SYLLABUS

1. Data about the program of study

1.1 Institution	The Technical University of Cluj-Napoca
1.2 Faculty	Faculty of Automation and Computer Science
1.3 Department	Automation
1.4 Field of study	System's Engineering
1.5 Cycle of study	Master
1.6 Program of study / Qualification	Cyber-Physical Systems (English)
1.7 Form of education	Full time

2. Data about the subject

2.1 Subject name		***Human Robot Interactions***		Subject code	**15.00**
2.2 Course responsible / lecturer		Conf. dr. Ing Anastasios NATSAKIS – tassos.natsakis@aut.utcluj.ro			
2.3 Teachers in charge of seminars / Laboratory / project		Conf. dr. Ing Anastasios NATSAKIS – tassos.natsakis@aut.utcluj.ro			
2.4 Year of study	2	2.5 Semester	1	2.6 Type of assessment (E - exam, C - colloquium, V – verification)	E
2.7 Subject category	Formative category: DA – advanced, DS – speciality, DC – complementary				DA
	Optionality: DI – imposed, DO – optional (alternative), DF – optional (free choice)				DI

3. Estimated total time

3.1 Number of hours per week	3	of which:	Course	2	Seminars	0	Laboratory	1	Project	0
3.2 Number of hours per semester	42	of which:	Course	28	Seminars	0	Laboratory	14	Project	0
3.3 Individual study:										
(a) Manual, lecture material and notes, bibliography										28
(b) Supplementary study in the library, online and in the field										14
(c) Preparation for seminars/laboratory works, homework, reports, portfolios, essays										14
(d) Tutoring										0
(e) Exams and tests										2
(f) Other activities:										0
3.4 Total hours of individual study (suma (3.3(a)…3.3(f)))										58
3.5 Total hours per semester (3.2+3.4)										100
3.6 Number of credit points										4

4. Pre-requisites (where appropriate)

4.1 Curriculum	Robot modeling, computer programming
4.2 Competence	Research objectives definition

5. Requirements (where appropriate)

5.1. For the course	N/A
5.2. For the applications	Presence is mandatory

6. Specific competence

6.1 Professional competences	• Interacts professionally in research and professional environments • Applies the principles of scientific ethics and integrity in research activities • Conducts interdisciplinary research • Thinks abstractly • Models and simulates hardware • Develops software prototypes • Uses software libraries
6.2 Cross competences	• Show initiative • Think analytically • Apply scientific, technological, and engineering knowledge

7. Expected Learning Outcomes

Knowledge	The student will know: • advanced applications of AI, machine learning, and HRI technologies in industrial contexts, including their integration into robot control systems, and human-machine interaction • standards, best practices, and regulations for quality, safety, security, and ethical conduct in professional and research activities • domain-specific software, CAD tools, technical instruments, and laboratory equipment for design, prototyping, and experimental validation
Skills	The student will be able to: • create prototypes, test systems, and optimize performance through experimental evaluation and comparative analysis • analyse technical data, evaluate alternatives, and apply problem-solving strategies to complex engineering challenges • use modelling, simulation, AI, machine learning, and HRI tools to develop intelligent, autonomous, and automated solutions
Responsibilities and autonomy	• The student will be responsible for carrying out professional or research projects in compliance with quality, safety, and security standard • The student will be responsible for promoting collaboration, teamwork, knowledge transfer, and innovation within professional and research environments

8. Discipline objective (as results from the *key competences gained*)

8.1 General objective	Acquire knowledge in design, programming and operating industrial robots.
8.2 Specific objectives	Industrial robots modelling, Robot control algorithms, Robot programming, Industrial applications

9. Contents

9.1 Lectures	Hours	Teaching methods	Notes
Definitions: robots, humans, interactions	2	Presentation, Examples, Practical applications	
Robot modelling	2		
Human modelling	2		
Non verbal communication: intention detection	2		
Non verbal communication: intention expression	2		
Verbal communication	2		
Decision making	2		
Learning human behaviour	2		
Task sharing between a human and a robot	2		
No contact applications: manufacturing	2		
Direct contact applications: rehabilitation	2		
Safety and ergonomics	2		
Experimental design and validation, control	2		

Ethical considerations	2		

Bibliography
1. Robot Control Systems. Natsakis T, UT Press, 2025.
2. Probabilistic Robotics. Thrun, Burgard, & Fox, MIT Press, 2005.
3. Computational Human-Robot Interaction. Thomaz, Hoffman, & Cakmak, Foundations and Trends in Robotics. Vol 4: No. 2-3. Now Publishers, 2016.
5. Human-Robot Interaction: Safety, Standardization, and Benchmarking. Barattini, Vicentini, Singh Virk, & Haidegger, Routledgeg 2019.
6. Cooperative inverse reinforcement learning. Hadfield-Menell, Russell, Abbeel, & Dragan. 2016, Advances in neural information processing systems, 29
7. Human-robot cross-training: Computational formulation, modeling and evaluation of a human team training strategy. Nikolaidis & Shah, 2013 8th ACM/IEEE International Conference on Human-Robot Interaction (HRI)
8. A Human Aware Mobile Robot Motion Planner. Sisbot, Marin-Urias, Alami, & Simeon, 2007, IEEE Transactions on Robotics
9. Predicting Intention of Motion During Rehabilitation Tasks of the Upper-Extremity. Natsakis & Bușoniu, 2021, 43rd Annual International Conference of the IEEE Engineering in Medicine & Biology Society (EMBC).

9.2 Applications - Seminars/Laboratory/Project	Hours	Teaching methods	Notes
Environment preparation	2	Practical applications, numerical methods	
Creating a package	2		
ROS2 topics and services	2		
Interacting with the Officebots simualtor	2		
Human follower example	2		
Human engegement detection	2		
Gesture control	2		

Bibliography
1. Programming Robots with ROS: A Practical Introduction to the Robot Operating System. Quigley, Gerkey, & Smart, O'Reilley, 2015.
2. A Concise Introduction to Robot Programming with ROS2. Francisco Martín Rico, CRC Press, 2022.
3. ROS4HRI framework. http://wiki.ros.org/hri

10. Bridging course contents with the expectations of the representatives of the community, professional associations and employers in the field

This course touches spans through many disciplines and industries, since the HRI domain is inherently very inter and intra-disciplinary. As such, many stakeholders from both the industrial and research side will benefit from the knowledge acquired by the students.

11. Evaluation

Activity type	Assessment criteria	Assessment methods	Weight in the final grade
Course	Demonstration of understanding of the role of each HRI component and how to combine them	Written examination	70%
Laboratory	Ability to develop example applications for human-robot interaction	Computer examination	30%
Minimum standard of performance: Final mark (course and laboratory) ≥ 5			

Date of filling in: 01.09.2025	**Responsible**	**Title First name Last name**	**Signature**
	Course	Conf. dr. Ing. NATSAKIS Anastasios	
	Applications	Conf. dr. Ing. NATSAKIS Anastasios	

Date of approval in the department of Automation _____	Head of department, Prof.dr.eng. Honoriu VĂLEAN
Date of approval in the Faculty of Automation and Computer Science Council _____	Dean, Prof.dr.eng. Vlad MUREȘAN