SYLLABUS

1. Information about the program

1.1 Higher education institution	Universitatea Politehnica Timișoara
1.2 Faculty[1] / Department[2]	ELECTRONICS, TELECOMMUNICATIONS AND INFORMATION TECHNOLOGIES / Applied Electronics Department
1.3 Field of study (name/code[3])	Electronics, Telecommunications and Information Technologies Engineering /20/20/10
1.4 Study cycle	Master
1.5 Study program (name/code/qualification)	AUTOMOTIVE ELECTRONIC SYSTEMS/ 20/20/10 / 2152

2. Information about discipline

2.1a Name of discipline/The educational classe[4]	Elements of artificial intelligence / DS						
2.1b Name of discipline in Romanian	Elemente de inteligență artificială						
2.2 Coordinator (holder) of course activities	Lect. Dr. Eng. Marina Adriana Mercioni						
2.3 Coordinator (holder) of applied activities[5]	Lect. Dr. Eng. Marina Adriana Mercioni						
2.4 Year of study[6]	2	**2.5** Semester	3	**2.6** Type of evaluation	E	**2.7** Regime of discipline[7]	DOP

3. Total estimated time (direct activities (fully assisted), partially assisted activities and unassisted activities[8])

3.1 Number of hours fully assisted/week	4 ,of which:	course	2	seminar/laboratory/project			2
3.1* Total number of hours fully assisted/sem.	56 ,of which:	course	28	seminar/laboratory/project			28
3.2 Number of on-line hours fully assisted/sem	,of which:	course		seminar/laboratory/project			
3.3 Number of hours partially assisted/week	,of which:	project, research		training		hours designing M.A. dissertation	
3.3* Number of hours partially assisted/ semester	,of which:	project of research		training		hours designing M.A. dissertation	
3.4 Number of hours of unassisted activities/ week	6.71 ,of which:	Additional documentation in the library, on specialized electronic platforms, and on the field					2
		Study using a manual, course materials, bibliography and lecture notes					2
		Preparation of seminars/ laboratories, homework, assignments, portfolios, and essays					2.71
3.4* Total number of hours of unasssited asctivities/ semester	94 ,of which:	Additional documentation in the library, on specialized electronic platforms, and on the field					28
		Study using a manual, course materials, bibliography and lecture notes					28
		Preparation of seminars/ laboratories, homework, assignments, portfolios, and essays					37.94
3.5 Total hrs./week[9]	10.71						
3.5* Total hrs./semester	150						
3.6 No. of credits	6						

4. Prerequisites (where applicable)

4.1 Curriculum	•
4.2 Learning outcomes	•

5. Conditions (where applicable)

5.1 of the course	• The classroom is equipped with a video projector and a smart whiteboard
5.2 to conduct practical activities	In accordance with the laboratory sheet •

6. **Learning outcomes** acquired through this discipline

Knowledge	• C4. The student/graduate understands techniques for preparing design sketches and technical documentation, integrated into the approval and validation processes of engineering projects. • C5. The student/graduate explains the principles and technologies of automation as applied to industrial processes. • C15. The student/graduate is familiar with testing procedures and standards applicable to power electronic systems, as well as engineering solutions for performance optimization. • C17. The student/graduate explains methods and techniques for designing sensors and integrated sensor systems within complex products.
Skills	• A1. The student/graduate approves engineering projects, applying quality standards, technical regulations, and sustainability criteria. • A4. The student/graduate prepares technical reports and project documentation, integrating testing data, comparative analyses, and implementation recommendations. • A5. The student/graduate drafts technical reports and project documentation in compliance with engineering standards. • A7. The student/graduate analyzes and interprets experimental data using statistical techniques and engineering methods. • A8. The student/graduate uses dedicated software for data analysis, interpreting information derived from industrial processes. • A14. The student/graduate integrates automation technologies into manufacturing and industrial monitoring processes. • A15. The student/graduate analyzes and interprets experimental and operational data to optimize industrial equipment performance.
Responsibility and autonomy	• RA1. The student/graduate assumes responsibility for coordinating and approving engineering projects, assessing the technical, economic, and environmental impact of proposed solutions. • RA2. The student/graduate demonstrates autonomy in leading scientific research and making complex engineering decisions, coordinating multidisciplinary technical teams. • RA4. The student/graduate promotes innovation and lifelong learning, integrating scientific and technological progress into research and development activities. • RA5. The student/graduate assumes responsibility for preparing and communicating technical reports to stakeholders. • RA6. The student/graduate engages in lifelong learning, continuously updating competences in line with scientific and technological progress. • RA9. The student/graduate coordinates multidisciplinary teams for the design, implementation, and testing of monitoring systems. • RA11. The student/graduate assumes responsibility for the accuracy and quality of analyses and results obtained in microsystems research. • RA13. The student/graduate coordinates and contributes to research and development teams, fostering collaboration and knowledge exchange.

7. **Objectives of the discipline** (based on the grid of learning outcomes acquired)

- Offering graduates a specialization dedicated to deepening their knowledge of Electronic Systems for the Automotive Industry.
- Providing skills related to the analysis, modeling, design, and implementation of complex automotive systems.
- Developing research skills for graduates of the bachelor's degree program in automotive electronics.
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8. **Content**

8.1 Course	Number of hours	Of which online	Teaching methods
Course 1. Introduction to intelligent systems	2		Whiteboard, Virtual Campus, Videoprojector
Course 2. Principles of evolutionary computing	2		
Course 3. Reinforcement learning	2		
Course 4. Fuzzy systems. Definitions and properties	2		
Course 5. Operations with fuzzy sets	2		

Course 6. Fuzzy relations	2		
Course 7. Linguistic variables	2		
Course 8. Fuzzy logic and approximate reasoning	2		
Course 9. Fuzzy controllers	2		
Course 10. Concepts of fuzzy controller design	2		
Course 11. Applications in image processing, automotive industry, robotics	2		
Course 12. Decisions in fuzzy environments. Expert systems	2		
Course 13. Swarm intelligence	2		
Course 14. Intelligent hybrid systems Feedback	2		

Bibliography[10]

1. C. D. Căleanu, Elemente de Inteligență artificială. Note de curs, 2020.
2. V. Tiponuţ, C.D. Căleanu, "Reţele neuronale. Arhitecturi şi algoritmi", Ed. Politehnica, Timişoara, 2001
3. A. P . Engelbrecht, Computational Intelligence. An Introduction, SE, Wiley, 2007.
4. Keller, Liu, Fogel, Fundamentals of Computational Intelligence, IEEE Press, 2016.
5. C. Alexandrescu, Sisteme Fuzzy. Aplicaţii în MATLAB, Ed. POLITEHNICA, 2001.
6. W. Siler, James J. Buckley, Fuzzy Expert Systems and Fuzzy Reasoning, John Wiley & Sons 2005.
7. Michael Negnevitsky, Articial Intelligence. A Guide to Intelligent Systems, 2nd ed., Pearson, 2004.

8.2 Applied activities[11]	Number of hours	Of which online	Teaching methods
1. Analysis of the components and characteristics of an intelligent system. Introductory study of modern AI architectures	2		
2. Implementing a genetic algorithm for optimizing a nonlinear function. Evolutionary computation stages and population performance evaluation	2		
3. Modeling an autonomous agent in a Grid-World environment. Application of the Q-Learning algorithm and convergence analysis	2		
4. Construction and comparison of membership functions for vague sets. Study of their properties and interpretation	2		
5. Applying fundamental operations on fuzzy sets (union, intersection, complement). Experimenting with t-norms and s-norms	2		
6. Representation and composition of vague relations through fuzzy matrices. Application of Max-Min and Max-Prod compositions	2		
7. Complete definition of a linguistic variable. Establishing the discourse universe, linguistic labels and associated functions	2		
8. Designing a fuzzy reasoning system using IF–THEN rules. Implementing Mamdani inference and defuzzification techniques	2		
9. Implementation of a fuzzy controller for controlling a physical quantity (temperature/speed). Modeling and simulation of the system behavior 10. Design and optimization stages of a fuzzy controller. Adjusting membership functions and refining the rule base 11. Implementing a fuzzy system in a practical application: image processing, automotive control or robotics. Comparative analysis of the results 12. Designing a mini-fuzzy expert system for decision-making in uncertain environments. Building the knowledge base and the inference mechanism	12		

13. Modeling an optimization process through group intelligence. Implementing the Particle Swarm Optimization or Ant Colony Optimization algorithm 14. Developing a hybrid intelligent system (Fuzzy–GA or Fuzzy–NN). Optimizing the parameters of a fuzzy system through evolutionary techniques			
	Bibliography[12] 1. C. D. Căleanu, Elemente de Inteligență artificială. Note de curs, 2020. 2. V. Tiponuţ, C.D. Căleanu, "Reţele neuronale. Arhitecturi şi algoritmi", Ed. Politehnica, Timişoara, 2001 3. Sutton, R. S., & Barto, A. G. (2018). Reinforcement learning: An introduction (2nd ed.). MIT Press. 4. Maxim Lapan, "Deep Reinforcement Learning Hands-On", 2020 5. Csaba Szepesvári, Algorithms for Reinforcement Learning, 2010 6. H. B. Verbruggen, Hans-Jürgen Zimmermann, Robert Babuška, Fuzzy Algorithms for Control (International Series in Intelligent Technologies, 14), 1999.		

9. Evaluation

Type of activity	**9.1** Evaluation criteria[13]	**9.2** Evaluation methods	**9.3** Share of the final grade
9.4 Course	Knowledge of AI architectures, algorithms and principles	Written exam	0.50
9.5 Applied activities	**S:**		
	L: The ability to develop applications based on AI paradigms	Oral exam	0.10
	P: Implementing a specific artificial intelligence topic	Oral exam	0.40
	Pr:		
	Tc-R[14]:		
9.6 Minimum performance standard (minimum amount of knowledge necessary to pass the discipline and the way in which this knowledge is verified[15]			
• Broad knowledge of AI architectures, algorithms and principles, verified by written exam, with a minimum score of 5.			

Date of completion	**Course coordinator (signature)**	**Coordinator of applied activities (signature)**
24.09.2025	Lect. Dr. Eng. Marina Adriana Mercioni	Lect. Dr. Eng. Marina Adriana Mercioni
Head of Department (signature)	**Date of approval in the Faculty Council** [16]	**Dean (signature)**
Assoc. Prof. Dr. Eng. Mircea Babaita	7.10.2025	Dr.habil.eng. Catalin Daniel Caleanu, Professor