

## AI-BASED INTELLIGENT ROBOTIC SYSTEM - TEACHING MATERIAL

The course consists of an integrated module combining a 2-hour lecture and a 2-hour practical session, designed to provide a comprehensive introduction to AI-based intelligent robotic systems and their industrial applications. It focuses on the role of artificial intelligence in modern robotics, emphasizing data-driven approaches, adaptive control, and the growing demand for flexibility and autonomy in Industry 4.0 environments.

**During the course**, students acquire a solid theoretical foundation in intelligent robotic systems, including key components such as sensors, actuators, controllers, and communication systems. The limitations of classical systems are highlighted, while intelligent approaches based on machine learning, deep learning, and fuzzy logic are introduced for data processing, decision support, and performance improvement.

The course presents major AI applications in robotics, including predictive maintenance, anomaly detection, vision-based control, and trajectory optimization. Students learn how AI enables fault detection, adaptation to changing conditions, and efficient motion planning.

**The practical session** provides hands-on experience in a MATLAB-based environment, where students work with simplified robotic models and apply AI methods to real engineering problems. They analyze sensor data, detect anomalies, evaluate system performance (e.g., RMSE), and compare trajectories using cost functions to identify optimal solutions.

Upon completion, students gain fundamental knowledge of intelligent robotic systems and practical skills in data analysis, modeling, and decision-making, supporting the development of analytical thinking and a data-driven engineering mindset essential for modern robotics and automation.

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