SYLLABUS
Academic year 2025-2026

Dean,
Prof. dr. eng. Vasile-Ion Manta

1. Program data

1.1 Higher education institution	"Gheorghe Asachi" Technical University of Iași
1.2 Faculty	Automatic Control and Computer Engineering
1.3 Department	Computers
1.4 Field of studies	Computers and Information Technology
1.5 The cycle of studies[1]	Master
1.6 Study program	Artificial Intelligence

2. Subject data

2.1 Name of the subject / Code				**Intelligent Systems** (*Sisteme inteligente*) / **AI.110**			
2.2 Course coordinator				prof. dr. eng. Florina Ungureanu			
2.3 Application instructor				s.l. dr. eng. Tudor Popovici			
2.4 Year of study[2]	1	2.5 Semester[3]	1	2.6 Type of assessment[4]	exam	2.7 Type of subject[5]	DS

3. Estimated total time of daily activities (hours per semester)

3.1 Number of hours per week	2	3.2 lectures	1	3.3a sem.		3.3b laboratory		3.3c project	1
3.4 Total hours in curriculum[6]	28	3.5 lectures	7	3.6a sem.		3.6b laboratory		3.6c project	7

Distribution of the time fund[7]	No. hours
Study by textbook, course support, bibliography and notes	30
Additional documentation in the library, on specialist electronic platforms and in the field	20
Preparation of seminars/labs/projects, assignments, reports and portfolios	20
Tutorial[8]	-
Examinations[9]	2
Other activities:	-

3.7 Total hours of individual study[10]	72
3.8 Total hours per semester[11]	100
3.9 Number of credits	4

4. Prerequisites (where applicable)

4.1 curriculum[12]	
4.2 competences	

5. Conditions (where applicable)

5.2 conducting the project[13]	• Laboratory room with computers and Internet access • Laboratory equipment for embedded computer development (power sources, multimeters, oscilloscopes, signal generators, development boards and extensions, embedded mobile platforms with sensors: cube robots, scaled model cars with proximity sensors, laser scanners and video cameras)

[1] *Bachelor / Master*
[2] *1-4 for Bachelor's, 1-2 for Master's*
[3] *1-8 for Bachelors, 1-3 for Masters*
[4] *Exam, colloquium or VP A/R – from the curriculum*
[5] *DF - fundamental subject, DID - subject in the field, DS - specialized subject or DC - complementary subject - from the education plan*
[6] *It is equal to 14 weeksx number of hours from point 3.1 (similar for 3.5, 3.6abc)*
[7] *The lines below refer to the individual study; the total is completed at point 3.7.*
[8] *Between 7 and 14 hours*
[9] *Between 2 and 6 hours*
[10] *The sum of the values on the previous lines, which refer to the individual study.*
[11] *The sum of the number of hours of direct teaching activity (3.4) and the number of hours of individual study (3.7); must be equal to the number of credits allocated to the subject (point 3.9)x 25 hours per credit.*
[12] *Mention the subjects that must be passed previously or equivalent*
[13] *Computing technique, software packages, experimental stands, etc.*

	• Open-source or free IDEs that allow students to develop code in C, C++, Python and Micropython (Visual Studio Code, Visual Studio Community Edition, PyCharm Community Edition)

6. Specific competences accumulated[14]

Number of credits assigned to the subject[15]:			**4**	Distribution of credits per competences[16]
Professional competences	CP1	Knowledge of advanced concepts of computer science and information technology and the ability to work with these concepts.		0.7
	CP2	Scientific and practical research in the field of intelligent systems.		0.7
	CP3	Problem solving using artificial intelligence methods and techniques in embedded systems and groups of embedded systems.		1.6
	CP4	Design and development of embedded artificial intelligence systems.		
	CP5	Usage of artificial intelligence tools and technologies.		0.7
	CPS1			
Transversal competences	CT1	Legislation compliant application of the intellectual property rights and of the principles, norms and values of the professional ethics code within their own strategies for rigorous, effective and responsible work.		0.1
	CT2	Application of communication techniques and effective group work; developing emphatic interpersonal communication skills and assuming leadership roles/functions in a multi-specialized team.		0.1
	CT3	Creating opportunities for continuous training and the effective usage of learning resources and techniques for personal development.		0.1
	CTS			

7. Objectives of the subject (resulting from the grid of specific competences accumulated)

7.1 General objective of the subject	A better understanding of the AI methods that are used in complex intelligent systems by designing systems as models that can be tested in simulation environments and then deployed on real devices with ease.
7.2 Specific objectives	The project aims to achieve a hands-on approach for designing intelligent and interactive systems by using tools and frameworks like ROS2 (Robot Operating Systems) that allow not only to model and build complex and distributed intelligent systems, but also to train and test the architectures in the companion simulation environments Gazebo.

8. Contents

8.1 Course	Teaching methods[17]	Remarks
Week 1: Introduction. **- Classification of intelligent systems** **- Intelligent system modelling** **- Development methods** **- Introduction to ROS infrastructure and developments in ROS2** **Week 3: ROS2 communication model** **- Decentralised architecture** **- Messages, Topics and the Publish/Subscribe approach for data flow** **- Services and Actions as interaction mechanisms** **- ROS Master node: orchestration** **Week 5: ROS2 Multi-Master** **- Interaction between independent ROS2 masters** **- Autonomous vs. Supervised design choices** **- Logistic warehouse case study** **Week 7: ROS2 SysOps/DevOps** **- Docker as a environment for developing, maintaining and reproducing intelligent systems**	Powerpoint presentations, answers to questions, explanations, case-studies, simulation presentation	

[14] *Competencies from the G1 and G1bis Grids of the study program, adapted to the specifics of the subject, for which credits are allocated (www.rncis.ro or the faculty website)*

[15] *From the education plan*

[16] *The credits allocated to the subject are distributed on professional and transversal competences according to the specifics of the subject*

[17] *Presentations, demonstrations, exercises, etc.*

- Dependency management and Host OS isolation **- ROS package management: from repository and building from sources** **Week 9: ROS2 Remote monitoring, diagnostic and control** **- ros_bridge as a flexible and secure extension to web interfaces** **- ros_brige authentication** **- simple web-UI for monitoring the ROS2 masters** **Week 11: Using and integrating ROS2 community packages** **- node configuration and starting - namespaces** **- launch files and scripts** **- integration testing in Gazebo simulation environment** **- using sensors and actuator models in simulation** **- Pixy2 case study vs ZED** **Week 13: ROS2 and complex sensors (sensor fusion, LiDARs and Depth cameras)** **- Indoor localization solutions** **- Using LiDARs for SLAM (simulation and practice) and collision avoidance** **- Using camera for obstacle detection, classification and advanced collision avoidance** **- Interaction through mixed-reality devices with intelligent systems**		
Course references: 1. Francisco Martín Rico, *A Concise Introduction to Robot Programming with ROS2*, ISBN 9781032264653, 264pp, 2023, Chapman & Hall 2. https://github.com/fmrico/book_ros2		
8.2c Project	Teaching methods[18]	Remarks
The project aims to design the software components for an intelligent system (e.g. a fleet of autonomous model cars with environment perception sensors) as ROS nodes developed in C++/Python/Matlab-Simulink to achieve a collaborative goal (e.g. formation driving on a track). The initial task include building and using models for the mechanical and hardware components so that the developed software can be tested in the simulation environment and after validation, deployed on the actual hardware for verification. **Week 2: Introduction, project plan and milestones, team forming, role assignment within teams** **Week 4: ROS infrastructure and communication model** **Week 6: Gazebo simulation environment, system modelling** **Week 8: Training AI in simulated environment and data synthesis** **Week 10: Evaluating interactions between independent intelligent systems** **Week 12: Deployment of the system on actual hardware and testing** **Week 14: Final presentation**	General and individual explanations, individual/ team work	
Project references: see course references, up to date documentation for the actual selected platforms, tutorials 1. Marco Matteo Bassa, *A very informal journey through ROS 2: patterns, anti-patterns, frameworks and best practices*, 125pp, ISBN 9783000746857, 2023 2. Francisco Martín Rico, *A Concise Introduction to Robot Programming with ROS2*, ISBN 9781032264653, 264pp, 2023, Chapman & Hall 3. https://github.com/fmrico/book_ros2		

9. Corroboration of the contents of the subject with the expectations of representatives of the epistemic community, professional associations and representative employers in the field related to the program[19]

ROS represents a modern infrastructure relevant in research and industry for building complex intelligent systems.

10. Evaluation

Type of activity	10.1 Evaluation criteria	10.2 Evaluation methods	10.3 Weight in the final grade
10.4a Exam	Acquired practical knowledge (quantity, correctness, accuracy)	Written theoretical test	30% (minimum 5)

[18] *Case study, demonstration, exercise, error analysis, etc.*

[19] *The connection with other subjects, the usefulness of the subject on the labor market*

10.4d Project	The quality of the completed project, the correctness of the project documentation, and the justification of the chosen solutions	• Final project demonstration, test validation • Milestones • Discussions with students	70% (minimum 5)
10.5 Minimum performance standard[20]: grade 5 in the exam and project work			

Date of completion,
4 December 2023

Signature of course coordinator,
prof. dr. eng. Florina Ungureanu

Signature of application instructor,
s.l.dr.eng. Tudor Popovici

Date of approval in the department,
7 December 2023

Director of department,
Assoc. prof. dr. eng. Andrei Stan

[20] *The minimum performance standard from the competences grid of the study program is customized to the specifics of the subject, if applicable.*