VIDZEMES AUGSTSKOLA

FACULTY OF ENGINEERING
STUDY COURSE DESCRIPTION

Course Title:	**APPLIED MATHEMATICS**					
Course code (LAIS):	**Mate1002**					
Study programme:	Information technology (ITk) Information technology (IT) Mechatronics (MTk) Mechatronics (MT)					
Level of Study programme:	☒	1st level professional higher education				
	☒	Professional Bachelor				
	☐	Professional Master				
	☐	Academic Master				
	☐	PhD level				
Type of Study programme:	☒	Compulsory course (Part A)				
	☐	Professional specialization courses (Part B, compulsory)				
	☐	Professional specialization optional courses (Part B, optional)				
	☐	Elective courses (Part C)				
Course Workload:	**Credits**		**ECTS**	**Academic hours**	**Contact hours**	**Independent work hours**
PL	4		6	160	64	96
NL	4		6	80	10	70
Course Author/ Tutor:	**Aija Cunska**					
	Lecturer, Dr. math.					
	aija.cunska@va.lv					
	Consultation: according to the schedule for each semester					
Study Form:	Full time studies, Part-time studies					
Study year, semester:	1st year, 1st semester					
Language:	English, Latvian					
Prerequisites for the Course:	A math course at the level of general secondary education. It is necessary to attend and undertake the equalisation course in maths proposed by Vidzeme University of Applied Sciences and to successfully complete the inspection work.					
Course Summary:	The aim of the study course is to promote knowledge on topics of Applied Mathematics connected with the process of information processing and understanding algorithms as well as build a view of possibilities of mathematical modelling and analysis. The program provides the students with theoretical knowledges and skills in the basics of Applied Mathematical science as well as practical basis for professional activities developing skills of scientifical analysis and skills of solving problems in order to provide basis for solving real-world problems. After completing the course students will be able to: provide practice with various challenges with real-world mathematics; draw conclusions; tackle realistic problems; interact with a professionals; define the problem statement; cope with big data; define and justify assumptions; validate and test results; choose an approach; combine mathematical, statistical and computational skills; communicate results to both general and technical audiences.					
Assessment:	Exam					
Requirements for Credits:	The student fulfils and observes the rules, independently and cooperate improves knowledge. To obtain a positive evaluation in the study course: → must be receive a positive assessment in each of the tests (see assessment methods of study results), → the number of justified absences of lectures and practical classes may not exceed 25% of the total amount of the course. A positive assessment in the test is received if the relevant topic has been mastered in general, however, insufficient understanding of some basic concepts is found, there are difficulties in the practical application of certain acquired knowledge.					
Abiding by the Academic	Students must abide by the academic and research ethics, Vidzeme University of Applied					

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<tr><td>Ethics</td><td colspan="2">Sciences Ethics Regulations, incl.:
→ study papers must be independently developed;
→ the study work should reference all statements, ideas and data used that have been authored by someone else;
→ appropriate data acquisition methods should be used in the acquisition of data, the research ethics must be respected, empirical data must be collected independently and cannot be distorted or falsified;
→ the examination must be carried out by the student independently, without the use of supporting materials and/or consultations with other students, unless the lecturer states otherwise.
In the event of non-compliance with the academic and research ethics, punishment is imposed in accordance with the ViA Ethics Regulations and the study course must be re-taken, unless the punishment is extramarital.</td></tr>
<tr><td rowspan="11">Learning Outcomes; the evaluation methods and criteria</td><td>Learning Outcomes</td><td>The evaluation methods and criteria</td></tr>
<tr><td colspan="2">Knowledge</td></tr>
<tr><td>Fully knows the concepts, formulas and relations on the topics of linear algebra, vector algebra, analytical geometry, functions, boundaries, differential equations, complex numbers and logic.</td><td>Test of general secondary education mathematics knowledge.
Inspection work on the subject of each topic.</td></tr>
<tr><td>Demonstrates an understanding of the correct use of formulas, mathematical language and symbols.</td><td>Practical works on the subject of each topic.
Integrated final test.</td></tr>
<tr><td colspan="2">Skills</td></tr>
<tr><td>Able to independently understand, argue and solve mathematical problems, demonstrating an understanding of it.</td><td>Integrated final test.</td></tr>
<tr><td>Is able to quickly find and apply the information, technologies and tools necessary for the performance of tasks.</td><td>Practical work with mathematical applications (Matlab, WolframAlpha, Photomath, etc.).</td></tr>
<tr><td>In cooperation with study members, is able to evaluate, select and explain various methods of solving mathematical problems.</td><td>Practical work, self-assessment and others assessment of study members on open - ended mathematics problems.</td></tr>
<tr><td colspan="2">Competency</td></tr>
<tr><td>Correctly creates, analyzes and applies mathematical relationships in real life, production and technology situations.</td><td>Presentation with practical application of the essence of mathematics.</td></tr>
<tr><td>Course Compulsory literature:</td><td colspan="2">1. Aspnes, J. (2020). Notes on Discrete Mathematics. https://www.cs.yale.edu/homes/aspnes/classes/202/notes.pdf
2. Cherney, D., Denton, T., Waldron, A. (2013). Linear Algebra. https://www.math.ucdavis.edu/~linear/linear-guest.pdf
3. Konev, V.V. (2009). Linear algebra, Vector algebra and Analytical geometry. https://portal.tpu.ru/SHARED/k/KONVAL/Textbooks/Tab1/Konev-Linear_Algebra_Vector_Algebra_and_Analytical_Geome.pdf
4. Lankham, I., Nachtergaele, B., Schilling, A. (2011). Linear Algebra. https://www.math.ucdavis.edu/~anne/linear_algebra/mat67_course_notes.pdf
5. Matthews, K.R. (1998). Elementary Linear Algebra. http://www.r-5.org/files/books/computers/algo-list/linear-algebra/Keith_Matthews-Elementary_Linear_Algebra-EN.pdf
6. RTU e-studijas. Augstākā matemātika 1.semestris. https://estudijas.rtu.lv/course/view.php?id=38111</td></tr>
<tr><td>Course additional literature:</td><td colspan="2">1. Conradi, W., Goranko, V. (2015). Logic and Discrete mathematics. A concise introduction.
2. Norman, D., Wolczuk, D. (2017). Algebra and Geometry. Introduction to Linear Algebra for Science and Engineering.
3. Strang, G. (2019). Linear Algebra and Learning from Data.
4. Strang, G. (2016). Introduction to linear algebra. Fifth edition.</td></tr>
<tr><td>Course confirmation date:</td><td colspan="2"></td></tr>
<tr><td>Date of course description update:</td><td colspan="2">01.07.2020.</td></tr>
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Study Course Plan:

Date	Theme	Academic hours		Study Form/ Organization of independent work of students and task description
		Contact hours	Independent work hours	
The date is specified before the implement ation of the course	Determinants. Operations with matrices. The rank of a matrix. Elementary transformations of a matrix. Inverse matrix. Matrix equations. Linear systems of equations.	5	7	Basic test. Lecture. Practical work in cooperation. Test to strengthen the topic.
	Linear systems of equations. Matrix method. Cramer`s Rule. Gaussian Elimination method.	5	7	Open problems for systems of linear equations for different solutions. Presentation on the application of linear algebra. Test to strengthen the topic. Working with math applications.
	Fundamental concepts of vectors. Linear operations with vectors. Projection of the vector on coordinate axis. Vector coordinates in space. Linear dependence of vectors. Scalar (or dot) product of two vectors. Vector (or Cross) product of two vectors. The scalar triple product of vectors in three-dimensional space.	5	7	Presentation on the use of vectors. Open - ended problems in calculating areas and volumes. Practical work with the opportunity to teach others. Test to strengthen the topic.
	Analytical geometry. Straight lines equations in the plane. Angle between straight lines. Second-order curves. Plane and line equations in space.	5	7	Lecture. Practical work in cooperation. Visualization. Working with math applications. Test to strengthen the topic.
	Logic and expressions. Propositional logic. Predicates and Quantification. The language of logic. Inference rules. Binary Relations. Graph Theory. Proof techniques. Mathematical induction method.	5	7	Lecture. Problems of open-ended mathematics. Practical work with the opportunity to teach others. Test to strengthen the topic.
	Set theory. Classes and sets. The algebra of sets. Comparison of sets. Sets and different types of relations. Operations of Sets. Venn Diagrams. Graphs, relations and functions.	4	7	Lecture. Practical work in cooperation. Test to strengthen the topic.
	Introduction in mathematical analysis. Basic concepts of functions. Limits and their calculations. Comparison of infinitely small values. Function continuity. Breakpoints and their types.	5	7	Presentation on applications of functions. Practical work in cooperation. Working with math applications. Test to strengthen the topic.
	Derivation of elementary functions. Geometric interpretation of the derivative. Basic rules of derivation. A derivative of a compound function. Basic formulas of derivative.	5	7	Lecture. Practical work with the opportunity to teach others. Self-esteem. Working with math applications. Test to strengthen the topic.
	Monotonity of functions, extremes, the highest and the lowest values in closed interval. Analysing the second derivative to find inflection points. Asymptotes of function graphic. General scheme of function research.	5	7	Presentation on the use of derivatives. Visualization. Working with math applications. Group work. Test to strengthen the topic.

	Complex numbers. Algebraic, trigonometric and exponential form of complex numbers. Operations with complex numbers.	4	7	Lecture. Practical work with the opportunity to teach others. Test to strengthen the topic.
	Higher order derivatives and differential equations. Basic theorems of differential calculus. L`hopital`s rules.	4	7	Lecture. Practical work in groups on understanding and application of differential calculus.
	Functions with several arguments. Concept of two arguments functions, limits and continuity. Partial derivatives and total differential. Total differential of a two-argument function.	4	7	Lecture. Practical work in groups on understanding and application of differential calculus. Interdisciplinary approach.
	Practical applications of mathematical calculations.	4	12	Student presentations.
	Integrated final test.	4		Exam
	Hours total:	***64***	***96***	

Study course plan for part-time students:

Date	Theme	Academic hours		Study Form/ Organization of independent work of students and task description
		Contact hours	Independent work hours	
The date is specified before the implement ation of the course	Determinants. Operations with matrices. The rank of a matrix. Elementary transformations of a matrix. Inverse matrix. Matrix equations. Linear systems of equations.	1	8	Presentation on the application of linear algebra. Working with math applications. Independent practical work. Test to strengthen the topic.
	Fundamental concepts of vectors. Linear operations with vectors. Projection of the vector on coordinate axis. Vector coordinates in space. Linear dependence of vectors. Scalar (or dot) product of two vectors. Vector (or Cross) product of two vectors. The scalar triple product of vectors in three-dimensional space.	1	8	Lecture. Presentation on the use of vectors. Open-ended problems in calculating areas and volumes. Independent practical work. Test to strengthen the topic.
	Line equation in Cartesian coordinate system. Equations of a line in a plane. Second order lines. Plane equation in space. Straight line equations in space. The simplest second-order surfaces.	1	8	Lecture. Working with math applications. Independent practical work. Test to strengthen the topic.
	Set theory. Classes and sets. The algebra of sets. Comparison of sets. Sets and different types of relations. Operations of Sets. Venn Diagrams. Graphs, relations and functions.	1	8	Lecture. Independent practical work. Test to strengthen the topic.
	Introduction in mathematical analysis. Basic concepts of functions. Limits and their calculations. Comparison of infinitely small values. Function continuity. Breakpoints and their types.	1	8	Presentation on function applications. Working with math applications. Independent practical work. Test to strengthen the topic.
	Derivation of elementary functions. Geometric interpretation of the derivative. Basic rules of derivation. A derivative of a compound function. Basic formulas of derivative.	1	8	Lecture. Practical work with the opportunity to teach others. Self-esteem. Working with math applications. Test to strengthen the topic.
	Monotonity of functions, extremes, the highest and the lowest values in closed interval. Analysing the second derivative to find inflection points. Asymptotes of	1	8	Presentation on the use of derivatives. Visualization. Working with math

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	function graphic. General scheme of function research.			applications. Group work. Test to strengthen the topic.
	Functions with several arguments. Concept of two arguments functions, limits and continuity. Partial derivatives and total differential. Total differential of a two-argument function.	1	7	Lecture. Practical work in cooperation to strengthen the topic. Interdisciplinary approach. Student presentations.
	Complex numbers. Algebraic, trigonometric and exponential form of complex numbers. Operations with complex numbers.	1	7	Lecture. Independent practical work. Test work to strengthen the topic.
	Integrated final test.	1		Exam.
	Hours total:	***10***	***70***	