# COURSE DESCRIPTION CARD - SYLLABUS

Course name
Basics of robotics [S1Inf1>ROBOT]

## Course

Field of study
Computing

Year/Semester
2/3

Area of study (specialization)
–

Profile of study
general academic

Level of study
first-cycle

Course offered in
Polish

Form of study
full-time

Requirements
elective

## Number of hours

Lecture
24

Laboratory classes
20

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. Providing students with basic knowledge of robotics, in the field of kinematics and dynamics of manipulators 2. Developing students' skills in solving simple engineering problems related to modeling the kinematics of industrial manipulators. 3. Familiarizing students with robot programming methods 4. Developing students' teamwork skills when solving engineering tasks related to launching and programming 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 module program covers the following topics:
- Robot programming languages
- Representation of a rigid body in space
- Direct and inverse kinematics problem
- Trajectory in internal and external space
- Dynamics of manipulators
- Mobile robots

## Course topics

The lecture will introduce the student to the following topics:
- Robot programming - discussion of how to program robots based on the KRL, VAL, Karel languages.
- Simple and inverse kinematics problem - discussion of the kinematics of a rigid body, including rotation

and translation matrices, interpretation of the kinematics matrix notation, discussion of the transposition matrix and its application to the description of direct and inverse kinematics, DH and ZDH notations, 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 movement of manipulator cells using polynomials of the third and fifth degree
- Dynamics of manipulators - presentation of matrix dynamics equations for rigid manipulators and manipulators with flexibility in joints.
- Mobile robots - the lecturer will present basic issues regarding the kinematics of mobile robots
During the laboratory, the student will become familiar with:
- Industrial robots in the laboratory (Robot Staubli, KUKA, Fanuc) - students will complete practical exercises in operating industrial robots:
a) Tool definition and manual control in the base space of connectors,
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 surroundings - scanner with 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 | 44 | 2,00 |
| Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation) | 31 | 1,00 |