**BIALYSTOK UNIVERSITY OF TECHNOLOGY**

**Faculty of Electrical Engineering**

**Field of study**
Erasmus program

**Level and form of study**
Bachelor Level; Master Level

**A group of modules /specialty**

**Education profile**
general

**Course name**
Fundamentals of Robotics: Design and Motion Control

**Course code**
IS-FEE-10088S

**Course type**
elective

**Course form(s) and number of hours**

<table>
<thead>
<tr>
<th>L</th>
<th>C</th>
<th>LC</th>
<th>P</th>
<th>SW</th>
<th>FW</th>
<th>S</th>
<th>Semester</th>
<th>ECTS credits</th>
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<tbody>
<tr>
<td>15</td>
<td>5</td>
<td>10</td>
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<td>Summer</td>
<td>3</td>
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**The programme is valid from**
2024/2025

**Introductory courses**

Introduction to fundamental knowledge related to robotics, including the construction, design, and application of robots and their components. Kinematics and dynamics of manipulators. Introduction to programming industrial robots.

**Course objectives**


**Framework programme content**

Introduction to fundamental knowledge related to robotics, including the construction, design, and application of robots and their components. Kinematics and dynamics of manipulators. Introduction to programming industrial robots.

**Other information about the course**

- the course is related to the scientific activity conducted at the University

**Student workload related to:**

- participation in lectures: 15 hours
- participation in other forms of activities: 15 hours
- participation in an examination: 0 hours
- participation in consultations: 3 hours
- completion of professional training: 0 hours
- preparation for passing a lecture/exam: 12 hours
- preparation for practical classes: 30 hours

**Total number of hours:**
75

**Total number of ECTS credits:**
3

**Expected discipline learning outcomes**

<table>
<thead>
<tr>
<th>Knowledge</th>
<th>Skills</th>
<th>Social competence</th>
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</table>

**Objectives and framework content prepared by**
Ph.D., Eng. Roman Trochimczuk

**Date:**

**Implementation in the academic year**
2024/2025

**Lecture**

3. Design of the kinematic chain of a robot and end-effectors.
4. Introduction to modeling the dynamics of multibody systems. Moments of inertia of a rigid body.
5. Manipulator Jacobians. Trajectory planning for manipulator motion.
7. Basics of programming, programming languages, and program structures.

**Programme content**

1. Modeling of the kinematics of selected structure of kinematic open chain using D-H notation.
2. Modeling of the dynamics manipulator selected structure with rigid links.
3. Concluding sessions. Passing the lectures.

**Classes**

1. Introducing the laboratory stand with robots and computer workstation with specialisation engineering software.
2. Kinematics and dynamics analysis of a selected manipulator structure using a chosen CAD/CAE tool.
3. Stiffness analysis of the kinematic chain under static and dynamic loads. Modal analysis of the developed structure and optimization of the kinematic chain.
4. Programming the motion of real industrial manipulators for selected industrial tasks.
5. Concluding sessions. Passing the specialist workshop.

**Specialist workshop**

1. Lecture on issues; Informational lecture; lecture with multimedia presentation; use of a computer with software.
### Course Coordinator

**Ph.D., Eng. Roman Trochimczuk**  
**Date:** 20.02.2024

### Expected Learning Outcomes Defined for the Field of Study

<table>
<thead>
<tr>
<th>Knowledge</th>
<th>Skills</th>
<th>Social Competence</th>
</tr>
</thead>
<tbody>
<tr>
<td>E1</td>
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<td>E6</td>
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</table>

### Basic References


### Supplementary References


### Course Methods

<table>
<thead>
<tr>
<th>Teaching Methods (on-site classes)</th>
<th>Subject exercises - practical tasks method</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Practical sessions at computers with engineering software; implementation of the assumed scenario in a specialized workshop with real industrial robot.</td>
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### Forms of Crediting

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<thead>
<tr>
<th>L</th>
<th>Written assessment with open-ended questions.</th>
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<tr>
<td>C</td>
<td>Preparation of a report.</td>
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<tr>
<td>SW</td>
<td>Preparation of a report.</td>
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</table>

### Conditions of Crediting

<table>
<thead>
<tr>
<th>L</th>
<th>Assessment of responses to open-ended questions in a written exam verifying learning outcomes.</th>
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<td>C</td>
<td>Evaluation of reports, assessment of ongoing progress in work, discussions, and participation in classes.</td>
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<td>SW</td>
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</table>

### Skills: The Student Can

- E1: The student can determine the \(D-H\) parameters necessary to solve robot or manipulator kinematics tasks.
- E2: The student can define and know the principle of operation of the different components of a robot.
- E3: The student knows the methods and tools for programming a robot.
- E4: The student can determine the basic dynamics of the manipulator mechanism.

### Social Competence: The Student Is Ready To

- E5: The student can, with due regard for health and safety regulations, operate and program a selected industrial manipulator.

### Expected Learning Outcomes

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