

**FS**UNIVERSITY OF LJUBLJANA  
Faculty of Mechanical Engineering

# Robotic Systems (6055-M)

**5 ECTS****Lecturer: R. Vrabič**

Lectures: 30h | Tutorials: 12h | Labs: 18h | Project: 0h | Lang.:

## Objectives

The objectives of this course are to provide students with a comprehensive understanding of robotic systems and their industrial applications. In an era of increasing automation and smart manufacturing, robotics plays a central role in modern industry. This course equips students with the theoretical foundations and practical skills necessary to design, program, and integrate robotic systems.

The course covers:

- Understanding of all types of industrial robots, including articulated robot arms and autonomous mobile robots
- Control, programming, and development of custom robotic applications
- Integration of industrial robots with other manufacturing systems
- Software and hardware interfaces in robotics, including ROS-based development

## Programme

1. Introduction to robotics, coordinate systems, homogeneous transformations
2. Direct kinematics of articulated robots, Denavit-Hartenberg notation, analytical and numerical inverse kinematics, velocity kinematics and manipulability, path planning, robot dynamics and control, industrial robot applications
3. Kinematics of mobile robots, path planning on maps, cameras and vision, Kalman filter, simultaneous localization and mapping, industrial applications of mobile robots

## Prerequisites

In order to successfully attend this course, the students must have:

- Basic knowledge in linear algebra (matrices) and analysis (derivatives)
- Basic programming skills (basic Python or similar)

## Learning outcomes

After attending this course, the student will:

- Understand the operation of all types of industrial robots
- Be able to use and program industrial robots using teach pendants, programming languages, and open-source interfaces (ROS)
- Be able to design and implement integration of industrial robots with other systems based on understanding robotic controllers
- Be able to design and implement custom robotic building blocks and systems

## Assessment

1. Written examination on theoretical content (50%)
2. Written examination on practical content (40%)
3. Report on laboratory work with industrial robots (10%)

## Literature

Peter Corke: *Robotics, Vision and Control*, Springer-Verlag Berlin Heidelberg, 2011

Tadej Bajd, Matjaž Mihelj, Marko Munič: *Introduction to Robotics*, Springer Dordrecht Heidelberg New York London, 2013

Gregor Klančar, Andrej Zdešar, Sašo Blažič, Igor Škrjanc: *Wheeled Mobile Robotics*, Butterworth-Heinemann, 2017

Morgan Quigley, Brian Gerkey, William D. Smart: *Programming Robots with ROS*, O'Reilly Media, 2015