STUDY MODULE DESCRIPTION FORM

Name of the module/subject		Code
Automatic Control and Robotics		**101034165uuuwwj0009**

Field of study	Profile of study (general academic, practical)	Year /Semester
Mathematics in Technology	**general academic**	**3 / 5**

Elective path/specialty	Subject offered in:	Course (compulsory, elective)
-	**Polish**	**elective**

Cycle of study:	Form of study (full-time,part-time)
First-cycle studies (Polish Qualifications Framework level six)	**full-time**

No. of hours	No. of credits
Lecture: **30** Classes: **30** Laboratory: **15** Project/seminars: **-**	**5**

Status of the course in the study program (Basic, major, other)	(university-wide, from another field)
major	**university-wide**

Education areas and fields of science and art	ECTS distribution (number and %)
Technical sciences	**5 100%**
Technical sciences	**5 100%**

Responsible for subject / lecturer:

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Prerequisites in terms of knowledge, skills and social competencies:

1	**Knowledge**	In the field of mathematics: algebra and differential equations. [K_W01 (P6S_WG)] In the field of selected branches of general physics; knowledge necessary to understand the basic physical phenomena occurring in the elements and systems of automation and robotics. [K_W05 (P6S_WG)] In the field of analog and digital electronic circuits and programmable systems; knowledge necessary to understand analog models of basic dynamic objects and to understand the operation of automatic control systems. K_W04 (P6S_WG)]
2	**Skills**	Is able to use basic mathematical tools and methods, including numerical ones for solving engineering problems. [K_U03 (P6S_UW)] He can extract information from the literature. [K_U06 (P6S_UW)] He can prepare documentation for laboratory classes. [K_U12 (P6S_UK)]
3	**Social competencies**	Understands the need for continuous training and raising professional competences. [K_K01 (P6S_KK)]

Assumptions and objectives of the course:

To get to know the principles and methods of analysis and design of automatic control systems. Familiarization with elements and devices used in industrial automation systems. To gain general insight into the issues of robotics. To understand the basis of robots modelling, control and programming.

Study outcomes and reference to the educational results for a field of study

Knowledge:

The graduate has a structured knowledge of terminology in the field of selected issues in technical sciences. [K_W03 (P6S_WG)]

He has structured and theoretically founded knowledge in the field of automation. [K_W04 (P6S_WG)]

Skills:

1. The graduate can build and analyze simple mathematical models. [K_U02 (P6S_UW)]

2. Is able to use mathematical tools and methods, including numerical methods, to solve engineering problems. [K_U03 (P6S_UW)]

3. Can construct an algorithm for solving a simple engineering task, implement it and test it in a chosen programming environment. [K_U04 (P6S_UW)]

3. Is able to select the appropriate sources of knowledge and obtain the necessary information from them and make a critical analysis and evaluation of solutions for complex and unusual engineering problems. [K_U06 (P6S_UW)]

4. Is able to use equipment, tools, etc. in accordance with general requirements and technical documentation. Can apply the principles of health and safety at work. [K_U09 (P6S_UW)]

5. Is able to develop documentation for the laboratory exercise and prepare a text containing a discussion of the results. He can communicate with people using specialized terminology. [K_U12 (P6S_UK)]

Social competencies:

1. The graduate is aware of the level of his knowledge in relation to the conducted research in exact and technical sciences. [K_K01 (P6S_KK)]

2. He is aware of deepening and expanding knowledge to solve emerging new technical problems. [K_K02 (P6S_KK)]

3. Is aware of his social role as a graduate of a technical university. He is ready to communicate popular scientific content to the society and to identify and resolve basic problems related to the field of his study. [K_K05 (P6S_KR)]

Assessment methods of study outcomes

Lecture: Evaluation of student's knowledge and skills on a written examination in a form of test consisting of about 10 questions or short problems.

Classes: Credit based on active participation in classes, or possibly: at the end of the semester, by passing the colloquium.

Laboratory: Ratings for the written tests at the beginning of each exercise. Evaluation of student's knowledge and skills based on his performance during the lab exercises and evaluation of student's reports from the performed exercises.

Course description

Automation:
Basic concepts, types and examples of automatic control systems. Laplace transform. Modelling dynamic objects Solving differential equations using Laplace transform. Static and dynamic linearisation. Conversion of flowcharts and determination of the resultant transfer function.

The characteristics in the time-domain and frequency-domain of dynamic objects and control systems: impulse response and step response, transfer function and spectral transfer function, Nyquist plots, Bode plots (magnitude and phase plot). The characteristics of the basic dynamical elements of control systems.

Types of controllers and their properties. Control quality indicators. Conditions and criteria for stability of linear control systems.

Elements and devices of automation. Construction and basics of programming industrial controllers. Automatic control of the internal combustion engine.

Robotics:
Basic concepts and issues: robot, robotics, manipulator, kinematic chains, degrees of freedom, Denavit-Hartenberg notation, the workspace coordinates and joint parameters, orientation and its notation, homogeneous coordinates and transformations.

The basic kinematic structures of manipulators. Forward and inverse kinematics for position and velocity; Jacobian.

Issues concerning mobile robots and their navigation, sensing and computer vision systems.

Laboratory:
basics of industrial robot operation, simulation of automatic control systems, programming industrial controllers PLC.

Update: 10.2018

Basic bibliography:

1. Rumatowski Karol, Podstawy automatyki. Układy liniowe o działaniu ciągłym. WPP, 2004

2. Horla Dariusz, Podstawy automatyki - ćwiczenia rachunkowe, WPP

3. Urbaniak Andrzej, Podstawy automatyki, WPP 2004

4. Markowski Andrzej, Automatyka w pytaniach i odpowiedziach, WNT, 1985

5. Spong M. W. Vidysagar M. Dynamika i sterowanie robotów WNT Warszawa 1997

6. Craig.J.J. Wprowadzenie do robotyki. Mechanika i sterowanie, WNT 1993

Additional bibliography:

1. Mazurek Jerzy, Podstawy automatyki, Wyd. Politechniki Warszawskiej
2. Żelazny Marek, Podstawy automatyki, PWN, Warszawa 1976
3. Brzózka Jerzy, Regulatory cyfrowe w automatyce, wyd. Mikom, Warszawa 2002
4. Findeisen Władysław, Poradnik inżyniera - automatyka
5. Bobrowski Dobiesław, Ratajczak Zbigniew, Przekształcenie Laplace'a i jego zastosowania, WPP
6. Mutambara A.: Design and analysis of automatic control, London, New York, 1999
7. Paraskevopoulos P.N.:Modern control enginneering, Marcel Dekker Inc., New York, Basel, 2002
8. McKerrow Ph. J. Introduction to Robotics, Addison-Wesley 1991
9. Fu K.S., Gonzalez R.C., Lee C.S.G. Robotics: Control, Sensing, Vision, and Intelligence, McGraw-Hill Book Comp.1989
10. Paul R.P. Robot Manipulators: Mathematics, Control, and Programming, Boston MIT Press 1981
11. Gerth Wilfried, Heimann Bodo, Popp Karl, Mechatronika - komponenty, metody, przykłady, PWN, Warszawa, 2001

Result of average student's workload

Activity	Time (working hours)
1. Participation in the lecture	30
2. Participation in the classes	30
3. Participation in the laboratory	15
4. Consultation and participation in the examination	15
5. Preparation to laboratory exercises	15
6. Elaboration of laboratory reports	15
7. Preparation to examination	10

Student’s workload

Source of workload	hours	ECTS
Total workload	130	5
Contact hours	75	3
Practical activities	15	1