GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Numerical Methods in Automatic Control - laboratory, PG_00047694		
Field of study	Automatic Control, Cybernetics and Robotics		
Date of commencement of studies	October 2020	Academic year of realisation of subject	2022/2023
Education level	first-cycle studies	Subject group	Optional subject group Subject group related to scientific research in the field of study
Mode of study	Full-time studies	Mode of delivery	at the university
Year of study	3	Language of instruction	Polish
Semester of study	6	ECTS credits	2.0
Learning profile	general academic profile	Assessment form	assessment
Conducting unit	Department of Decision Systems and Robotics -> Faculty of Electronics, Telecommunications and Informatics		
Name and surname of lecturer (lecturers)	Subject supervisor	dr inż. Mariusz Domżalski	
	Teachers	dr inż. Mariusz Domżalski	

Lesson types and methods of instruction

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	0.0	0.0	30.0	0.0	0.0	30

E-learning hours included: 0.0

Learning activity and number of study hours

Learning activity	Participation in didactic classes included in study plan	Participation in consultation hours	Self-study	SUM
Number of study hours	30	2.0	18.0	50

Subject objectives

Learning and mastering the practice of modern numerical algorithms required to solve number of engineering problems.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K6_U04] can apply knowledge of programming methods and techniques as well as select and apply appropriate programming methods and tools in computer software development or programming devices or controllers using microprocessors or programmable elements or systems specific to the field of study	Student is able to implement numerical methods algorithms. Student is able to assess the correctness of numerical algorithms.	[SU4] Assessment of ability to use methods and tools [SU1] Assessment of task fulfilment
[K6_U01] can apply mathematical knowledge to formulate and solve complex and non-typical problems related to the field of study and perform tasks, in an innovative way, in not entirely predictable conditions, by:n- appropriate selection of sources and information obtained from them, assessment, critical analysis and synthesis of this information,n- selection and application of appropriate methods and toolsn	Student is able to analyze mathematical problems and choose appropriate numerical methods to solve them. Student is able to use external sources when solving numerical problems.	[SU3] Assessment of ability to use knowledge gained from the subject [SU2] Assessment of ability to analyse information

Subject contents

1. Numbers representation, errors, numerical stability.
2. Solution of linear algebraic equations: Gauss elimination.
3. LU factorization, the matrix inverse, vector and matrix norms, matrix condition number.
4. Solution of systems of nonlinear equations: Newton-Raphson method.
5. LQR optimal control.
6. Approximation. Nonlinear regression. Least squares method.
7. Kalman filtering.
8. Interpolation. Newton polynomials. Splines and piecewise interpolation.
9. Numerical integration of functions. Romberg method. Gauss quadrature.
10. Solution of ordinary differential equations: Euler's method, Heun's method, midpoint method.
11. Solution of systems of ordinary differential equations: Runge-Kutta method.
12. Equations and systems of differential equations: boundary-value problems. Finite-difference method.

<table>
<tr><td>Prerequisites and co-requisites</td><td colspan="2"></td></tr>
<tr><td>Assessment methods and criteria</td><td colspan="2"><table><tr><th>Subject passing criteria</th><th>Passing threshold</th><th>Percentage of the final grade</th></tr><tr><td>Programming excercises</td><td>50.0%</td><td>100.0%</td></tr></table></td></tr>
<tr><td rowspan="3">Recommended reading</td><td>Basic literature</td><td>• Lecture notes in Numerical Methods in Automation and Robotics.</td></tr>
<tr><td>Supplementary literature</td><td>• Anthony Ralston, A First Course in Numerical Analysis, 2nd edition, Dover Publications, 2001.
• Numerical Recipes in C, Second Edition (1992), http://http://www.nrbook.com/a/bookcpdf.php.
• Steven C. Chapra, Applied Numerical Methods with MATLAB for Engineers and Scientists, 2nd edition, McGraw-Hill, 2006.</td></tr>
<tr><td>eResources addresses</td><td></td></tr>
<tr><td>Example issues/ example questions/ tasks being completed</td><td colspan="2">The least squares method in identifying the transmittance of a dynamic linear object.

Implementation of the Kalman filter for a discrete system.

Solving ordinary differential equations using Runge-Kutta methods.

Solving partial differential equations using the finite difference method.</td></tr>
<tr><td>Work placement</td><td colspan="2">Not applicable</td></tr>
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