Syllabus

1. Data about the program of study

1.1 Institution	Technical University of Cluj-Napoca
1.2 Faculty	Automation and Computer Science
1.3 Departament	Automation
1.4 Field of study	Systems Engineering
1.5 Cycle of study	Master of Science
1.6 Program of study/Qualification	Cyber-Physical Systems (English)
1.7 Form of education	Full time
1.8 Codul disciplinei	15.00

2. Data about the subject

2.1 Subject name	***Human Robot Interaction***				
2.2 Course responsible/lecturer	ȘL. dr. Ing Anastasios NATSAKIS – tassos.natsakis@aut.utcluj.ro				
2.3 Teachers in charge of applications	ȘL dr. Ing. Anastasios NATSAKIS – tassos.natsakis@aut.utcluj.ro				
2.4 Year of study	2	2.5 Semester	1	2.6 Assessment *(E/C/V)*	E
2.7 Type of subject	*DF – fundamental, DD – in the field, DS – specialty, DC – complementary*				DA
	DI – compulsory, DO – elective, Dfac – optional				DI

3. Estimated total time

3.1 Number of hours per week	3	of which:	Course	2	Seminar	0	Laboratory	1	Project	0
3.2 Number of hours per semester	42	of which:	Course	28	Seminar	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 (sum of (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 modelling, 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 competences

6.1 Professional competences	C3 Operating with fundamentals of control engineering, process modelling, simulation, identification and analysis methods, and computer aided design.
6.2 Cross competences	

7. Course objectives

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

8. Contents

8.1 Lecture	No. 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. Probabilistic Robotics. Thrun, Burgard, & Fox, MIT Press, 2005.
2. Computational Human-Robot Interaction. Thomaz, Hoffman, & Cakmak, Foundations and Trends in Robotics. Vol 4: No. 2-3. Now Publishers, 2016.
3. Human-Robot Interaction: Safety, Standardization, and Benchmarking. Barattini, Vicentini, Singh Virk, & Haidegger, Routledgeg 2019.
4. Cooperative inverse reinforcement learning. Hadfield-Menell, Russell, Abbeel, & Dragan. 2016, Advances in neural information processing systems, 29
5. 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)
6. A Human Aware Mobile Robot Motion Planner. Sisbot, Marin-Urias, Alami, & Simeon, 2007, IEEE Transactions on Robotics
7. Predicting Intention of Motion During Rehabilitation Tasks of the Upper-Extremity. Natsakis & Buşoniu, 2021, 43rd Annual International Conference of the IEEE Engineering in Medicine & Biology Society (EMBC).

8.2 Applications (laboratory)	No. hours	Teaching methods	Notes
Introduction to ROS and ROS2		Practical applications, numerical methods	
RviZ visualisation system			
Dynamic simulators (Gazebo, webots, opensim etc)			
Defining realistic scenarios using the ROS4HRI			
Gesture recognition			
Programming an engagement detector			
Engegment detection with real data			
Voice commands			
Actions definition and decision making			
Reinforcement learning			
Trajectory planning			
Controller design			
Experimental design			

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

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

10. 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:		**Title First name NAME**	**Signature**
06.06.2024	Course	Ș.L dr. Ing. Anastasios NATSAKIS	
	Applications	Ș.L dr. Ing. Anastasios NATSAKIS	

Date of approval by the Department Board ……..

Head of Departament .....
Prof.dr.ing. Honoriu VĂLEAN

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Date of approval by the Faculty Council ……

Dean
Prof.dr.ing. Mihaela Dinsoreanu

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