<table>
<tr><td>Subject code:
F.4(1)</td><td colspan="3">Subject name: Mathematical Methods in Modern Information Technologies</td></tr>
<tr><td>Study load:
5 ECTS</td><td>Load of contact hours: 60
(lectures: 20 h,
labs: 40 h)</td><td>Study semester:
Autumn</td><td>Assessment:
Exam</td></tr>
<tr><td>Objectives:</td><td colspan="3">The primary objective of the course is to develop the understanding of connections between computer science and mathematics. The students will develop proficiency with the ability to apply mathematical methodologies to solving real world problems.</td></tr>
<tr><td>Course outline:</td><td colspan="3">Topics covered:

1) Digital signal processing.
2) Integral Transforms and their Applications.
3) Linear algebra applications in computer science.
4) Systems of polynomial equations.
5) Introduction to Symbolic Computations.
6) Boolean algebra.
7) Superpositions of functions. Functional complexity.</td></tr>
<tr><td>Learning Outcomes:</td><td colspan="3">By the end of the course students (in the terms of knowledge, skills, and attitudes) should be able to:
1 – critically evaluate basic concepts from Integral Transforms Theory, and apply them to theoretical and appropriate applied problems in computer science;
2 – use the concepts of digital signal processing in real-life applications;
3 – use the concepts of linear algebra in real-life applications and critical evaluate the connections between linear algebra and computer science;
4 – critically evaluate basic concepts from Boolean Algebra Theory, and apply them to theoretical and appropriate applied problems in computer science;
5 – solve systems of polynomial equations by symbolic methods.</td></tr>
<tr><td>Assessment Methods:</td><td colspan="3">The final grade is composed of: 50% for individual or group project, 50% for final exam.</td></tr>
<tr><td>Teacher(s):</td><td colspan="3">Alexander Loboda</td></tr>
<tr><td>Prerequisite subject(s):</td><td colspan="3">None</td></tr>
<tr><td>Compulsory Literature:</td><td colspan="3"></td></tr>
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	Steven Smith "Digital Signal Processing: A Practical Guide for Engineers and Scientists". Newnes, 2013. R. L. Goodstein "Boolean Algebra". Dover Publications, 2012. James E. Humphreys "Introduction to Lie Algebras and Representation Theory". Springer, 1994. David Cox, John Little, Donal O'Shea "Ideals, Varieties, and Algorithms: An Introduction to Computational Algebraic Geometry and Commutative Algebra". Springer; 2nd edition, 2006.
Replacement Literature:	Ian Anderson "A first course in discrete mathematics". Springer, 2001. L. Debnath "Wavelet Transforms and Time-Frequency Signal Analysis". Birkhauser, 2000.
Participation requirements:	Attendance is mandatory for this course. Students are required to attend classes and to participate in class discussions, small group exercises and projects. Students are responsible for all material presented in each session. Attendance is considered in the calculation of the student's final grade. If a student misses 20% or more of the class sessions, there will be grade penalties, and the instructor reserves the right to issue a failing grade for lack of attendance.
Independent work:	1. Advanced approximation methods. 2. Function series and their applications. 3. The Fourier transform applications. 4. The Radon transform applications. 5. The wavelet transform applications. 6. Solving large systems of polynomial equations: methods and main problems. 7. Symbolic computation algorithms. 8. Lie algebras and their applications. 9. Applications and examples of experimental mathematics. 10. Fuzzy logic applications in computer science. ii.
Grading criteria scale or the minimal level necessary for passing the subject:	Course Grading: Projects = 50% Final Exam = 50% Grading Scale: 90-100 (A – Superior Work) 70-89 (B – Good Work) 50-69 (C – Average Work) 0-49 (F – Unsatisfactory Work)

Information about the course:	Room ___, on ___ at ___
1) Date 1	**Lecture 1** Digital signal processing
2) Date 2	**Lab 1** Interpolation and approximation theory. Frequency response.
3) Date 3	**Lab 2** Function series and their applications.
4) Date 4	**Lecture 2** Integral Transforms and their Applications.
5) Date 5	**Lab 3** The Fourier transform. The Laplace transform.
6) Date 6	**Lab 4** The Radon transform.
7) Date 7	**Lecture 3** Integral Transforms and their Applications.
8) Date 8	**Lab 5** The wavelet transform.
9) Date 9	**Lab 6** Discrete Fourier transform. Fast Fourier transform.
10) Date 10	**Lecture 4** Linear algebra applications in computer science.
11) Date 11	**Lab 7** Lagrange theorem. Weierstrass theorem.
12) Date 12	**Lab 8** Systems of linear equations and other algebraic objects in computer science.
13) Date 13	**Lecture 5** Systems of polynomial equations.
14) Date 14	**Lab 9** Systems of polynomial equations related to some modern problems in mathematics (Lie algebras).
15) Date 15	**Lab 10** Systems of polynomial equations related to some modern problems in mathematics (invertibility of polynomial mappings and the Jacobian Conjecture).
16) Date 16	**Lecture 6** Introduction to Symbolic Computations.
17) Date 17	**Lab 11** Elimination theory.
18) Date 18	**Lab 12** Groebner bases.
19) Date 19	**Lecture 7** Introduction to Symbolic Computations.
20) Date 20	**Lab 13** Groebner bases.
21) Date 21	**Lab 14** Other methods of polynomial systems solving.

22) Date 22	**Lecture 8** Boolean algebra.
23) Date 23	**Lab 15** Boolean function. Many-valued logic.
24) Date 24	**Lab 16** Polynomial representations of the operations of Boolean algebra.
25) Date 25	**Lecture 9** Superpositions of functions. Functional complexity.
26) Date 26	**Lab 17** Hilbert superpositions and functional complexity.
27) Date 27	**Lab 18** Elements of fuzzy logic.
28) Date 28	**Lecture 10** Superpositions of functions. Functional complexity.
29) Date 29	**Lab 19** Individual or group projects presentation
30) Date 30	**Lab 20** Individual or group projects presentation