COURSE DESCRIPTION CARD - SYLLABUS

Course name
Basics of robotics [N1Inf1>ROBOT]

Course

Field of study
Computing

Year/Semester
2/4

Area of study (specialization)
–

Profile of study
general academic

Level of study
first-cycle

Course offered in
Polish

Form of study
part-time

Requirements
elective

Number of hours

Lecture
12

Laboratory classes
16

Other
0

Tutorials
0

Projects/seminars
0

Number of credit points

3,00

Coordinators

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Lecturers

Prerequisites

Students starting this course should have a basic knowledge of linear algebra (matrix operations: addition of matrices, matrix multiplication, matrix transpose, matrix inversion, matrix pseudo-inversion), mathematical analysis and general engineering. Must have the ability to solve basic problems from the scope of the required knowledge and the ability to obtain information from the indicated sources. Student should understand the need to extend his/her competences. In addition, in respect to the social skills the student should show attitudes as honesty, responsibility, perseverance, curiosity, creativity, manners, and respect for other people.

Course objective

1. Provide students with basic knowledge of robotics, in terms of kinematics and dynamics of manipulators 2. Develop in students' ability to solve simple engineering problems related to the modeling of kinematics of industrial manipulators. 3. Form in students the ability to work as a team in solving engineering tasks related to commissioning and programming of robotic systems.

Course-related learning outcomes

Knowledge:

1. Has a structured, theoretically based general knowledge of electronics, digital technology and computer systems architecture-[K1st_W3].
2. Has knowledge of the significant directions of development and the most important achievements of robotics and other related scientific disciplines, in particular electronics and automation and robotics-[K1st_W5].
3. Knows the basic techniques, methods and tools used in the process of solving computer tasks, mainly of an engineering nature, in the key issues of computer science-[K1st_W7].

Skills:
1. Properly plan and perform experiments in robotics, including measurements and computer simulations, interpret the obtained results, and correctly draw conclusions from them -[K1st_U3].
2. formulate and solve computer tasks in the field of robotics, to apply appropriately selected methods, including analytical, simulation or experimental methods -[K1st_U4].
3. Design electronic circuits and construct and program simple systems microprocessor systems -[K1st_U13].

Social competences:
1. Understands that knowledge and skills in robotics are becoming obsolete very quickly-[K1st_K1].
2. Is aware of the importance of knowledge in solving engineering problems in robotics and knows examples and understands the causes of malfunctioning information systems that have led to to serious financial, social losses-[K1st_K2].

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

The learning outcomes presented above are verified as follows:
Formative assessment:
a) in the scope of lectures: based on answers to questions about the material discussed in previous lectures,
b) in the laboratory: based on the evaluation of the current progress of the tasks,
Total assessment:
Verification of the established learning outcomes is realized by:
- evaluation of the report prepared partly during the class and partly after the class; This evaluation also includes the ability to work in a team,
- evaluation of knowledge and skills demonstrated in a written exam
Obtaining additional points for activity during classes, especially for:
- discussion of additional aspects of the issue,
- efficiency of application of the acquired knowledge when solving the assigned problem,
- ability to cooperate as part of a team practically implementing a detailed task in the laboratory,
- comments related to the improvement of teaching materials,
- pointing out the perceptual difficulties of students that enable ongoing improvement of the teaching didactic process.

Programme content

The lecture will introduce the student to the following topics:
- Simple and inverse task of kinematics - discussion of kinematics of rigid bodies including. rotation and translation matrices, interpellation of matrix notation of kinematics, discussion of matrix transposition and its application to the description of simple and inverse kinematics, discussion of the definition of chain kinematics, degrees of freedom and geometric parameters of manipulator links
- Trajectory in inner and outer space - discussion of the description of the trajectory of motion of manipulator links using third and fifth degree polynomials
- Dynamics of manipulators - presentation of matrix equations of dynamics for rigid manipulators and manipulators with flexibility in the joints.
- Measurement systems used in robotics - during the lecture, students will learn about measurement methods and the construction and principle of operation of measurement sensors used in robotics.
- Mobile robots - the instructor will present the basic issues of kinematics of mobile robots.
As part of the laboratory, the student will become familiar with:
- Industrial robots located in the laboratory (Robot Staubli, KUKA, Fanuc) - students will carry out practical exercises in the operation of industrial robots: defining the tool and manual control in the joint

space, base,
- Presentation of practical exercises in programming industrial robots, realizing simple programming tasks - programming of PTP, linear motion type.
- Kinematics and localization of a two-wheeled mobile robot
- Building a local map of the environment - scanner with infrared sensor

Course topics

During the lecture, the student will become familiar with the following topics:
- Robot programming - discussion of the method of programming robots based on the KRL, VAL, Karel languages.
- Direct and inverse kinematics tasks - discussion of the kinematics of a rigid body taking into account the rotation and translation matrices, interpretation of the matrix notation of kinematics, discussion of the transposition matrix and
applying it to describe direct and inverse kinematics, DH and ZDH notation, discussion of the definition of the kinematic chain, degrees of freedom and geometric parameters of the manipulator links
- Trajectory in internal and external space - discussion of the description of the trajectory of the manipulator links using third- and fifth-degree polynomials
- Manipulator dynamics - presentation of matrix equations of dynamics for rigid manipulators
and manipulators with flexibility in joints. - Mobile robots - the instructor will present basic issues related to the kinematics of mobile robots

As part of the laboratory, the student will become familiar with:

- Industrial robots located in the laboratory (Robot Staubli, KUKA, Fanuc) - students
will carry out practical exercises in the operation of industrial robots:
a) Defining the tool and manual control in the joint space, base,
b) Carrying out simple programming tasks - programming PTP, linear motion.
- Kinematics and localization of a two-wheeled mobile robot (optional)
- Building a local map of the environment - scanner with an infrared sensor (optional)

Teaching methods

1. Lectures: presentation illustrated with examples supplied on the board, multimedia presentations
2. Auditorium exercises: problem solving, case studies

Bibliography

Basic:
1. Wprowadzenie do robotyki. Mechanika i sterowanie, J.J. Craig, WNT Warszawa, 1993.
2. Dynamika i sterowanie robotów, M.W. Spong, M. Vidyasagar, WNT, Warszawa 1997.
3. Manipulatory i roboty mobilne. Modele, planowanie ruchu, sterowanie, K. Tchoń, A. Mazur, I. Dulęba, R. Hossa, R. Muszyński, Akademicka Oficyna Wydawnicza, Warszawa, 2000.
4. Modelowanie I sterowanie robotów, K. Kozłowski, P. Dutkiewicz, W. Wróblewski, Wydawnictwo Naukowe PWN, Warszawa, 2003.
5. Podstawy robotyki. Teoria i elementy manipulatorów, praca zbiorowa pod red. Adama Moreckiego i Józefa Knapczyka, WNT, Warszawa 1993,1999.

Additional:
1. Modeling and Control of Robot Manipulators, Sciavicco, B. Siciliano, Springer-Verlag, London, 2000.

Breakdown of average student's workload

	Hours	ECTS
Total workload	75	3,00
Classes requiring direct contact with the teacher	28	1,00
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	47	2,00