

FACULTY OF ELECTRICAL  
ENGINEERING**SUBJECT CARD**

Name in Polish: **Programowanie w środowisku MATLAB**  
 Name in English: **Programming in MATLAB**  
 Main field of study (if applicable): **Control Engineering and Robotics**  
 Specialization (if applicable):  
 Level and form of studies: **1st level, full-time**  
 Kind of subject: **obligatory**  
 Subject code: **ARR043204**  
 Group of courses: **NO**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU):	15		30		
Number of hours of total student workload (CNPS):	60		60		
Form of crediting:	crediting with grade		crediting with grade		
For group of courses mark (X) final course:					
Number of ECTS points:	2		2		
including number of ECTS points for practical (P) classes :			2		
including number of ECTS points for direct teacher-student contact (BK) classes:	1.40		1.40		

**PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES**

1. Has a basic knowledge on PC computer usage
2. Has a basic knowledge on algorithms creation
3. Has a basic knowledge on the methods of mathematical description of linear control systems, their performance and analysis
4. Is able to use the PC computer on basic level
5. Can make a programme for PC computer on basic level
6. Can solve the problems related to the analysis of linear controlled systems; knows how to use the proper mathematical methods for time-domain analysis of controlled plants
7. Understands the necessity of taking part in student laboratories and exercises to obtain new knowledge and skills

**SUBJECT OBJECTIVES**

- C1. Familiarizing students with theoretical knowledge related to programming in MATLAB environment  
 C2. Familiarizing students with basic practical knowledge related to programming in MATLAB environment  
 C3. The acquisition of practical knowledge and skills for calculating of basic parameters and quantities characterizing linear control systems and analysis of controlled objects, using MATLAB

**SUBJECT EDUCATIONAL EFFECTS***relating to knowledge:*

- PEK\_W01 Has knowledge on basic rules of programming in MATLAB and SIMULINK  
 PEK\_W02 Has knowledge how to apply programming methods, numerical and graphical methods  
 PEK\_W03 Has matured knowledge on ways of MATLAB application for testing steady-state and dynamical performance of different controlled plants

*relating to skills:*

- PEK\_U01 Can design the computer programme for calculation of characteristics, parameters and dynamical responses of simple controlled systems  
 PEK\_U02 Can design computer programme using MATLAB/SIMULINK software and suitable numerical and graphic methods

*relating to social competences:*

- PEK\_K01 Understand the need for continuous life-long learning and qualifications improving, concentration in fundamental problems and developing skills for applying the obtained knowledge

PROGRAMME CONTENT		
Form of classes - lecture		Number of hours:
Lec 1	Introduction to MATLAB, basic instructions in MATLAB window, calculation of arithmetic and algebraic equations, data types	2
Lec 2	Developing of user functions, graphics, matrix and vector calculations, complex numbers, structural instructions	2
Lec 3	Control systems analysis and synthesis using MATLAB (transfer functions, step and impulse answers, system stability, frequency characteristics, controllability and observability, transients in dynamical systems)	2
Lec 4	Solving of differential equations using MATLAB. Numerical differentiation and integration. Processing off measurement data using MATLAB	2
Lec 5	Application of SIMULINK to design of simple control systems (modeling of simple electrical circuits)	2
Lec 6	Application of SIMULINK to design of closed-loop control systems (modeling of mechatronic systems)	2
Lec 7	Application of MATLAB-SIMULINK for computer aided design of control systems and DSP based systems.	2
Lec 8	Crediting with grade.	1
Total hours:		15

Form of classes - laboratory		Number of hours:
Lab 1	Introduction to MATLAB – basic instructions and programming rules	2
Lab 2	Matrix calculus – basic matrix and vector operations.	2
Lab 3	Graphics programming in MATLAB	2
Lab 4	Solving of linear equation sets	2
Lab 5	Solving of interpolation and approximation tasks	2
Lab 6	MATLAB application for solving of differential equation sets	2
Lab 7	Numerical differentiation and integration in MATLAB	2
Lab 8	MATLAB application for analysis and synthesis of linear systems in time and frequency domain	2
Lab 9	Introduction to SIMULINK. Different transient's generation. Drawing of dynamical systems' answers to different reference signals	2
Lab 10	Testing of dynamical properties of linear controllers P, PI, PID. Chosen criteria of adjustment of controller parameters, their influence to transient response of the system with controller to different reference signals.	2
Lab 11	Modeling of simple linear control systems	2
Lab 12	Modeling of nonlinear control systems	2
Lab 13	Modeling of the DC motor based on its differential equations and transfer function	2
Lab 14	Dynamical analysis of the DC motor speed control system	2
Lab 15	Crediting with grade	2
Total hours:		30

TEACHING TOOLS USED
N1. Lecture with multimedia tools combined with classical lecture (problem oriented)
N2. Own work – studying problems and preparation to the exam
N3. Consultations
N4. Own work – preparation to the laboratory exercises
N5. Testing of student knowledge with short test before laboratory exercises
N6. Laboratory exercises – discussion of the obtained experimental results in reports

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT		
Evaluation <small>F – forming (during semester) P – concluding (at semester end)</small>	Educational effect number	Way of evaluating educational effect achievement
F1(W)	PEK_W01 PEK_W02 PEK_W03	Test (written)
P(W)	P=F1	
F1(L)	PEK_U01 PEK_U02	Evaluation of student preparation to laboratory exercises
F2(L)	PEK_U01 PEK_U02 PEK_K01	Activity in the laboratory practices
F3(L)	PEK_U01 PEK_U02	Evaluation of the laboratory reports
P(L)	P=0,2*F1+0,4*F2+0,4*F3	

<b>PRIMARY AND SECONDARY LITERATURE</b>
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<b>PRIMARY LITERATURE:</b>
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| <p>[1] Mrozek B., Mrozek Z., MATLAB uniwersalne środowisko do obliczeń naukowo-technicznych, Wydawnictwo PLJ, Warszawa 2011</p> <p>[2] Zalewski A., Cegieła R., MATLAB - obliczenia numeryczne i ich zastosowanie, Nakom, Poznań, 1996</p> <p>[3] Brzózka J., Dorobczyński L., Programowanie w MATLAB,, MIKOM, Warszawa, 1998</p> |
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<b>SECONDARY LITERATURE:</b>
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| <p>[1] Saadat H., Computational aids in control systems using Matlab, McGraw-Hill, Inc., New York 1993,</p> <p>[2] Ogata K., Solving Control Engineering Problems with MATLAB, PRENTICE HALL, New Jersey 1993</p> |
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<b>SUBJECT SUPERVISOR</b>
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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT  
**ARR043204 - Programming in MATLAB**  
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY **Control Engineering and Robotics**

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1AiR_W13	C.1 C.2	Lec1 Lec2 Lec3 Lec4 Lec5 Lec6 Lec7 Lec8	N.1 N.2 N.3
PEK_W02	K1AiR_W13	C.1 C.2	Lec1 Lec2 Lec3 Lec4 Lec5 Lec6 Lec7 Lec8	N.1 N.2 N.3
PEK_W03	K1AiR_W13	C.1 C.2	Lec1 Lec2 Lec3 Lec4 Lec5 Lec6 Lec7 Lec8	N.1 N.2 N.3
PEK_U01	K1AiR_U11	C.3	Lab1 Lab2 Lab3 Lab4 Lab5 Lab6 Lab7 Lab8 Lab9 Lab10 Lab11 Lab12 Lab13 Lab14 Lab15	N.4 N.5 N.6
PEK_U02	K1AiR_U11	C.3	Lab1 Lab2 Lab3 Lab4 Lab5 Lab6 Lab7 Lab8 Lab9 Lab10 Lab11 Lab12 Lab13 Lab14 Lab15	N.4 N.5 N.6
PEK_K01	K1AiR_K03 K1AiR_K04 K1AiR_K05	C.3	Lab1 Lab2 Lab3 Lab4 Lab5 Lab6 Lab7 Lab8 Lab9 Lab10 Lab11 Lab12 Lab13 Lab14 Lab15	N.1 N.2 N.3 N.4 N.5 N.6