(*faculty stamp*)

COURSE DESCRIPTION

1. Course title: CAD OF CONTROL SYSTEMS	**2. Course code**
3. Validity of course description: 2016/2017	
4. Level of studies: BSc programme	
5. Mode of studies: intramural studies	
6. Field of study:	(FACULTY SYMBOL)
7. Profile of studies:	
8. Programme:	
9. Semester:	
10. Faculty teaching the course: Marian Błachuta	
11. Course instructor: Roman Czyba	
12. Course classification:	
13. Course status: compulsory	
14. Language of instruction: English	
15. Pre-requisite qualifications: Algebra and Analytic Geometry, Introduction to System Dynamics, Control Fundamentals, Microprosessor Systems	
16. Course objectives: The objective of the lectures is to give fundamentals of numerical procedures and programs used for Computer Aided Design in Control Systems, while laboratory aims at fast prototyping tools used to design embedded controllers for selected laboratory plants. The theory is complemented with practical aspects of embedded control system.	
17. Description of learning outcomes:	

Nr	Learning outcomes description	Method of assessment	Teaching methods	Learning outcomes reference code
1.	Has knowledge of chosen areas of linear algebra used in numerical procedures and sources of errors in numerical programs	SP	WT,WM	
2.	Knows and understands basic linear algebra algorithms implemented in MATLAB	SP	WT,WM	
3.	Knows the basic algorithms of computer-aided design of control systems and algorithms for rapid prototyping of embedded systems	SP	WT,WM	
4.	Can carry out the process of analysis and synthesis of control algorithm using the CADCS tools	RP	P	
5.	Is able to implement the control algorithm to an embedded system using tools for rapid prototyping	RP	P	
6.	Is able to make their own decisions about the best design solutions	RP	P	
7.	Is able to present and defend the proposed design solution	OP	P	

18. Teaching modes and hours

Lecture 30 Laboratory 30

19. Syllabus description:

Semester : 7

Lecture:

I. Introduction: History of CADCS, stages of design process, evolution of design tools, MATRIXx and MATLAB approaches to the design process.
II. Selected Problems of Linear Algebra: norms of vectors and matrices, typical norms, relationships between norms of vectors and matrices, typical induced norms. Particular types of matrices and their properties, orthogonal matrices and their properties, complex matrices, normal matrix, Hermitian matrix, unitary matrices and their properties, Schur matrix and eigenvalues of a matrix, unitary similarity transformation to a Schur matrix
III. Selected issues of numerical methods: sources of errors in numerical computations, floating point arithmetic and its precision, IEEE Standard 754, exceptions, overflow, underflow, rounding errors. Backward stability and problem conditioning, condition numbers.
IV. Selected numerical algorithms: LU factorization, solving systems of linear equations, condition number of a matrix. Hausholder transformation an QR factorization. Least-squares problem and its solution via QR factorization. Hessenberg form of a matrix. Eigenvalues computation via QR algorithm, generalized eigenvalues and QZ algorithm. Singular Value Decomposition, its properties and applications. Computing matrix exponent and matrix logarithm. Overview of MATLAB matrix functions.
V. Numerical procedures for control: algorithms for conversion from state-space to transfer function form, Markov parameters, canonical representations of state-space models and their relationship with transfer function, transformations between continuous-time and discrete-time systems, δ - operator models, computation of frequency plots, van Dooren algorithm for investigation of the structure of controllability and observability, controllability and observability Gramians, balanced realizations, model approximation, Lyapunov equations and associated numerical algorithms

Laboratory:

I. Introduction. Configuration of environments Simulink and CodeWarrior.
II. Interface RS232. Fundamentals of programming.
III. Data transmission in CAN network.
IV. PWM control method. Reading analog values.
V. Modeling of the DC motor dynamics.
VI. PID discrete regulation.
VII. Prototyping of control system.

20. Examination:

21. Primary sources:

1. P.Hr. Petkov, N.D. Christov, M.M. Konstantinov Computational methods for linear control systems, Prentice Hall International, 1991;
2. G.W. Stewart: Matrix Algorithms, vol. 1. Basic Decompositions, SIAM, 1998;

22. Secondary sources:

1. Phillips CL., Harbor R.D.: Feedback Control Systems (Third Edition) Prentice Hall, 1996.
2. Goodwin G.C., Graebe S.F., Salgado M.E.: Control Systems Design, Prentice Hall, 2001
3. J. Maciejowski: Multivariable Feedback Design, Addison-Wesley, 1989

23. Total workload required to achieve learning outcomes

Lp.	Teaching mode :	Contact hours / Student workload hours
1	Lecture	30/0
2	Classes	/
3	Laboratory	30/30
4	Project	/
5	BA/ MA Seminar	/
6	Other	/
	Total number of hours	60/30

24. Total hours: 90

25. Number of ECTS credits: 3

26. Number of ECTS credits allocated for contact hours: 2

27. Number of ECTS credits allocated for in-practice hours (laboratory classes, projects): 1

26. Comments:

Approved:

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(date, Instructor's signature) (*date , the Director of the Faculty Unit signature)*