(*faculty stamp*)

COURSE DESCRIPTION

Z1-PU7	WYDANIE N1	Strona 1 z 3

1. Course title: ROBOTICS	**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: MACROCOURSE	(FACULTY SYMBOL) AEII
7. Profile of studies: General Academic	
8. Programme: AUTOMATIC CONTROL	
9. Semester: 6	
10. Faculty teaching the course: Institute of Automatic Control, Rau1	
11. Course instructor: Aleksander Staszulonek Ph.D.	
12. Course classification: specialization course	
13. Course status: compulsory	
14. Language of instruction: English	
15. Pre-requisite qualifications: Before this course student should attend lectures on mathematical analysis, differential equations, algebra, physics and microcomputer programming. Strongly recommended is knowledge of assembly and C language programming. Knowledge of Lagrange equations is significant advantage as well. Additionally Mathematical analysis, Physics, Mechanics, Syste's Dynamics.	
16. Course objectives: Course is part of specialized curriculum content and is related to education in areas of robotics, embedded systems, robot control systems and servomechanism control. The goal of this course is to provide students with the main elements of robot theory: mathematics, programming and control. The theory is complemented with laboratory exercises familiarizing students with practical aspects or robot control systems structure, control algorithms and programming.	
17. Description of learning outcomes:	

Nr	Learning outcomes description	Method of assessment	Teaching methods	Learning outcomes reference code
1.	Knows kinematical structure of industrial robots and their sensory systems.	SP/PS	**WT/WM/L**	K_W14
2.	Knows robot control systems and applied control methods and algorithms .	SP/PS	**WT/WM/L**	K_W15, K_W20
3.	Is familiar with robot manipulator's kinematics and dynamics.	SP/PS	**WT/WM/L**	K_W14
4.	Is familiar with servomechanisms and drives applied in robot manipulators.	SP/PS	**WT/WM/L**	K_W15, K_W21
5.	Can derive kinematic and dynamic equations of robot manipulators.	SP/PS	**WT/WM/L**	K_U08, K_U18
6.	Is able to solve direct and reverse kinematic problems for robot manipulator.	SP/PS	**WT/WM/L**	K_U18
7.	Is able to evaluate quality of control system, select appropriate control algorithm and tune its parameters.	SP/PS	**WT/WM/L**	K_U01, K_U11
8.	Is able to develope software for robot control and desired trajectory execution.	SP/PS	**WT/WM/L**	K_U02, K_U03, K_U19

18. Teaching modes and hours

Lecture / BA /MA Seminar / Class / Project / Laboratory

Sem 6 - Lecture 30 h., Sem 6 – Laboratory 30 h

19. Syllabus description:

Semester 6 :

Lecture:

Program of the course includes: introduction to C and assembly language programming of embedded control systems, homogenous transformations, derivation of kinematic equations, kinematic equations solution, dynamics, control, trajectory execution and programming.

Section dedicated to homogenous transformations contains description of basic definitions like vectors, planes, coordinate frames, basic transformations, relative and inverse transformations, equivalent angle and axis of rotation. Section dedicated to derivation of kinematic equations deals with different coordinate systems, specification of A matrices for manipulator's prismatic and rotational links, specification of T matrices in terms of A matrices. As the example, kinematic equations of Stanford and Elbow Manipulators are derived. Methods leading to the solution of kinematic equations are described and solutions for Stanford and Elbow manipulators are presented. The dynamics of robot manipulators is then presented using Lagrangian equations. Requirements imposed on robot control systems are presented and set point and tracking control problems defined. Basic theory and methodology of robot control is presented on the examples of most frequently applied control structures. PID and sliding mode controllers are discussed.

Laboratory:

The laboratory exercises include the following tasks:

1. Robot control system structure and servomechanism control
2. Introductory aspects of C and assembly language programming of embedded controllers
3. Programming of communication between embedded system and servocontroller
4. Programming of single degree of freedom controller with digital PID algorithm
5. Implementation of desired trajectory specification
6. Programming of 6 degrees of freedom embedded controller and motion coordination

Synchronization of the robot.

20. Examination: NO

21. Primary sources:

1. Gessing R. Teoria sterowania T.1. Układy liniowe, Skrypt Pol.Śl., Gliwice, 1991, Wyd. 2.
2. Richard P. Paul – "Robot Manipulators: Mathematics, Programming, And Control"
3. Itkis U.: Control Systems of Variable Structure

22. Secondary sources:

1. Brian W. Kernighan, Denis M. Ritchie – "Język ANSI C", WNT Warszawa 2004, Wyd IX
2. Kaczorek T., Dzieliński A., Dąbrowski W., Łopatka R.: „Podstawy teorii sterowania", WNT 2009, Wyd. 3.

23. Total workload required to achieve learning outcomes

Lp.	Teaching mode :	Contact hours / Student workload hours
1	Lecture	30/20
2	Classes	0/0
3	Laboratory	30/30
4	Project	0/0
5	BA/ MA Seminar	0/0
6	Other	10/10
	Total number of hours	70/60

24. Total hours:130

25. Number of ECTS credits: 5

26. Number of ECTS credits allocated for contact hours: 3

27. Number of ECTS credits allocated for in-practice hours (laboratory classes, projects): 2

26. Comments:

Approved:

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(date, Instructor's signature)

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(*date , the Director of the Faculty Unit signature)*