FACULTY OF ELECTRICAL ENGINEERING

SUBJECT CARD

Name in Polish:	**Podstawy robotyki**
Name in English:	**Basics of robotics**
Main field of study (if applicable):	**Industrial Control Engineering**
Specialization (if applicable):	
Level and form of studies:	**1st level, full-time**
Kind of subject:	**obligatory**
Subject code:	**ARE009001**
Group of courses:	**NO**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU):	30		15		
Number of hours of total student workload (CNPS):	60		30		
Form of crediting:	crediting with grade		crediting with grade		
For group of courses mark (X) final course:					
Number of ECTS points:	2		1		
including number of ECTS points for practical (P) classes :			1		
including number of ECTS points for direct teacher-student contact (BK) classes:	1.40		0.70		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. He has knowledge of the description of the continuous and discrete automatic control systems, their properties and the analysis of automation in the field of statics, dynamics and stability of continuous and discrete linear control systems.
2. He is able to correctly and effectively use knowledge of linear algebra and analytic geometry for qualitative and quantitative analysis of mathematical problems related discipline engineering studies
3. He is able to correctly and effectively use knowledge of differential and integral calculus of functions of one variable to a qualitative and quantitative analysis of mathematical problems related discipline engineering studies

SUBJECT OBJECTIVES

C1. Introduction to basic tasks and methods of robotics
C2. Acquisition of knowledge about methods of solving robotic tasks
C3. Acquisition of skills necessary to control, program and explore industrial robots
C4. Acquisition of skills necessary to apply sensor information to robot control

SUBJECT LEARNING OUTCOMES

relating to knowledge:

PEU_W01	Student knows methods of description and analysis of manipulator’s direct kinematics
PEU_W02	Student knows methods of solving of inverse kinematic tasks for manipulator
PEU_W03	Student knows methods of description of rigid, flexible and mobile robot’s dynamics

relating to skills:

PEU_U01	Student can operate, control and program industrial robots, including definition of coordinate frame related to tool for industrial robots
PEU_U02	Student can apply control algorithm for mobile robot

relating to social competences:

PEU_K01	He can think and act in a creative and enterprising way.

PROGRAMME CONTENT		
Form of classes - lecture		**Number of hours:**
Lec 1	Introduction. Short presentation of historical robotics. Division of robots.	2
Lec 2	Rigid body motion. Rotations. SO(3) group	2
Lec 3	Translations. Composed transformations.	2
Lec 4	Homogenous coordinates.	2
Lec 5	Direct kinematics – Denavit-Hartenberg algorithm.	2
Lec 6	Kinematics expressed in coordinates.	2
Lec 7	Jacobi matrix and singular configurations.	2
Lec 8	Solving methods of inverse kinematic task.	2
Lec 9	Dynamics of rigid manipulator – Euler-Lagrange formalism.	2
Lec 10	Control algorithms for rigid manipulators.	2
Lec 11	Dynamics of flexible manipulator.	2
Lec 12	Kinematics of mobile robots – nonholonomic systems.	2
Lec 13	Driftless control systems.	2
Lec 14	Dynamics of mobile robots.	2
Lec 15	Test.	2
	Total hours:	**30**

Form of classes - laboratory		**Number of hours:**
Lab 1	Introduction. Health and safety training.	1
Lab 2	Programming of industrial robot IRB-1400 – basic commands, definition of user-defined tool.	4
Lab 3	Programming of industrial robot FANUC – basic manipulation of elements.	4
Lab 4	Mobile robot’s motion planning.	4
Lab 5	Summary of classes.	2
	Total hours:	**15**

TEACHING TOOLS USED

N1. Traditional lecture.
N2. Laboratory classes.
N3. Consultation.
N4. Individual work- study of literature.

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

Evaluation *F – forming (during semester) P – concluding (at semester end)*	**Educational effect number**	**Way of evaluating educational effect achievement**
F1(W)	PEU_W01 PEU_W02 PEU_W03	test
P(W)	P=F1	
F1(L)	PEU_U01 PEU_U02	reports
P(L)	P=F1	

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] K. Tchoń et al.: "Manipulatory i roboty mobilne: modele, planowanie ruchu, sterowanie", Akademicka Oficyna Wydawnicza PLJ, Warszawa 2000
[2] M. Spong, M. Vidyasagar :"Dynamika i sterowanie robotów", WNT, Warszawa 1997
[3] E. Jezierski: "Dynamika robotów" WNT, Warszawa 2006
[4] Instrukcje do ćwiczeń http://rab.ict.pwr.wroc.pl/lab_010/

SECONDARY LITERATURE:

[1] J. J. Craig: „Wprowadzenie do robotyki: mechanika i sterowanie”, WNT, Warszawa 1993
[2] R. Murray, Z. Li, S. S. Sastry: „A Mathematical Introduction to Robotic Manipulation”, CRC Press, Boca Raton 1994
[3] Springer Handbook of Robotics: Springer-Verlag, Berlin 2008
[4] B. Siciliano, et. al.: „Robotics”, Springer-Verlag, London 2009

SUBJECT SUPERVISOR
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