



## Subject card

Subject name and code	Modelling and Simulation Languages , PG_00053916						
Field of study	Automatic Control, Cybernetics and Robotics						
Date of commencement of studies	October 2021	Academic year of realisation of subject			2023/2024		
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	5	ECTS credits			4.0		
Learning profile	general academic profile	Assessment form			exam		
Conducting unit	Department of Automatic Control -> Faculty of Electronics, Telecommunications and Informatics						
Name and surname of lecturer (lecturers)	Subject supervisor		dr inż. Marcin Ciołek				
	Teachers		dr inż. Marcin Ciołek				
Lesson types and methods of instruction	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	30.0	0.0	15.0	0.0	0.0	45
	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	45		4.0		51.0	100
Subject objectives	New skills of process modelling and simulation using MATLAB language						
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		Gaining skills of using MATLAB tool		[SU3] Assessment of ability to use knowledge gained from the subject		
	[K6_U11] can plan and organise individual and team work		Gaining skill of using MATLAB to solve modeling problems		[SU3] Assessment of ability to use knowledge gained from the subject		

Subject contents	<p>1. Numerical calculations in floating point arithmetic, standard IEEE. Representation of numbers. Precision. PC machine accuracy. Rounding. Emergencies (NaN, Inf). The loss of accuracy.</p> <p>2. The "condition number" of a matrix. Accuracy and stability of numerical algorithms. Analysis of errors of the solution of a system of linear equations. Emergencies (NaN, Inf). The loss of accuracy.</p> <p>3. Representation of the data and addressing in Matlab. Basic elements of data processing in Matlab (sorting, averaging, correlation analysis).</p> <p>4. Methods for regression and polynomial approximation. Interpolation. Differential Equations and filtration. The Fourier analysis and the Fast Fourier Transform. Multidimensional data structures in Matlab. Emergencies (NaN, Inf). The loss of accuracy.</p> <p>5. Norms. Dot product. Orthogonality. Projections. Orthogonal transformation. Solving systems of linear equations.</p> <p>6. Factorization of linear operators. Eigenvalue problem and generalized eigenvalue problem for a linear operator. Decomposition of a linear operator in the singular values.</p> <p>7. An estimate of the number of linearly independent rows or columns of a full matrix. The Moore-Penrose pseudoinverse. The task of least squares. The sensitivity of the solution of a system of linear equations to errors in the data.</p> <p>8. Models in state-space linear systems (objects) dynamic invariant with respect to time. Determination of the state space model based on the description of a system of linear ordinary differential equations. Linearization of nonlinear differential equations. Numerical solution of the equation of state.</p> <p>9. Stiff problems of the dynamic systems. Periodic solution.</p> <p>10. Modeling objects (processes) of a very large size - methods based on the description in the form of a sparse matrix. Representation of the sparse matrix. Basic arithmetic operations using sparse matrices. Solving systems of linear equations with sparse matrices. Factorization of sparse matrix. Eigenvalue problem of sparse matrix.</p>		
Prerequisites and co-requisites			
Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
	The final exam	50.0%	100.0%
Recommended reading	Basic literature	<p>1. P. Davis: Differential Equations - Modelling with MATLAB, Prentice Hall, 1999.</p> <p>2. Documentation of MATLABa i SIMULINKa</p>	
	Supplementary literature	<p>1. L.F. Shampine, I. Gladwell, S. Thompson: Solving ODEs with MATLAB, Cambridge University Press, 2003.</p>	
	eResources addresses	<p>Adresy na platformie eNauczanie:          Języki Modelowania i Symulacji - Moodle ID: 33850  <a href="https://enauzanie.pg.edu.pl/moodle/course/view.php?id=33850">https://enauzanie.pg.edu.pl/moodle/course/view.php?id=33850</a></p>	
Example issues/ example questions/ tasks being completed			
Work placement	Not applicable		