX
36.07	18.03	27.87	9.84	8.2	0.0

Provides: doc. RNDr. Ľubomír Antoni, PhD., doc. RNDr. Gabriela Andrejková, CSc., RNDr. Zoltán Szoplák, RNDr. Šimon Horvát, PhD.

Date of last modification: 31.03.2022

Approved: prof. RNDr. Tomáš Madaras, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚMV/ MPA/19	**Course name:** Markov's processes and their applications

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: 6

Recommended semester/trimester of the course: 1.

Course level: II.

Prerequisities:

Conditions for course completion:
Total evaluation based on 2 written tests (2x40p) + assignment (5p) and oral exam (40p).
At least 50% must be obtained from each part.
Final evaluation: ≥90% A; ≥80% B; ≥70% C; ≥60% D; ≥50% E; <50% FX.

Learning outcomes:
Student should:
1. Obtain the knowledge about modelling of real stochastic processes.
2. Apply theoretical knowledge in practical problems solving in queuing and renewal theory.
3. Obtain basic skills with CAS software SageMath based on Python.

Brief outline of the course:
1. Stochastic (random) processes (definition, characteristics, classification of processes).
2. Markov chains (Markov property, transition matrix, discrete-time Markov chains).
3. Classification of states of the process.
4. Evaluation of transitions, optimal strategies, Howard´s algorithm.
5. Special chains with continuous time (continuous-time Markov chains, intensity of transition, Kolmogorov´s differential equations, Poisson process).
6. Birth-and-death processes.
7. Applications in queuing theory (Kendall´s classification of queuing systems, efficiency indicators, opened systems without waiting).
8.-9. Opened systems with waiting, closed systems.
10. Applications in renewal theory and reliability. Markov chains in discrete renewal models.
11. Renewal process with continuous time.
12. Reliability of the system of elements.
13. Limit theorems of renewal theory.

Recommended literature:
1. Skřivánková V., Hančová M.: Náhodné procesy a ich aplikácie, UPJŠ, Košice, 2018 (in Slovak)
2. Beichelt F.: Applied Probability and Stochastic Processes, 2nd Ed., Chapman and Hall, 2016
3. Ross S. M.: Introduction to Probability Models, 12th ed., Elsevier, 2019
4. Janková, K. a kol. Markovove reťazce a ich aplikácie, epos, 2014 (in Slovak)

5. Prášková Z., Lachout P.: Základy náhodných procesu, MFF UK, Praha, 1998 (in Czech)

Course language:
Slovak

Notes:
The students are required to have basic knowledge about axiomatical theory of probability, distributions and characteristics of random variables.

Course assessment
Total number of assessed students: 89

A	B	C	D	E	FX
24.72	16.85	20.22	19.1	15.73	3.37

Provides: doc. RNDr. Martina Hančová, PhD., RNDr. Andrej Gajdoš, PhD.

Date of last modification: 13.09.2021

Approved: prof. RNDr. Tomáš Madaras, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚMV/ MTE/22	**Course name:** Mathematical economics

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: 5

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

Course level: II.

Prerequisities:

Conditions for course completion:
Two written exams in solving problems. Final evaluation is based on written exams and theoretical oral exam.

Learning outcomes:
To learn basic notions and methods of the modern mathematical economics.

Brief outline of the course:
The notion of exchange economy. Edgeworth box. Preferences and utility functions. Optimality in exchange economies. Existence of core. Walrasian equilibrium. Optimality and decentralization. Production economies.

Recommended literature:
1. C.D. Aliprantis, D.J. Brown, O. Burkinshaw: Existence and optimality of competitive equilibria, Springer 1989
2. W. Hildenbrand, A.P. Kirman: Equilibrium analysis, North Holland, 1988
3. A. Takayama: Mathematical economics, Cambridge University Press, 1985

Course language:
Slovak

Notes:
The subject uses methods of convex programming, topology, game theory. The knowledge of basic notions of Microeconomics is recommended.

Course assessment
Total number of assessed students: 89

A	B	C	D	E	FX
24.72	22.47	17.98	20.22	10.11	4.49

Provides: prof. RNDr. Katarína Cechlárová, DrSc.

Date of last modification: 19.04.2022

Approved: prof. RNDr. Tomáš Madaras, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚMV/ MSM/14	**Course name:** Mathematical modelling

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: II.

Prerequisities:

Conditions for course completion:
Acquiring the required number of credits in the structure defined by the study plan.

Learning outcomes:
Evaluation of student‘s competences with respect to the profile of the graduate.

Brief outline of the course:

Recommended literature:

Course language:
Slovak

Notes:

Course assessment
Total number of assessed students: 15

A	B	C	D	E	FX
53.33	20.0	13.33	13.33	0.0	0.0

Provides:

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/ MST/19	**Course name:** Mathematical statistics

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: 5

Recommended semester/trimester of the course: 1.

Course level: I., II.

Prerequisities:

Conditions for course completion:
Total evaluation based on two written tests during the semester (2x40p) and the result of the written (30p) and oral part of the exam (30p).
At least 50% must be obtained from each part.
Final evaluation: ≥90% A; ≥80% B; ≥70% C; ≥60% D; ≥50% E; <50% FX.

Learning outcomes:
Student should obtain the knowledge about basic statistical methods and the ability to apply theoretical knowledge in practical problems solving.

Brief outline of the course:
1. Random vectors (definition, distributions, characteristics, joint and marginal distributions).
2. Covariance, correlation and regression.
3. Random sample, sampling distributions and characteristics.
4. Some important statistics and their distributions.
5. Point estimators and their properties.
6. Maximum likelihood method.
7. Interval estimates, confidence interval construction (2 weeks).
8. Testing of statistical hypothesis (critical region, level of significance and power of test, methods for searching optimal critical regions).
9. Some important parametric tests (2 weeks).
10. Some important nonparametric tests (2 weeks).

Recommended literature:
1. Skřivánková V.: Pravdepodobnosť v príkladoch, UPJŠ, Košice, 2006 (in Slovak)
2. Skřivánková V.-Hančová M.: Štatistika v príkladoch, UPJŠ, Košice, 2005 (in Slovak)
3. Casella, G., Berger, R., Statistical Inference, 2nd ed., Duxbury Press, 2002
4. DeGroot, M. H., Schervish, M. J.: Probability and Statistics, 4th ed., Pearson, Boston, 2012
5. Anděl J.: Základy matematické statistiky, MatfyzPress, Praha, 2011 (in Czech)

Course language:
Slovak

Notes:

Course assessment Total number of assessed students: 174					
A	B	C	D	E	FX
25.29	21.84	14.37	18.97	12.07	7.47
Provides: doc. RNDr. Martina Hančová, 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: KF/FMPV/22	**Course name:** Methodology of Science 1

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

Number of ECTS credits: 2

Recommended semester/trimester of the course:

Course level: II.

Prerequisities:

Conditions for course completion:
Attendance: A student may have one unexcused absence in seminar at the most. Absence in more than one seminar must be reasoned and substituted by consultations. Conditions of continuous and final control: during the semester a student is continuously checked and assessed according to his/her activity. To be awarded the credits, a student must pass a test from knowledge obtained in the lectures and seminars. Results of the test will make up the final grade.

Learning outcomes:
The course is aimed at getting familiar with the basic issues of methodology and philosophy of science. Significant part will be devoted to presenting the main concepts of the philosophy of science in the 20th century and this aim will be achieved by reading the source and interpretive texts.

Brief outline of the course:
• Falsificationism and critical realism by K. R. Popper.
• Development and critique of the Popper's concept.
• Understanding the science development in the work by T. S. Kuhn.
• Methodology of scientific research programmes of I. Lakatos.
• Methodological anarchism of P. Feyerabend.
• W.V.O. Quine – the issue of relation between theory and empiricism.

Recommended literature:
BILASOVÁ, V. – ANDREANSKÝ, E.: Epistemológia a metodológia vedy. Prešov: FF PU 2007.
FAJKUS, B.: Filosofie a metodologie vědy. Praha: Academia 2005.
BEDNÁRIKOVÁ, M. Úvod do metodológie vied. Trnavská univerzita: Trnava 2013.
DÉMUTH, A. Filozofické aspekty dejín vedy. Trnavská univerzita: Trnava 2013.
FEYERABEND, P.: Proti metodě. Prel. J. Fiala. Praha: Aurora 2001.
KUHN, T. S.: Štruktúra vedeckých revolúcií. Prel. Ľ. Valentová. Bratislava 1982.

Course language:
Slovak

Notes:

Course assessment
Total number of assessed students: 6

A	B	C	D	E	FX
100.0	0.0	0.0	0.0	0.0	0.0

Provides: prof. PhDr. Eugen Andreanský, PhD.

Date of last modification: 01.02.2022

Approved: prof. RNDr. Tomáš Madaras, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚBEV/ MOB2/10	**Course name:** Molecular Biology

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: 3

Recommended semester/trimester of the course: 2.

Course level: I., II.

Prerequisities:

Conditions for course completion:

Learning outcomes:
Familiarize students with the structure, properties and functions of information macromolecules and their work, focusing primarily on the molecular mechanisms of regulation of DNA replication, gene expression and cell cycle.

Brief outline of the course:
1. Structure and properties of information biomacromolecules.
2. Chromatine molecular structure and dynamics and oragnization of chromosome.
3. Replication of chromosomal and extrachromosomal DNAs.
4. Mutations and DNA reapir.
5. Prokaryotic and eukaryotic genome. Human genome.
6. Mobile gene elements.
7. Transcription and postranscription processing of RNA.
8. Translation and posttraslational modification of proteins. Protein degradation.
9. Interaction of proteins with DNA. Regulation of gene expression in prokaryots.
10. Regulation of gene expression in eukaryots.
11. Cell signaling.
12. Cell cycle and cell cycle control.

Recommended literature:
E. Mišúrová:Molekulárna biológia. Učebné texty, PF UPJŠ Košice, 1999
E. Mišúrová, P. Solár: Molekulová biológia. Učebné texty, PF UPJŠ, 2007
S.Rosypal:Úvod do molekulární biologie. Grafex Blansko, Brno,1999
D.P. Clark: Molecular Biology, Elsevier Academic Press, London, 2005
D.P. Clark, N.Pazdernik, M. McGehee: Molecular Biology, 3rd Edition, Elsevier 2018

Course language:

Notes:

Course assessment
Total number of assessed students: 1

A	B	C	D	E	FX
100.0	0.0	0.0	0.0	0.0	0.0

Provides: doc. RNDr. Peter Pristaš, CSc., RNDr. Mária Piknová, PhD., RNDr. Zuzana Jendželovská, PhD.

Date of last modification: 19.12.2021

Approved: prof. RNDr. Tomáš Madaras, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚMV/TOR/22	**Course name:** Optimal control theory

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: 6

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

Course level: II.

Prerequisities:

Conditions for course completion:
Based on two written tests during the semester and on the oral examination.

Learning outcomes:
To learn the basic notions of controllable systems.

Brief outline of the course:
Controllable systems. Pontrjagin maximum principle. Linear systems, bang-bang controls, singular controls.. Discrete systems, dynamic programming, Bellmann's optimality principle. Practical applications of theoretical results.

Recommended literature:

1. V. G. Bolťanskij, Matematičeskije metody optimaľnoho upravlenija,Nauka, Moskva, 1966.
2. P. Brunovský, Matematická teória optimálneho riadenia, Alfa, Bratislava, 1980.
3. J. J. D'Azzo, C.H. Houpis, Linear Control System Analysis and Design, McGraww-Hill, 1995.
4. J. Macki, A. Strauss, Introduction to Optimal Control Theory, Springer, Berlin, 1980.
5. M. Vlach, Optimální řízení regulovatelných systému, SNTL, Praha, 1975.
6. K. Macki, A. Strauss: Introduction to Optimal Control Theory, Springer, 1980.
7. G. Feichtinger, R.F. Hartl: Optimale Kontrolle okonomischer Prozesse, Berlin, 1986.

Course language:
Slovak

Notes:
The students are required to have basic knowledge about differential equations. Properties of convex sets are recommended.

Course assessment
Total number of assessed students: 90

A	B	C	D	E	FX
24.44	26.67	22.22	13.33	13.33	0.0

Provides: prof. RNDr. Katarína Cechlárová, DrSc.

Date of last modification: 19.04.2022

Approved: prof. RNDr. Tomáš Madaras, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: KF/ FILA/22	**Course name:** Philosophical Antropology
Course type, scope and the method: **Course type:** Practice **Recommended course-load (hours):** **Per week:** 2 **Per study period:** 28 **Course method:** present	
Number of ECTS credits: 2	
Recommended semester/trimester of the course:	
Course level: II.	
Prerequisities:	
Conditions for course completion:	
Learning outcomes:	
Brief outline of the course:	
Recommended literature:	
Course language:	
Notes:	

Course assessment
Total number of assessed students: 0

A	B	C	D	E	FX
0.0	0.0	0.0	0.0	0.0	0.0

Provides: doc. PhDr. Kristína Bosáková, PhD.
Date of last modification: 01.02.2022
Approved: prof. RNDr. Tomáš Madaras, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚMV/ POT/10	**Course name:** Polyhedral theory

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: 4

Recommended semester/trimester of the course: 2.

Course level: II.

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 overview of the theory of convex polyhedra and polyhedral maps.

Brief outline of the course:
Week 1: Polyhedra, complexes, maps, planar graphs.
Week 2: Basic properties of three-dimensional convex polyhedra (operations with polyhedra, Euler's formula and its consequences).
Week 3: Platonic, Archimedean and related polyhedra.
Weeks 4-6: Characterization of graphs of convex polyhedra, Steinitz's theorem.
Week 7: Hamiltonian polyhedra.
Week 8: The longest cycles in convex polyhedra.
Week 9: Face vectors of polyhedra, Eberhard's theorem.
Weeks 10-11: Local structure of polyhedra.
Week 12: Sphere inscribability and circumscribability of polyhedra.
Week 13: Applications of polyhedra in sciences.

Recommended literature:
E. Jucovič: Konvexné mnohosteny, Veda Bratislava 1981
B. Grünbaum: Convex polytopes (2nd edition), Springer New York, 2003
G.M. Ziegler: Lectures on Polytopes, Springer-Verlag, New York, 1996
S. Jendrol', H.-J. Voss: Light subgraphs of graphs embedded in the plane - a survey, Discrete Math. 313 (2013), 406-421

Course language:
Slovak or English

Notes:
Basic knowledge of geometry and advanced knowledge of graph theory are assumed.

Course assessment
Total number of assessed students: 11

A	B	C	D	E	FX
100.0	0.0	0.0	0.0	0.0	0.0

Provides: prof. RNDr. Tomáš Madaras, PhD.

Date of last modification: 19.04.2022

Approved: prof. RNDr. Tomáš Madaras, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚTVŠ/ ÚTVŠ/CM/13	**Course name:** Seaside Aerobic Exercise

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

Number of ECTS credits: 2

Recommended semester/trimester of the course:

Course level: I., II.

Prerequisities:

Conditions for course completion:
Completion: passed
Condition for successful course completion:
- active participation in line with the study rule of procedure and course guidelines
- effective performance of all tasks- aerobics, water exercise, yoga, Pilates and others

Learning outcomes:
Content standard:
The student demonstrates relevant knowledge and skills in the field, which content is defined in the course syllabus and recommended literature.
Performance standard:
Upon completion of the course students are able to meet the performance standard and:
- perform basic aerobics steps and basics of health exercises,
- conduct verbal and non-verbal communication with clients during exercise,
- organise and manage the process of physical recreation in leisure time

Brief outline of the course:
Brief outline of the course:
1. Basic aerobics – low impact aerobics, high impact aerobics, basic steps and cuing
2. Basics of aqua fitness
3. Basics of Pilates
4. Health exercises
5. Bodyweight exercises
6. Swimming
7. Relaxing yoga exercises
8. Power yoga
9. Yoga relaxation
10. Final assessment

Students can engage in different sport activities offered by the sea resort – swimming, rafting, volleyball, football, table tennis, tennis and other water sports in particular.

Recommended literature:
1. BUZKOVÁ, K. 2006. Fitness jóga. Praha: Grada. 167 s.

2. ČECHOVSKÁ, I., MILEROVÁ, H., NOVOTNÁ, V. Aqua-fitness. Praha: Grada. 136 s.
3. EVANS, M ., HUDSON, J., TUCKER, P. 2001. Umění harmonie: meditace, jóga, tai-či, strečink. 192 s.
4. JARKOVSKÁ, H., JARKOVSKÁ, M. 2005. Posilováni s vlastním tělem 417 krát jinak. Praha: Grada. 209 s.
5. KOVAŘÍKOVÁ, K. 2017. Aerobik a fitness. Karolium, 130 s.

Course language:
Slovak language

Notes:

Course assessment
Total number of assessed students: 54

abs	n
11.11	88.89

Provides: Mgr. Agata Dorota Horbacz, PhD.

Date of last modification: 29.03.2022

Approved: prof. RNDr. Tomáš Madaras, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: KF/ FIVYC/22	**Course name:** Selected Topics in Philosophy of Education (General Introduction)

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

Number of ECTS credits: 2

Recommended semester/trimester of the course:

Course level: II.

Prerequisities:

Conditions for course completion:

Learning outcomes:

Brief outline of the course:

Recommended literature:

Course language:

Notes:

Course assessment
Total number of assessed students: 2

A	B	C	D	E	FX
100.0	0.0	0.0	0.0	0.0	0.0

Provides: PhDr. Dušan Hruška, PhD.

Date of last modification: 27.04.2022

Approved: prof. RNDr. Tomáš Madaras, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚMV/ SHMa/22	**Course name:** Seminar on history of mathematics I

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

Number of ECTS credits: 2

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

Course level: I., II.

Prerequisities:

Conditions for course completion:
Conditions for continuous evaluation:
1. Participation in teaching in accordance with the study rules and instructions of the teacher.
2. Activity.
3. Homework and tests.
4. Seminar work and its presentation at the seminar – poster from history of mathematics on the selected topic
Conditions for successful completion of the course:
1. Participation in teaching in accordance with the study regulations and according to the instructions of the teacher;
2. Credits will be awarded to students who score at least 50% on homework assignments and tests. Additional points can be achieved for the presentation of a seminar paper.

Learning outcomes:
The student knows the main stages of the development of mathematics, the history of the development of the language of mathematics, the development of selected concepts and some mathematical disciplines. The student understands the parallels between the phylogeny and ontogeny of mathematical thinking.

Brief outline of the course:
Prehistory, ontogeny and phylogeny.
Mathematics in ancient cultures: Egypt, Mesopotamia, China, India.
Mathematics in ancient Greece: Origins of Greek natural philosophy and mathematics. The discovery of incommensurability and its consequences (Pythagoras and his school). Classical problems of Greek mathematics. Problems with infinity (Zeno). Eudoxus' method. Plato, Aristotle, Euclid and his Foundations. Archimedes of Syracuse, Eratosthenes, Apollónios, Claudios Ptolemy, Diophantos.
Arabic mathematics and its relation to medieval European mathematics.
The origins of modern mathematics. The search for the roots of polynomial equations. The origins of analytic geometry. Probability. Infinitesimal calculus. Number theory. Non-Euclidean geometry. The origin of set theory.
Development of mathematical symbolism.

Selected topics in school mathematics from the perspective of the history of mathematics.

Recommended literature:

Burton, D. M.: The History of Mathematics: An Introduction. McGraw−Hill, 2007.
Devlin, K.: Jazyk matematiky. Dokořán, 2002. (in czech)
Čižmár, J . Dejiny matematiky (Od najstarších čias po takmer súčasnosť) Perfekt, 2017. (in slovak)
Mareš , M . Příběhy matematiky. Pistorius, 2011. (in czech)

Course language:
Slovak

Notes:

Course assessment
Total number of assessed students: 143

A	B	C	D	E	FX
68.53	16.78	7.69	3.5	2.8	0.7

Provides: doc. RNDr. Ingrid Semanišinová, PhD.

Date of last modification: 24.08.2022

Approved: prof. RNDr. Tomáš Madaras, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚMV/ SHMb/22	**Course name:** Seminar on history of mathematics II

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

Number of ECTS credits: 2

Recommended semester/trimester of the course: 3.

Course level: I., II.

Prerequisities:

Conditions for course completion:
Conditions for continuous evaluation:
1. Participation in teaching in accordance with the study rules and instructions of the teacher.
2. Activity.
3. Homeworks.
4. Seminar work on the selected topic and its presentation at the seminar
Conditions for successful completion of the course:
1. Participation in teaching in accordance with the study regulations and according to the instructions of the teacher;
2. Credits will be awarded to students who score at least 50% on homework assignments and tests. Additional points can be achieved for the presentation of a seminar paper.

Learning outcomes:
Students will demonstrate an understanding of the history of the development of some mathematical disciplines and selected concepts. They will demonstrate this understanding by scoring at least 50% on previous topics and homework assignments.

Brief outline of the course:
1. Algebra and geometry of 16th and 17th century - Tartaglia, Vieta, Descartes
2. Beginning of modern number theory - Mersenne, Fermat
3. Development of infinitesimals -- Newton, Leibniz, Bernoulliovci
4. Complex and hypercomplex numbers -- Hamilton, Cayley, Clifford
5. Combinatory and probability - Pascal, Fermat
6. Algebra in the 18th and 19th century - Gauss, Abel, Galois
7. Non-Euclidean geometries - Gauss, Lobačevskij, Bolyai
8. Mathematical analysis in the 19th century - Cauchy, Bolzano, Weierstrass
9. Set theory - Bolzano, Cantor, Zermelo, Franklin
10. Mathematics in the beginning of 20th century - Peano, Hilbert, Gödel

Recommended literature:
Berlinghoff, W.P., Gouvea, F.Q.: Math through the Ages, MAA Press, 2015.
Čižmár, J . Dejiny matematiky (Od najstarších čias po takmer súčasnosť) Perfekt, 2017.
Hairer, E., Wanner, G.: Analysis by its History, Springer, 2008.

Mareš , M . Příběhy matematiky. Pistorius, 2011.

Course language:
Slovak

Notes:

Course assessment
Total number of assessed students: 10

A	B	C	D	E	FX
40.0	40.0	20.0	0.0	0.0	0.0

Provides:

Date of last modification: 21.09.2023

Approved: prof. RNDr. Tomáš Madaras, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚTVŠ/ TVa/11	**Course name:** Sports Activities I.

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

Number of ECTS credits: 2

Recommended semester/trimester of the course: 1.

Course level: I., II.

Prerequisities:

Conditions for course completion:
Min. 80% of active participation in classes.

Learning outcomes:
Sports activities in all their forms prepare university students for their professional and personal life. They have a great impact on physical fitness and performance. Specialization in sports activities enables students to strengthen their relationship towards the selected sport in which they also improve.

Brief outline of the course:
Brief outline of the course:
The Institute of physical education and sport at the Pavol Jozef Šafárik University offers 20 sports activities aerobics; aikido, basketball, badminton, body-balance, body form, bouldering, floorball, yoga, power yoga, pilates, swimming, fitness, indoor football, SM system, step aerobics, table tennis, chess, volleyball, tabata, cycling.
Additionally, the Institute of physical education and sport at the Pavol Jozef Šafárik University offers winter courses (ski course, survival) and summer courses (aerobics by the sea, rafting on the Tisza River) with an attractive programme, sports competitions with national and international participation.

Recommended literature:
BENCE, M. et al. 2005. Plávanie. Banská Bystrica: FHV UMB. 198s. ISBN 80-8083-140-8. [online] Dostupné na: https://www.ff.umb.sk/app/cmsFile.php?disposition=a&ID=571
BUZKOVÁ, K. 2006. Fitness jóga, harmonické cvičení těla I duše. Praha: Grada. ISBN 8024715252.
JARKOVSKÁ, H, JARKOVSKÁ, M. 2005. Posilování s vlastním tělem 417 krát jinak. Praha: Grada. ISBN 9788024757308.
KAČÁNI, L. 2002. Futbal:Tréning hrou. Bratislava: Peter Mačura – PEEM. 278s. ISBN 8089197027.
KRESTA, J. 2009. Futsal.Praha: Grada Publishing, a.s. 112s. ISBN 9788024725345.
LAWRENCE, G. 2019. Power jóga nejen pro sportovce. Brno: CPress. ISBN 9788026427902.
SNER, Wolfgang. 2004. Posilování ve fitness. České Budějovice: Kopp. ISBN 8072322141.

STACKEOVÁ, D. 2014. Fitness programy z pohledu kinantropologie. Praha: Galén. ISBN 9788074921155.
VOMÁČKO, S. BOŠTÍKOVÁ, S. 2003. Lezení na umělých stěnách. Praha: Grada. 129s. ISBN 8024721743.

Course language:
Slovak language

Notes:

Course assessment
Total number of assessed students: 15193

abs	abs-A	abs-B	abs-C	abs-D	abs-E	n	neabs
86.05	0.07	0.0	0.0	0.0	0.05	8.69	5.15

Provides: Mgr. Patrik Berta, Mgr. Agata Dorota Horbacz, PhD., Mgr. Dávid Kaško, PhD., Mgr. Ladislav Kručanica, PhD., Mgr. Richard Melichar, Mgr. Petra Tomková, PhD., Mgr. Marcel Čurgali, Mgr. Alena Buková, PhD., doc. PaedDr. Ivan Uher, MPH, PhD., prof. RNDr. Stanislav Vokál, DrSc., Mgr. Zuzana Küchelová, PhD.

Date of last modification: 07.02.2024

Approved: prof. RNDr. Tomáš Madaras, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚTVŠ/ TVb/11	**Course name:** Sports Activities II.

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

Number of ECTS credits: 2

Recommended semester/trimester of the course: 2.

Course level: I., II.

Prerequisities:

Conditions for course completion:
active participation in classes - min. 80%.

Learning outcomes:
Sports activities in all their forms prepare university students for their professional and personal life. They have a great impact on physical fitness and performance. Specialization in sports activities enables students to strengthen their relationship towards the selected sport in which they also improve.

Brief outline of the course:
Brief outline of the course:
The Institute of physical education and sport at the Pavol Jozef Šafárik University offers 20 sports activities aerobics; aikido, basketball, badminton, body-balance, body form, bouldering, floorball, yoga, power yoga, pilates, swimming, fitness, indoor football, SM system, step aerobics, table tennis, chess, volleyball, tabata, cycling.
Additionally, the Institute of physical education and sport at the Pavol Jozef Šafárik University offers winter courses (ski course, survival) and summer courses (aerobics by the sea, rafting on the Tisza River) with an attractive programme, sports competitions with national and international participation.

Recommended literature:
BENCE, M. et al. 2005. Plávanie. Banská Bystrica: FHV UMB. 198s. ISBN 80-8083-140-8. [online] Dostupné na: https://www.ff.umb.sk/app/cmsFile.php?disposition=a&ID=571
BUZKOVÁ, K. 2006. Fitness jóga, harmonické cvičení těla I duše. Praha: Grada. ISBN 8024715252.
JARKOVSKÁ, H, JARKOVSKÁ, M. 2005. Posilování s vlastním tělem 417 krát jinak. Praha: Grada. ISBN 9788024757308.
KAČÁNI, L. 2002. Futbal:Tréning hrou. Bratislava: Peter Mačura – PEEM. 278s. ISBN 8089197027.
KRESTA, J. 2009. Futsal.Praha: Grada Publishing, a.s. 112s. ISBN 9788024725345.
LAWRENCE, G. 2019. Power jóga nejen pro sportovce. Brno: CPress. ISBN 9788026427902.
SNER, Wolfgang. 2004. Posilování ve fitness. České Budějovice: Kopp. ISBN 8072322141.

STACKEOVÁ, D. 2014. Fitness programy z pohledu kinantropologie. Praha: Galén. ISBN 9788074921155.
VOMÁČKO, S. BOŠTÍKOVÁ, S. 2003. Lezení na umělých stěnách. Praha: Grada. 129s. ISBN 8024721743.

Course language:
Slovak language

Notes:

Course assessment
Total number of assessed students: 13318

abs	abs-A	abs-B	abs-C	abs-D	abs-E	n	neabs
84.37	0.51	0.02	0.0	0.0	0.05	10.78	4.28

Provides: Mgr. Agata Dorota Horbacz, PhD., Mgr. Dávid Kaško, PhD., Mgr. Marcel Čurgali, Mgr. Patrik Berta, Mgr. Ladislav Kručanica, PhD., Mgr. Richard Melichar, Mgr. Petra Tomková, PhD., Mgr. Alena Buková, PhD., doc. PaedDr. Ivan Uher, MPH, PhD., prof. RNDr. Stanislav Vokál, DrSc., Mgr. Zuzana Küchelová, PhD.

Date of last modification: 07.02.2024

Approved: prof. RNDr. Tomáš Madaras, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚTVŠ/ TVc/11	**Course name:** Sports Activities III.

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

Number of ECTS credits: 2

Recommended semester/trimester of the course: 3.

Course level: I., II.

Prerequisities:

Conditions for course completion:
min. 80% of active participation in classes

Learning outcomes:
Sports activities in all their forms prepare university students for their professional and personal life. They have a great impact on physical fitness and performance. Specialization in sports activities enables students to strengthen their relationship towards the selected sport in which they also improve.

Brief outline of the course:
Brief outline of the course:
The Institute of physical education and sport at the Pavol Jozef Šafárik University offers 20 sports activities aerobics; aikido, basketball, badminton, body-balance, body form, bouldering, floorball, yoga, power yoga, pilates, swimming, fitness, indoor football, SM system, step aerobics, table tennis, chess, volleyball, tabata, cycling.
Additionally, the Institute of physical education and sport at the Pavol Jozef Šafárik University offers winter courses (ski course, survival) and summer courses (aerobics by the sea, rafting on the Tisza River) with an attractive programme, sports competitions with national and international participation.

Recommended literature:
BENCE, M. et al. 2005. Plávanie. Banská Bystrica: FHV UMB. 198s. ISBN 80-8083-140-8. [online] Dostupné na: https://www.ff.umb.sk/app/cmsFile.php?disposition=a&ID=571
BUZKOVÁ, K. 2006. Fitness jóga, harmonické cvičení těla I duše. Praha: Grada. ISBN 8024715252.
JARKOVSKÁ, H, JARKOVSKÁ, M. 2005. Posilování s vlastním tělem 417 krát jinak. Praha: Grada. ISBN 9788024757308.
KAČÁNI, L. 2002. Futbal:Tréning hrou. Bratislava: Peter Mačura – PEEM. 278s. ISBN 8089197027.
KRESTA, J. 2009. Futsal.Praha: Grada Publishing, a.s. 112s. ISBN 9788024725345.
LAWRENCE, G. 2019. Power jóga nejen pro sportovce. Brno: CPress. ISBN 9788026427902.
SNER, Wolfgang. 2004. Posilování ve fitness. České Budějovice: Kopp. ISBN 8072322141.

STACKEOVÁ, D. 2014. Fitness programy z pohledu kinantropologie. Praha: Galén. ISBN 9788074921155.
VOMÁČKO, S. BOŠTÍKOVÁ, S. 2003. Lezení na umělých stěnách. Praha: Grada. 129s. ISBN 8024721743.

Course language:
Slovak language

Notes:

Course assessment
Total number of assessed students: 9100

abs	abs-A	abs-B	abs-C	abs-D	abs-E	n	neabs
88.37	0.07	0.01	0.0	0.0	0.02	4.46	7.07

Provides: Mgr. Marcel Čurgali, Mgr. Agata Dorota Horbacz, PhD., Mgr. Dávid Kaško, PhD., Mgr. Patrik Berta, Mgr. Ladislav Kručanica, PhD., Mgr. Richard Melichar, Mgr. Petra Tomková, PhD., Mgr. Alena Buková, PhD., doc. PaedDr. Ivan Uher, MPH, PhD., prof. RNDr. Stanislav Vokál, DrSc., Mgr. Zuzana Küchelová, PhD.

Date of last modification: 07.02.2024

Approved: prof. RNDr. Tomáš Madaras, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚTVŠ/ TVd/11	**Course name:** Sports Activities IV.

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

Number of ECTS credits: 2

Recommended semester/trimester of the course: 4.

Course level: I., II.

Prerequisities:

Conditions for course completion:
min. 80% of active participation in classes

Learning outcomes:
Sports activities in all their forms prepare university students for their professional and personal life. They have a great impact on physical fitness and performance. Specialization in sports activities enables students to strengthen their relationship towards the selected sport in which they also improve.

Brief outline of the course:
Brief outline of the course:
The Institute of physical education and sport at the Pavol Jozef Šafárik University offers 20 sports activities aerobics; aikido, basketball, badminton, body-balance, body form, bouldering, floorball, yoga, power yoga, pilates, swimming, fitness, indoor football, SM system, step aerobics, table tennis, chess, volleyball, tabata, cycling.
Additionally, the Institute of physical education and sport at the Pavol Jozef Šafárik University offers winter courses (ski course, survival) and summer courses (aerobics by the sea, rafting on the Tisza River) with an attractive programme, sports competitions with national and international participation.

Recommended literature:
BENCE, M. et al. 2005. Plávanie. Banská Bystrica: FHV UMB. 198s. ISBN 80-8083-140-8. [online] Dostupné na: https://www.ff.umb.sk/app/cmsFile.php?disposition=a&ID=571
BUZKOVÁ, K. 2006. Fitness jóga, harmonické cvičení těla I duše. Praha: Grada. ISBN 8024715252.
JARKOVSKÁ, H, JARKOVSKÁ, M. 2005. Posilování s vlastním tělem 417 krát jinak. Praha: Grada. ISBN 9788024757308.
KAČÁNI, L. 2002. Futbal:Tréning hrou. Bratislava: Peter Mačura – PEEM. 278s. ISBN 8089197027.
KRESTA, J. 2009. Futsal.Praha: Grada Publishing, a.s. 112s. ISBN 9788024725345.
LAWRENCE, G. 2019. Power jóga nejen pro sportovce. Brno: CPress. ISBN 9788026427902.
SNER, Wolfgang. 2004. Posilování ve fitness. České Budějovice: Kopp. ISBN 8072322141.

STACKEOVÁ, D. 2014. Fitness programy z pohledu kinantropologie. Praha: Galén. ISBN 9788074921155.
VOMÁČKO, S. BOŠTÍKOVÁ, S. 2003. Lezení na umělých stěnách. Praha: Grada. 129s. ISBN 8024721743.

Course language:
Slovak language

Notes:

Course assessment
Total number of assessed students: 5671

abs	abs-A	abs-B	abs-C	abs-D	abs-E	n	neabs
82.81	0.28	0.04	0.0	0.0	0.0	7.97	8.9

Provides: Mgr. Marcel Čurgali, Mgr. Agata Dorota Horbacz, PhD., Mgr. Dávid Kaško, PhD., Mgr. Patrik Berta, Mgr. Ladislav Kručanica, PhD., Mgr. Richard Melichar, Mgr. Petra Tomková, PhD., Mgr. Alena Buková, PhD., doc. PaedDr. Ivan Uher, MPH, PhD., prof. RNDr. Stanislav Vokál, DrSc., Mgr. Zuzana Küchelová, PhD.

Date of last modification: 07.02.2024

Approved: prof. RNDr. Tomáš Madaras, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚMV/ NPR/19	**Course name:** Stochastic processes

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: 6

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

Course level: II.

Prerequisities:

Conditions for course completion:
Total evaluation based on a written test (30p) + individual project work (30p) and oral exam (40p).
At least 50% must be obtained from each part.
Final evaluation: ≥90% A; ≥80% B; ≥70% C; ≥60% D; ≥50% E; <50% FX.

Learning outcomes:
To obtain knowledge of the stationary stochastic processes analysis in time domain and spectral domain.
To study properties of random processes with discrete time (time series) and continuous time and their application in finance.
To obtain skills in time series analysis with software R.

Brief outline of the course:
1.-2. Stationary precess, linear process.
3. Causal and invertible process.
4. Time domain analysis (autocovariance, autocorrelation and partial autocorrelation function).
5. Sample characteristic of time series and their properties.
6.-7. Frequency domain analysis (spectral density and distribution function, periodogram).
8. Prediction of time series.
9. Random processes with continuous time (fundamental concepts).
10. Brownian motion, Itô's process, Itô's lemma and its application.
11.-12. The Black-Scholes formula.

Recommended literature:
1. Brockwell P., Davis R.: Introduction to Time Series and Forecasting, 3rd ed., Springer, New York, 2016
2. Prášková Z.: Základy náhodných procesů II, Karolinum, Praha, 2004 (in Czech)
3. Tsay R.: Analysis of Financial Time Series, 3rd ed., Wiley Interscience, New Jersey, 2010
4. Shumway R., Stoffer D.: Time Series Analysis and Its Applications with R Examples, 4th ed., Springer, New York, 2017
5. Melicherčík I., Olšarová L., Úradníček V.: Kapitoly z finančnej matematiky, Epos, Bratislava, 2005 (in Slovak)
6. Oksendal B.K.: Stochastic Differential Equations, 6th ed., Springer, 2014

Course language:
Slovak

Notes:
The students are required to have basic knowledge about random vectors and their characteristics, conditional distribution, estimation theory and hypothesis testing.

Course assessment
Total number of assessed students: 83

A	B	C	D	E	FX
40.96	21.69	19.28	9.64	6.02	2.41

Provides: doc. RNDr. Martina Hančová, PhD.

Date of last modification: 19.04.2022

Approved: prof. RNDr. Tomáš Madaras, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚFV/SEV/10	**Course name:** Structure and Evolution of the Universe

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: 4

Recommended semester/trimester of the course: 2.

Course level: I., II.

Prerequisities:

Conditions for course completion:
To successfully complete the course, the student must demonstrate sufficient understanding of the basic knowledge of the structure and evolution of the universe. Knowledge of the basic properties of stars and methods of their determination, the structure, evolution and energy sources of stars, the structure of matter in the universe and its evolution is required. The condition for obtaining credits is passing a written or oral exam, preparation, and presentation of a semester essay. The credit evaluation of the course considers the following student workload: direct teaching (1 credit), self-study (2 credit) and assessment (1 credits). The minimum threshold for completing the course is to obtain at least 50% of the total score, using the following rating scale: A (90-100%), B (80-89%), C (70-79%), D (60- 69%), E (50-59%), Fx (0-49%).

Learning outcomes:
After completing the lectures, the student will master the basic knowledge about the properties of stars and methods of their determination, structure, evolution and energy sources of stars, the structure of matter in the universe and its evolution. It will also have sufficient physical knowledge and mathematical apparatus to enable independent solving of a wide range of tasks related to space research.

Brief outline of the course:
1. Basic properties of stars and methods of their determination: radiation flux, apparent and absolute magnitude, distances of stars, colors of stars.
2. Temperature of stars, black body radiation, spectra of atoms and molecules, non-thermal radiation.
3. Spectral classifications, luminosity classes, HR diagram, masses of stars.
4. Structure of stars: basic equations of stellar structure, transfer of energy by radiation and convection, production of energy in stars, fusion reactions.
5. Evolution of stars: interstellar matter and formation of stars and stellar systems, Jeans' criterion, protostars.
6. Evolution of stars: main sequence stars, giants, final stages of star evolution - white dwarfs, neutron stars and black holes.
7. Distribution of matter in the universe: Milky Way, its structure, dynamics, and evolution, types of galaxies, quasars, intergalactic matter, local group of galaxies.

8. Clusters and super-clusters of galaxies, large-scale structure of the universe, dark matter, and dark energy.
9. Evolution of the universe: historical development of views on the universe, Olberson's paradox, gravitational paradox, Cosmological principle.
10. Isotropicity and homogeneity of the universe, relic radiation, expansion of the universe. Steady state theory.
11. Relativistic cosmology: cosmological solutions of Einstein's equations, models of the universe and their properties, theory of the expanding universe, the Big Bang, the age of the universe.
12. Origin of the universe: the initial stages of the expansion of the universe, inflationary expansion and nucleogenesis, the formation of galaxies and galaxy clusters.

Recommended literature:

1. Carroll, B. W., Ostlie, D. A., An Introduction to Modern Astrophysics, Addison-Wesley Publishing Company, Reading, Massachusetts, 1996;
2. Contopoulos, D. Kotsakis, Cosmology, the structure and evolution of the Universe, Springer, 1984;
3. Pasachoff, J.M., Filippenko, A., The Cosmos: Astronomy in the New Millennium, Cambridge University Press, 2013;
4. Vanýsek, V., Základy astronomie a astrofyziky, Academia, Praha,1980;
5. Čeman, R., Pittich, E., Vesmír 1 - Slnečná sústava, MAPA Slovakia, Bratislava, 2002;
6. Čeman, R., Pittich, E., Vesmír 2 - Hviezdy - Galaxie, MAPA Slovakia, Bratislava, 2003;

Course language:
Slovak, English

Notes:

Course assessment
Total number of assessed students: 144

A	B	C	D	E	FX
36.81	27.78	13.89	11.81	9.72	0.0

Provides: doc. RNDr. Rudolf Gális, PhD.

Date of last modification: 20.09.2021

Approved: prof. RNDr. Tomáš Madaras, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚMV/ SVK/10	**Course name:** Students scientific 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: 4	
Recommended semester/trimester of the course:	
Course level: I., II.	
Prerequisities:	
Conditions for course completion:	
Learning outcomes: Individual scientific work of students. Publishing of obtained results in a written form and as a public presentation.	
Brief outline of the course:	
Recommended literature: With respect to the research problematics (article in journals, books).	
Course language: Slovak or English	
Notes:	
Course assessment Total number of assessed students: 24	

abs	n
100.0	0.0

Provides:
Date of last modification: 01.12.2021
Approved: prof. RNDr. Tomáš Madaras, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice	
Faculty: Faculty of Science	
Course ID: ÚTVŠ/ LKSp/13	**Course name:** Summer Course-Rafting of TISA River

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

Number of ECTS credits: 2

Recommended semester/trimester of the course:

Course level: I., II.

Prerequisities:

Conditions for course completion:
Completion: passed
Condition for successful course completion:
- active participation in line with the study rule of procedure and course guidelines
- effective performance of all tasks: carrying a canoe, entering and exiting a canoe, righting a canoe, paddling

Learning outcomes:
Content standard:
The student demonstrates relevant knowledge and skills in the field, which content is defined in the course syllabus and recommended literature.
Performance standard:
Upon completion of the course students are able to meet the performance standard and:
- implement the acquired knowledge in different situations and practice,
- implement basic skills to manipulate a canoe on a waterway,
- determine the right spot for camping,
- prepare a suitable material and equipment for camping.

Brief outline of the course:
Brief outline of the course:
1. Assessment of difficulty of waterways
2. Safety rules for rafting
3. Setting up a crew
4. Practical skills training using an empty canoe
5. Canoe lifting and carrying
6. Putting the canoe in the water without a shore contact
7. Getting in the canoe
8. Exiting the canoe
9. Taking the canoe out of the water
10. Steering
a) The pry stroke (on fast waterways)
b) The draw stroke

11. Capsizing
12. Commands

Recommended literature:
1. JUNGER, J. et al. Turistika a športy v prírode. Prešov: FHPV PU v Prešove. 2002. ISBN 8080680973.
Internetové zdroje:
1. STEJSKAL, T. Vodná turistika. Prešov: PU v Prešove. 1999.
Dostupné na: https://ulozto.sk/tamhle/UkyxQ2lYF8qh/name/Nahrane-7-5-2021-v-14-46-39#!ZGDjBGR2AQtkAzVkAzLkLJWuLwWxZ2ukBRLjnGqSomICMmOyZN==

Course language:
Slovak language

Notes:

Course assessment
Total number of assessed students: 209

abs	n
37.32	62.68

Provides: Mgr. Dávid Kaško, PhD.

Date of last modification: 29.03.2022

Approved: prof. RNDr. Tomáš Madaras, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚMV/TKO/22	**Course name:** Theory of codes

Course type, scope and the method:
Course type: Lecture / Practice
Recommended course-load (hours):
Per week: 3 / 1 **Per study period:** 42 / 14
Course method: present

Number of ECTS credits: 6

Recommended semester/trimester of the course: 1.

Course level: II.

Prerequisities:

Conditions for course completion:
A student is evaluated according to an oral examination during which he/she answers two questions chosen by him/her at random, one from the group A and one from the group B (both for 50 points at maximum). Evaluation scale: A ... 90-100 p., B ... 80-89 p., C ... 70-79 p., D ... 60-69 p., E ... 50-59 p., FX ... 0-49 p.

Learning outcomes:
A student gets acquainted with basic principles and theoretical bases of text coding and possibilities of their application.

Brief outline of the course:
Monoids. Basic notions of theory of codes. Examples of codes. Important classes of codes. Maximal codes. Submonoids generated by codes. Stable submonoids. Group codes. Free hull of a set of words. Test for recognising codes. Measure of a code. Bernoulli distribution. Dyck code. Complete sets in monoids. Thin codes. Composition of codes. Indecomposable codes.

Recommended literature:
J. Berstel and D. Perrin, Theory of Codes, Academic Press, 1985

Course language:
Slovak

Notes:

Course assessment
Total number of assessed students: 25

A	B	C	D	E	FX
44.0	16.0	4.0	4.0	20.0	12.0

Provides: Mgr. Martin Vodička

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/ TOP/15	**Course name:** Topology

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: 4

Recommended semester/trimester of the course: 2.

Course level: II.

Prerequisities:

Conditions for course completion:
Exam

Learning outcomes:
To acquaint the student with basic knowledge of point-set topology.

Brief outline of the course:
Basic notions and results of point-set topology. Connected and arcwise connected space. Compactness and compactification. Uniform space, basic properties. Metric and separable space. Dimension and its basic properties. The notion of a manifold and examples of manifolds. Homotopy, homotopy group.

Recommended literature:
R. Engelking, General Topology, Heldermann, Berlin, 1989.
J.L. Kelley, General Topology, Springer, 1955.
I.M. Singer and J.A. Thorpe, Lecture Notes on Elementary Topology and Geometry, Springer, 1967.

Course language:
Slovak

Notes:

Course assessment
Total number of assessed students: 12

A	B	C	D	E	FX
91.67	0.0	8.33	0.0	0.0	0.0

Provides: RNDr. Jaroslav Šupina, PhD.

Date of last modification: 19.04.2022

Approved: prof. RNDr. Tomáš Madaras, PhD.

COURSE INFORMATION LETTER

University: P. J. Šafárik University in Košice

Faculty: Faculty of Science

Course ID: ÚMV/UAL/10	**Course name:** Universal algebra

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: 5

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

Course level: II.

Prerequisities:

Conditions for course completion:
According to results of the exam (written+oral).

Learning outcomes:
To develop students' abstract thinking. Gain basic knowledge of universal algebra and be able to apply it to problems and mathematical problems. Demonstrate knowledge of mathematical content in context. Completion of the course significantly completes the profile of the graduate.

Brief outline of the course:
Algebraic structures. Homomorphisms and congruences. Direct and subdirect products. Terms. Free algebras. Birkhoff theorems about varieties.

Recommended literature:
M. Kolibiar a kol.: Algebra a príbuzné disciplíny. Bratislava, 1991.
S. Burris, H.P. Sankappanavar: A Course in Universal Algebra. Springer-Verlag, 1981.
B. Jónsson: Topics in universal algebra, Springer-Verlag 1972.
G. Grätzer: Universal Algebra, 2nd edition, Springer Verlag, 1979.

Course language:
Slovak

Notes:

Course assessment
Total number of assessed students: 27

A	B	C	D	E	FX
33.33	25.93	25.93	3.7	7.41	3.7

Provides: prof. RNDr. Danica Studenovská, CSc.

Date of last modification: 19.04.2022

Approved: prof. RNDr. Tomáš Madaras, PhD.