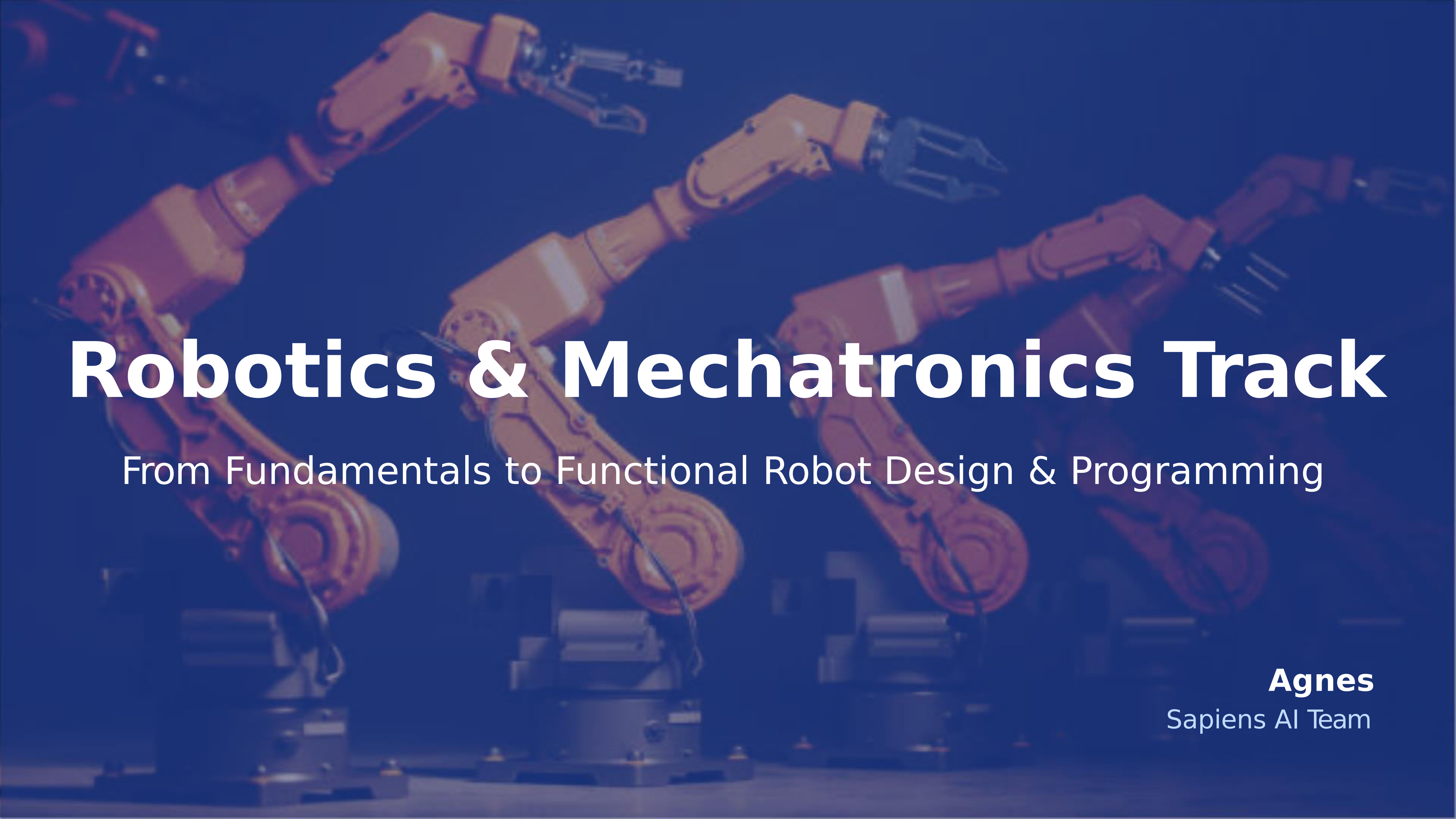


Robotics & Mechatronics Track

From Fundamentals to Functional Robot Design & Programming

Agnes
Sapiens AI Team

Program Goal & Core Topics

Program Goal

Foundational Mastery

Gain a comprehensive understanding of robotics fundamentals & mechatronics integration. Mechatronics involves the seamless integration of mechanical systems with electronics and software to create highly functional and efficient products and processes. This multidisciplinary field is a crucial foundation for advancements in automation and manufacturing.

Practical Application & Design

Develop the ability to design, build, and program simple robots. While mechatronics focuses on blending mechanical and electrical systems, robotics emphasizes the practical aspects of designing, building, and programming autonomous machines to perform specific tasks. This includes learning fundamental theory, hardware components, and programming tools.

Real-world Culmination

Key Core Topics

Fundamentals
Learn core concepts of mechatronics and robotics systems design.

Sensors
Integrate and interpret sensor data for robotic perception and navigation.

Microcontrollers
Master microcontrollers as the brain of mechatronic systems.

Control
Apply modern control systems theory for accuracy and efficiency.

Phase 1: Foundational Concepts (Month 1)

Robotics Fundamentals & Microcontroller Control (Online)

Week 1	Week 2	Week 3	Week 4

Intro to Robotics & Kinematics

Foundations: Understand robotics' role in automation, integrating mechanical, electrical, and software fields.

Kinematics: Learn the basics of robot motion, essential for controlling robotic arms and mobile platforms.

Sensors & Data Acquisition

Perception: Explore sensors (proximity, vision, force) crucial for a robot's environmental awareness.

Integration: Focus on acquiring and processing sensor data to enable intelligent robot navigation and decisions.

Actuators & Motor Control

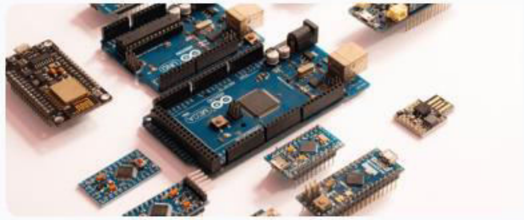
Actuators: Discover how motors (DC, servo) convert energy into mechanical motion for manipulation.

Control: Grasp PWM fundamentals for managing motor speed and direction, a key control skill.

Microcontroller Control

The Brain: Learn how microcontrollers command robotic systems by integrating hardware and software.

Application: Program Arm-based systems to apply control theory and build functional robot behaviors.



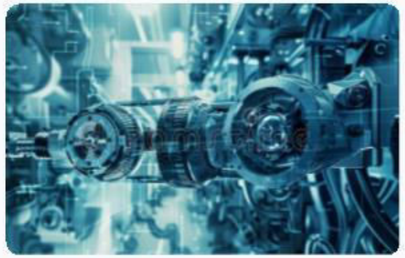
Phase 1: Core Concepts (Month 2)

Mechatronics, Control Systems & Robot Programming (Online)

Week 5: Basics of Mechatronics Systems & Integration

Mechatronics Foundation: Delve into the seamless integration of mechanical, electronic, and software systems, crucial for automation.

System Integration: Explore skills essential for industries using robotics and automated control systems.



Week 6: Control Systems in Robotics

Theory & Application: Understand control systems to enable precise and efficient robotic operations.

Practical Examples: Learn applications in industrial robots and automated lines for stable performance.

Week 7: Robot Programming & Path Planning Basics

Programming Fundamentals: Develop skills to program robots, interpret sensor data, and coordinate movements.

Path Planning: Focus on navigating spaces, avoiding obstacles, and optimizing routes for autonomy.

Program Focus: Interdisciplinary Training & Practical Application

Robotics Simulation & Mini-Project Preparation

Week 8: Bridging Virtual Environments to Hands-On Project Development

Robotics Simulation Tools

Virtual Prototyping: Introduction to industry-standard robotics simulation environments such as **Gazebo** and **CoppeliaSim**. These powerful tools facilitate virtual prototyping, comprehensive testing, and iterative debugging of robot designs and algorithms in a safe, controlled, and cost-effective manner.

Accelerated Development: Utilizing simulation drastically accelerates development cycles, enables testing of complex scenarios, and allows for the refinement of control strategies without the limitations or risks associated with physical hardware.

Mini-Project Scoping

Project Choice

Decide between a **Robot Arm**, emphasizing manipulation and kinematics, or a **Line Follower**, focusing on navigation and control.

Hardware

Identify essential components: **microcontrollers** (Arduino), **sensors** (IR, ultrasonic), and **actuators** (servo/DC motors). (Source)

Software

Outline programming logic (**C/C++**), control

Phase 2: Capstone Project: Implementation (Month 3)

Hands-on Industry Immersion (Offline)

Week 9: Robot Assembly & System Integration

This week focuses on the tangible construction of robotic systems, precisely combining mechanical structures with electronic components. It emphasizes the foundational understanding of how diverse parts interact to form a cohesive, functional unit.

Gain practical experience in assembling and integrating mechanical, electrical, and software elements into a robust mechatronic system. This phase mirrors critical industry practices where specialists build and integrate systems for industrial robots and advanced automated manufacturing.

Week 10: Core Robot Programming & Control Logic

Dive deep into programming robots to execute precise tasks, with a strong focus on core control logic. This involves writing sophisticated code for microcontrollers to directly interface with physical hardware, ensuring accurate and responsive movement.

Practical application of integrating various sensors onto the physical robot. This includes establishing connections, developing software to interpret sensor data, and performing calibration to guarantee accurate readings essential for navigation.

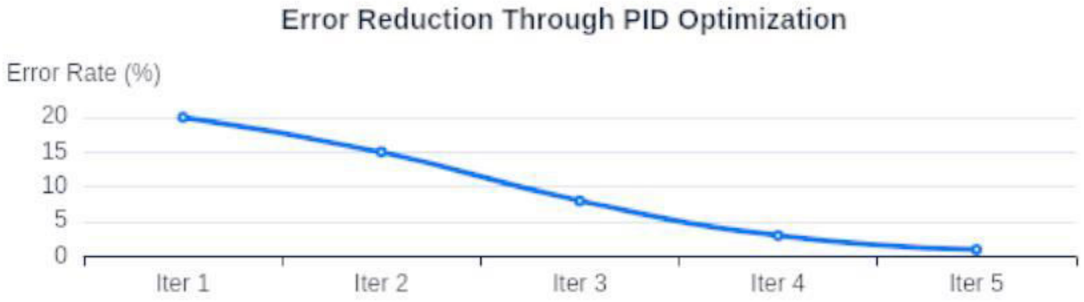
Project Refinement: Advanced Control & Debugging

Week 11: Optimizing Performance & Ensuring Robustness

Advanced Control Algorithms: PID Optimization

PID Fundamentals: Implement and fine-tune advanced control algorithms, focusing on PID optimization. This enhances a robot's ability to maintain a desired output by minimizing error in a dynamic environment.

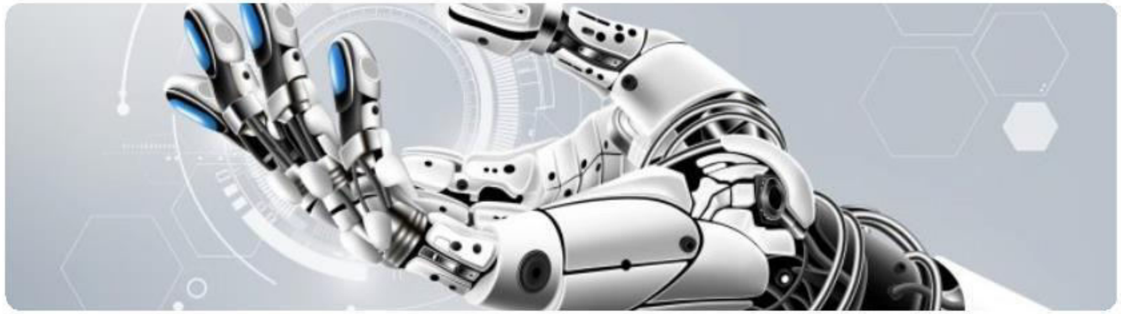
Performance Tuning: Learn to adjust PID parameters for optimal responsiveness, stability, and precision. This iterative process directly translates to improved robot performance, ensuring accurate task execution.



Smoother Motion Profiles & Feedback Integration

Refined Trajectories: Develop techniques for smoother motion profiles, eliminating jerky actions for greater efficiency and reduced component wear through advanced interpolation and trajectory planning.

Sensor-Based Feedback: Integrate feedback loops using sensor data to continuously monitor and correct position and velocity, ensuring high precision and adaptive control.



Obstacle Avoidance Logic for Autonomous Navigation

Perception & Decision-Making: Implement robust obstacle avoidance logic, enabling robots to interpret sensor data to safely navigate around obstacles in complex environments.

Path Re-planning: Focus on dynamic path re-planning algorithms that allow the robot to intelligently adjust its trajectory in real-time, preventing collisions while maintaining its objectives.

Hardware/Software Co-debugging and Iterative Testing

Integrated Debugging: Engage in comprehensive hardware/software co-debugging to resolve issues arising from the interaction between physical components and control software.

Systematic Iteration: Conduct iterative testing cycles to systematically validate performance, refine control parameters, and identify edge cases, ensuring a robust final solution.

Project Showcase & Career Launchpad

Your Pathway from Innovation to Industry

Empowering Your Professional Journey

Career Development Workshops

Tailored sessions on essential job search tools: crafting your **Resume**, building a compelling **Portfolio**, and optimizing your **LinkedIn profile** to meet industry expectations.

Mock Interviews

Practice crucial **Technical & Behavioral Preparedness** through realistic mock interview scenarios, enhancing confidence and preparing you for real-world opportunities in the automation sector.

Networking Session

Engage directly with **Industry Professionals** for invaluable mentorship, insights into career paths, and potential job leads in robotics and advanced manufacturing.

Graduation & Certification

Formal recognition of your achievements through a symbolic **Graduation Ceremony & Certification**, signifying successful completion of the

Capstone Innovation

The pinnacle of your training, **Week 12** is dedicated to the **Final Project Presentation & Documentation**. Showcase your functional robotic arm or line-following robot, demonstrating mastery in design, integration, programming, and control systems.

Conclusion & Future Opportunities

Empowering the Next Generation of Robotics Engineers

Future-Ready Skills: Our program is meticulously designed to cultivate a new generation of robotics engineers, equipping them with a comprehensive understanding of mechatronics, control systems, and programming to meet the evolving demands of the automated manufacturing industry.

Holistic Development: Beyond technical proficiency, we foster critical thinking, problem-solving,

Practical Skills for Real-World Applications

Hands-on Expertise: Through project-based learning, students gain invaluable experience in designing, building, and programming functional robots. Every module is geared towards real-world applicability, from microcontroller integration to advanced control logic.

Industry Relevance: This intensive curriculum ensures our engineers possess the tangible skills required to immediately

Join the Sapiens AI Innovator Community

Collaborative Network: Become part of an exclusive community of forward-thinking innovators. Engage in continuous learning, share insights, and collaborate on groundbreaking projects that push the boundaries of robotics and AI.

Shape the Future: This community provides a platform for mentorship, networking, and access to cutting-edge resources, empowering you to actively participate in the creation of our