ÓBUDA UNIVERSITY
JOHN VON NEUMANN FACULTY OF INFORMATICS

Institute of Applied Mathematics			Semester 1. of the curriculum 2023-24-1			
Name of the subject:	Code of the subject:	Credits:	Weekly hours:			
				lec	sem	lab
Basic Mathematics	NMXMA1EBNF	6	full-time	2	2	0
Responsible person for the subject: Dr. GÁBOR Hegedüs			Classification: associate professor			
Subject lecturer(s):						
Prerequisites:						
Way of the assessment:	mid-term grade					

Course description	
Goal:	
Course description:	

Lecture schedule	
Education week	Topic
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Mid-term requirements	
Conditions for obtaining a mid-term grade/signature	

Assessment schedule	
Education week	Topic

Method used to calculate the *mid-term grade* (to be filled out only for subjects with mid-term grades)

Type of the replacement	
Type of the replacement of written test/mid-term grade/signature	

Type of the exam (to be filled out only for subjects with exams)

Calculation of the exam mark (to be filled only for subjects with exams)	
Final grade calculation methods:	
References	
Obligatory:	
Recommended:	
Other references:	

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Institute of Applied Mathematics			Semester 1. of the curriculum 2023-24-1			
Name of the subject:	Code of the subject:	Credits:	Weekly hours:			
				lec	sem	lab
Mathematical Foundations of Informatics	NMXIMAEBNF	6	full-time	2	3	0
Responsible person for the subject: Dr. Magdolna SZŐKE			Classification: senior lecturer			
Subject lecturer(s):						
Prerequisites:						
Way of the assessment:	exam					

Course description	
Goal:	The aim of the subject is to acquire the mathematical knowledge necessary for IT.
Course description:	Number systems, number representations. Basic knowledge of number theory. Recursion and mathematical induction. Matrices, determinants, systems of linear equations. Basic knowledge of propositional logic and predicate logic.

Lecture schedule	
Education week	Topic
1.	Number systems, conversion; number representations
2.	Divisibility and its properties; prime factorisation
3.	Concept of series, notable series. Recursive definition of sequences.
4.	Mathematical induction; indirect proof
5.	Concept of matrices, matrix operations, concept of determinants
6.	Properties of determinants, inverse matrix, adjugate matrix
7.	1st midterm test
8.	Systems of linear equations, solution by Cramer's rule
9.	Gaussian elimination
10.	Propositonal logic: statements, operations
11.	Evaluation of formulae, normal forms
12.	Arguments
13.	2nd midterm test
14.	Predicate logic, midterm test retake

Mid-term requirements	
Conditions for obtaining a mid-term grade/signature	Participation in classes, activity in practice lessons, writing the two midterm tests, and achieving at least 50% of the total score.

Assessment schedule	
Education week	Topic
7.	1st midterm test
13.	2nd midterm test
14.	Retake of one of the tests

Method used to calculate the *mid-term grade* (to be filled out only for subjects with mid-term grades)

Type of the replacement	
Type of the replacement of written test/mid-term grade/signature	The missing or the less successful midterm test can be retaken in the 14th week. In case the student has written both mid-term papers, but their result is

	under 50%, they have an opportunity to write a signature retake exam covering the whole course material in the exam-period.
Type of the exam (to be filled out only for subjects with exams)	
Written	
Calculation of the exam mark (to be filled only for subjects with exams)	
The exam contains theoretical questions and calculation exercises of the overall course material (altogether 70 points max). If the student does not reach at least 50% of the maximum score, the result is fail (1). Otherwise, 30% of their midterm test result will be added to the exam score, thus a total 100 point can be achieved. In case the student fulfilled the signature requirements at the signature retake exam, their midterm score is 15, regardless of the actual score. The final exam grade can be determined by the chart below.	
Final grade calculation methods:	
86-100: excellent (5) 74-85: good (4) 62-73: satisfactory (3) 50-61: pass (2) 0-49: fail (1)	
References	
Obligatory:	Seymour Lipschutz, Marc Lipson: Discrete Mathematics, 2007 http://elearning.uni-obuda.hu/
Recommended:	
Other references:	

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Institute of Cyberphysical Systems			Semester 1. of the curriculum 2023-24-1			
Name of the subject:	Code of the subject:	Credits:	Weekly hours:			
				lec	sem	lab
Electronics Basic	NKXEAIEBNF	5	full-time	2	0	1
Responsible person for the subject: Dr. Henrietta KOMORÓCKI-STEINER			Classification: associate professor			
Subject lecturer(s):						
Prerequisites:						
Way of the assessment:	exam					

Course description	
Goal:	The main objective of the course is to prepare the teaching of electronics, thus providing a basis for the basic concepts and calculations related to electrical and magnetic systems.
Course description:	This course introduces the student to the basics of electrical phenomena: the generation of charges, their flow, and the properties and main parameters of passive components used in electrical systems and circuits. A study of the primary laws and the effects of electric current follows this. The students will understand the electr Fundamental laws of electrical systems ic field, followed by a comparison of the electric and magnetic phenomena, and the most critical parameters of the two fields, highlighting their differences and similarities. We then turn to the induction phenomenon and introduce the alternating current concept. Finally, we will learn about the operation of some devices that are also important in practice.

Lecture schedule	
Education week	Topic
1.	Fundamentals of electricity: properties of matter, formation and measurement of charges
2.	Fundamental laws of electrical systems
3.	The structure of electrical systems (components)
4.	Main computational problems and problems related to electrical systems
5.	Work, power, heat, chemical effects of electric current and their engineering definition
6.	Electric field
7.	Electricity and magnetism
8.	Electric and magnetic fields
9.	Electromagnetic induction
10.	Alternating current
11.	Electric and magnetic devices (generator, motor, compass)
12.	Complex application tasks and related computational tasks and online test
13.	Laboratory final exam and Theoretical final exam
14.	Substitution: Laboratory final exam and Theoretical final exam

Mid-term requirements	
Conditions for obtaining a mid-term grade/signature	During the semester, students' performance is determined on the basis of the small practical exams, the online Test, the theoretical and practical big exams.

	To obtain a mark, the aggregate results of the practical small exams, the practical big exams, the theoretical big exams, the practical big exams and the practical big exams are taken into account. must be at least at the satisfactory level, i.e. separately 60%, and the online test must be at least 80% and the aggregate laboratory performance must be acceptable.

Assessment schedule

Education week	Topic
11	Small exam
12	Completion of online test
13	Lab final exam and Theoretical final exam

Method used to calculate the *mid-term grade* (to be filled out only for subjects with mid-term grades)

Method for determining the end-of-semester grade (E)
All rates (small exams, large (final) exams, online tests) will be expressed as a percentage.
Method of calculating the grade (if all other conditions):
MARK = (Lab major exam % + Theoretical major exam %) / 2 [%]
(each of the two exams separately must reach 60%)

Type of the replacement

Type of the replacement of written test/mid-term grade/signature	

Type of the exam (to be filled out only for subjects with exams)

Writing

Calculation of the exam mark (to be filled only for subjects with exams)

Point thresholds for each merit grade:
0% - 59%: unsatisfactory (1)
60% - 69%: satisfactory (2)
70% - 79%: average (3)
80% - 89%: good (4)
90% - 100%: excellent (5)

Final grade calculation methods:

Method for determining the end-of-semester grade (E)
All rates (small exams, large (final) exams, online tests) will be expressed as a percentage.
Method of calculating the grade (if all other conditions):
MARK= (Lab major exam % + Theoretical major exam %) / 2 [%]
(each of the two exams separately must reach 60%)

References

Obligatory:	Boysen Earl: Complete Electronics Self-teaching Guide with Projects John Wiley & Sons Inc, 2012 Charles Platt: Make: Electronics: Learning by Discovery: A hands-on primer for the new electronics enthusiast Make Community LLC 2021 Ronald Tocci , Neal Widmer , Gregory Moss: Digital systems Pearson Education 2017
Recommended:	
Other references:	MOODLE

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Institute of Applied Mathematics			Semester 2. of the curriculum 2023-24-2			
Name of the subject:	Code of the subject:	Credits:	Weekly hours:			
				lec	sem	lab
Calculus I.	NMXAN1EBNF	4	full-time	2	2	0
Responsible person for the subject: Dr. István VAJDA			Classification: senior lecturer			
Subject lecturer(s):						
Prerequisites:	NMXMA1EBNF	Basic Mathematics				
Way of the assessment:	exam					

Course description	
Goal:	The aim of the course is to develop students' conceptualization and problem-solving abilities through the acquisition of the basic concepts of univariate mathematical analysis; as well as an introduction to the use of the Matlab program.
Course description:	Convergence of series, continuity, and limit of functions. Differential calculus of univariate functions, derivation rules, applications, function analysis. Indefinite and definite integral. Symbolic and numerical integration techniques, applications.

Lecture schedule	
Education week	Topic
1.	The concept of sequence of numbers. Monotonicity boundedness, convergence.
2.	Limits and operations. Some often used types of sequences. Cauchy's criteria.
3.	Series of numbers and their convergence. Geometric and telescoping series.
4.	Series with only positive terms. Alternating series.
5.	Differentiability of functions, derivatives. Rules of differentiation.
6.	Higher order derivatives. Derivatives of elementary functions.
7.	Tangent of a curve. Osculation of curves, angle of curves. L'Hôpital's rule. Rolle's theorem, mean value theorem.
8.	Examining monotonicity, extrema, concavity, ... with derivatives. Analysing functions.
9.	The Riemann integral. Properties of integrals. Integral function.
10.	Antiderivatives and indefinite integrals. Technics of integration.
11.	Integration by parts, integration with substitution.
12.	Integration of elementary functions. Numeric methods of integration.
13.	Applications of integrals.
14.	Improper integrals.

Mid-term requirements	
Conditions for obtaining a mid-term grade/signature	To get a signature students absence can be no more than 30% of the lessons, and they need to obtain at least 50% of the points accessible on the midterm test.

Assessment schedule	
Education week	Topic
7.	Sequences, series, differential calculus
13.	Differential and integral calculus
14.	Retake

Method used to calculate the *mid-term grade* (to be filled out only for subjects with mid-term grades)

Type of the replacement	
Type of the replacement of written test/mid-term grade/signature	Students may retake only one of the midterm tests, namely the one with less points, or they can write a missing one on the 14th week. In the exam period there is a signature retake exam as well, however it can be written by only those, who have written both of their tests till the end of the last education week. On the signature retake exam there will be questions from the whole material of the semester.

Type of the exam (to be filled out only for subjects with exams)
It is a written exam, which can be completed by a short oral part if it is necessary.

Calculation of the exam mark (to be filled only for subjects with exams)
30% of the accessible points comes from the midterm test, another 30% from the theoretic questions, 40% from the calculation problems of the exam. Students need to achieve at least 50% from each to get a passing grade.

Final grade calculation methods:

0-49%	Fail (1)
50-61%	Satisfactory (2)
62-73%	Average (3)
74-85%	Good (4)
86-100%	Excellent (5)

References	
Obligatory:	J. Hass, M. D. Weir, G.B. Thomas: University Calculus Early Transcendentals, Addison-Wesley, 2007.
Recommended:	
Other references:	Course materials in the Moodle system. (https://elearning.uni-obuda.hu/)

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Institute of Applied Mathematics			Semester 2. of the curriculum 2023-24-2			
Name of the subject:	Code of the subject:	Credits:	Weekly hours:			
				lec	sem	lab
Discrete Mathematics and Linear Algebra	NMXDM1EBNF	4	full-time	2	2	0
Responsible person for the subject: Dr. Magdolna SZŐKE			Classification: senior lecturer			
Subject lecturer(s):						
Prerequisites:	NMXIMAEBNF	Mathematical Foundations of Informatics				
Way of the assessment:	exam					

Course description	
Goal:	The aim of the subject is to develop the student's conceptualization, abstraction, and problem-solving abilities by learning about the basic topics of discrete mathematics, as well as their applications in problem solving and model creation
Course description:	

Lecture schedule	
Education week	Topic
1.	Properties of homogeneous binary relations. Equivalence relations
2.	Partial ordernig, lattices
3.	Distributive lattices, Boolean algebras
4.	Combinatorics, binomial theorem
5.	Basic concepts of graphs. Trees
6.	Paths, connectedness. Colouring, planar graphs
7.	1st midterm test
8.	Vector spaces, linear independency, basis
9.	Rank of a matrix, systems of linear equations
10.	Linear transformations. Geometrical properties
11.	Eigenvalue, eigenvectors
12.	Linear maps. Image space, kernel space.
13.	2nd midterm test. Algebraic structures
14.	Algebraic structures cont. Midterm test retake

Mid-term requirements	
Conditions for obtaining a mid-term grade/signature	Participation in classes, activity in practice lessons, writing the two midterm tests, and achieving at least 50% of the total score.

Assessment schedule	
Education week	Topic
7.	1st midterm test
13.	2nd midterm test
14.	Retake of one of the tests

Method used to calculate the *mid-term grade* (to be filled out only for subjects with mid-term grades)

Type of the replacement	
Type of the replacement of written test/mid-term grade/signature	The missing or the less successful midterm test can be retaken in the 14th week. In case the student has written both mid-term papers, but their result is

	under 50%, they have an opportunity to write a signature retake exam covering the whole course material in the exam-period.
Type of the exam (to be filled out only for subjects with exams)	
Written	
Calculation of the exam mark (to be filled only for subjects with exams)	
The exam contains theoretical questions and calculation exercises of ther overall course material (altogether 70 points max). If the student does not reach at least 50% of the maximum score, their result is fail (1). Otherwise, 30% of their midterm test result will be added to the exam score, thus a total of 100 points can be achieved. In case the student fulfilled the signature requirements at the signature retake exam, their midterm score is 15, regardless of the actual score. The final exam grade can be detemined by the chart below.	
Final grade calculation methods:	
86-100: excellent (5) 74-85: good (4) 62-73: satisfactory (3) 50-61: pass (2) 0-49: fail (1)	
References	
Obligatory:	Seymour Lipschutz, Marc Lipson: Discrete Mathematics, 2007 http://elearning.uni-obuda.hu/
Recommended:	
Other references:	

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Institute of Applied Mathematics			Semester 3. of the curriculum 2024-25-1			
Name of the subject:	Code of the subject:	Credits:	Weekly hours:			
				lec	sem	lab
Calculus II.	NMXAN2EBNF	4	full-time	2	2	0
Responsible person for the subject: Dr. István VAJDA			Classification: senior lecturer			
Subject lecturer(s):						
Prerequisites:	NMXAN1EBNF	Calculus I.				
Way of the assessment:	exam					

Course description	
Goal:	Learning the basic concepts and techniques of univariate and multivariate analysis based on the international trends and requirements of IT education. Creating a clear conceptual system, developing problem-solving skills, providing the student with mathematical tools for further studies.
Course description:	Ordinary differential equations. Laplace-transform. Numeric series. Function series: Taylor and Fourier series. Multivariate functions.

Lecture schedule	
Education week	Topic
1.	The concept and applications of differential equations. Classification. Separable differential equations.
2.	First order linear differential equations.
3.	Second order linear differential equations. Resonance.
4.	The Laplace-transform. (Concept and properties.) The Laplace-transform of some well-known types of functions. Inverse Laplace-transform.
5.	Applications of Laplace-transform. Solving differential equations with Laplace-transform.
6.	Series of functions. Region of convergence. Pointwise and uniform convergence. Operations with series of functions.
7.	Taylor-series and their applications. The Taylor-formula.
8.	Fourier-series.
9.	Multivariate functions. (Boundedness, extrema, continuity, limits.)
10.	Differential calculus of multivariate functions. Partial and total derivatives. Tangent plane and normal line. Estimation of errors of calculations.
11.	Extrema of bivariate functions. Saddle points.
12.	Integration of bivariate functions on rectangles and normal regions.
13.	Integration of multivariate functions with substitution. Applications of integrals.
14.	Practice, preparing for the exam.

Mid-term requirements	
Conditions for obtaining a mid-term grade/signature	To get a signature students absence can be no more than 30% of the lessons, and they need to obtain at least 50% of the points accessible on the midterm test.

Assessment schedule	
Education week	Topic
6.	Differential equations, Laplace-transform.
13.	Series of functions. Multivariate functions.
14.	Retake

Method used to calculate the *mid-term grade* (to be filled out only for subjects with mid-term grades)

Type of the replacement	
Type of the replacement of written test/mid-term grade/signature	Students may retake only one of the midterm tests, namely the one with less points, or they can write a missing one on the 14th week. In the exam period there is a signature retake exam as well, however it can be written by only those, who have written both of their tests till the end of the last education week. On the signature retake exam there will be questions from the whole material of the semester.
Type of the exam (to be filled out only for subjects with exams)	
It is a written exam, which can be completed by a short oral part if it is necessary.	
Calculation of the exam mark (to be filled only for subjects with exams)	
30% of the accessible points comes from the midterm tests, another 30% from the theoretic questions, 40% from the calculation problems of the exam. Students need to achieve at least 50% from each to get a passing grade.	
Final grade calculation methods:	
0-49%	Fail (1)
50-61%	Satisfactory (2)
62-73%	Average (3)
74-85%	Good (4)
86-100%	Excellent
References	
Obligatory:	J. Hass, M. D. Weir, G.B. Thomas: University Calculus Early Transcendentals, Addison-Wesley, 2007.
Recommended:	
Other references:	Course materials in the Moodle system. (https://elearning.uni-obuda.hu/)

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Institute of Cyberphysical Systems			Semester 3. of the curriculum 2024-25-1			
Name of the subject:	Code of the subject:	Credits:	Weekly hours:			
				lec	sem	lab
Physics	KTXFI1EBNF	4	full-time	2	1	0
Responsible person for the subject: Dr. Ervin RÁCZ			Classification: associate professor			
Subject lecturer(s):						
Prerequisites:	NMXAN1EBNF	Calculus I.				
Way of the assessment:	exam					

Course description	
Goal:	To provide engineers with a fundamental knowledge of the physics of motion, sound and light so that they can later use this knowledge in robot AI and other IT developments. The curriculum includes basic concepts of mechanics, statics dynamics, simple support calculations, as well as basic skills in designing moving devices and robots. After these, the student will be able to understand a detailed introduction to wave theory and vibrations, including the definition of wave and vibration, interference, and the description of analogue signals using wave functions. After signals and waves, the students will study a discussion of the basics of optics, the dual nature of light, and basic lenses and lens systems as essential knowledge for computer engineers.
Course description:	The basic concepts of mechanics, statics and dynamics, simple support calculations, and the basic design of moving devices and robots are covered. The next unit is a detailed introduction to wave theory and vibrations, including the definition of wave and vibration, interference, and the description of analogue signals using wave functions. The following unit discusses the basics of optics, the dual nature of light, and basic lenses and lens systems as essential knowledge for computer engineers. In the course, students will learn how to measure physics and the limits of its accuracy. The course covers two areas of physics: basic mechanics and wave theory. In mechanics, students learn the basic concepts and laws of kinetics and, kinematics, dynamics. Applying Newton's laws also introduces the basic motions: uniform and alternating motion, the path-time function, circular motion, and harmonic motion. Two subsections about wave theory are covered: vibrations, sound waves, and the basics of optics: concepts of geometrical optics and the operation of primary optical devices.

Lecture schedule	
Education week	Topic
1.	Basic concepts of kinesiology
2.	Statics
3.	Dynamics
4.	Work and energy
5.	General mass attraction, artificial celestial bodies
6.	Simple machines
7.	Solidity
8.	Vibrations and waves
9.	Phonetics
10.	Geometric photonics

11.	Photometric instruments
12.	Complex application problems and related calculation examples + online test
13.	Laboratory final exam and Theoretical final exam
14.	Substitution: final exam and Theoretical final exam

Mid-term requirements	
Conditions for obtaining a mid-term grade/signature	During the semester, students' performance is determined based on the small practical exams, the online Test, the theoretical and practical big exams. To obtain a mark, the aggregate results of the practical small exams, the practical big exams, the theoretical big exams, the practical big exams and the practical big exams are taken into account. must be at least at the satisfactory level, i.e. separately 60%, and the online test must be at least 80% and the aggregate laboratory performance must be acceptable.

Assessment schedule	
Education week	Topic
11	Completion of online test
12	Small exam
13	Lab final exam and Theoretical final exam

Method used to calculate the *mid-term grade* (to be filled out only for subjects with mid-term grades)

Type of the replacement	
Type of the replacement of written test/mid-term grade/signature	The students can make up one small exam during the semester in week 11. The two final exams (the final laboratory exam and the final theoretical exam) are required to obtain the mid-term grade. The students can make up in week 14. All parts must be made up in the signature makeup examination: - Presentation of the completed worksheets (from week 1 to week 12). - Small exam questions - Lab final exam - Theoretical final

Type of the exam (to be filled out only for subjects with exams)

Written

Calculation of the exam mark (to be filled only for subjects with exams)

Method for determining the end-of-semester grade (E)
All rates (small exams, large (final) exams, online tests) will be expressed as a percentage.
Method of calculating the grade (if all other conditions):
MARK= (Lab major exam % + Theoretical major exam %) / 2 [%]
(each of the two exams separately must reach 60%)

Final grade calculation methods:

Point thresholds for each merit grade:
0% - 59%: unsatisfactory (1)
60% - 69%: satisfactory (2)
70% - 79%: average (3)

80% - 89%: good (4) 90% - 100%: excellent (5)	
References	
Obligatory:	Lewin Walter H. G.:I love physics Simon and Schuster 2012 Kuhn Karl F. Basic Physics: A Self-Teaching Guide Jossey Bass 2020 Jossey Bass: Mechanics for Physics Olympiads: Secrets on Elementary Mechanics and Too many rare Solving Problems (volume 1) CreateSpace Independent Publishing Platform 2016
Recommended:	
Other references:	

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Institute of Applied Mathematics			Semester 4. of the curriculum 2024-25-2			
Name of the subject:	Code of the subject:	Credits:	Weekly hours:			
				lec	sem	lab
Probability Theory and Mathematical Statistics	NMXVMSEBNF	5	full-time	2	2	0
Responsible person for the subject: Dr. Péter KÁRÁSZ			Classification: associate professor			
Subject lecturer(s):						
Prerequisites:	NMXAN2EBNF	Calculus II.				
Way of the assessment:	exam					

Course description	
Goal:	
Course description:	

Lecture schedule	
Education week	Topic
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Mid-term requirements	
Conditions for obtaining a mid-term grade/signature	

Assessment schedule	
Education week	Topic

Method used to calculate the *mid-term grade* (to be filled out only for subjects with mid-term grades)

Type of the replacement	
Type of the replacement of written test/mid-term grade/signature	

Type of the exam (to be filled out only for subjects with exams)

Calculation of the exam mark (to be filled only for subjects with exams)	
Final grade calculation methods:	
References	
Obligatory:	
Recommended:	
Other references:	

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			Semester 1. of the curriculum 2023-24-1			
Name of the subject:	Code of the subject:	Credits:	Weekly hours:			
				lec	sem	lab
Physical Education 1	GTTTS1EBNF	1	full-time	1	0	1
Responsible person for the subject:			Classification:			
Subject lecturer(s):						
Prerequisites:						
Way of the assessment:	mid-term grade					

Course description	
Goal:	
Course description:	

Lecture schedule	
Education week	Topic
1.	
2.	
3.	
4.	
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Mid-term requirements	
Conditions for obtaining a mid-term grade/signature	

Assessment schedule	
Education week	Topic

Method used to calculate the *mid-term grade* (to be filled out only for subjects with mid-term grades)

Type of the replacement	
Type of the replacement of written test/mid-term grade/signature	

Type of the exam (to be filled out only for subjects with exams)

Calculation of the exam mark (to be filled only for subjects with exams)	
Final grade calculation methods:	
References	
Obligatory:	
Recommended:	
Other references:	

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			Semester 2. of the curriculum 2023-24-2			
Name of the subject:	Code of the subject:	Credits:	Weekly hours:			
				lec	sem	lab
Physical Education 2	GTTTS2EBNF	1	full-time	0	1	0
Responsible person for the subject:			Classification:			
Subject lecturer(s):						
Prerequisites:						
Way of the assessment:	mid-term grade					

Course description	
Goal:	
Course description:	

Lecture schedule	
Education week	Topic
1.	
2.	
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Mid-term requirements	
Conditions for obtaining a mid-term grade/signature	

Assessment schedule	
Education week	Topic

Method used to calculate the *mid-term grade* (to be filled out only for subjects with mid-term grades)

Type of the replacement	
Type of the replacement of written test/mid-term grade/signature	

Type of the exam (to be filled out only for subjects with exams)

Calculation of the exam mark (to be filled only for subjects with exams)	
Final grade calculation methods:	
References	
Obligatory:	
Recommended:	
Other references:	

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			Semester 3. of the curriculum 2024-25-1			
Name of the subject:	Code of the subject:	Credits:	Weekly hours:			
				lec	sem	lab
Physical Education 3	GTTTS3EBNF	1	full-time	0	1	0
Responsible person for the subject:			Classification:			
Subject lecturer(s):						
Prerequisites:						
Way of the assessment:	mid-term grade					

Course description	
Goal:	
Course description:	

Lecture schedule	
Education week	Topic
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Mid-term requirements	
Conditions for obtaining a mid-term grade/signature	

Assessment schedule	
Education week	Topic

Method used to calculate the *mid-term grade* (to be filled out only for subjects with mid-term grades)

Type of the replacement	
Type of the replacement of written test/mid-term grade/signature	

Type of the exam (to be filled out only for subjects with exams)

Calculation of the exam mark (to be filled only for subjects with exams)	
Final grade calculation methods:	
References	
Obligatory:	
Recommended:	
Other references:	

ÓBUDA UNIVERSITY
JOHN VON NEUMANN FACULTY OF INFORMATICS

			Semester 4. of the curriculum 2024-25-2			
Name of the subject:	Code of the subject:	Credits:	Weekly hours:			
				lec	sem	lab
Physical Education 4	GTTTS4EBNF	1	full-time	0	1	0
Responsible person for the subject:			Classification:			
Subject lecturer(s):						
Prerequisites:						
Way of the assessment:	mid-term grade					

Course description	
Goal:	
Course description:	

Lecture schedule	
Education week	Topic
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Mid-term requirements	
Conditions for obtaining a mid-term grade/signature	

Assessment schedule	
Education week	Topic

Method used to calculate the *mid-term grade* (to be filled out only for subjects with mid-term grades)

Type of the replacement	
Type of the replacement of written test/mid-term grade/signature	

Type of the exam (to be filled out only for subjects with exams)

Calculation of the exam mark (to be filled only for subjects with exams)	
Final grade calculation methods:	
References	
Obligatory:	
Recommended:	
Other references:	

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Biomatics and Applied Artificial Intelligence Institute			Semester 1. of the curriculum 2023-24-1			
Name of the subject:	Code of the subject:	Credits:	Weekly hours:			
				lec	sem	lab
Learning Methodology	NBXTM1EBNF	6	full-time	2	1	0
Responsible person for the subject: Dr. Valéria PÓSER			Classification: associate professor			
Subject lecturer(s):						
Prerequisites:						
Way of the assessment:	mid-term grade					

Course description	
Goal:	The aim of the subject is twofold. On the one hand, students will learn about the latest learning methodologies, how to acquire and synthesise higher education knowledge, logical skills and time management skills. In addition, they will learn about the institution and the faculty and the opportunities it offers them, and gain an institutional perspective. They will learn about the University, its faculties and other departments, the university innovation ecosystem and its elements (incubation, services), types of scholarships, specialisations, specialised organisations (IEEE, NJSZT), the system of professional colleges and talent management.
Course description:	Themes: Knowledge about the University, university life, behaviour norms, administration, training; Learning methods, strategies, techniques in higher education, engineering, IT, information society. Group work / individual learning. Talent management (tandem courses, mentoring, professional circles (Neumann College), competitions, TDK). Research opportunities at the University. Student projects. Curriculum planning. Preparation for lectures, exercises, consultations. Study techniques for effective and efficient preparation for exams. Learning time management.

Lecture schedule	
Education week	Topic
1.	Aim, structure and requirements of the subject. Structure, management, documents and documents of the University,
2.	Bologna education system, credit system, NFTv, The structure of the training, curricular network, criterion subjects, interrelationship of subjects; relationship with the MSc.
3.	Management of student affairs (Neptun, administrators, applications, appeals, mentoring system. Ethics of university behaviour, culture of university behaviour.
4.	Learning methods in higher education, developing self-regulated learning. Assessing our learning style.
5.	Learning methods in the information society. Group work / individual learning.
6.	Learning strategies (techniques of adapting to learning, specific learning methods, methods to learn while - relaxing). and frequently used learning techniques in the field of technical education.
7.	Management of absences - cross semesters, conditions and possibilities to complete university (rules, regulations; thesis (Diploma thesis portal), final examination; language requirements).
8.	Thesis/Diploma Work writing process.
9.	Notes, textbooks; use of electronic materials; Quality assurance of education (student feedback).

10.	Simple learning techniques for all. Note-taking techniques. More independent processing techniques for larger learning materials.
11.	Talent management, mentoring, professional circles (Neumann College), competitions.
12.	Research opportunities at the University. Student projects.
13.	Speed reading, flash reading. Watching expert presentations - videos, analysis and evaluation. Individual experiments to master the method.
14.	Lesson planning. Preparation for lectures, exercises, consultations. Study techniques for effective and efficient preparation for examinations. Learning time management.

Mid-term requirements	
Conditions for obtaining a mid-term grade/signature	Each weekly course will include a series of test questions and homework assignments, which at least five to five must be successfully completed.

Assessment schedule	
Education week	Topic

Method used to calculate the *mid-term grade* (to be filled out only for subjects with mid-term grades)

The average of the 5 best test scores and the 5 best homework scores is the mid-year mark.

Type of the replacement	
Type of the replacement of written test/mid-term grade/signature	Replacement of the mid-term mark: once in the first 10 working days of the examination period.

Type of the exam (to be filled out only for subjects with exams)

Calculation of the exam mark (to be filled only for subjects with exams)

Test scores are calculated on the following scale:
0% - 49%: fail (1)
50% - 61%: pass (2)
62% - 73%: satisfactory (3)
74% - 85%: good (4)
86% - 100%: excellent (5)

Final grade calculation methods:

References

Obligatory:	Óbuda University - Organisational and Operational Rules, 2022.
Recommended:	Wright, Jean. Learning to learn in higher education. Vol. Routledge, 2018.
Other references:	Class materials hosted in Moodle.

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Institute of Cyberphysical Systems			Semester 4. of the curriculum 2024-25-2			
Name of the subject:	Code of the subject:	Credits:	Weekly hours:			
				lec	sem	lab
Business and project management	NKXVP1EBNF	4	full-time	0	4	0
Responsible person for the subject: Dr. Anikó ALMÁSI			Classification: senior lecturer			
Subject lecturer(s):						
Prerequisites:						
Way of the assessment:	mid-term grade					

Course description	
Goal:	The aim of the course is to introduce students to the complex system of business development and project management. By completing the course, participants will acquire basic economics and business knowledge, as well as micro and macro-economic, financial, innovation and management skills, primarily from a corporate perspective. We deal with different budget, market, project, organisational and competitive issues of companies of different sizes. We also cover the legal background (taxation, labour law, etc.) so that students have up-to-date knowledge whether they are thinking of starting a start-up or working as an employee in a multinational company.
Course description:	The course takes a practical approach to the business-oriented topics of business development and project management. The assessment of the external and internal environment, business plan, resource planning are essential tasks for students both as business leaders and project managers. During the semester, group exercises (business plan preparation, pitch) simulate real business situations.

Lecture schedule	
Education week	Topic
1.	Starting a business - legal framework
2.	Assessment of the economic environment
3.	Internal environment: assessment of resources, business objectives
4.	Business plan
5.	Project management: time, resources, capacity, budget planning
6.	Consultation for the group exercise: business plan preparation
7.	Mid-term exam, group task (presentation of business plan)
8.	Value creation, customer focus, market research, product and service development
9.	Growth opportunities: venture capital investments, pitch
10.	Innovation, competitiveness, barriers of growth
11.	Risk analysis, project life cycle, milestone
12.	Consultation for group exercise: pitch
13.	Mid-term exam, group task (pitch)
14.	Live case

Mid-term requirements	
Conditions for obtaining a mid-term grade/signature	2 mid-term exams minimum 50% pass, 2 group assignments minimum 50% pass, Live case minimum 50% pass

Assessment schedule	
Education week	Topic
7	Mid-term exam 1

13	Mid-term exam 2
14	Live case

Method used to calculate the *mid-term grade* (to be filled out only for subjects with mid-term grades)
Method of assesment: mid-term performance assesment, individual + group performance assesment with test and project tasks. End of the semester grade calculated from the sum of continuous performance: 100%
Type of the replacement

Type of the replacement of written test/mid-term grade/signature	The group assignment can be substituted only with individual permission and by special agreement. It is obligatory to indicate this at the beginning of the semester and to agree on the substitution! Supplementary assignments: in week 14 or once during the examination period.

Type of the exam (to be filled out only for subjects with exams)
Calculation of the exam mark (to be filled only for subjects with exams)
Final grade calculation methods:
0 – 59 %: fail (1) 60-69%: pass (2) 70-79% satisfactory (3) 80-89%: good (4) 90-100%: excellent (5)
References

Obligatory:	Jarjabka Ákos és tsai: Projektmenedzsment ismeretek. 2020. PTE Chikán Attila: Vállalatgazdaságtan. 2021. Akadémiai Kiadó Moodle
Recommended:	Szerb László – Konlósi Éva – Páger Balázs: Új technológiai cégek az Ipar4.0 küszöbén. 2020. Vezetéstudomány, LI. évf. 6. szám 81-96. old.
Other references:	

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Biomatics and Applied Artificial Intelligence Institute			Semester 2. of the curriculum 2023-24-2			
Name of the subject:	Code of the subject:	Credits:	Weekly hours:			
				lec	sem	lab
Tutoring preparation and project documentation techniques	NBXTPLEBNF	5	full-time	2	1	0
Responsible person for the subject: Prof. Dr. Kornélia LAZÁNYI			Classification: professor			
Subject lecturer(s):						
Prerequisites:						
Way of the assessment:	mid-term grade					

Course description	
Goal:	The subject serves to prepare students for the Tutoring subject both from a methodological and also from a project management point of view.
Course description:	During the course students get to know the different learning and pedagogical methodologies and procedures, in addition to tutoring methods and their effective implementation in practice. They are preparing for tutoring. In addition, students will learn about project documentation methodologies, which will help them in the planning and follow-up of projects and tutoring, as well as in the preparation of reports. Furthermore, these techniques can be effectively used during their studies to document their own development and to record their scientific and research results, which will be particularly useful in connection with thesis and diploma work but can also be used well when preparing TDK papers.

Lecture schedule	
Education week	Topic
1.	Introduction to the subject
2.	Individual aspects of learning
3.	Groups, group roles
4.	Assertive communication
5.	Conflict management
6.	Tutoring and teaching
7.	Report
8.	Introduction to project management
9.	Principles of designing a project
10.	Task breakdown structure
11.	Tutoring as a project
12.	Monitoring
13.	Effective time management
14.	Report

Mid-term requirements	
Conditions for obtaining a mid-term grade/signature	Completion of the two quarterly reports with a minimum of 50% each.

Assessment schedule	
Education week	Topic
7	Learning, teaching methodology
14	Project management tools

Method used to calculate the *mid-term grade* (to be filled out only for subjects with mid-term grades)	
Type of the replacement	
Type of the replacement of written test/mid-term grade/signature	It is possible to make up for the insufficient reports in the first 10 days of the exam period, in the framework of a midterm mark retake exam, where students can present their missing or inadequate reports separately, or even both together.
Type of the exam (to be filled out only for subjects with exams)	
Calculation of the exam mark (to be filled only for subjects with exams)	
Final grade calculation methods:	
0-59 points - insufficient 60-69 points - sufficient 70-79 points - average 80-89 points - good 90-100 point - excellent	
References	
Obligatory:	Rabow, Jerome, Tiffani Chin, and Nima Fahimian. Tutoring matters: Everything you always wanted to know about how to tutor. Temple University Press, 1999. Shea Correll, M. (2005). Peer mentoring: An intrusive approach. Essays in Education, 14(1), 6. Trautman, S. (2006). Teach what you know: A practical leader's guide to knowledge transfer using peer mentoring. Pearson Education. Budge, S. (2006). Peer mentoring in postsecondary education: Implications for research and practice. Journal of College reading and learning, 37(1), 71-85.
Recommended:	
Other references:	Additional material uploaded to the Moodle system

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Biomatics and Applied Artificial Intelligence Institute			Semester 3. of the curriculum 2024-25-1			
Name of the subject:	Code of the subject:	Credits:	Weekly hours:			
				lec	sem	lab
Tutoring	NBXTU1EBNF	4	full-time	0	2	0
Responsible person for the subject: Prof. Dr. Kornélia LAZÁNYI			Classification: professor			
Subject lecturer(s):						
Prerequisites:	NBXTPLEBNF	Tutoring preparation and project documentation techniques				
Way of the assessment:	mid-term grade					

Course description	
Goal:	The purpose of the subject is to deepen the professional knowledge of senior students in certain subjects of their choice by summarizing and delivering the course material, and to support first-year students through tutoring with professional knowledge, relevant information related to university life and through social support.
Course description:	The practical application of the tools learned in the Preparation for tutoring and project documentation techniques course takes place in the Tutoring course. The students, helping their younger peers, apply the acquired pedagogical and tutoring knowledge in practice. They recognize students in need of special support and initiate the involvement of professionals. They support their peers not only in learning, but also in acquiring the knowledge necessary for their university citizenship. While introducing the tutored students to the student life of the institution, imparting practical knowledge and useful information related to studies and opportunities, the tutors develop their communication, conflict management and analytical thinking skills, and they get to know the legal background and techniques for handling sensitive data in practice too.

Lecture schedule	
Education week	Topic
1.	Half-term meeting, commitments, schedule
2.	Tutoring 1- Contact
3.	Information about university opportunities
4.	Tutoring 2 - Identification of learning style, formulation of objectives
5.	Methods suitable for different learning styles
6.	Tutoring 3 – Creation of a timetable
7.	Report
8.	Tutoring 4– professional suppor
9.	Tutoring 5 – professional suppor
10.	Tutoring 6 – professional suppor
11.	Career plans, tasks
12.	Tutoring 7 – professional/social support
13.	Self-evaluation
14.	Report

Mid-term requirements	
Conditions for obtaining a mid-term grade/signature	Completion of the two quarterly reports with a minimum of 50% each.

Assessment schedule	
Education week	Topic

7	Report on contact and aims
14	Report on results

Method used to calculate the *mid-term grade* (to be filled out only for subjects with mid-term grades)
The grade is determined based on the total score obtained on the two reports.
Type of the replacement

Type of the replacement of written test/mid-term grade/signature	It is possible to make up for the insufficient reports in the first 10 days of the exam period, in the framework of a midterm mark retake exam, where students can present their missing or inadequate reports separately, or even both together.

Type of the exam (to be filled out only for subjects with exams)
Calculation of the exam mark (to be filled only for subjects with exams)
Final grade calculation methods:
0-59 points - insufficient 60-69 points - sufficient 70-79 points - average 80-89 points - good 90-100 point - excellent
References

Obligatory:	Rabow, Jerome, Tiffani Chin, and Nima Fahimian. Tutoring matters: Everything you always wanted to know about how to tutor. Temple University Press, 1999. Fazlioglu, M. (2019). Beyond the Nature of Data: Obstacles to Protecting Sensitive Information in the European Union and the United States. Fordham Urb. LJ, 46, 271. Shea Correll, M. (2005). Peer mentoring: An intrusive approach. Essays in Education, 14(1), 6. Trautman, S. (2006). Teach what you know: A practical leader's guide to knowledge transfer using peer mentoring. Pearson Education. Budge, S. (2006). Peer mentoring in postsecondary education: Implications for research and practice. Journal of College reading and learning, 37(1), 71-85.
Recommended:	Nelson, K., & Creagh, T. (2012). Good practice for safeguarding student learning engagement in higher education institutions: Final Report 2012.
Other references:	Additional material uploaded to the Moodle system

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Software Engineering Institute			Semester 1. of the curriculum 2023-24-1			
Name of the subject:	Code of the subject:	Credits:	Weekly hours:			
				lec	sem	lab
Problemsolving using programming	NSXPP1EBNF	6	full-time	1	0	3
Responsible person for the subject: Dr. Szabolcs SERGYÁN			Classification: associate professor			
Subject lecturer(s):						
Prerequisites:						
Way of the assessment:	mid-term grade					

Course description	
Goal:	
Course description:	

Lecture schedule	
Education week	Topic
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Mid-term requirements	
Conditions for obtaining a mid-term grade/signature	

Assessment schedule	
Education week	Topic

Method used to calculate the *mid-term grade* (to be filled out only for subjects with mid-term grades)

Type of the replacement	
Type of the replacement of written test/mid-term grade/signature	

Type of the exam (to be filled out only for subjects with exams)

Calculation of the exam mark (to be filled only for subjects with exams)	
Final grade calculation methods:	
References	
Obligatory:	Rabow, Jerome, Tiffani Chin, and Nima Fahimian. Tutoring matters: Everything you always wanted to know about how to tutor. Temple University Press, 1999. Shea Correll, M. (2005). Peer mentoring: An intrusive approach. Essays in Education, 14(1), 6. Trautman, S. (2006). Teach what you know: A practical leader's guide to knowledge transfer using peer mentoring. Pearson Education. Budge, S. (2006). Peer mentoring in postsecondary education: Implications for research and practice. Journal of College reading and learning, 37(1), 71-85.
Recommended:	
Other references:	

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Software Engineering Institute			Semester 2. of the curriculum 2023-24-2			
Name of the subject:	Code of the subject:	Credits:	Weekly hours:			
				lec	sem	lab
Basics of Software Development	NSXSFAEBNF	6	full-time	2	0	3
Responsible person for the subject: Dr. VÁMOSSY Zoltán			Classification: associate professor			
Subject lecturer(s):						
Prerequisites:	NSXPP1EBNF	Problemsolving using programming				
Way of the assessment:	exam					

Course description	
Goal:	
Course description:	

Lecture schedule	
Education week	Topic
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Mid-term requirements	
Conditions for obtaining a mid-term grade/signature	

Assessment schedule	
Education week	Topic

Method used to calculate the *mid-term grade* (to be filled out only for subjects with mid-term grades)

Type of the replacement	
Type of the replacement of written test/mid-term grade/signature	

Type of the exam (to be filled out only for subjects with exams)

Calculation of the exam mark (to be filled only for subjects with exams)	
Final grade calculation methods:	
References	
Obligatory:	
Recommended:	
Other references:	

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Institute of Cyberphysical Systems			Semester 2. of the curriculum 2023-24-2			
Name of the subject:	Code of the subject:	Credits:	Weekly hours:			
				lec	sem	lab
Databases	NKXAB1EBNF	5	full-time	2	0	2
Responsible person for the subject: Dr. FLEINER Rita			Classification: associate professor			
Subject lecturer(s):						
Prerequisites:	NSXPP1EBNF	Problemsolving using programming				
Way of the assessment:	mid-term grade					

Course description	
Goal:	Lecture: In the framework of the subject, students get acquainted with the theoretical foundations and implementation of database management systems, the database design process, and modern data management methods. Lab: The aim of the training is to apply the theory of relational database management systems in practice, and to introduce SQL through the use of a specific client-server type database management system (Oracle 12g).
Course description:	Lecture: Basic concepts of relational database management. Data modelling. ER diagram. Theory and use of the relational model. Anomalies. Normalisation, normal forms, 1NF, 2NF, 3NF, BCNF. Database design. Operations in relational algebra. SQL language, DDL, DML, DCL. Structure and use of indexes. Database architectures. Database management system architecture. Query processing flow. Database optimisation. Transaction management, logging. Laboratory: Basic concepts of relational database design (relations, relational operations), Normalization (0NF, 1NF, 2NF, 3NF), database anomalies. Queries using SQL SELECT statement, join tables, subqueries. DML instructions, database transactions. DDL statements, table creation, data types, constraints, view tables, top-N analysis. Authorization management, DCL instructions. Analytical functions in Oracle12gR2.

Lecture schedule	
Education week	Topic
1.	Lec: Introduction to the world of databases Lab: Introduction to Oracle 12c, Simple SQL queries (SELECT, WHERE, ORDER BY statements)
2.	Lec: Data modelling, Single-relationship data model. Lab: Multi-table queries
3.	Lec: Single-relation data model rewriting to relational model. Lab: Multi-table queries. Hierarchical queries.
4.	Lec: Normal forms, dependencies, decomposition of relations. Lab: DDL, constraints.
5.	Lec: Relational algebra, relational data model. Lab: DML, views.
6.	Lec: Relational algebra expressions and practice. Lab: Exercise DDL and DML statements through exercises.
7.	Lec: Database management system architecture. Lab: Group functions (GROUP BY, HAVING statement parts).
8.	Lec: Data storage, file organisation, indexes. Lab: Subqueries
9.	Lec: Query processing, query optimisation. Lab: subqueries
10.	Lec: Transaction handling. Lab: PL/SQL basics, triggers.
11.	Lec: Advanced SQL topics. Lab: PL/SQL basics, triggers.
12.	Lec: Advanced SQL topics. Lab:. Database administration skills. Transaction management
13.	Lec: Lecture test Lab: Lab test.
14.	Lec: Replacement Lecture test Lab: Replacement Lab test

Mid-term requirements	
Conditions for obtaining a mid-term grade/signature	Pass at least 51% of the lecture test, lab test and database design test

Assessment schedule	
Education week	Topic
5	Database design task test
13	Theoretical test from the lecture material. Lab test from the labs materials.
14	Replacement of theoretical test from the lecture material. Replacement of the lab test from the labs. Replacement of the database design exercise test.

Method used to calculate the *mid-term grade* (to be filled out only for subjects with mid-term grades)
The mid-year grade is determined by the sum of the points earned on the lecture test, the lab test egy the database design test.

Type of the replacement	
Type of the replacement of written test/mid-term grade/signature	At week 14, all tests can be replaced. A minimum of 51% must be achieved in each test to pass.

Type of the exam (to be filled out only for subjects with exams)

Calculation of the exam mark (to be filled only for subjects with exams)

Final grade calculation methods:
0% - 51% - insufficient (1) 52% - 65% - fair (2) 66% - 75% - average (3) 76% - 87% - good (4) 88%- 100%- excellent (5)

References	
Obligatory:	Jeffrey D. Ullman; Jennifer Widom: Adatbázisrendszerek – Alapvetés (2. kiadás), Panem, 2009. Budapest, ISBN: 9635454815 Elmasri, R., Navathe, S. B.:Fundamentals of Database Systems 7th Edition, ISBN: 978-0133970777 Kende M., Nagy I.: Oracle-példatár (SQL, PL/SQL). Panem, Budapest, 2005, ISBN 963 545 436 8
Recommended:	
Other references:	The slides used in the lecture will be available on the course website at https://elearning.uni-obuda.hu/ after the lecture.

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Institute of Cyberphysical Systems			Semester 2. of the curriculum 2023-24-2			
Name of the subject:	Code of the subject:	Credits:	Weekly hours:			
				lec	sem	lab
Electronics	NKXEL1EBNF	5	full-time	2	0	2
Responsible person for the subject: Dr. Henrietta KOMORÓCKI-STEINER			Classification: associate professor			
Subject lecturer(s):						
Prerequisites:	NKXEAIEBNF	Electronics Basic				
Way of the assessment:	mid-term grade					

Course description	
Goal:	In this course, students will learn the essential tools and areas of analogue signal processing, the theoretical operation, properties and typical applications of essential electronic components. They will gain insight into computer-aided electronic design and learn the basics of metrology.
Course description:	The course provides insight into the application of passive and active components. The students will build filters and measure using passive components followed by active ones. Their construction and operation are listed, as well as the simpler circuits that can be built from them. Ideal and real operational amplifiers are then discussed: their parameters and primary connections are described. These functions will be simulated and measured and made into a programming task. Then we will prepare application exercises: filters, diodes, transistors, and amplifiers. These will be mainly measurement and programming tasks.

Lecture schedule	
Education week	Topic
1.	Combining passive components: how filters work
2.	Operation, characteristics and modes of operation of primary electronic circuit devices: the diode
3.	Operation, characteristics and modes of operation of primary electronic circuit devices: the transistor
4.	Operation, characteristics and modes of operation of primary electronic circuit devices: transistor basic circuits
5.	Transistor switching mode: switching mode of a bipolar transistor.
6.	Construction and operation of the MOS transistor, switching mode of the MOS transistor.
7.	Basic concepts of analogue signal amplification, operational amplifier (ME), concept of ideal ME, and characteristics.
8.	Essential characteristics of ideal operational amplifiers, simulation studies of electronic circuits and the principles of feedback
9.	Basic operational amplifier circuits
10.	Essential characteristics of real operational amplifiers, frequency dependence, frequency compensation and typical nonlinear applications of operational amplifiers
11.	Complex application problems and related computational problems 1: Filters, diodes and transistors in practice

12.	Complex application tasks and related computational exercises 2: The role of operational amplifiers and how to complete the online test
13.	Laboratory final exam and Theoretical final exam
14.	Replacement: final exam and Theoretical final exam

Mid-term requirements	
Conditions for obtaining a mid-term grade/signature	During the semester, students' performance is determined on the basis of the small practical exams, the online Test, the theoretical and practical big exams. To obtain a mark, the aggregate results of the practical small exams, the practical big exams, the theoretical big exams, the practical big exams and the practical big exams are taken into account. must be at least at the satisfactory level, i.e. separately 60%, and the online test must be at least 80% and the aggregate laboratory performance must be acceptable.

Assessment schedule	
Education week	Topic
11	Small exam
12	Completion of online test
13	Laboratory final exam and Theoretical final exam

Method used to calculate the *mid-term grade* (to be filled out only for subjects with mid-term grades)
Method for determining the end-of-semester grade (E) All rates (small exams, large (final) exams, online tests) will be expressed as a percentage. Method of calculating the grade (if all other conditions): MARK= (Lab major exam % + Theoretical major exam %) / 2 [%] (each of the two exams separately must reach 60%)

Type of the replacement	
Type of the replacement of written test/mid-term grade/signature	The students can make up one small exam during the semester in week 11. The two final exams (the final laboratory exam and the final theoretical exam) are required to obtain the mid-term grade. The students can make up in week 14. All parts must be made up in the signature makeup examination: - Presentation of the completed worksheets (from week 1 to week 12). - Small exam questions - Lab final exam - Theoretical final

Type of the exam (to be filled out only for subjects with exams)

Calculation of the exam mark (to be filled only for subjects with exams)
Point thresholds for each merit grade: 0% - 59%: unsatisfactory (1) 60% - 69%: satisfactory (2) 70% - 79%: average (3) 80% - 89%: good (4) 90% - 100%: excellent (5)

Final grade calculation methods:	
References	
Obligatory:	Boysen Earl: Complete Electronics Self-teaching Guide with Projects John Wiley & Sons Inc, 2012 Charles Platt: Make: Electronics: Learning by Discovery: A hands-on primer for the new electronics enthusiast Make Community LLC 2021 Charles Platt: Make: MORE Electronics: Learning by Discovery: Journey Deep Into the World of Logic Chips, Amplifiers, Sensors, and Randomicity Make Community LLC 2021
Recommended:	
Other references:	

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JOHN VON NEUMANN FACULTY OF INFORMATICS

Software Engineering Institute			Semester 3. of the curriculum 2024-25-1			
Name of the subject:	Code of the subject:	Credits:	Weekly hours:			
				lec	sem	lab
Algorithms and data structures *	NSXAA1EBNF	5	full-time	3	0	2
Responsible person for the subject: Prof. Dr. Sándor SZÉNÁSI			Classification: professor			
Subject lecturer(s):						
Prerequisites:	NSXSFAEBNF	Basics of Software Development				
Way of the assessment:	exam					

Course description	
Goal:	The aim of the course is to introduce the basic data structures, their implementation and basic use cases. In addition, students will be introduced to the basic strategies and programming paradigms used in general problem solving and optimization.
Course description:	The course introduces the basic operations of data structures (list, queue, stack, set, dictionary) and their use cases. It then discusses the commonly used possible implementations (arrays, ordered arrays, linked lists, binary search trees, hash tables). It then introduces special-purpose data structures (graphs, B-trees, heaps) and additional graph algorithms (shortest path search, spanning tree search, topological ordering). Students will be introduced to the basic strategies that can be used to solve general and optimization problems (brute force method, divide and conquer, memoization method, dynamic programming, greedy algorithms, backtracking, branch and bound). Finally, they gain insights into the world of functional and logic programming.

Lecture schedule	
Education week	Topic
1.	Generic types. List, queue, stack, set, dictionary operations. Implementation using array and ordered array.
2.	Linked list structure and operations. Implementation of queue, stack.
3.	Binary search tree structure and operations. Set implementation.
4.	Construction and operations of heap. Priority queue implementation. Heap-sort.
5.	B-tree structure and operations.
6.	Hash functions. Structure and operations of hash table. Dictionary implementation.
7.	Graph structure and basic operations (Breadth-First Search, Depth-First Search, topological ordering).
8.	Operations with weighted graphs (finding shortest paths, finding minimum spanning tree).
9.	Brute force method. Divide and conquer strategy. Memoization method. Dynamic programming.
10.	Design and use of greedy algorithms.
11.	Backtracking. Branch and bound method.
12.	Basics of functional programming.
13.	Fundamentals of logic programming.
14.	Consultation
Mid-term requirements	

Conditions for obtaining a mid-term grade/signature	In the labs, students will be given tasks to independently solve, the solutions of which must be uploaded to Moodle by the given deadline. Failure to do so/uploading unacceptable solutions will be considered as absence from class. During the semester, students will write two examinations outside of class (expected in weeks 7 and 13). These examinations are compulsory. A signature will be given to students who have passed both final exams with at least satisfactory level.

Assessment schedule

Education week	Topic
7.	Implementation of basic data structures.
13.	Using problem solving methods in practice.
14.	Replacement of an exam.

Method used to calculate the *mid-term grade* (to be filled out only for subjects with mid-term grades)

Type of the replacement

Type of the replacement of written test/mid-term grade/signature	If the student has not written or has not reached the satisfactory level in one of the examinations, he/she may write a replacement exam from the given topic in the last week. The result of this test replaces the result of the missing/original test. If the student has failed to write both exams or has not achieved a satisfactory level in either, he/she may only obtain a signature on the signature replacement exam announced during the examination period. The minimum level required to obtain a signature in the signature replacement exam is satisfactory.

Type of the exam (to be filled out only for subjects with exams)

The exam consists of two parts: in the first, written part, the student must achieve at least satisfactory level, if this is not met, he/she will receive a fail mark. The second oral examination is open to students who have achieved at least a pass mark in the written examination of the day.

Calculation of the exam mark (to be filled only for subjects with exams)

A student who has obtained at least a satisfactory result in both the written and oral examinations may obtain a mark other than failed. The mid-year performance (average of the two tests) is weighted 25%, the writen exam result 25% and the oral exam result 50% in the calculation of the final exam mark.

Final grade calculation methods:

0%-49%: failed
50%-61%: satisfactory
62%-73%: average
74%-85%: good
86%-100%: excellent

References

Obligatory:	Lecture slides available in the Moodle system.
Recommended:	T.H. Cormen, C.E. Leiserson, R. L. Rivest, C. Stein: Introduction to Algorithms, MIT Press, 2022
Other references:	

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Software Engineering Institute			Semester 3. of the curriculum 2024-25-1			
Name of the subject:	Code of the subject:	Credits:	Weekly hours:			
				lec	sem	lab
Advanced software development *	NSXHSFEBNF	4	full-time	2	0	2
Responsible person for the subject: Dr. Zoltán VÁMOSSY			Classification: associate professor			
Subject lecturer(s):						
Prerequisites:	NSXSFAEBNF	Basics of Software Development				
Way of the assessment:	mid-term grade					

Course description	
Goal:	
Course description:	

Lecture schedule	
Education week	Topic
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Mid-term requirements	
Conditions for obtaining a mid-term grade/signature	

Assessment schedule	
Education week	Topic

Method used to calculate the *mid-term grade* (to be filled out only for subjects with mid-term grades)

Type of the replacement	
Type of the replacement of written test/mid-term grade/signature	

Type of the exam (to be filled out only for subjects with exams)

Calculation of the exam mark (to be filled only for subjects with exams)	
Final grade calculation methods:	
References	
Obligatory:	
Recommended:	
Other references:	

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Institute of Cyberphysical Systems			Semester 3. of the curriculum 2024-25-1			
Name of the subject:	Code of the subject:	Credits:	Weekly hours:			
				lec	sem	lab
Digital systems	NKXDR1EBNF	4	full-time	2	0	2
Responsible person for the subject: Dr. Henrietta KOMORÓCKI-STEINER			Classification: associate professor			
Subject lecturer(s):						
Prerequisites:	NKXEL1EBNF	Electronics				
Way of the assessment:	mid-term grade					

Course description	
Goal:	The course aims to familiarize students with the basic knowledge of digital electronics required for a technical computer scientist, essential building blocks of digital systems, the development trends of logic families, the application issues of logic families and the building blocks that can be used for the programmed implementation of complex functions. In the course, students will learn about the theoretical operation of digital systems (logic networks), the basic methods of their description, the operation of logic networks through examples, insights into the design of logic networks, and computer simulation methods through problem-solving and demonstrations. The objective of the course is to familiarise students with the basic knowledge of digital electronics required for the computer engineer, essential building blocks of digital systems, the development trends of logic families, the application issues of logic families and the building blocks that can be used for the programmed implementation of complex functions.
Course description:	After the concept of logic circuits and their theoretical operation, we discuss the basic types of logic circuits and their description options. After the basics of Boolean algebra, we introduce the universal logic functions and the building blocks that implement them. The student will then be able to design and study combinatorial networks. To do this, they will learn the basics of systematic design methods, the essential tools and the most critical methods of analysis. They will be aware of the characteristics of ideal and actual building blocks and the difference between them. The introduction to the basic types of serial networks will include a discussion of their description methods and building blocks. Then the design and study of asynchronous networks: the student will be able to design and simulate single and multi-output logic circuits using electronic CAD software and to design, implement, test and document complex digital circuits using FPGA circuits. Other tasks include generating downloadable files, online downloading, testing, debugging, and documentation.

Lecture schedule	
Education week	Topic
1.	Basics of Boolean algebra
2.	Description methods for combinatorial networks
3.	Ideal and real building blocks, characteristics of real building blocks
4.	Sequence networks

5.	Design and analysis of synchronous networks
6.	Typical synchronous networks
7.	Application of logic families: the diode
8.	General characteristics of logic circuits: the transistor
9.	The finite state machine: elements of the CPU
10.	The finite state machine: steps to implement a CPU
11.	Computer-aided design simulation, CAD operation and mathematical principles
12.	Complex application tasks and related computational tasks and completion of the online test
13.	Laboratory final exam and Theoretical final exam
14.	Replacement: final exam and Theoretical final exam

Mid-term requirements	
Conditions for obtaining a mid-term grade/signature	During the semester, students' performance is determined on the basis of the small practical exams, the online Test, the theoretical and practical big exams. To obtain a mark, the aggregate results of the practical small exams, the practical big exams, the theoretical big exams, the practical big exams and the practical big exams are taken into account. must be at least at the satisfactory level, i.e. separately 60%, and the online test must be at least 80% and the aggregate laboratory performance must be acceptable.

Assessment schedule

Education week	Topic
11	Small exam
12	Completion of online test
13	Laboratory final exam and Theoretical final exam

Method used to calculate the *mid-term grade* (to be filled out only for subjects with mid-term grades)

Method for determining the end-of-semester grade (E)
All rates (small exams, large (final) exams, online tests) will be expressed as a percentage.
Method of calculating the grade (if all other conditions):
MARK= (Lab major exam % + Theoretical major exam %) / 2 [%]
(each of the two exams separately must reach 60%)

Type of the replacement	
Type of the replacement of written test/mid-term grade/signature	The students can make up one small exam during the semester in week 11. The two final exams (the final laboratory exam and the final theoretical exam) are required to obtain the mid-term grade. The students can make up in week 14. All parts must be made up in the signature makeup examination: - Presentation of the completed worksheets (from week 1 to week 12). - Small exam questions - Lab final exam - Theoretical final

Type of the exam (to be filled out only for subjects with exams)

Calculation of the exam mark (to be filled only for subjects with exams)
Final grade calculation methods:
0% - 59%: unsatisfactory (1) 60% - 69%: satisfactory (2) 70% - 79%: average (3) 80% - 89%: good (4) 90% - 100%: excellent (5)

References	
Obligatory:	Ronald Tocci , Neal Widmer , Gregory Moss: Digital systems Pearson Education 2017 Floyd, Thomas L: Digital Fundamentals Pearson Education 2021 Axelevitch Alexander: Digital Electronic Circuits - The Comprehensive ViewWorld Scientific Pub Co Inc 2018
Recommended:	
Other references:	

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Institute of Cyberphysical Systems			Semester 3. of the curriculum 2024-25-1			
Name of the subject:	Code of the subject:	Credits:	Weekly hours:			
				lec	sem	lab
Computer Networks	NKXSH1EBNF	4	full-time	2	0	2
Responsible person for the subject: Dr. Eszter Balázsné KAIL			Classification: senior lecturer			
Subject lecturer(s):						
Prerequisites:						
Way of the assessment:	exam					

Course description	
Goal:	The aim of the course is to introduce students to network technologies, to familiarize them with the basic characteristics and uses of network devices and transmission media that form the basis of IT systems.
Course description:	An overview of networks from their inception to the emergence and spread of modern networking trends. The student will gain insight into the basic design and operating principles, the use of technical language, and the design and implementation processes. They will learn about the architecture of the models that make up a system, how they evolved and how they are used, and the essential roles of the different parts of these models in early and current systems. Other aspects of these networks, such as the role of network storage and network security, will also be mentioned, laying the foundations for the knowledge to be acquired later. The main topics of the course are: the reasons for the emergence of networks, the evolution and structure of reference models, the principles of model layering, the main standards, addressing schemes, data transmission methods, data representation schemes, modern technological trends.

Lecture schedule	
Education week	Topic
1.	Lec: Introduction to Requirements, Development and evolution of networks LAB: Introduction to the requirements framework, introduction to network basics
2.	Lec: Network standards, standard organisations, models LAB: Traffic analysis using WireShark
3.	Lec: Physical components and properties of networks LAB: Cisco IOS management in a command line interface
4.	Lec: Switching processes, how they work in a local area network LAB: Managing switches and virtual LANs
5.	Lec:Addressing schemes LAB: Subnetting, using variable length subnet masks (VLSM)
6.	Lec: Routing principles for internal and external networks LAB: Static routing
7.	Lec: Transport layer protocols LAB: Configuring default and floating static routes
8.	Lec: Structure and operation of the Internet and its services LAB: Configuring up dynamic routing
9.	Lec: Emergence and evolution of network security LAB: Setting up DHCP
10.	Lec: Brief introduction to network storage systems LAB: Setting up network address translation systems (NAT, PAT)
11.	Lec: Emerging trends in networking (IPv6, IoT devices) LAB: Creating Access Control Lists (ACL)
12.	Lec: Network design and implementation principles at SME level LAB: Server service simulation options

13.	Laboratory exam
14.	Laboratory exam replacement
Mid-term requirements	
Conditions for obtaining a mid-term grade/signature	The student will write a final test in week 13 during lab time. This test can be replaced in week 14. A signature is given for a successful final test.
Assessment schedule	
Education week	Topic
13	Laboratory exam
14	Laboratory exam replacement
Method used to calculate the *mid-term grade* (to be filled out only for subjects with mid-term grades)	
Type of the replacement	
Type of the replacement of written test/mid-term grade/signature	The final test can be replaced during the first two weeks of the exam period.
Type of the exam (to be filled out only for subjects with exams)	
Written exam on the material presented in the lectures.	
Calculation of the exam mark (to be filled only for subjects with exams)	
The exam mark is calculated on the basis of the performance in the laboratory exam and the result of the written exam using the following formula: Exam mark = 0.7 * Laboratory exam result (%) + 0.3 * Written Exam result (%) In both exams, the student must achieve at least a satisfactory result (50%) for the examination to be valid.	
Final grade calculation methods:	
0% - 49%: unsatisfactory (1) 50% - 61%: satisfactory (2) 62% - 73%: average (3) 74% - 85%: good (4) 86% - 100%: excellent (5)	
References	
Obligatory:	Lecture slides available at at https://elearning.uni-obuda.hu/
Recommended:	Douglas, E. Comer. „Computer networks and Internets” (2009). ISBN: 978-0-13-606127-4 Andrew, S. Tanenbaum. „Computer Networks” (2003). ISBN: 978-0-13-349945-2 Wendell Odom: CCNA Routing and Switching 200-125 Official Cert Guide Library, Pearson Education, 2016, ISBN: 1587205815
Other references:	

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Software Engineering Institute			Semester 4. of the curriculum 2024-25-2			
Name of the subject:	Code of the subject:	Credits:	Weekly hours:			
				lec	sem	lab
Full-stack development *	NSXFSSEBNF	5	full-time	2	0	2
Responsible person for the subject: Dr. Zoltán VÁMOSSY			Classification: associate professor			
Subject lecturer(s):						
Prerequisites:	NSXHSFEBNF	Advanced software development *				
Way of the assessment:	mid-term grade					

Course description	
Goal:	
Course description:	

Lecture schedule	
Education week	Topic
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Mid-term requirements	
Conditions for obtaining a mid-term grade/signature	

Assessment schedule	
Education week	Topic

Method used to calculate the *mid-term grade* (to be filled out only for subjects with mid-term grades)

Type of the replacement	
Type of the replacement of written test/mid-term grade/signature	

Type of the exam (to be filled out only for subjects with exams)

Calculation of the exam mark (to be filled only for subjects with exams)	
Final grade calculation methods:	
References	
Obligatory:	
Recommended:	
Other references:	

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Software Engineering Institute			Semester 4. of the curriculum 2024-25-2			
Name of the subject:	Code of the subject:	Credits:	Weekly hours:			
				lec	sem	lab
Softwaretechnology	NSXST1EBNF	4	full-time	2	0	0
Responsible person for the subject: Dr. Zoltán VÁMOSSY			Classification: associate professor			
Subject lecturer(s):						
Prerequisites:	NSXSFAEBNF	Basics of Software Development				
Way of the assessment:	exam					

Course description	
Goal:	
Course description:	

Lecture schedule	
Education week	Topic
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Mid-term requirements	
Conditions for obtaining a mid-term grade/signature	

Assessment schedule	
Education week	Topic

Method used to calculate the *mid-term grade* (to be filled out only for subjects with mid-term grades)

Type of the replacement	
Type of the replacement of written test/mid-term grade/signature	

Type of the exam (to be filled out only for subjects with exams)

Calculation of the exam mark (to be filled only for subjects with exams)	
Final grade calculation methods:	
References	
Obligatory:	
Recommended:	
Other references:	

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Biomatics and Applied Artificial Intelligence Institute			Semester 4. of the curriculum 2024-25-2			
Name of the subject:	Code of the subject:	Credits:	Weekly hours:			
				lec	sem	lab
System theory	NBXRE1EBNF	4	full-time	2	1	0
Responsible person for the subject: Prof. Dr. Levente KOVÁCS			Classification: professor			
Subject lecturer(s):						
Prerequisites:	NMXAN2EBNF	Calculus II.				
Way of the assessment:	exam					

Course description	
Goal:	
Course description:	

Lecture schedule	
Education week	Topic
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Mid-term requirements	
Conditions for obtaining a mid-term grade/signature	

Assessment schedule	
Education week	Topic

Method used to calculate the *mid-term grade* (to be filled out only for subjects with mid-term grades)

Type of the replacement	
Type of the replacement of written test/mid-term grade/signature	

Type of the exam (to be filled out only for subjects with exams)

Calculation of the exam mark (to be filled only for subjects with exams)	
Final grade calculation methods:	
References	
Obligatory:	
Recommended:	
Other references:	

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Software Engineering Institute			Semester 4. of the curriculum 2024-25-2			
Name of the subject:	Code of the subject:	Credits:	Weekly hours:			
				lec	sem	lab
Artificial intelligence *	NSXMI1EBNF	5	full-time	2	0	2
Responsible person for the subject: Dr. Gábor KERTÉSZ			Classification: associate professor			
Subject lecturer(s):						
Prerequisites:	NSXAA1EBNF	Algorithms and data structures *				
Way of the assessment:	mid-term grade					

Course description	
Goal:	
Course description:	

Lecture schedule	
Education week	Topic
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Mid-term requirements	
Conditions for obtaining a mid-term grade/signature	

Assessment schedule	
Education week	Topic

Method used to calculate the *mid-term grade* (to be filled out only for subjects with mid-term grades)

Type of the replacement	
Type of the replacement of written test/mid-term grade/signature	

Type of the exam (to be filled out only for subjects with exams)

Calculation of the exam mark (to be filled only for subjects with exams)	
Final grade calculation methods:	
References	
Obligatory:	
Recommended:	
Other references:	

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Institute of Cyberphysical Systems			Semester 4. of the curriculum 2024-25-2			
Name of the subject:	Code of the subject:	Credits:	Weekly hours:			
				lec	sem	lab
Operating systems *	NKXOR1EBNF	5	full-time	2	0	3
Responsible person for the subject: Dr. habil. Róbert LOVAS			Classification: associate professor			
Subject lecturer(s):						
Prerequisites:	NKXSH1EBNF	Computer Networks				
Way of the assessment:	exam					

Course description	
Goal:	The course aims to familiarize students with operating systems' theory, development, and tasks, contemporary modern operating systems, and related technologies. In addition, the lab part aims to gain experience in managing client and server operating systems in the case of command-line and graphical interface systems in parallel with the review of theoretical operation and to learn and practice engineering processes in this topic by designing, implementing, testing and documenting a self-installed system.
Course description:	During the lectures, students will get acquainted with the main tasks of operating systems, the development of components that implement specific tasks, and the solutions used in currently widespread operating systems (Windows, Unix versions, Linux). Topics: History of Operating Systems, Architecture of major OSs. Main functions of OSs (purpose, design space, with real-world examples): processes and threads, scheduling, memory management, I/O management – including especially file management and file systems, and Virtualization from an Operating System perspective. During the exercises, students will review the user and administrative use of client and server operating systems, automation of system tasks, and management of server services. In addition, during the semester, they will gain experience installing, configuring, and testing systems and services by compiling their virtualized server-client architecture.

Lecture schedule	
Education week	Topic
1.	P: Introduction: purpose, concept, historical overview, development, and classification of operating systems Lab: Requirements Explained, Operating System Basics - Windows
2.	P: Overview of major operating systems (Windows, Unix, Linux) - their history, key features Lab: Operating System Basics - Linux
3.	P: Processes and threads - process management Lab: File systems and permissions
4.	P: Processes and threads - threads, options for implementing the kernel Lab: Linux script - basics
5.	P: Process and thread scheduling Lab: Linux script - control structures
6.	P: Memory management before virtual memory management is formed Lab: Linux script - text and file processing, homework consultation
7.	P: Virtual memory management, kernel memory management Lab: Server Architecture Design
8.	P: I/O management, disc management (both traditional HDDs and SSDs) Lab: Server Basics and Network Services (DNS, DHCP)

9.	P: File management, file systems Lab: Web Service
10.	P: Backups, backup methods Lab: File sharing and centralized user management, directories
11.	P: Virtualization for operating systems Lab: Communication Services, mailing
12.	P: Synchronization and communication between processes (IPC) Lab: Monitoring, homework presentation
13.	P: Operating system-level solutions for highly available systems Lab: Midterm thesis
14.	P: An overview of the structure of Windows and Linux Lab: Supplementary Midterm Thesis

Mid-term requirements	
Conditions for obtaining a mid-term grade/signature	To obtain the signature, it is necessary to achieve at least 50% results on the midterm test and with homework.

Assessment schedule	
Education week	Topic
13.	Midterm thesis – from the practical curriculum of the entire semester
14.	Supplementary midterm thesis – from the practical curriculum of the whole semester
During Exam period	Signature replacement thesis – from the practical curriculum of the entire semester

Method used to calculate the *mid-term grade* (to be filled out only for subjects with mid-term grades)

Type of the replacement	
Type of the replacement of written test/mid-term grade/signature	If the midterm thesis does not reach the 50% result or has not been written, it is possible to write a supplementary midterm thesis in week 14. If neither the midterm nor the supplementary midterm thesis reaches 50%, it is possible to write a signature replacement thesis during the exam period. It is possible to replace the semester-long task: o In the time of supplementary midterm test (week 14) with a deduction of 25 % points. o In the time of s signature replacement thesis at 50 % with a deduction of points.

Type of the exam (to be filled out only for subjects with exams)

Written

Calculation of the exam mark (to be filled only for subjects with exams)

To complete the course, it is necessary to achieve at least 50% results on the midterm test, with homework, and the exam separately. The sum of the points gained will form the final grade.
The maximum points:
Midterm thesis: 10
Homework: 30
Exam: 70

Final grade calculation methods:

Achieved points / Grade
91 – 110 / excellent (5)
81 – 90 / good (4)
71 – 80 / average (3)
50 – 70 / satisfactory (2)

Below 50 / failed (1)	
References	
Obligatory:	WILLIAM STALLINGS: Operating Systems: Internals and Design Principles, 9th ed, ISBN: 9352866711
Recommended:	P. Yosifovich, M. Russinovich, A. Ionescu, D. Solomon: Windows Internals: System architecture, processes, threads, memory management, and more, 7th ed, ISBN: 9780735684188 Kaiwan N Billimoria: Linux Kernel Programming: A comprehensive guide to kernel internals, writing kernel modules, and kernel synchronization, ISBN: 178995343X
Other references:	

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Biomatics and Applied Artificial Intelligence Institute			Semester 4. of the curriculum 2024-25-2			
Name of the subject:	Code of the subject:	Credits:	Weekly hours:			
				lec	sem	lab
Comprehensive exam	NKXKSAEBNF	0	full-time	0	0	0
Responsible person for the subject: Prof. Dr. Levente KOVÁCS			Classification: professor			
Subject lecturer(s): Dr. Zoltán VÁMOSSY, Dr. Eszter Balázsné KAIL						
Prerequisites:	NSXAA1EBNF NKXDR1EBNF	Algorithms and data structures * Digital systems				
Way of the assessment:	comprehensive exam					

Course description	
Goal:	
Course description:	

Lecture schedule	
Education week	Topic
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Mid-term requirements	
Conditions for obtaining a mid-term grade/signature	

Assessment schedule	
Education week	Topic

Method used to calculate the *mid-term grade* (to be filled out only for subjects with mid-term grades)

Type of the replacement	
Type of the replacement of written test/mid-term grade/signature	

Type of the exam (to be filled out only for subjects with exams)

Calculation of the exam mark (to be filled only for subjects with exams)	
Final grade calculation methods:	
References	
Obligatory:	
Recommended:	
Other references:	

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Institute of Cyberphysical Systems			Semester 5. of the curriculum 2025-26-1			
Name of the subject:	Code of the subject:	Credits:	Weekly hours:			
				lec	sem	lab
Introduction to Computer Architectures *	NBXSS1EBNF	4	full-time	3	0	0
Responsible person for the subject: Prof. Dr. Dezső SIMA			Classification: professor emeritus			
Subject lecturer(s):						
Prerequisites:	NKXDR1EBNF	Digital systems				
Way of the assessment:	exam					

Course description	
Goal:	The aim of the course is to provide students with a deeper understanding of the internal structure and operating mechanisms of computers and processors, and to introduce them to the main concepts, cause-effect relationships and emerging trends. The course will introduce students to instruction-level architectures, the micro-architecture of traditional Neumann computers. The approach of the course is based on the design space concept and focuses on concrete implementation examples and trends.
Course description:	Topics: Computing models, architectures, ISA. Memory space and register space. Data types, operations, operand types, instruction formats, addressing modes. User-manageable state attributes. RISC, CISC architectures and main features of the most common instruction level architectures. Operation execution unit, operation execution, the principle of parallel addition and multiplication. Basics of bus system, types of buses, parallel/serial buses, main features of most important parallel and serial buses (FSB, USB, PCIe, HT, QPI). DMA, and interrupt system. The concept of DRAM, types of DRAM technologies (SDRAM, DDR memory generations). Evolution of transistor technology. Levels of parallelism that can be exploited. Flynn and modern classification of processors. Data, control and resource dependencies and their main management techniques and how to maintain sequential consistency. Conveyor belt and superscalar processors. ISA extensions (MMX, SSE, ...). Cache organization alternatives, cache coherence, trends, examples. Processor performance issues. Main areas of dissipation management. Thread level and process level parallel architectures.

Lecture schedule	
Education week	Topic
1.	Computing models, the concept of architecture, data space, register space
2.	Instruction processing thread, state space, state operations, building blocks of microprocessors
3.	Arithmetic-logic unit structure, working principle. Operation executor
4.	Floating point number representation, IEEE754 standard
5.	Bus system, I/O system, DMA
6.	Interrupt system, Memory, addressing modes,
7.	Transistor technology evolution
8.	Introduction to parallel processing, dependencies and sequential consistency
9.	Pipeline architectures, CISC-RISC architectures
10.	1st, 2nd and 3rd generation superscalars. ISA extensions. Netburst architecture
11.	Performance, dissipation and frequency constraints, thread and process level parallel architectures
12.	Alternatives for cache organisation
13.	Lecture ZH
14.	Substitution of lecture ZH

Mid-term requirements	
Conditions for obtaining a mid-term grade/signature	Pass mark of at least 51% in the ZH lecture

Assessment schedule	
Education week	Topic
13	Theoretical ZH from the lecture material
14	Replacement of the theoretical ZH from the lecture material.

Method used to calculate the *mid-term grade* (to be filled out only for subjects with mid-term grades)

Type of the replacement	
Type of the replacement of written test/mid-term grade/signature	In week 14, the ZH can be replaced. A minimum of 51% must be achieved in the ZH to pass

Type of the exam (to be filled out only for subjects with exams)

Written exam
Admission to the examination is only possible if the subjects specified as prerequisites have been passed. Students write an examination paper during the examination period in order to obtain a mark. The marking of questions is linear. Bonus marks will be awarded for a logical, clear and convincing answer to each question, and malus marks for a mosaic, confused and uncertain answer. Marks for drawings will only be awarded if their context (description of operation, example, etc.) demonstrates understanding. Successful is the examination paper,
- at least 15% of all questions have been answered, and
- at least the minimum score per paper is achieved.

Calculation of the exam mark (to be filled only for subjects with exams)

The minimum score (out of 100%):
60% with the first exam,
which increases by 6% after the first failed exam.

Final grade calculation methods:

Exam mark	First time score in %	After first failed exam, in %
pass (5)	90-100	90-100
good (4)	80-99	80-99
average (3)	70-79	70-79
fair (2)	60-69	66-69
unsatisfactory (1)	<60	<66

References

Obligatory:	Materials published on Moodle
Recommended:	• D. Sima, T. Fountain és P. Kacsuk: Advanced Computer Architectures, Addisson Wesley Longman 1997 • J. L. Hennessy és D. A. Patterson: Computer Architecture: A Quantitative Approach, Morgan Kaufmann Inc., San Mateo, 2002
Other references:	The slides used in the lecture will be available on the course website at https://elearning.uni-obuda.hu/ after the lecture.

ÓBUDA UNIVERSITY
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Biomatics and Applied Artificial Intelligence Institute			Semester 5. of the curriculum 2025-26-1			
Name of the subject:	Code of the subject:	Credits:	Weekly hours:			
				lec	sem	lab
IT security	NKXSA1EBNF	5	full-time	2	0	2
Responsible person for the subject: Dr. Valéria PÓSER			Classification: associate professor			
Subject lecturer(s):						
Prerequisites:	NKXOR1EBNF	Operating systems *				
Way of the assessment:	exam					

Course description	
Goal:	The main aim of the course is to develop a security-aware approach, to provide a comprehensive overview of IT security by introducing each area and to prepare future IT engineers to deal with IT security challenges that they will face in their future work.
Course description:	The main topics of the course are: A brief historical overview of IT security. Ethical issues, motivations, targets. security awareness, regulations. Cryptology, cryptographic algorithms and basic protocols. Vulnerability of workstations, servers, networks and infrastructures. Physical protection. Malware (malware). User authentication, privilege and access management. Operating systems password management. Password choice problems, password cracking. Network attack methods. Network perimeter protection (firewalls, IDS/IPS). PKI infrastructure. Communication security, Internet security protocols. Secure mail and data storage. Security of mobile platforms and cloud-based systems. Application vulnerability. Risk management.

Lecture schedule	
Education week	Topic
1.	LEC: Basic concepts of information security. Ethical issues. Legal regulations. LAB: Requirements. The test environment. Putting basic concepts into practice.
2.	LEC: Risk analysis, risk management. LAB: Risk management.
3.	LEC: Cryptography. Symmetric, asymmetric encryption, digital signature. LAB: Overview of risks and security measures on an example system.
4.	LEC: Overview of cryptographic algorithms. LAB: Encryption - historical basics.
5.	LEC: Password management. LAB: Encryption - server-side basics
6.	LEC: Malicious code, virus protection. LAB: Network security - border protection
7.	LEC: Network border security. LAB: Network security - DMZ, VPN
8.	LEC: Authentication, user identification. LAB: Operating Systems Security - AAA
9.	LEC: Public key infrastructure. LAB: Operating Systems Security - Group Policy
10.	LEC: Authorisation management. LAB: Exercise.
11.	LEC: Safety Application Development, Web Application Security. LAB: User Security Awareness
12.	LEC: Data protection, data backup.

	LAB: Data backup and monitoring
13.	LEC: Guest lecture. LAB: Final paper
14.	LEC: Preliminary exam. LAB: Extra Final paper

Mid-term requirements	
Conditions for obtaining a mid-term grade/signature	The conditional of signature are the successful (at least satisfactory) completion of a final paper containing practical exercises and the submission of the mid-therm assignment. Optionally, extra credit may be obtained by completing supplementary course materials and module tests. Attendance of laboratory exercises is compulsory.

Assessment schedule	
Education week	Topic
13.	Practical ZH
14.	Preliminary exam Practical ZH reetake, correction

Method used to calculate the *mid-term grade* (to be filled out only for subjects with mid-term grades)

Type of the replacement	
Type of the replacement of written test/mid-term grade/signature	Extra final paper at week 14. Substitution of the signature: once during one of the first 10 working days of the examination period.

Type of the exam (to be filled out only for subjects with exams)

Students who meet the signature requirements during the semester (even during the last week) may take a written preliminary examination at the last week.
Otherwise, they may take an oral examination during the examination period.

Calculation of the exam mark (to be filled only for subjects with exams)

The exam mark is determined on the basis of the oral exam result or the written pre-exam mark and the performance of the mid-semester practicals (ZH, assignment, optional supplementary material test results).

Final grade calculation methods:

0% - 49%: fail (1)
50% - 61%: pass (2)
62% - 73%: satisfactory (3)
74% - 85%: good (4)
86% - 100%: excellent (5)

References	
Obligatory:	Class materials published in Moodle.
Recommended:	• Mark S. Merkow Jim Breithaupt: Information Security: Principles and Practices, Second Edition, Pearson Education, 2014 (electronic note) • Howard M.: "A tutorial on linear and differential cryptanalysis." Cryptologia 26.3, 189-221, 2002 (electronic note)
Other references:	

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Software Engineering Institute			Semester 5. of the curriculum 2025-26-1			
Name of the subject:	Code of the subject:	Credits:	Weekly hours:			
				lec	sem	lab
Mobile programming *	NBXIB1EBNF	4	full-time	1	0	2
Responsible person for the subject: Dr. Gabriella SIMON-NAGY			Classification: senior lecturer			
Subject lecturer(s):						
Prerequisites:	NSXFSSEBNF	Full-stack development *				
Way of the assessment:	mid-term grade					

Course description	
Goal:	The goal of the subject is the introduction of mobile application development using .NET MAUI, and also show other alternatives (Android, iOS, other cross-platform technologies).
Course description:	.NET MAUI architecture overview, building and executing a mobile application in emulator.Creating a UI with XAML. Model-View-ViewModel design pattern, data binding, commands, dependency injection.Navigation between pages. Accessing platform functions (e.g. location, sensor data, networking). Accessing data over the network, local data storage options. Android, iOS, other cross-platform technologies.

Lecture schedule	
Education week	Topic
1.	.NET MAUI architecture, project structure, creating simple apps
2.	GUI design and implementation using XAML
3.	Project structure based on MVVM design pattern
4.	Data binding
5.	Using Commands
6.	Dependency injection
7.	Local data storage on mobile devices
8.	Accessing remote data
9.	Network connection handling
10.	Location, accessing and using sensor data
11.	Mobile application testing
12.	Other cross-platform and native development options
13.	Test
14.	Test retake

Mid-term requirements	
Conditions for obtaining a mid-term grade/signature	**Students can take the lab test on week 13, retake on week 14 if necessary. There is also a small-group app development assignment that must be completed. The condition for obtaining a mid-term grade is at least 50% achievment on the test and successful completion of the assignment. Mid-term grade will be denied without a retake chance in case of more than 30% absence from labs, or any kind of cheating on the tests or the assignment.**

Assessment schedule	
Education week	Topic
13.	Test
14.	Test retake

Method used to calculate the *mid-term grade* (to be filled out only for subjects with mid-term grades)	
The mid-term grade is calculated from the test result percent: **0 - 49%: insufficient (1)** **50 - 62%: satisfactory (2)** **63 - 74%: average (3)** **75 - 86%: good (4)** **87 - 100%: excellent (5)** **In case of an unsuccessful group assignment, the mid-term grade will be insufficient (1) regardless of the test result.**	
Type of the replacement	
Type of the replacement of written test/mid-term grade/signature	**Students can retake the lab test and submit the corrected assignment on week 14 or in the exam period.**
Type of the exam (to be filled out only for subjects with exams)	
Calculation of the exam mark (to be filled only for subjects with exams)	
Final grade calculation methods:	
References	
Obligatory:	**Material published in Moodle.**
Recommended:	Michael Stonis: Enterprise Application Patterns Using .NET MAUI (e-book)
Other references:	.NET Multi-platform App UI documentation

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Institute of Cyberphysical Systems			Semester 6. of the curriculum 2025-26-2			
Name of the subject:	Code of the subject:	Credits:	Weekly hours:			
				lec	sem	lab
Modern computer architectures	NSXMP1EBNF	4	full-time	2	0	0
Responsible person for the subject: Prof. Dr. Dezső SIMA			Classification: professor emeritus			
Subject lecturer(s):						
Prerequisites:	NBXSS1EBNF	Introduction to Computer Architectures *				
Way of the assessment:	exam					

Course description	
Goal:	The lecture aims at the familiarization of students with key notions, cause-and-effect relationships and unfolding trends concerning processors. Case examples help to understand the curriculum.
Course description:	Overview of the evolution of Intel's Core 2-based client-, HEDT-, server- and mobile processors. Cornerstones of AMD's Zen family, evolution of Zen-based processor lines. Key features of the evolution of ARM's ISA, and Armv8/v9-based CPU-s. Basics of power management. Power management techniques at the circuit-, processor- and platform level. Turbo boost techniques. Evolution of the micro-architecture of mobile processors, symmetric, big.little and dynamIQ multicores. Evolution of 2-socket server processors, key issues of the implementation of server processors. Arm ISA-based client- and server processors.

Lecture schedule	
Education week	Topic
1.	Overview of Intel's Core 2 family
2.	Overview of Intel's Core 2 family
3.	Overview of AMD's Zen family
4.	Overview of AMD's Zen family
5.	Evolution of the Arm ISA and Armv8/v9-based CPU-s
6.	Evolution of the Arm ISA and Armv8/v9-based CPU-s
7.	Mid-term test
8.	Power management
9.	Power mangement
10.	Evolution of mobil processors
11.	Evolution of mobil processors
12.	Evolution of 2S processors
13.	Evolution of 2S processors
14.	Arm ISA-based client- and server processors

Mid-term requirements	
Conditions for obtaining a mid-term grade/signature	Mid-term test, exam.

Assessment schedule	
Education week	Topic
7.	Overview of Intel's Core 2 family
7.	Overview of AMD's Zen family
7.	Evolution of the Arm ISA and Armv8/v9-based CPU-s

Method used to calculate the *mid-term grade* (to be filled out only for subjects with mid-term grades)

Type of the replacement	
Type of the replacement of written test/mid-term grade/signature	Replacement of written mid-term test at an agreed time
Type of the exam (to be filled out only for subjects with exams)	
Multiple-choice or explanatory written exam	
Calculation of the exam mark (to be filled only for subjects with exams)	
Multiple-choice or explanatory written exam	
Final grade calculation methods:	
0%-49% 1 (failed) 50%-62% 2 (satisfactory) 63%-74% 3 (average) 75%-84% 4 (good) 85%-100% 5 (excellent)	
References	
Obligatory:	Electronic textbook available in the Moodle.
Recommended:	- D. Sima, T. Fountain és P. Kacsuk: Advanced Computer Architectures, Addisson Wesley Longman 1997 - J. L. Hennessy és D. A. Patterson: Computer Architecture: A Quantitative Approach, Morgan Kaufmann Inc., San Mateo, 2002
Other references:	

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Software Engineering Institute			Semester 5. of the curriculum 2025-26-1			
Name of the subject:	Code of the subject:	Credits:	Weekly hours:			
				lec	sem	lab
Project work I.	NDPPM1EBNF	4	full-time	0	0	3
Responsible person for the subject: Dr. László CSINK			Classification: associate professor			
Subject lecturer(s):						
Prerequisites:						
Way of the assessment:	mid-term grade					

Course description	
Goal:	
Course description:	

Lecture schedule	
Education week	Topic
1.	
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9.	
10.	
11.	
12.	
13.	
14.	

Mid-term requirements	
Conditions for obtaining a mid-term grade/signature	

Assessment schedule	
Education week	Topic

Method used to calculate the *mid-term grade* (to be filled out only for subjects with mid-term grades)

Type of the replacement	
Type of the replacement of written test/mid-term grade/signature	

Type of the exam (to be filled out only for subjects with exams)

Calculation of the exam mark (to be filled only for subjects with exams)	
Final grade calculation methods:	
References	
Obligatory:	
Recommended:	
Other references:	

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Software Engineering Institute			Semester 6. of the curriculum 2025-26-2			
Name of the subject:	Code of the subject:	Credits:	Weekly hours:			
				lec	sem	lab
Project work II.	NDPPM2EBNF	4	full-time	0	0	4
Responsible person for the subject: Dr. László CSINK			Classification: associate professor			
Subject lecturer(s):						
Prerequisites:						
Way of the assessment:	mid-term grade					

Course description	
Goal:	
Course description:	

Lecture schedule	
Education week	Topic
1.	
2.	
3.	
4.	
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10.	
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12.	
13.	
14.	

Mid-term requirements	
Conditions for obtaining a mid-term grade/signature	

Assessment schedule	
Education week	Topic

Method used to calculate the *mid-term grade* (to be filled out only for subjects with mid-term grades)

Type of the replacement	
Type of the replacement of written test/mid-term grade/signature	

Type of the exam (to be filled out only for subjects with exams)

Calculation of the exam mark (to be filled only for subjects with exams)	
Final grade calculation methods:	
References	
Obligatory:	
Recommended:	
Other references:	

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Biomatics and Applied Artificial Intelligence Institute			Semester 7. of the curriculum 2026-27-1			
Name of the subject:	Code of the subject:	Credits:	Weekly hours:			
				lec	sem	lab
Thesis work	NDDSD1EBNF	15	full-time	0	0	0
Responsible person for the subject: Prof. Dr. Levente KOVÁCS			Classification: professor			
Subject lecturer(s):						
Prerequisites:						
Way of the assessment:	mid-term grade					

Course description	
Goal:	
Course description:	

Lecture schedule	
Education week	Topic
1.	
2.	
3.	
4.	
5.	
6.	
7.	
8.	
9.	
10.	
11.	
12.	
13.	
14.	

Mid-term requirements	
Conditions for obtaining a mid-term grade/signature	

Assessment schedule	
Education week	Topic

Method used to calculate the *mid-term grade* (to be filled out only for subjects with mid-term grades)

Type of the replacement	
Type of the replacement of written test/mid-term grade/signature	

Type of the exam (to be filled out only for subjects with exams)

Calculation of the exam mark (to be filled only for subjects with exams)	
Final grade calculation methods:	
References	
Obligatory:	
Recommended:	
Other references:	

ÓBUDA UNIVERSITY
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Institute of Applied Mathematics			Semester 1. of the curriculum 2023-24-1			
Name of the subject:	Code of the subject:	Credits:	Weekly hours:			
				lec	sem	lab
Mentoring	NDIPT1EBNF	0	full-time	0	1	0
Responsible person for the subject: Dr. István VAJDA			Classification: senior lecturer			
Subject lecturer(s):						
Prerequisites:						
Way of the assessment:	signature					

Course description	
Goal:	Students get acquainted with the structure and life of the university, and they can manage issues occurring during their studies.
Course description:	Documents regulating students life (e.g. Study And Examination Regulations Of Óbuda University), types of stipends and other allowances, fees, students administrative commitments, the student government. Curriculum, the net of subjects, sample curriculum, prerequisites, criteria, distance training courses, KMOOC. Ways of assessments, midterm tests, exams, how to register for an exam, midterm grade. Special professional modules. Degree project, thesis. Available services in the university, open lab, library, psychologist, Students' Public Centres. The Neptun, Moodle and Teams systems. Cooperative studies. Erasmus, TDK conferences, working as a demonstrator. Community programmes.

Lecture schedule	
Education week	Topic
1.	Voting for students leaders. The university, faculties, buildings, classrooms.
2.	Studying system of a university, lectures, practical lessons, labs. Ways of assessment (signature, midterm grade, midterm tests, exams, homework, projects.)
3.	The net of subjects (prerequisites). Types of stipends, how to calculate the study stipend. Hungarian state (partial) stipend, state supported, subject to tuition fee payment Rules of reclassification.
4.	Methods of efficient learning.
5.	Special professional modules. Distance training courses, K-MOOC. Degree project, thesis..
6.	Library services. Directory databases.
7.	Students' Public Centres and their services. Services of the university psychologists.
8.	Making plans for the future studies, based on the experiences of the first midterm tests.
9.	TDK conferences. How to become a demonstrator?
10.	Cooperative studies.
11.	The Erasmus system.
12.	Plan for the exam period. How to register for an exam. Exam fees.
13.	
14.	

Mid-term requirements	
Conditions for obtaining a mid-term grade/signature	Students have to visit the lessons regularly. Absence can not be higher as 30% of the lessons.

Assessment schedule	
Education week	Topic
Method used to calculate the *mid-term grade* (to be filled out only for subjects with mid-term grades)	
Type of the replacement	
Type of the replacement of written test/mid-term grade/signature	
Type of the exam (to be filled out only for subjects with exams)	
Calculation of the exam mark (to be filled only for subjects with exams)	
Final grade calculation methods:	
References	
Obligatory:	
Recommended:	
Other references:	Document uploaded into the MOODLE system.

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Biomatics and Applied Artificial Intelligence Institute			Semester 5. of the curriculum 2025-26-1			
Name of the subject:	Code of the subject:	Credits:	Weekly hours:			
				lec	sem	lab
Control Engineering	NBXIT1EBNF	5	full-time	1	0	2
Responsible person for the subject: Prof. Dr. Levente KOVÁCS			Classification: professor			
Subject lecturer(s):						
Prerequisites:	NBXRE1EBNF	System theory				
Way of the assessment:	mid-term grade					

Course description	
Goal:	Students will get acquainted with the basics of control theory based on knowledge from system theory. After a brief review of the analysis of linear continuous time dynamics systems, we discuss the basics of control theory, such as closed-loop analysis, root locus, phase margin, gain margin, stability. We study series compensators (PID controllers) which are the most widespread used controllers in industry. We discuss in detail the relationship of the type number of the open loop system and the steady-state error, and the effect of the integrating and differentiating terms on the closed-loop. During laboratory practice the students learn several methods for series compensator (PID) design. At the end of the semester, we discuss the effect of sampling (as a result of the digital implementation) on the closed-loop, and design methods of digital controllers. The students will acquire the knowledge to design PID controllers and implement them on microcontrollers
Course description:	linear systems, closed-loop systems, series compensators, PID controllers, stability, phase margin, gain margin, steady-state error, disturbance rejection, digital implementation.

Lecture schedule	
Education week	Topic
1.	Description of LTI systems, MATLAB implementation.
2.	Dynamic system examples, simulations with MATLAB.
3.	Analysis of closed-loop, solving a DC servo as an example in Matlab.
4.	System analysis summary, examples.
5.	P type controller design, gain- and phase margin.
6.	P and PI controller design.
7.	P and PD controller design.
8.	PID controller design, discrete-time realization.
9.	Practice with examples.
10.	PID controller design, examples.
11.	PID controller design, examples.
12.	Summary, examples.
13.	Laboratory practice midterm.
14.	Laboratory practice midterm retake.

Mid-term requirements	
Conditions for obtaining a mid-term grade/signature	Student participation in the laboratory practice is required (min 8 labratory). Successful midterm tests.

Assessment schedule	
Education week	Topic
13.	Laboratory practice midterm
14.	Laboratory practice midterm retake

Method used to calculate the *mid-term grade* (to be filled out only for subjects with mid-term grades)

A minimum of 50% must be achievid in each part.
Final grade = average of the midterm tests.

Type of the replacement

Type of the replacement of written test/mid-term grade/signature	laboratory practice midterm retake

Type of the exam (to be filled out only for subjects with exams)

-

Calculation of the exam mark (to be filled only for subjects with exams)

-

Final grade calculation methods:

Achieved result	Grade
22-25	excellent (5)
19-21	good (4)
16-18	average (3)
13-15	satisfactory (2)
0-12	failed (1)

References

Obligatory:	Lecture notes (download form https://elearning.uni-obuda.hu/)
Recommended:	The Control Handbook, Second Edition (Levine), Control System Toolbox User's Guide - MathWorks
Other references:	Given by the lecturer

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Institute of Cyberphysical Systems			Semester 5. of the curriculum 2025-26-1			
Name of the subject:	Code of the subject:	Credits:	Weekly hours:			
				lec	sem	lab
Embedded and Sensor Based Systems	NKXBE1EBNF	5	full-time	1	0	2
Responsible person for the subject: Prof. Dr. András MOLNÁR			Classification: professor			
Subject lecturer(s):						
Prerequisites:	NKXDR1EBNF	Digital systems				
Way of the assessment:	exam					

Course description	
Goal:	The course introduces students to the operation and application of basic sensors, signal types, filtering methods, the use of measurement tools, and basic design methodologies used in the world of embedded systems. They will also learn the basics of sensor alignment and communication protocols. Students will learn the AVR C programming language in practice.
Course description:	Lecture: types of signals (analog, digital, quasi-digital). Construction and operation of counting, approximating flash A/D converters. Signal conversion (U/F, I/F converters). Pulse transmitters, sensors. Measurement data processing, post processing and real time filtering. Analog sensors and their characteristics. Role and need of measuring amplifiers. Impedance matching. Thermal compensation, measurement bridge. Detection and measurement of gamma radiation (GM tube and scintillation detectors) Special gamma radiation imaging. Lab: architecture, operation, programming of microcontroller architectures, embedded software development methodology, communication protocols, practical use of sensors.

Lecture schedule	
Education week	Topic
1.	Lec: Type of signals Lab: Overview of microcontroller architectures
2.	Lec: Structure and operation of A/D converters Lab: Electronics basics
3.	Lec: Covnersion of signals Lab: introduction and use of GPIO ports
4.	Lec: Signal transmitters Lab: use and operation of A/D
5.	Lec: Processing measurement data Lab: State machine operation, programming
6.	Lec: Signals filtering Lab: Use of signal filtering
7.	Lec: Analog sensors Lab: Operation of Timers
8.	Lec: Amplifiers Lab: Communation protokols
9.	Lec: Impedance matching Lab: Sensors matching
10.	Lec: Heat compensation Lab: Interrupts
11.	Lec: Operation of measuring bridge Lab: Using digital signal
12.	Lec: Gamma-ray based imaging Lab: Operation of memory types
13.	Lec : Lab: Labor ZH
14.	Lec : Lab: Labor ZH pótlás

Mid-term requirements	
Conditions for obtaining a mid-term grade/signature	Pass at least 51% of the laboratory ZH

Assessment schedule	
Education week	Topic
13.	Lab ZH from the lab material.
14.	Replacement of lab ZH from the lab material.

Method used to calculate the *mid-term grade* (to be filled out only for subjects with mid-term grades)	
Type of the replacement	
Type of the replacement of written test/mid-term grade/signature	Once during the exam period, according to rules.
Type of the exam (to be filled out only for subjects with exams)	
Type of exam: written	
Calculation of the exam mark (to be filled only for subjects with exams)	
The mark is determined by the score achived in the exam.	
Final grade calculation methods:	
0%-59%: fail (1) 60%-69%: pass (2) 70%-79% satisfactory (3) 80% - 89%: good (4) 90%-100%: excellent (5)	
References	
Obligatory:	Harsányi G.: Érzékelők az orvosbiológiában, BME Villamosmérnöki és Informatikai Kar, Orvosbiológiai Mérnökképzés, OBMK, 1998. Lambert Miklós: Szenzorok - elmélet és gyakorlat: 2009. ISBN 13:9789638740113 Dr. Zoltán István: Méréstechnika, Műegyetemi kiadó, Azonosító: 55029, 1997., pp. 86-92
Recommended:	
Other references:	The slides used in the lecture and lab will be available after class on the course website at https://elearning.uni-obuda.hu/.

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Biomatics and Applied Artificial Intelligence Institute			Semester 6. of the curriculum 2025-26-2			
Name of the subject:	Code of the subject:	Credits:	Weekly hours:			
				lec	sem	lab
Introduction to Robotics	NBXRT1EBNF	6	full-time	3	0	2
Responsible person for the subject: Dr. Péter GALAMBOS			Classification: associate professor			
Subject lecturer(s): Dr. Péter GALAMBOS, Sándor TARSOLY						
Prerequisites:	NKXBE1EBNF	Embedded and Sensor Based Systems				
Way of the assessment:	exam					

Course description	
Goal:	The goal of this course is to provide a foundation in robotics-related engineering and to familiarize students with programming industrial robots.
Course description:	The topic of the subject is handled in two parallel branches as follows. **Engineering foundations of robotics (A):** Development and historical milestones of robotics. Industrial robot structures and areas of application. Aspects of robot selection. A simplified mechanical model of an elementary robot joint. Technical implementation of servo drives (sensors, motors, control units). Motion of point-like bodies and rigid bodies. Description of geometric and kinematic constraints. Dynamics of point-like bodies and rigid bodies. 3D spatial transformations (rotation, translation, homogeneous transformation). Outlook for describing the motion of mobile robots, odometry. Nonlinear characteristics of robot mechanisms. **Robot programming (B):** The concept, purpose, and execution environment of the robot program. Features of industrial robot programming languages. Abstract spaces and coordinate systems used in robot programming. Robot movement, interpolation methods. Types of robot peripherals and their connection to the robot controller. Programming of Universal Robots (UR) type robots, URSim environment. Programming FANUC robots in FANUC TP language, RoboGuide offline programming environment. RoboDK as a vendor-independent offline programming environment.

Lecture schedule	
Education week	Topic

1.	A: Introductory lecture. The development of robotics and its historical milestones. B: Introductory lecture. The concept, purpose, execution environment of the robot program.
2.	A: Industrial robot structures and application areas. Aspects of robot selection. B: The birth of the robot program: technological requirements, cell design, programming.
3.	A: Simplified mechanical model of an elementary robot joint. B: Characteristics and possibilities of robot programming languages and runtime environments.
4.	A: Technical implementation of servo drives (sensors, power transmission). B: The connection of the robot with the outside world: connecting sensors, actuators, safety devices and control devices. Finalization of individual project assignments.
5.	A: Technical implementation of servo drives (sensors, power transmission). B: The connection of the robot with the outside world: connecting sensors, actuators, safety devices and control devices. Issuing stand-alone robotics tasks.
6.	A: Technical implementation of servo drives (motors, control units). B: Programming Universal Robots collaborative robots.
7.	A: Linear Algebra Review. Cultural historical perspective. B: Programming Universal Robots collaborative robots.
8.	A: Movement of a material point. B: Programming Universal Robots collaborative robots.
9.	A: Motion of rigid bodies. B: Programming FANUC robots.
10.	A: Material point and dynamics of rigid bodies. B: Programming FANUC robots.
11.	A: 3D spatial transformations. B: Offline robot programming in the RoboDK environment
12.	A: Outlook for describing the movement of mobile robots, odometry. B: Offline robot programming in the RoboDK environment
13.	A: Nonlinear characteristics of robot mechanisms. B: Test

14.	A/B: Review of the semester's material. Exam preparation consultation. A/B: Presentation of substitute Test and individual project presentations.

Mid-term requirements	
Conditions for obtaining a mid-term grade/signature	- Writing a Test with a score of at least 40% - Submission of an independent assignment with a score of at least 40%

Assessment schedule	
Education week	Topic
13.	The topics of the "B" sessions (robot programming) for weeks 1-12
14.	Presentation of the individual project

Method used to calculate the *mid-term grade* (to be filled out only for subjects with mid-term grades)

Type of the replacement	
Type of the replacement of written test/mid-term grade/signature	- The Test can be replaced in the last week - The presentation of the individual task (project) can be replaced in the first week of the exam period

Type of the exam (to be filled out only for subjects with exams)

The students who obtain the signature will take an oral exam on the subject, during which they will report on their knowledge acquired from the topics of "Part A" of the engineering fundamentals of robotics.

Calculation of the exam mark (to be filled only for subjects with exams)

The formation of the exam mark results from the weighted sum of the results of the oral exam, the ZH and the independent task, but in the case of all three, the sufficient level must be met.
Calculation method of the exam mark:

0.3 * TEST + 0.2 * PROJECT + 0.5 * EXAM

Final grade calculation methods:

- 40%: Failed,
- 55%: Sufficient,
- 70%: Satisfying,
- 85%: Good,
- 100%: Excellent

References	
Obligatory:	
Recommended:	[1] Andreas Bihlmaier, Robotics for Programmers, 1st ed., New York, NY: Manning, 2022. (ISBN 978-1-63343-963-4) [2] J.W. Gruenke, Programming FANUC robots for industrial applications. Orland Park, IL: American Technical Publishers, 2021. (ISBN 978-0-8269-3412-3) [3] K. CAPEK, R.U.R. (ROSSUM'S UNIVERSAL ROBOTS). AGO! Press, 2015. (ISBN 978-1-4794-4573-8) [4] K. Simonyi, A Cultural History of Physics, 1st edition. Boca Raton, Fla: A K Peters/CRC Press, 2012.
Other references:	

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Institute of Cyberphysical Systems			Semester 6. of the curriculum 2025-26-2			
Name of the subject:	Code of the subject:	Credits:	Weekly hours:			
				lec	sem	lab
Embedded programming, communication protocols	NKXBP1EBNF	5	full-time	0	0	3
Responsible person for the subject: Prof. Dr. András MOLNÁR			Classification: professor			
Subject lecturer(s):						
Prerequisites:	NKXBE1EBNF	Embedded and Sensor Based Systems				
Way of the assessment:	mid-term grade					

Course description	
Goal:	The course introduces students to the architecture of microcontrollers, the operation and application of basic peripherals, signal types, communication protocols used in distributed systems, basic design methodologies used in the world of embedded systems, and the operation and application of bus networks in the automotive industry. They will learn the basics of sensor integration and communication protocols. Students will learn the AVR C programming language in practice.
Course description:	The aim of the course is to introduce students to the programming of microcontrollers, which are widely used in the embedded systems world. They will gain an insight into embedded software design methodology, the operation of AVR and ARM processors, the use of integrated peripherals, distributed systems, and communication protocols between sensors. Subject matter: software design methodology for embedded systems (superloops, state machines), architecture and operation of AVR and ARM architectures, integrated peripherals (timers, ADC, DAC), basics of digital data transmission, main characteristics of bus systems, practical use of communication protocols (I2C, UART/USART, SPI), operation and application of bus networks in the automotive industry (CAN, VAN, LIN, FlexRay).

Lecture schedule	
Education week	Topic
1.	Software design methodologies
2.	AVR and ARM architectures
3.	Timers
4.	ADC, DAC
5.	Basics of digital data transmission
6.	Bus systems
7.	General communication protocol 1
8.	General communication protocol 2
9.	General communication protocol 3
10.	Communication protocol in the automotive industry 1
11.	Communication protocol in the automotive industry 2
12.	Communication protocol in the automotive industry 3
13.	Lab ZH
14.	Lab ZH replacement

Mid-term requirements	
Conditions for obtaining a mid-term grade/signature	Pass at least 51% of the laboratory ZH

Assessment schedule	
Education week	Topic

13.	Midterm exam from the all topic.
14.	Midterm exam from the all topic. (Replacement)

Method used to calculate the *mid-term grade* (to be filled out only for subjects with mid-term grades)

0% - 59%: fail (1)
60%-69%: pass (2)
70%-79%: satisfactory (3)
80%-89%: good (4)
90%-100%: excellent (5)

Type of the replacement

Type of the replacement of written test/mid-term grade/signature	Once during the exam period, according to rules.

Type of the exam (to be filled out only for subjects with exams)

Calculation of the exam mark (to be filled only for subjects with exams)

Final grade calculation methods:

References

Obligatory:	Dr. Kováts Miklós, Dr. Szalay Zsolt: Gépjárművek buszhálózatai. Maróti Könyvkiadó, Budapest, 2013, ISBN: 978-963-994-510-4 Aradi Szilárd, Bécsi Tamás: Járműfedélzeti rendszerek I. Akadémiai Kiadó, Budapest, 2018, ISBN: 978-963-454-388-6 Elecia White: Making Embedded Systems, O'Reilly Media, Inc. 2011, ISBN: 978-144-930-214-6
Recommended:	
Other references:	The slides used in the lab will be available after class on the course website at https://elearning.uni-obuda.hu/.

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Institute of Cyberphysical Systems			Semester 7. of the curriculum 2026-27-1			
Name of the subject:	Code of the subject:	Credits:	Weekly hours:			
				lec	sem	lab
Sensor Networks, IoT Systems	NKXSI1EBNF	4	full-time	1	0	2
Responsible person for the subject: Prof. Dr. András MOLNÁR			Classification: professor			
Subject lecturer(s):						
Prerequisites:	NKXBP1EBNF	Embedded programming, communication protocols				
Way of the assessment:	mid-term grade					

Course description	
Goal:	The aim is to present the characteristics of IoT systems designed by connecting sensors and actuators; to review the most important standards and protocols related to the design of such systems.
Course description:	Topics: IoT models, communication (including non-IP-based solutions), data transfer issues, MQTT. Data processing, edge computing. Security and reliability issues. In the labs, students work in groups of 2-3 people to form a sensor network of BLE-enabled devices with a gateway capable of IP communication. The central communication node via MQTT is a Node-Red-based system on which students solve data processing and visualization tasks.

Lecture schedule	
Education week	Topic
1.	P: IoT concept, main use cases, architecture models Lab: Getting to know the environment, creating simple test programs for an ESP32s single card device, simple measurements (e.g., temperature)
2.	Lab: Getting started with Node-RED, communicating over WiFi over HTTP
3.	P: IoT architecture layers (devices and gateways) Lab: Node-RED-based data collection, alarm, and visualization with multiple sensors (group task)
4.	Lab: MQTT basics, replacing HTTP communication with MQTT-based messaging
5.	P: IoT architecture layers resume (IoT platform and business layer) Lab: Conducting an MQTTT-based messaging-based task (best practices, solution patterns)
6.	Lab: Expanding a task based on MQTT-based messaging with two-way connectivity (changing the configuration of sensor units)
7.	P: IoT security Lab: getting to know BLE-based communication, simple PoC codes
8.	Lab: Design and implementation of a solution based on a gateway component (BLE-MQTT) implemented on BLE-based endpoints and ESP32s
9.	P: Wireless communication options Lab: Continuation of what started in the previous lab (two-way communication)
10.	Lab: Continuation of what started in a previous lab (error handling capabilities on endpoints, gateway component, and central component)
11.	P: MQTT and its alternatives Lab: Midterm (program creation)
12.	Lab: widespread cloud-based IoT platform services - Amazon
13.	P: IoT platform services Lab: widespread cloud-based IoT platform services - Microsoft
14.	Lab: midterm replacement

Mid-term requirements	
Conditions for obtaining a mid-term grade/signature	Successful midterm thesis

Assessment schedule	
Education week	Topic
11.	Simple IoT app (microcontroller side code)
14.	Replacement option

Method used to calculate the *mid-term grade* (to be filled out only for subjects with mid-term grades)

Type of the replacement	
Type of the replacement of written test/mid-term grade/signature	Once during the exam period, according to rules

Type of the exam (to be filled out only for subjects with exams)

Written

Calculation of the exam mark (to be filled only for subjects with exams)

The basis of the exam grade is the result of the written exam thesis.

Final grade calculation methods:

0% - 50%: failed (1)
51% - 65%: satisfactory (2)
66% - 75%: average (3)
76% - 85%: good (4)
86% - 100%: excellent (5)

References	
Obligatory:	Perry Lea: IoT and Edge Computing for Architects: Implementing edge and IoT systems from sensors to clouds with communication systems, analytics, and security, 2nd Edition, Packt 2020, ISBN: 1839214805
Recommended:	K. Townsend, C. Cufí, Akiba, R. Davidson, Getting Started with Bluetooth Low Energy: Tools and Techniques for Low-Power Networking 1st Edition, O'reilly 2014, ISBN: 1491949511 Chris Hobbs: Embedded Software Development for Safety-Critical Systems, Second Edition, Routledge 2019, ISBN-10: 0367338858 Milan Milenkovic: Internet of Things: Concepts and System Design 1st ed., Springer 2020, ISBN: 3030413489
Other references:	

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Software Engineering Institute			Semester 5. of the curriculum 2025-26-1			
Name of the subject:	Code of the subject:	Credits:	Weekly hours:			
				lec	sem	lab
Advanced Databases	NKXKD1EBNF	5	full-time	2	0	2
Responsible person for the subject: Dr. Rita FLEINER			Classification: associate professor			
Subject lecturer(s):						
Prerequisites:	NKXAB1EBNF	Databases				
Way of the assessment:	exam					

Course description	
Goal:	In the course, students familiarize themselves with advanced topics, concepts, methods, tools of relational and non-relational databases.
Course description:	Expanding basic SQL knowledge, PL/SQL language, extensions for concatenated grouping, analytic functions, subquery factoring, advanced DML expressions, materialized views. Oracle architecture, processing of SQL statements, performance tuning, execution plan, access paths and join methods, CBO statistics, selectivity, cost. Massive parallel processing databases. NoSQL databases, types, architecture, properties. Using MongoDB, Neo4j, HBase and Redis: basics, architecture, queries. Migration from relational data model to different NoSQL data models.

Lecture schedule	
Education week	Topic
1.	Lecture: schema design, normal forms, data dictionary. Lab: Advanced queries
2.	Lecture: Architecture and operation of Oracle. Lab: Complex DML statements, PL/SQL advanced examples.
3.	Lecture: Index structures, access paths, join methods. Lab: Analysing execution plans
4.	Lecture: Query performance tuning based on execution plan. Lab: Performance optimization using different methods.
5.	Lecture: Open source relational databases. Lab: PostgreSQL database basics
6.	Lecture: MPP (massive parallel processing) databases. Lab: PostgreSQL advanced queries
7.	Lecture: NoSQL databases. Lab: Export-import file formats
8.	Lecture: Key-value stores, Redis. Lab: Redis
9.	Lecture: Document stores, MongoDB. Lab: MongoDB
10.	Lecture: Graph databases, Neo4J. Lab: Neo4J
11.	Lecture: NoSQL database design, migration from relational to non-relational data model. Lab: Data export-import, migration from relational to non-relational data model.
12.	Lecture: Column stores, HBase. Lab: HBase
13.	Lecture: Review of exam material. Lab: Test
14.	Lecture: Preliminary exam. Lab: Test retake

Mid-term requirements	
Conditions for obtaining a mid-term grade/signature	Students can take the lab test on week 13, retake on week 14 if necessary. The condition for obtaining a signature is at least 50% achievment on the test. Signature will be denied without a retake chance in case of more than 30% absence from labs, or any kind of cheating on the tests. Students can take a preliminary exam on week 14, where a 4 or 5 grade can be obtained if successful. If the % of preliminary exam is below grade 4 level then the result will not count in the exam grade calculation.

Assessment schedule	
Education week	Topic
13	Test
14	Test retake
14	Preliminary exam
Method used to calculate the *mid-term grade* (to be filled out only for subjects with mid-term grades)	
Type of the replacement	
Type of the replacement of written test/mid-term grade/signature	Test retake is possible on week 14 and also in the exam period on the signature retake exam.
Type of the exam (to be filled out only for subjects with exams)	
The exam consists of two parts: (1) Written test: at least 50% necessary, else the exam grade is 1, and the student can not continue with the oral part. (2) Oral exam: at least 50%, else the exam grade is 1.	
Calculation of the exam mark (to be filled only for subjects with exams)	
Exam mark will be calculated from mid-term test result %, written test % and oral exam result % in a 50-25-25% ratio.	
Final grade calculation methods:	
0 - 49%: insufficient (1) 50 - 62%: satisfactory (2) 63 - 74%: average (3) 75 - 86%: good (4) 87 - 100%: excellent (5)	
References	
Obligatory:	Material published in Moodle.
Recommended:	Ullman J.D., Widom J.: Adatbázisrendszerek; alapvetés, 2. kiadás, PANEM Kiadó, Budapest, 2008 Elmashri, R., Navathe, Sh.: Fundamentals of Database Systems, Benjamin/Cummings Publ. Comp., Redwood City, 1994. Garcia E., Ullman J. D., Widom J.: Adatbázisrendszerek (Megvalósítás), Panem, Budapest, 2000 Gaurav, V.: Getting Started with NoSQL. Packt Publishing, 2013 McCreary, D., Kelly, A.: Making Sense of NoSQL. Manning Publications Co., 2013
Other references:	Official documentation of the database systems included in the course.

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Institute of Cyberphysical Systems			Semester 6. of the curriculum 2025-26-2			
Name of the subject:	Code of the subject:	Credits:	Weekly hours:			
				lec	sem	lab
Data Warehousing and Business Intelligence	NKXAT1EBNF	5	full-time	2	0	2
Responsible person for the subject: Dr. Rita FLEINER			Classification: associate professor			
Subject lecturer(s):						
Prerequisites:	NKXKD1EBNF	Advanced Databases				
Way of the assessment:	exam					

Course description	
Goal:	In the course, students learn the concepts and skills necessary for designing data warehouses and creating data integration workflows. During the course students learn how to build a small, basic data warehouse, populate it with data, and create dashboards and other visualizations to analyze and communicate the data to a broad audience. The course gives an overview of how business intelligence technologies can support decision making across any number of business sectors. Students learn how data warehouses are used for business reporting and online analytical processing, creating visualisations and dashboards, business performance management and descriptive analytics.
Course description:	Introduction to data warehouse and business intelligence, Data warehouse architecture and data modelling, Data integration, Report generation, Loading procedures, Operating BI systems, BI management and consulting, BI trends. Data in the Enterprise, Competitiveness and Data, Data Evaluation.

Lecture schedule	
Education week	Topic
1.	T: Introduction to data warehouse and business intelligence technology L: Getting to know the development environment and MS SQL
2.	T: Data warehouse architecture and data modelling I. L: Implementation of the star schema
3.	T: Data warehouse architecture and data modelling II. L: Getting to know SSIS I.
4.	T: Reporting categories L: Getting to know SSIS II.
5.	T: Reporting categories II. L: The ETL Process: Extract and Transform
6.	T: Operation of BI systems L: The ETL Process: Load
7.	T: Business Intelligence Management and Consulting L: Power BI: data sources and transformation
8.	T: The basics of data visualisation L: Power BI: data modelling and visualisation
9.	T: Business Intelligence Trends L: SSIS and Power BI assignments, presentation of termly project work
10.	T: Data at the company. Specification problems L: Strategic and operational decision support
11.	T: Competitiveness and data. Environment, output. L: Building a data model
12.	T: Data evaluation. Handling biases, analysis errors. L: Business analyses, reports
13.	T: Roundtable discussion on BI with business stakeholders L: Final test
14.	T: Repetition: review of the topics covered in the oral test L: Extra final test

Mid-term requirements	
Conditions for obtaining a mid-term grade/signature	Completion of at least 51% of the lab assignments and the project work.

Assessment schedule	
Education week	Topic
9.	Presentation of project work
13.	Final test
14.	Extra final test
Method used to calculate the *mid-term grade* (to be filled out only for subjects with mid-term grades)	
Type of the replacement	
Type of the replacement of written test/mid-term grade/signature	Lab test in the 14th week. The signature can be replaced during the first week of the exam period. The signature replacement exam includes all the material from the labs.
Type of the exam (to be filled out only for subjects with exams)	
Oral examination	
Calculation of the exam mark (to be filled only for subjects with exams)	
The final mark is the sum of the following 4 items: 1. the score of the project work (max. 20 points) 2. the score of the final test (max. 30 points) 3. score on the oral exam (max. 40 points) 4. based on student performance and activity (max. 10 points) The student can achieve a maximum of 100 points during the semester.	
Final grade calculation methods:	
0% - 50%: insufficient (1) 51% - 65%: satisfactory (2) 66% - 75%: average (3) 76% - 85%: good (4) 86% - 100%: excellent (5)	
References	
Obligatory:	Ralph Kimball: The Data Warehouse Toolkit (3rd e.) ISBN: 9781118530801 William H. Inmon: Building the Data Warehouse (4th e.) ISBN: 9780764599446
Recommended:	Daniel Linstedt: Building a Scalable Data Warehouse with Data Vault 2.0
Other references:	The slides used in the lecture will be available on the course website at https://elearning.uni-obuda.hu/ after the lecture.

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Institute of Cyberphysical Systems			Semester 6. of the curriculum 2025-26-2			
Name of the subject:	Code of the subject:	Credits:	Weekly hours:			
				lec	sem	lab
Big Data and Cloud based services	NKXBD1EBNF	5	full-time	2	0	2
Responsible person for the subject: Dr. habil. Róbert LOVAS			Classification: associate professor			
Subject lecturer(s):						
Prerequisites:	NKXBA1EBNF	Introduction to data science				
Way of the assessment:	exam					

Course description	
Goal:	The aim of the course is to familiarize students with Big Data technologies and present the theoretical and practical operation of these systems. The aim, processes, possible implementations and background of collecting, storing, processing and visualising large data sets will be presented. The topics will also be practically implemented by students using pre-installed systems, systems they have installed themselves in the lab and systems based on cloud technology. Several different Big Data frameworks and data processing, data visualization and analysis technologies (Apache Hadoop, Spark, Kafka, Databricks) will be introduced, so that students will learn and master the relevant topics from several approaches, both in self-installed and cloud-based systems.
Course description:	During the course, students will learn about the theoretical background of Big Data systems, the problems of managing available, unprocessed and large amounts of data, the processes and possibilities of collecting, storing, processing and visualising this data, analytical technologies, security and ethical issues. Each topic will describe these main processes of Big Data systems and offer practical solutions for their implementation. Students will practice using data processing, storage, visualisation and analytical technologies used today to perform tasks that demonstrate the main processes of Big Data data management. This will allow them to learn Open Source and business model systems in practice, as well as learn how to use self-deployed and cloud-based systems.

Lecture schedule	
Education week	Topic
1.	Presentation: Introduction to Big Data technology Lab: Setting up a lab environment, learning about related cloud technologies
2.	Presentation: Hadoop framework, HDFS, YARN Lab: Deploying Spark in a virtualized environment
3.	Presentation: BigData file formats Lab: Basics of Python and Jupiter notebook for data processing and analytics
4.	Presentation: Data processing in general Lab: File formats, data import and export
5.	Presentation: Batch processing with Spark framework Lab: Spark API tasks
6.	Presentation: Stream processing with Spark and Storm frameworks Lab: Batch processing
7.	Presentation: Apache Kafka Lab: Stream processing from Kafka source
8.	Presentation: Data access and visualisation Lab: Databricks platform
9.	Presentation: Analytics and machine learning

	Lab: Databricks Delta Lake
10.	Presentation: Process automation Lab: Databricks visualization and analytics
11.	Presentation: Big Data case studies, ethical issues Lab: Databricks Workshop
12.	Presentation: Hadoop cluster management Lab: security issues, mid-term assignment consultation
13.	Midterm thesis
14.	Supplementary Midterm Thesis

Mid-term requirements

Conditions for obtaining a mid-term grade/signature	To obtain the signature, it is necessary to achieve at least 50% results on the midterm test and with homework.

Assessment schedule

Education week	Topic
13	Midterm thesis – from the theoretical and practical curriculum of the entire semester
14	Supplementary midterm thesis – from the theoretical and practical curriculum of the whole semester
During exam period	Signature replacement thesis – from the theoretical and practical curriculum of the entire semester

Method used to calculate the *mid-term grade* (to be filled out only for subjects with mid-term grades)

Type of the replacement

Type of the replacement of written test/mid-term grade/signature	If the midterm thesis does not reach the 50% result or has not been written, it is possible to write a supplementary midterm thesis in week 14. If neither the midterm nor the supplementary midterm thesis reaches 50%, it is possible to write a signature replacement thesis during the exam period. It is possible to replace the homework: o In the time of supplementary midterm test (week 14) with a deduction of 25 % points. o In the time of s signature replacement thesis at 50 % with a deduction of points.

Type of the exam (to be filled out only for subjects with exams)

Oral exam

Calculation of the exam mark (to be filled only for subjects with exams)

To complete the course, it is necessary to achieve at least 50% results on the midterm test, with homework, and the exam separately. The sum of the points gained will form the final grade.

Task	Maximum points
Midterm thesis	20
Homework	30
Exam	50
Sum	100

Final grade calculation methods:

0 – 49: unsatisfactory (1) 50 – 69: satisfactory (2) 70 – 79: average (3) 80 – 89: good (4) 90 – 100: excellent (5)

References	
Obligatory:	Alex Holmes: Hadoop In Practice, 2nd Edition, September 2014, ISBN 978-1-617-29222-4
Recommended:	Dirk deRoos, Paul C. Zikopoulos, Roman B. Melnyk PhD, Bruce Brown, Rafael Coss: Hadoop for Dummies, 2014 John Wiley & Sons, Inc., Hoboken, New Jersey, ISBN 978-1-118-65220-6 Elmasri, R., Navathe, S. B.:Fundamentals of Database Systems 7th Edition, ISBN: 978-0133970777
Other references:	

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Institute of Cyberphysical Systems			Semester 7. of the curriculum 2026-27-1			
Name of the subject:	Code of the subject:	Credits:	Weekly hours:			
				lec	sem	lab
Advanced data analysis	NKXHA1EBNF	5	full-time	2	0	2
Responsible person for the subject: Dr. Enikő NAGY			Classification: associate professor			
Subject lecturer(s):						
Prerequisites:	NKXAT1EBNF	Data Warehousing and Business Intelligemce				
Way of the assessment:	mid-term grade					

Course description	
Goal:	Through practical exercises, the course will introduce students to innovative financial solutions and the theoretical foundations needed to develop them. They will be able to analyse and understand how they work and how they can be used. The course will cover how to analyse and visualise source data with differences in magnitude, and how to quickly produce charts and statements. Using a variety of chart types, you will learn to graphically represent, read, evaluate, analyse and compare data. The handling of different data types and data formats (structured, semi-structured data processing, category type, interval scaled, ratio scaled data processing) and the processing of sensitive and personal data. Another important unit of study is the solution of large-scale linear programming (or other optimisation) problems with many variables and constraints. There are several software tools developed to solve optimisation problems efficiently. Their applications and capabilities are reviewed. General optimisation problems are also solved, where the constraints and the objective function are not necessarily linear. Thus, in addition to linear programming problems, solutions to nonlinear optimization problems are also covered.
Course description:	Lectures: cases and theories. Financial Literacy in the Context of Excel. Data cleansing, financial functions, filters, optimization, charts, value curves, statements, pivot tables, options analysis, using Solver, data management, creating financial spreadsheets, Practice: through Excel exercises, students will learn about innovative financial solutions, how to analyze them, understand how they work and how to use them.

Lecture schedule	
Education week	Topic
1.	Introduction, Excel spreadsheet options for solving financial tasks Warm-up exercises
2.	Data cleaning, formula writing, financial functions, statements
3.	Useful functions, statistical functions, main categories of distributions
4.	Financial calculations in Excel: interest, repayment, investment, annuity
5.	Calculation techniques for loan structures: annuity and non-annuity structures
6.	Credit modelling techniques, Project comparisons
7.	Data transfer from other systems, web, online database, charts
8.	Data visualisation, chart types, combined charts, financial forecast visualisation
9.	Using pivot tables for statements
10.	Target value search, capital budgeting, profit maximisation with Solver
11.	Creating data tables (projects, calculations, plans, facts, accounts)
12.	Complex exercises: trended historical data, annual profit and loss statements
13.	Writing tests
14.	Replacement, correction
Mid-term requirements	

Conditions for obtaining a mid-term grade/signature	During the semester, students will write a two-part (multiple-choice test and practical exercises with Ms Excel) final paper on the course material in week 13. The papers will be worth 50-50 points, the sum of which will give a final score (max. 100 points). A minimum of 26 points is required in both exams to pass the course.

Assessment schedule

Education week	Topic
13	Multiple-choice test and practical exercises
14	Completion of Tests

Method used to calculate the *mid-term grade* (to be filled out only for subjects with mid-term grades)

The final semester grade is based on the number of marks obtained in the examinations, for which a maximum of 100 points can be obtained. A satisfactory grade requires 52 points, a medium grade 63, a good grade 74 and an excellent grade 85.

Type of the replacement

Type of the replacement of written test/mid-term grade/signature	One of the tests can be substituted in week 14, the last exercise. In a complex mid-term grade, both tests can be made up with a valid (medical) certificate of absence. Again, a minimum of 26 points must be achieved on both tests. Correction is also possible in week 14. It is important to note that in all cases, by writing a correction test paper, the result of the latter test will be counted towards the practical grade.

Type of the exam (to be filled out only for subjects with exams)

Calculation of the exam mark (to be filled only for subjects with exams)

Final grade calculation methods:

0% - 51%: insufficient (1)
52% - 62%: satisfactory (2)
63% - 73%: average (3)
74% - 84%: good (4)
85% - 100%: excellent (5)

References

Obligatory:	Materials published in Moodle Bártfai Barnabás (2012) Excel haladóknak, BBS-INFO KÖNYVK. ÉS INFORM. KFT. ISBN: 9789639425774 Bártfai Barnabás (2015) Excel a gyakorlatban - Gyakorlati példákkal és azok részletes megoldási leírásaival ISBN: 9786155477164 Timothy R. Mayes (2019) Financial Analysis with Microsoft Excel 9th Edition
Recommended:	Wayne Winston (2019) Microsoft Excel 2019 Data Analysis and Business Modeling (Business Skills) 6th Edition Susanne Chishti - Janos Barberis (2016) The FinTech Book, Wiley
Other references:	

ÓBUDA UNIVERSITY
JOHN VON NEUMANN FACULTY OF INFORMATICS

Institute of Cyberphysical Systems			Semester 5. of the curriculum 2025-26-1			
Name of the subject:	Code of the subject:	Credits:	Weekly hours:			
				lec	sem	lab
Introduction to data science	NKXBA1EBNF	5	full-time	2	0	2
Responsible person for the subject: Dr. Eszter Balázsné KAIL			Classification: senior lecturer			
Subject lecturer(s):						
Prerequisites:	NKXAB1EBNF	Databases				
Way of the assessment:	mid-term grade					

Course description	
Goal:	The aim of the course is to provide a practical approach to the basic concepts and processes of data science. Through real-life application examples from practice, students will gain precise theoretical and practical hands-on knowledge by experiencing the material in depth. Machine learning algorithms form the backbone of the theoretical knowledge, while practical exercises provide a practical representation of the theory through the use of the Python language.
Course description:	CRISP DM and its 6 phases, data cleaning, supervised, unsupervised learning, overfitting, underfitting, model validation, learning/validation/testing sets, cross-validation, Bias-Variance, least squares, Linear Regression, Gradient Method, Maximum-likelihood estimation, Logistic regression, Learning/validation/testing set, Cross-validation, Bias-Variance tradeoff, Precision-Recall, F1-score, ROC curve, SVM, Neural networks, Decision trees, Random forests, Boosting, Unsupervised learning, Clustering, K-means clustering, Reinforcement learning.

Lecture schedule	
Education week	Topic
1.	History, examples, basic concepts, case studies
2.	Mathematical, statistical basics (frequencies, percentiles, mean, median, standard deviation, covariance, correlation, types of graphs)
3.	CRISP DM and data preparation
4.	Advanced statistical methods
5.	Supervised learning - Classification
6.	Regression methods
7.	Validation
8.	Neural networks
9.	Deep learning
10.	Unsupervised learning, clustering, K-means
11.	Reinforcement learning
12.	Reinforcement learning
13.	Theoretical and Laboratory test
14.	Theoretical and Laboratory test (replacement)

Mid-term requirements	
Conditions for obtaining a mid-term grade/signature	During the semester, students will take final tests in week 13 based on the lecture and lab material. Student can obtain maximum 50-50 points for each test, the sum of which will be the final score (max. 100 points). A minimum of 26 points is required for both the final and final exams to pass the course.

Assessment schedule	
Education week	Topic
13.	Theoretical and Laboratory test

14.	Theoretical and Laboratory test (replacement)

Method used to calculate the *mid-term grade* (to be filled out only for subjects with mid-term grades)

The final semester mark is the average of the scores of the tests, for which a maximum of 100 points can be obtained. For a satisfactory mark, 52 points, 63 points for a medium, 74 points for a good and 85 points for an excellent mark are required.

Type of the replacement

Type of the replacement of written test/mid-term grade/signature	During the first week of the exam period both test can be replaced.

Type of the exam (to be filled out only for subjects with exams)

Calculation of the exam mark (to be filled only for subjects with exams)

Final grade calculation methods:

The final semester mark is the average of the scores of the tests, for which a maximum of 100 points can be obtained. For a satisfactory mark, 52 points, 63 points for a medium, 74 points for a good and 85 points for an excellent mark are required.

References

Obligatory:	Lecture slides available at at https://elearning.uni-obuda.hu/
Recommended:	Richard S. Sutton and Andrew G. Barto: Reinforcement Learning: An Introduction, 2nd edition, Bradford Books, 2018, ISBN: 0262039249 J. Leskovec, A. Rajaraman, J. D. Ullman: Mining of Massive Datasets, 3rd edition, Cambridge University Press, 2020, ISBN: 1108476341 J. Gareth et al.: An Introduction to Statistical Learning, 2nd edition, Springer-Verlag New York Inc., 2021, ISBN: 1071614177
Other references:	

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Institute of Cyberphysical Systems			Semester 5. of the curriculum 2025-26-1			
Name of the subject:	Code of the subject:	Credits:	Weekly hours:			
				lec	sem	lab
Network Technologies	NKXHT1EBNF	5	full-time	2	0	2
Responsible person for the subject: Dr. Eszter Balázsné KAIL			Classification: senior lecturer			
Subject lecturer(s):						
Prerequisites:	NKXSH1EBNF	Computer networks				
Way of the assessment:	exam					

Course description	
Goal:	This course aims to provide an insight into today's networking technologies. The subject is strongly based on the Computer Networks course. Configuration, testing and troubleshooting of networks built from real devices will help students to master the course material.
Course description:	The course will provide insight into advanced switching (CEF), traffic management (OSPF, BGP) and redundancy protocols (STP, RSTP, Etherchannel, HSRP, GLBP). It introduces currently used VPN technologies (IPSEC, SSL) and solutions supporting IPv4-IPv6 migration (NAT, CG-NAT). The course will cover the theoretical background, theoretical possibilities and typical practices of these protocols and technologies.

Lecture schedule	
Education week	Topic
1.	Introduction, revision
2.	Basic and advanced switching techniques
3.	Protocols supporting redundancy I (STP, RSTP, Etherchannel)
4.	Protocols supporting redundancy II (HSRP, VRRP, GLBP)
5.	Dynamic routing protocols OSPFv2, OSPFv3
6.	Dynamic routing protocols EIGRP
7.	External Gateway Protocol - Introduction to BGP
8.	IPv4, IPv6 migration support solutions (NAT, CG-NAT)
9.	VPN - IPSec
10.	VPN - SSL
11.	SDN
12.	NFV
13.	Lab exam
14.	Lab exam (replacement)

Mid-term requirements	
Conditions for obtaining a mid-term grade/signature	The students are required to attend at least 70% of the classes, and pass the laboratory exam with at least a satisfactory result.

Assessment schedule	
Education week	Topic
13	Laboratory exam
14	Laboratory exam replacement

Method used to calculate the *mid-term grade* (to be filled out only for subjects with mid-term grades)

Type of the replacement	
Type of the replacement of written test/mid-term grade/signature	During the first week of the exam period the laboratory exam can be replaced
Type of the exam (to be filled out only for subjects with exams)	
Oral exam based on predefined topics.	
Calculation of the exam mark (to be filled only for subjects with exams)	
The final grade is the average of the laboratory and the theoretical exam.	
Final grade calculation methods:	
References	
Obligatory:	Lecture slides available at at https://elearning.uni-obuda.hu/
Recommended:	A. S. Tanenbaum és D. J. Wetherall: Computer Networks, 3rd edition, Panem, Budapest, 2013 (in Hungarian) Wendell Odom: CCNA Routing and Switching 200-125 Official Cert Guide Library, Pearson Education, 2016, ISBN: 1587205815 Edgeworth Brad: CCNP and CCIE Enterprise Core, Official Cert Guide, Cisco Press, 2019, ISBN13: 9781587145230 The Cisco Networking Academy online curriculum (in English)
Other references:	

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Institute of Cyberphysical Systems			Semester 5. of the curriculum 2025-26-1			
Name of the subject:	Code of the subject:	Credits:	Weekly hours:			
				lec	sem	lab
Cloud Computing Services	NKXFS1EBNF	5	full-time	2	0	2
Responsible person for the subject: Dr. habil. Róbert LOVAS			Classification: associate professor			
Subject lecturer(s):						
Prerequisites:	NKXOR1EBNF	Operating systems				
Way of the assessment:	mid-term grade					

Course description	
Goal:	The primary objective of the course is to learn about cloud computing systems and to acquire basic theoretical and practical knowledge of the use of public (e.g. Amazon Web Services, Microsoft Azure), private (e.g. OpenNebula, OpenStack) and hybrid cloud platforms from both the user and operator side. Students will be introduced to the service models offered by clouds (IaaS/PaaS/SaaS), their design characteristics, typical solutions and related management and automation options. Based mainly on open-source solutions, the creation and operation of private clouds providing infrastructure services will also be presented step-by-step. Furthermore, students will learn about the theoretical and practical background of software container-based technologies.
Course description:	Deployment, operation and general use of OpenNebula private cloud solution. Deployment of S3 compatible data storage. Cloud orchestration and management of different cloud objects. Usage and deployment of Docker container technology and Docker Swarm cluster. Creating distributed NoSQL database based on containers. Understanding the different service models of cloud computing (IaaS/PaaS/SaaS) and deployment types. The different development and test environments, specific development and programming paradigms and design patterns, standard and popular practices will be described.

Lecture schedule	
Education week	Topic
1.	Lec: Clouds and software models Lab: Introduction to Parallel Computing
2.	Lec: IaaS: APIs, development and test tools Lab: Docker I: Foundation of Docker container technology
3.	Lec: PaaS: APIs, development and test tools Lab: Docker II: Foundation of Docker container technology
4.	Lec: SaaS: APIs, development and test tools Lab: Docker Swarm: Distributed container platform
5.	Lec: OpenNebula I: Open-source cloud and edge computing platform Lab: OpenNebula I: Deployment
6.	Lec: OpenNebula II: Open-source cloud and edge computing platform Lab: OpenNebula II: General usage
7.	Lec: Design patterns I: Scalability Lab: OpenNebula III: General administration
8.	Lec: Design patterns II: High Availability Lab: MinIO: S3 compatible object storage
9.	Lec: Design patterns III: Static data Lab: Cassandra: Distributed column oriented database
10.	Lec: Design patterns IV: Dynamic data Lab: Cloud orchestration tools I.
11.	Lec: Design patterns V: Databases

	Lab: Cloud orchestration tools II.
12.	Lec: Design patterns VI: Data processing Lab: Cloud contextualisation tools
13.	Lec: Midterm test Lab: Midterm test
14.	Lec: Midterm test retake Lab: Midterm test retake

Mid-term requirements	
Conditions for obtaining a mid-term grade/signature	Passing at least 51% of the midterm test Completion of the Project work

Assessment schedule	
Education week	Topic
13	Midterm test
14	Replacement occasion of the midterm test

Method used to calculate the *mid-term grade* (to be filled out only for subjects with mid-term grades)

The final grade is determined by the midterm test

Type of the replacement	
Type of the replacement of written test/mid-term grade/signature	In week 14, the midterm test can be retake. A minimum of 51% must be achieved to pass the subject.

Type of the exam (to be filled out only for subjects with exams)

Calculation of the exam mark (to be filled only for subjects with exams)

Final grade calculation methods:

0% - 50%: fail (1)
51% - 62%: pass (2)
63% - 75%: satisfactory (3)
76% - 88%: good (4)
89% - 100%: excellent (5)

References	
Obligatory:	Materials published in Moodle B. A. Sosinsky, Cloud computing bible. Wiley, 2011, ISBN: 978-0-470-90356-8
Recommended:	B. Wilder: Cloud architecture patterns, O'Reilly, 2012, ISBN: 978-1-4493-1977-9 M. Young, Implementing cloud design patterns for AWS: create highly efficient design patterns for scalability, redundancy, and high availability in AWS Cloud. Birmingham, UK: Packt Publishing, 2015, ISBN: 978-1-78217-735-7 A. Mouat, Using docker. Beijing: O'Reilly Media, Inc., 2016, ISBN: 978-1-4919-1592-9
Other references:	The slides and material used in the lecture will be available on the course website at https://elearning.uni-obuda.hu/ after the lecture.

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Biomatics and Applied Artificial Intelligence Institute			Semester 6. of the curriculum 2025-26-2			
Name of the subject:	Code of the subject:	Credits:	Weekly hours:			
				lec	sem	lab
Security of Computer Networks and Clouds	NKXSH1EBNF	5	full-time	2	0	2
Responsible person for the subject: Dr. Anna Vörösné BÁNÁTI-BAUMANN			Classification: senior lecturer			
Subject lecturer(s):						
Prerequisites:	NKXHT1EBNF	Network Technologies				
Way of the assessment:	exam					

Course description	
Goal:	The aim of the course is to familiarise students with basic network and cloud security issues, so that students gain a deeper insight into the different types of attacks and the mechanisms and techniques used to defend against them.
Course description:	The curriculum introduces network security basics: the devices, applications that comprise the network infrastructure, access management, authentication, authorization and accounting possibilities, router hardening, switch security issues, network Intrusion Detection Systems (IDS), network Intrusion Prevention Systems (IPS), Virtual Private Networks (VPN). During the lessons students also learn how to configure and maintain network devices with security measures and how to defend against known vulnerabilities. Finally, the students learn about cloud security models and the Openstack private cloud; it's security solutions via Keystone and Neutron components.

Lecture schedule	
Education week	Topic
1.	Introduction to network security, security threats
2.	Securing network devices, Network monitoring and management
3.	Authentication, Authorization, Accounting
4.	ACLs and firewall technologies
5.	Zone based firewall
6.	Intrusion Detection- IDS, IPS
7.	Securing Local Area Networks
8.	Basics of secure communication
9.	VPNs - IPSec
10.	Dedicated firewall, ASA
11.	Openstack basics, Openstack Keystone
12.	Openstack Neutron, Cloud security models
13.	Lab exam and online test
14.	Retake exams

Mid-term requirements	
Conditions for obtaining a mid-term grade/signature	

Assessment schedule	
Education week	Topic
13.	Lab exam and online test

14.	Retake exams
Method used to calculate the *mid-term grade* (to be filled out only for subjects with mid-term grades)	
Type of the replacement	
Type of the replacement of written test/mid-term grade/signature	**The online test and the lab exam can be retaken during the first 10 working days of the exam period.**
Type of the exam (to be filled out only for subjects with exams)	
Oral exam based on predefined topics.	
Calculation of the exam mark (to be filled only for subjects with exams)	
The average of the lab and oral exam .	
Final grade calculation methods:	
References	
Obligatory:	
Recommended:	
Other references:	

ÓBUDA UNIVERSITY
JOHN VON NEUMANN FACULTY OF INFORMATICS

Biomatics and Applied Artificial Intelligence Institute			Semester 6. of the curriculum 2025-26-2			
Name of the subject:	Code of the subject:	Credits:	Weekly hours:			
				lec	sem	lab
Security of Information Systems and Services	NBXIS1EBNF	5	full-time	2	0	2
Responsible person for the subject: Dr. Valéria PÓSER			Classification: associate professor			
Subject lecturer(s):						
Prerequisites:	NKXSA1EBNF	IT Security				
Way of the assessment:	exam					

Course description	
Goal:	Understanding the threats of IT systems, their stored data and applications, and security requirements: monitoring infrastructure of operation systems, protection solutions, protection methods for server services and client operating systems, secure communication options supported by operating systems, vulnerability assessment, security requirements for standard user programs.
Course description:	Information system and related fundamental concepts. Corporate security supervision and its typical problems. Basic expectations concerning operating systems. Forms, components, tools, and motivations of attacks. Plan for the supervision infrastructure. Risk analysis. Protection of Active Directory. Defence and central management of servers and client computers against viruses and penetration. User authentication. Real-time synchronisation of user register data sources. Identity and access management. Secure connection on the services. Planning and implementing public key infrastructure. The most widespread corporate IT services provided on internet/intranet/cloud. Reduction of risks originating from software vulnerability. Elimination of common development mistakes of web applications. Data protection, data rescue and recovery.

Lecture schedule	
Education week	Topic
1.	LEC: Description of the content and requirements of the subject. Basic concepts. LAB: Diagnostic tools.
2.	LEC: Basic requirements for the operating system. LAB: AD, domain work.
3.	LEC: Directory and file system security. AD protection. User authentication and privilege management. LAB: AD. Domain work. GPMC
4.	LEC: Directory integration. LAB: MMC configuration.
5.	LEC: User and access management. LAB: Directory integration.
6.	LEC: Components of attacks. LAB: User and access management.
7.	LEC: Remote access methods. VPN protocols. LAB: Exercise.
8.	LEC: Design of public key infrastructure. PKI infrastructure elements and operation. Certificate management. LAB: VPN.
9.	LEC: Data backup and restore. LAB: Encryptions, certificates.
10.	LEC: Software vulnerability. Security testing tools. LAB: Data backup exercise.

11.	LEC: Software management. LAB: Case study.
12.	LEC: Risk analysis. LAB: Consultation.
13.	LEC: Application Security. LAB: Final practical paper
14.	LEC: Preliminary exam. LAB: Extra Final practical paper

Mid-term requirements	
Conditions for obtaining a mid-term grade/signature	The conditional of signature are the successful (at least satisfactory) completion of a final paper containing practical exercises. Attendance at lectures and laboratories is subject to the rules of the Study and Examination Regulations. Attendance will be checked at all times.

Assessment schedule	
Education week	Topic
13.	Final practical paper
14.	Preliminary exam. Extra Final practical paper

Method used to calculate the *mid-term grade* (to be filled out only for subjects with mid-term grades)

Type of the replacement	
Type of the replacement of written test/mid-term grade/signature	Extra final paper at week 14. Substitution of the signature: once during one of the first 10 working days of the examination period.

Type of the exam (to be filled out only for subjects with exams)

Oral exam

Calculation of the exam mark (to be filled only for subjects with exams)

The grade for the exam is determined on the basis of the student's oral performance and the practical final paper. The result of the oral examination must also reach the minimum satisfactory level.

Final grade calculation methods:

0% - 49%: fail (1)
50% - 61%: pass (2)
62% - 73%: satisfactory (3)
74% - 85%: good (4)
86% - 100%: excellent (5)

References	
Obligatory:	Class materials published in Moodle.
Recommended:	Valéria Oláh Póserné: Security of Information Services, Digitális Tankönyvtár, 2011 (in Hungarian, electronic notes) Tibor Szentgyörgyi – Csaba Filkor – Balázs Borbély: Construction of a Modern Working Environment, Windows Server 2012, Windows 8 and Office 365 bases, Jedlik Oktatási Stúdió Budapest, 2012 (in Hungarian, electronic notes)

	Gregg Kreizman: An Introduction to Information Security Architecture, Gartner The Future of IT Conference, 2011 (electronic notes) IBM Knowledge Center (electronic notes)
Other references:	

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JOHN VON NEUMANN FACULTY OF INFORMATICS

Institute of Cyberphysical Systems			Semester 7. of the curriculum 2026-27-1			
Name of the subject:	Code of the subject:	Credits:	Weekly hours:			
				lec	sem	lab
Technologies of Virtualised Networks and Data Centers *	NKXVA1EBNF	5	full-time	2	0	2
Responsible person for the subject: Dr. habil. Róbert LOVAS			Classification: associate professor			
Subject lecturer(s):						
Prerequisites:	NKXFS1EBNF	Cloud Computing Services				
Way of the assessment:	mid-term grade					

Course description	
Goal:	The course focuses on the system-level theory, design issues and key practical implementations of cloud computing as middleware at an advanced level, mainly focusing on open-source practices (OpenStack) and infrastructure services (IaaS). Students will learn about the theoretical background and practical application of modern infrastructure building tools using different Infrastructure-as-Code tools. Furthermore, software container based (Docker) tools will be introduced, with a focus on their distributed deployment using some cluster building tools (Docker Swarm, Kubernetes). Finally, the design and development of platform services for various Big Data and IoT domains using these tools will be presented through a case study.
Course description:	The course provides a short overview on theoretical and practical knowledge concerning public, private, and hybrid clouds from the aspects of users, system engineers, and operators. The students get acquainted with the types of services (IaaS/PaaS/Saas) offered by clouds, and the main characteristics of their implementations, as well as their typical solutions. Some selected components of cloud, as a middleware, are discussed in details; starting from the block and object stores (e.g. Cinder/Swift), through the components responsible for the authentication (e.g. Keystone), ending with the telemetry and orchestration tools (e.g. Ceilometer/Heat). In the field of platform services, the students get a short overview on the cloud based deployments and use cases of Big Data tools.

Lecture schedule	
Education week	Topic
1.	Introduction
2.	OpenStack: Basics
3.	OpenStack: Keystone, Glance
4.	OpenStack: Nova, Neutron
5.	OpenStack: Cinder, Swift
6.	OpenStack: Heat, Ceilometer
7.	Docker: Container technology
8.	Distributed container platform (Docker Swarm, Kubernetes)
9.	Cloud orchestration tools (Terraform)
10.	AWS: EC2 (IaaS)
11.	AWS: S3
12.	MS Azure (PaaS)
13.	Midterm test
14.	Midterm test retake

Mid-term requirements

Conditions for obtaining a mid-term grade/signature	• Passing at least 51% of the midterm test • Completion of the project work

Assessment schedule

Education week	Topic
13	Midterm test
14	Replacement occasion of the midterm test

Method used to calculate the *mid-term grade* (to be filled out only for subjects with mid-term grades)

The final grade is determined by the midterm test

Type of the replacement

Type of the replacement of written test/mid-term grade/signature	In week 14, the midterm test can be retake. A minimum of 51% must be achieved to pass the subject.

Type of the exam (to be filled out only for subjects with exams)

Calculation of the exam mark (to be filled only for subjects with exams)

Final grade calculation methods:

0% - 50%: fail (1)
51% - 62%: pass (2)
63% - 75%: satisfactory (3)
76% - 88%: good (4)
89% - 100%: excellent (5)

References

Obligatory:	Materials published in Moodle M. Dorn, Preparing for the Certified OpenStack Administrator exam: a complete guide for test takers. Birmingham, UK: Packt Publishing, 2017, ISBN: 978-1-78712-120-1
Recommended:	T. Fifield et al., OpenStack operations guide, First edition. Sebastopol, CA: O'Reilly Media, Inc., 2014, ISBN: 978-1-4919-0630-9 Y. Brikman, Terraform: up and running: writing infrastructure as code, Third edition. Sebastopol, CA: O'Reilly, 2022, ISBN: 978-1-09-811674-3
Other references:	The slides and material used in the lecture will be available on the course website at https://elearning.uni-obuda.hu/ after the lecture.

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Software Engineering Institute			Semester 5. of the curriculum 2025-26-1			
Name of the subject:	Code of the subject:	Credits:	Weekly hours:			
				lec	sem	lab
Parallel and distributed systems programming	NSXPP1EBNF	5	full-time	2	0	2
Responsible person for the subject: Dr. Gábor KERTÉSZ			Classification: associate professor			
Subject lecturer(s):						
Prerequisites:	NKXKSAEBNF	Comprehensive exam				
Way of the assessment:	exam					

Course description	
Goal:	
Course description:	

Lecture schedule	
Education week	Topic
1.	
2.	
3.	
4.	
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8.	
9.	
10.	
11.	
12.	
13.	
14.	

Mid-term requirements	
Conditions for obtaining a mid-term grade/signature	

Assessment schedule	
Education week	Topic

Method used to calculate the *mid-term grade* (to be filled out only for subjects with mid-term grades)

Type of the replacement	
Type of the replacement of written test/mid-term grade/signature	

Type of the exam (to be filled out only for subjects with exams)

Calculation of the exam mark (to be filled only for subjects with exams)	
Final grade calculation methods:	
References	
Obligatory:	
Recommended:	
Other references:	

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Software Engineering Institute			Semester 5. of the curriculum 2025-26-1			
Name of the subject:	Code of the subject:	Credits:	Weekly hours:			
				lec	sem	lab
Advanced Algorithms *	NSXHA1EBNF	4	full-time	2	0	2
Responsible person for the subject: Prof. Dr. Sándor SZÉNÁSI			Classification: professor			
Subject lecturer(s):						
Prerequisites:	NKXKSAEBNF	Comprehensive exam				
Way of the assessment:	exam					

Course description	
Goal:	The aim of the course is to introduce the theoretical and practical foundations of advanced computational problem-solving algorithms, and to investigate their customizability and parallelization.
Course description:	Students will be introduced to the basic types of optimization problems and the basic methods that can be used to solve them: gradient-based methods, evolutionary methods, physics-based solutions, swarm mechanism-based methods. Different clustering algorithms are also covered.

Lecture schedule	
Education week	Topic
1.	The concept and task of optimisation. Formalisation of optimisation tasks.
2.	Hill-Climbing algorithm and its variants.
3.	Basic evolution based algorithms.
4.	Additional evolution-based methods.
5.	Genetic programming.
6.	NSGA I.
7.	NSGA II.
8.	Swarm-based methods. Particle Swarm Optimization.
9.	Physics-based methods. Simulated Annealing.
10.	Random Optimization.
11.	Tabu search.
12.	Clustering. K-means procedure.
13.	DBSCAN procedure. Hierarchical methods.
14.	Presentation of assignments.

Mid-term requirements	
Conditions for obtaining a mid-term grade/signature	To obtain a signature, you must complete three termly assignments selected from the list presented in the first class. Any of the methods taught can be used in the solutions, but each problem must be solved using a different technique. Each solution must be accompanied by a short documentation of the results achieved, in addition to the program code. The signature is conditional on the independent solution of three assignments at least a satisfactory level, their uploading to Moodle by the deadline and their defence on one of the dates indicated. The final deadline for this is the end of the term.

Assessment schedule	
Education week	Topic

Method used to calculate the *mid-term grade* (to be filled out only for subjects with mid-term grades)	
Type of the replacement	
Type of the replacement of written test/mid-term grade/signature	If the number or level of semester assignments is insufficient, they may be made up in the signature substitution examination held during the examination period.
Type of the exam (to be filled out only for subjects with exams)	
The exam is oral. A list of possible questions is available on the subject's website.	
Calculation of the exam mark (to be filled only for subjects with exams)	
The exam mark is based on the student's oral performance.	
Final grade calculation methods:	
Obligatory:	Lecture slides available in the Moodle system.
Recommended:	T. Weise: Global Optimization Algorithms – Theory and Application, 2009 J. Brownlee: Clever Algorithms, 2011
Other references:	

ÓBUDA UNIVERSITY
JOHN VON NEUMANN FACULTY OF INFORMATICS

Software Engineering Institute			Semester 6. of the curriculum 2025-26-2			
Name of the subject:	Code of the subject:	Credits:	Weekly hours:			
				lec	sem	lab
Data-parallel Programming	NSXAP1EBNF	4	full-time	0	0	2
Responsible person for the subject: Prof. Dr. Sándor SZÉNÁSI			Classification: professor			
Subject lecturer(s):						
Prerequisites:	NSXPP1EBNF	Parallel and distributed systems programming				
Way of the assessment:	mid-term grade					

Course description	
Goal:	The course introduces students to the specifics of data parallel programming, the CUDA C programming language and general-purpose programming for graphics accelerators.
Course description:	Students will learn about the basic features and characteristics of GPU hardware. They will then learn the basics of the CUDA C programming language (kernel implementation, data parallel code execution, thread and block handling). Using this knowledge, they will learn about memory management, synchronisation and atomic operations. Finally, the course will cover optimization, programming on multiple GPUs and alternative development options (using CUDA libraries, OpenCL).

Lecture schedule	
Education week	Topic
1.	GPU hardware features. Thread launch. Data-parallel vector addition.
2.	Using multidimensional index space. Synchronization. Parallel word search in text.
3.	Concept and use of blocks. Handling large-scale tasks. Multiplication of matrices.
4.	Atomic operations. Parallelisation of aggregation. Data parallel minimum selection.
5.	Mid-term test
6.	Using shared memory. Data parallel sorting.
7.	CUDA memory model. Matrix multiplication optimization with shared memory.
8.	Optimization issues. Finding an ideal block size.
9.	Use of streams. Development in a multi-GPU environment. Parallel image processing.
10.	Using CUDA class libraries. Random numbers, linear algebra.
11.	OpenCL introduction.
12.	Mid-term test
13.	Presentation of mid-term assignments.
14.	Replacement test/presentations

Mid-term requirements	
Conditions for obtaining a mid-term grade/signature	Students will write two mid-term exams during the semester (expected in weeks 5 and 12). These are compulsory. Students will also be required to complete an assignment during the semester. Following the guidelines outlined in the first class, the draft of the assignment will be presented in week 5, followed by the fully implemented application in a class presentation in week 13.

Assessment schedule	
Education week	Topic
6.	Basic CUDA programming.
12.	CUDA optimization.
14.	Replacement test

Method used to calculate the *mid-term grade* (to be filled out only for subjects with mid-term grades)	
A midterm grade of better than unsatisfactory may be awarded to a student who has passed both examinations at least at satisfactory level, and who submitted and presented his/her midterm assignment on time which has beed accepted by the instructor. The mid-term mark is the average of the marks for the examination, which may be influenced by the quality of the mid-term assignment by ±1 grade.	
Type of the replacement	
Type of the replacement of written test/mid-term grade/signature	If a student has not written or has not reached the satisfactory level in one of the mid-term exams, he/she may write a revision exam from the given topic in the last week. The result of this test replaces the result of the original test. If the student has failed to write both papers or has not achieved a satisfactory level in either of them, he/she may only obtain a mid-term grade better than failed in the mid-term replacement examination announced in the examination period. The mark obtained here is considered to be the mid-year mark. If the student fails to submit the mid-term assignment by the deadline specified above or if the instructor does not accept it as being of satisfactory quality by the end of the semester, he/she may revise the mid-term assignment in the examination period during the mid-term replacement exam, in which case he/she does not have to make up the final examination tests.
Type of the exam (to be filled out only for subjects with exams)	
Calculation of the exam mark (to be filled only for subjects with exams)	
Final grade calculation methods:	
0-49%: failed 50-61%: satisfactory 62-73%: average 74-85%: good 86-100%: excellent	
References	
Obligatory:	NVIDIA: CUDA C Programming Guide
Recommended:	
Other references:	

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Software Engineering Institute			Semester 6. of the curriculum 2025-26-2			
Name of the subject:	Code of the subject:	Credits:	Weekly hours:			
				lec	sem	lab
Developing Large Software Systems	NSXNR1EBNF	4	full-time	3	0	0
Responsible person for the subject: Dr. Zoltán VÁMOSSY			Classification: associate professor			
Subject lecturer(s): Dr. habil József TICK, András KOVÁCS						
Prerequisites:	NSXST1EBNF	Softwaretechnology				
Way of the assessment:	mid-term grade					

Course description	
Goal:	In the framework of the subject, students learn the methods of developing large software systems. They get to know the model-based development of complex software systems, the advanced principles and paradigms of software technology and their application possibilities.
Course description:	Features of software as a product, special challenges of developing large systems, project management of large systems - concepts, project and process metrics, estimation, scheduling, quality management, Software Process Improvement, CMMI, security issues of software systems - Vulnerability types, effective protection , secure code, MS methodology, configuration management, continuous integration – version control systems, branching, work item tracking, project delivery and system integration – Scaled Agile Framework (SAFe model), DevOps mindset, Domain model properties, it's role in software design, DDD (Domain Driven Design), software architecture and Systematic Architecture Design, Risk based testing, Development of a test strategy, testing in industrial practice. Design patterns

Lecture schedule	
Education week	Topic
1.	Software as a product / Creational patterns I. (Factory method, Abstract factory, builder)
2.	Special challenges of large system development
3.	Software quality assurance / Creational patterns II. (Singleton, Prototype)
4.	Software Process Improvement, CMMI
5.	Secure Code / Structural patterns I. (Adapter, Bridge, Composite, Flyweight)
6.	Secure Development Methodologies
7.	Configuration management, continuous integration / Structural patterns II. (Facade, Proxy, Decorator)
8.	Domain modell
9.	Systematic Architecture Design / Behavioral patterns I. (Iterator, Chain of responsibility, Visitor, Observer, Command, Mediator)
10.	Testing in industrial practice
11.	Behavioral patterns II. (Strategy, Template method, Memento, State, Interpreter)
12.	Risk-based Testing
13.	Mid-term Test
14.	Re-take Test

Mid-term requirements	
Conditions for obtaining a mid-term grade/signature	**Mid-term grade based on the mid-term test or re-take test.**

Assessment schedule

Education week	Topic
13.	Mid-Term Test
14.	Re-Take Test

Method used to calculate the *mid-term grade* (to be filled out only for subjects with mid-term grades)

Type of the replacement

Type of the replacement of written test/mid-term grade/signature	In the case if the mid-term test does not reach 50%, the student can replace the test in the form of re-take test in the 14th week. If the student did not obtain the mid-term grade (min. 50%) during the study period, but achieved at least 20% on the mid-term test or re-take test, then at the beginning of the exam period, according to the provisions of the „Study and Exam Rules and Regulations" (TVSZ), the mid-term grade can be replaced.

Type of the exam (to be filled out only for subjects with exams)

Calculation of the exam mark (to be filled only for subjects with exams)

Final grade calculation methods:

Mid-term grade: 0-19% banned 20-49% failed 50-62% passed 63-74% satisfactory 75-87% good 88-100% excellent

References

Obligatory:	Teaching materials uploaded to the moodle system.
Recommended:	Ian Sommerville: Software Engineering, 10th edition, Addison-Wesley, 2015 Bruce R. Maxim and Roger S. Pressman: Software Engineering: A Practitioner's Approach, 8/e McGraw Hill, 2019 Erich Gamma,Richard Helm,Ralph Johnson,John Vlissides: Design Patterns: Elements of Reusable Object Oriented Software, Addison Wesley, 1994 Martin Fowler: Refactoring, Addison Wesley, 1999
Other references:	

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Software Engineering Institute			Semester 6. of the curriculum 2025-26-2			
Name of the subject:	Code of the subject:	Credits:	Weekly hours:			
				lec	sem	lab
Modern Software Technology	NSXST3EBNF	4	full-time	2	0	0
Responsible person for the subject: Dr. Adrienn DINEVA			Classification: associate professor			
Subject lecturer(s): Dr. habil József TICK, Márk TÖRÖK						
Prerequisites:	NSXST1EBNF	Softwaretechnology				
Way of the assessment:	exam					

Course description	
Goal:	Within the framework of the subject, the student should get to know and master the challenges and the mostly used modern technologies for solving them, which most often arise in industrial practice during modern software development.
Course description:	In relation to each problem area, we examine what practical tools are typically available to solve the problems, which are the professional principles that appear in them, so the student is able to solve the tasks that occur in large software systems in practice. Among other topics, we touch on version management strategies, conflict management, dependency management, build tools, continuous integration, enterprise architectures and design patterns, as well as cloud technologies and services.

Lecture schedule	
Education week	Topic
1.	Version management strategies, conflict management
2.	Dependency management, efficient use of Build tools
3.	Continuous Integration and Delivery (CI+CD+CD)
4.	Issue management, task decomposition, estimation
5.	Code review in practice
6.	Enterprise architectures and design patterns
7.	Multiple levels of testing in the development process
8.	Cloud technologies and services
9.	Application of container technologies
10.	Microservices
11.	Scalable data storage and processing
12.	SCRUM in industrial practice
13.	Mid-term Test
14.	Re-take Test

Mid-term requirements	
Conditions for obtaining a mid-term grade/signature	**Signature based on the mid-term test or re_take test.**

Assessment schedule	
Education week	Topic
13.	Mid-Term Test
14.	Re-Take Test

Method used to calculate the *mid-term grade* (to be filled out only for subjects with mid-term grades)

Type of the replacement	
Type of the replacement of written test/mid-term grade/signature	In the case if the mid-term test does not reach 50%, the student can replace the test in the form of re-take test in the 14th week. If the student did not obtain the signature (min. 50%) during the study period, but achieved at least 20% on the mid-term test or re-take test, then at the beginning of the exam period, according to the provisions of the „Study and Exam Rules and Regulations" (TVSZ), signature can be replaced.
Type of the exam (to be filled out only for subjects with exams)	
In case of successful signature, the oral exam completed during the exam period gives the mid-term grade.	
Calculation of the exam mark (to be filled only for subjects with exams)	
Final grade calculation methods:	
Signature: 0-19% banned 20-49% signature refused 50-100% signature	
References	
Obligatory:	Teaching materials uploaded to the moodle system.
Recommended:	Jez Humble, David Farley, "Continuous Delivery: Reliable Software Releases through Build, Test, and Deployment Automation", Addison-Wesley Professional, 2010 Kenneth Geisshirt, Emanuele Zattin, Aske Olsson, Rasmus Voss, "Git Version Control Cookbook: Leverage version control to transform your development workflow and boost productivity", Packt Publishing, 2018 Bahaaldine Azarmi, "Scalable Big Data Architecture: A practitioners guide to choosing relevant Big Data architecture", Apress, 2015 Guy Harrison, "Next Generation Databases: NoSQL, NewSQL, and Big Data", APress, 2016
Other references:	

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Software Engineering Institute			Semester 7. of the curriculum 2026-27-1			
Name of the subject:	Code of the subject:	Credits:	Weekly hours:			
				lec	sem	lab
Backend and frontend development	NSXBF1EBNF	4	full-time	0	0	4
Responsible person for the subject: Dr. Zoltán VÁMOSSY			Classification: associate professor			
Subject lecturer(s):						
Prerequisites:	NSXFSSEBNF	Full-stack development *				
Way of the assessment:	mid-term grade					

Course description	
Goal:	The goal of the course is to familiarize the students about the backend and frontend development techniques in regards of application development.
Course description:	In the course of the subject, continuing the material of the prerequisite subject, the students repeat MVC application development, learn about security options, user and role management. They learn to identify users with an external provider (e.g. Facebook, O365, Google). User management is also learned in an API-based environment, and they learn about token-based authorization. They learn about modern deployment options, cloud platforms and containerization. They develop a client application in Javascript and Typescript using the Angular programming framework. They learn about modern CSS layouts and develop responsive applications.

Lecture schedule	
Education week	Topic
1.	MVC repeat
2.	User and role management, social login
3.	API
4.	
5.	
6.	
7.	
8.	
9.	
10.	
11.	
12.	
13.	
14.	

Mid-term requirements	
Conditions for obtaining a mid-term grade/signature	

Assessment schedule	
Education week	Topic

Method used to calculate the *mid-term grade* (to be filled out only for subjects with mid-term grades)

Type of the replacement	
Type of the replacement of written test/mid-term grade/signature	
Type of the exam (to be filled out only for subjects with exams)	
Calculation of the exam mark (to be filled only for subjects with exams)	
Final grade calculation methods:	
References	
Obligatory:	
Recommended:	
Other references:	