



UNIVERSITETI / UNIVERSITY
"ISA BOLETINI"
MITROVICA

Robotics and Automation in Manufacturing		
Faculty:	Mechanical and Computer Engineering	
Department:	Mechanical Engineering and Economic Engineering	
Level:	Master's	
Course code:	204MTM	
Course Title	Robotics and Automation in Manufacturing	
Course Status:	Elective	(Compulsory or Elective)
Semester:	III	(Winter /Summer)
Contact Hours:	2+2	(According to approved program)
ECTS:	5	(According to approved program)
Schedule/Room:	Monday, 9 ⁰⁰ -12 ¹⁰ , K5	
Academic year:	2026/27	
Lectures:	Prof. Ass. Dr.sc. Luan Mulaku	
Assistent:		
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Descriptions of course	This course provides an advanced study of robotics and automation technologies applied in modern manufacturing environments. It covers the design, programming, and integration of robotic systems and automated machinery to improve production efficiency, quality, and flexibility. Topics include robotic kinematics and dynamics, sensor and actuator technologies, programmable logic controllers (PLCs), industrial communication protocols, and intelligent control systems. Students will engage in practical exercises, simulations, and project-based learning to develop skills in designing and implementing automated manufacturing solutions. Ethical considerations and safety standards in automated production are also emphasized.	
	The goal of this course is to equip students with advanced knowledge and practical skills in the design, programming, and integration of robotic and automated systems within manufacturing environments. Students will develop the ability to apply robotics and automation technologies to optimize production processes, enhance operational efficiency, ensure quality control, and address safety and ethical considerations in modern manufacturing industries.	

Course objectives	• Understand and explain fundamental concepts and components of robotics and automation systems used in manufacturing. • Analyze and design automated manufacturing processes incorporating robotic systems and programmable logic controllers (PLCs). • Develop programming skills for industrial robots and automation devices to perform complex manufacturing tasks. • Evaluate different sensors, actuators, and control systems essential for robotic automation in production lines. • Apply advanced techniques for integrating robotics with manufacturing processes to improve productivity and quality. • Identify and solve practical challenges related to automation system reliability, maintenance, and safety in manufacturing environments. • Assess ethical, environmental, and economic impacts of robotics and automation technologies in industrial applications. • Collaborate effectively in multidisciplinary teams to design and implement robotics and automation solutions for real-world manufacturing problems.
Expected Learning Outcomes	Knowledge • K1: Explain the core principles of robotics and automation and their applications in manufacturing systems. • K2: Describe the structure and functioning of industrial robots, sensors, actuators, PLCs, and CNC systems. • K3: Understand modern trends in intelligent manufacturing systems, including IoT integration and Industry 4.0 technologies. Skills • S1: Analyze and design automated manufacturing solutions using robotic systems and programmable controllers. • S2: Program basic tasks for PLCs, CNC machines, and robotic arms. • S3: Evaluate system performance and identify faults using diagnostic tools and sensor data. • S4: Integrate sensors, actuators, and control systems to build functioning automation subsystems. Competence • C1: Design and implement small-scale robotics and automation systems to solve real manufacturing problems. • C2: Apply safety standards and ethical considerations in the deployment of automated manufacturing systems. • C3: Work effectively in interdisciplinary teams, communicating technical concepts clearly in both oral and written forms. • C4: Demonstrate independent learning and critical thinking to keep up with technological developments in automation and robotics.

	Week	Subjects
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Program	Week - I	Introduction to Robotics and Industrial Automation - Definitions: robotics vs. automation - Historical development and trends in industrial robotics - Key benefits and limitations of automation in manufacturing
	Week - II	Types and Applications of Industrial Robots - Cartesian, SCARA, articulated, delta, and collaborative robots (cobots) - Applications: welding, painting, assembly, material handling - Selection criteria for industrial robots
	Week - III	Robot Kinematics and Dynamics - Degrees of freedom (DOF) and joint types - Forward and inverse kinematics - Basic motion planning in robotic systems
	Week - IV	Sensors and Vision Systems in Robotics - Proximity, force/torque, vision, and tactile sensors - Machine vision systems and object recognition - Sensor fusion in robotic control
	Week - V	Robot Programming and Control Systems - Robot programming languages (RAPID, KRL, etc.) - Offline programming and simulation - Open-loop vs. closed-loop control systems
	Week - VI	Automation Hardware and Communication - PLCs and their role in robotics - I/O interfacing, signal conditioning - Industrial communication protocols (EtherCAT, OPC UA, Profinet)
	Week - VII	Midterm Exam (Colloquium I) – Review and testing of units I–VI.
	Week - VIII	SCADA and HMI in Robotic Automation - Supervisory control of robotic cells - Data acquisition from robots - Human-Machine Interfaces in robotics

Week - IX	Collaborative Robots (Cobots) and Safety Systems • ISO standards for robot safety • Cobots in flexible manufacturing environments • Safe human-robot interaction
Week - X	Automated Guided Vehicles (AGVs) and AMRs • Navigation, path planning, and obstacle avoidance • Fleet control systems • Integration with robotic work cells
Week - XI	Advanced Topics: AI and Machine Learning in Robotics • Predictive maintenance using AI • Adaptive control systems • Intelligent vision and object tracking
Week - XII	Group Project Initiation – Robotic Workcell Design • Define problem statement and goals • System design and component selection
Week - XIII	Project Development and Testing • Integration of sensors, actuators, and control • Simulations and safety validation
Week - XIV	Project Presentations and Demonstrations • Evaluation of technical performance • Class feedback and discussion
Week - XV	Final Exam and Course Wrap-up • Comprehensive assessment • Final feedback and course reflections

Literature	
Literature	• Groover, M.P. (2020). <i>Automation, Production Systems, and Computer-Integrated Manufacturing</i>. 5th Edition, Pearson. • Craig, J.J. (2018). <i>Introduction to Robotics: Mechanics and Control</i>. 4th Edition, Pearson. • Spong, M.W., Hutchinson, S., & Vidyasagar, M. (2020). <i>Robot Modeling and Control</i>. 2nd Edition, Wiley. • Bolton, W. (2021). <i>Programmable Logic Controllers</i>. 7th Edition, Newnes. • Kelton, W.D., Sadowski, R.P., & Sturrock, D.T. (2015). <i>Simulation with Arena</i>. 6th Edition, McGraw-Hill. • Rooks, B. (2020). <i>Industrial Robotics: The Next Generation</i>. Springer.
Teaching methodology	The learning process is developed by combining traditional and modern methods to ensure a deep acquisition of theoretical knowledge and the development of practical skills applicable in modern manufacturing industry. The main methods used are: • Structured Lectures (Lecturing): For the systematic presentation of basic and advanced concepts of mechatronic systems, automation, and robotics in manufacturing. • Problem-Based Learning (PBL): Students engage in identifying and solving real manufacturing and automation problems through the application of interdisciplinary knowledge (mechanical, electronic, software). • Flipped Classroom: Learning materials are distributed in advance in the form of videos, diagrams, and manuals. Contact sessions are used for discussions, testing, practical demonstrations, and problem-solving. • Project-Based Learning: Students work in groups to design and implement a functional mechatronic system applied to a production line—going through stages of analysis, design, construction, and testing. • Case Study Method: Analysis and discussion of real cases from manufacturing and automation industries, focusing on the use of PLCs, robotics, sensors, and SCADA to solve practical challenges. • Laboratory Demonstrations: Practical application of technologies such as PLC programming, interfacing with sensors and actuators, use of HMI/SCADA, industrial robotics, and CNC systems. • Computer Simulations: Use of software such as: ○ TIA Portal / LOGO Soft Comfort (PLC programming) ○ MATLAB/Simulink (modeling and automatic control) ○ Factory I/O (production line simulation) ○ Proteus / Multisim (electronic circuits and control systems simulation) • Industry Lecturers: Invitations to professionals and engineers from the industrial sector to share experiences, standards, and technologies currently used in automated manufacturing. Student Workload Contribution (which should correspond to the student learning outcomes – 1 ECTS credit = 25 hours)

	Activity	Hour	Day/week	Total
	Lecture	2	15	30
	Theoretical exercises	2	15	30
	Practical work	3	3	9
	Meetings with the instructor/consultations	1	15	15
	Field exercises	1	2	2
	Tests, quizzes, seminars	2	2	4
	Homework assignments	3	2	6
	Student's independent study time (in library or at home)	4	3	12
	Final exam preparation	3	3	9
	Time spent on assessments (tests, quizzes, final exam)	2	2	4
	Projects, presentations, etc.	2	2	4
Total				125

Assessment	Assessment Methods and Criteria:		
	Activity	Weight (%)	
	Test	20%	
	Project report & Defense	30%	
	Seminar Presentations	10%	
	Final exam	40%	
	Total	100%	
	• (According to the statute and regulations for studies at UIBM.)		
	Final grade:	Pikët (%)	Nota
		91 – 100	10
		81 - 90	9
		71 - 80	8
	61 - 70	7	
	51 - 60	6	

Academic Policies	Attendance, Ethics and Deadlines (Robotics and Automation in Manufacturing) Criteria for regular attendance and rules of conduct during the teaching process are established. Students are expected to actively participate in lectures, laboratory exercises, simulation tasks, and practical activities related to robotics and automation in manufacturing. Computer-Based Work All assignments, programming tasks, simulations, projects, and reports must be prepared using appropriate robotics and automation tools (e.g., PLC systems, MATLAB/Simulink, RobotStudio, or similar software). Students are required to comply with technical and professional standards in programming, modeling, analysis, and system documentation. Clear presentation of control diagrams, algorithms, and simulation results is mandatory. Academic Ethics All assignments, projects, programming tasks, and reports must be the original work of the student or assigned group. Copying code, programs, simulations, or materials from other sources without proper citation is strictly prohibited. Any violation of academic integrity will result in negative evaluation. Deadlines Submission deadlines for assignments, projects, and reports will be defined at the beginning of the semester or activity. Late submissions will not be accepted without valid justification. Students are responsible for completing all course requirements within the specified deadlines. Consultations Students have the right to request consultations with the instructor regarding robot programming, automation systems, PLCs, simulations, and technical report preparation whenever necessary. Rules of Conduct and Academic Policies: • Active participation in lectures and exercises is expected. • Engagement in discussions, comments, and free expression of opinions, arguments, and academic viewpoints is encouraged. • Independent work and the use of additional information sources (scientific websites, journals, conference proceedings, etc.) are mandatory. • Respect for the schedule of lectures and exercises, without infringing on academic freedom (mobile phones must be on silent). • Respect for colleagues' words, opinions, and ideas. • Late arrivals and early departures without valid reasons from lectures, exercises, tests, or exams are not allowed. • Preparation and delivery of lectures is the responsibility of the instructor. • Students who miss more than four lectures or exercises without valid reasons will not receive attendance approval. • Students must have official documentation to take exams. • Students dissatisfied with their grade may appeal in writing to the Dean within two working days after results are announced, in accordance with the UMIB Statute. • Violation of exam rules, including use of unauthorized aids, will result in a failing grade. Plagiarism or copying will be sanctioned according to university regulations. ○
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