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
1.4 Study cycle	Master
1.5 Study program (name/code/qualification)	Automotive Electronic Systems 202010/23925

2. Information about discipline

2.1a Name of discipline/The educational classe[4]	Deep Neural Networks / DF						
2.1b Name of discipline in Romanian	Rețele neuronale profunde						
2.2 Coordinator (holder) of course activities	Prof. dr. habil. eng. Cătălin Daniel Căleanu						
2.3 Coordinator (holder) of applied activities[5]	Lect. Dr. Eng. Marina Adriana Mercioni						
2.4 Year of study[6]	1	**2.5** Semester	1	**2.6** Type of evaluation	V	**2.7** Regime of discipline[7]	DO

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	28 ,of which:	course	14	seminar/laboratory/project	14

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	5 ,of which:	Additional documentation in the library, on specialized electronic platforms, and on the field	1
		Study using a manual, course materials, bibliography and lecture notes	2
		Preparation of seminars/ laboratories, homework, assignments, portfolios, and essays	2
3.4* Total number of hours of unasssited asctivities/ semester	69 ,of which:	Additional documentation in the library, on specialized electronic platforms, and on the field	23
		Study using a manual, course materials, bibliography and lecture notes	23
		Preparation of seminars/ laboratories, homework, assignments, portfolios, and essays	23

3.5 Total hrs./week[9]	9
3.5* Total hrs./semester	125
3.6 No. of credits	5

4. Prerequisites (where applicable)

4.1 Curriculum	• Programming languages, Mathematics
4.2 Learning outcomes	• Knowledge of Python programming, mathematical analysis and linear algebra

5. Conditions (where applicable)

5.1 of the course	• Computer lab with internet connection, video projector/smartboard
5.2 to conduct practical activities	Computer lab with PCs, internet connection •

6. Learning outcomes acquired through this discipline

Knowledge	• C1. The student/graduate demonstrates advanced knowledge of the categories of electronics, the principles of electricity and engineering, and the physics and mathematics required for the design and analysis of complex electronic systems. • C5. The student/graduate explains the principles and technologies of automation as applied to industrial processes. • C9. The student/graduate demonstrates advanced knowledge of the operating principles and integration of microsystems and MEMS. • C14. The student/graduate explains methods and techniques for modeling power electronic systems, including the analysis of components and their interactions. •
Skills	• A2. The student/graduate conducts scientific research in electronics, developing innovative methods and solutions for circuits, semiconductors, and advanced technological applications. • A4. The student/graduate prepares technical reports and project documentation, integrating testing data, comparative analyses, and implementation recommendations. • 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. •
Responsibility and autonomy	• 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. • RA8. The student/graduate demonstrates autonomy in the use of analysis software and in decision-making regarding the design and testing of equipment. • 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)

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  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.
- Understanding architectures and algorithms for deep neural networks.
- Development of applications with deep neural networks.
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8. Content

8.1 Course	Number of hours	Of which online	Teaching methods
Introduction	2	2	Whiteboard, Virtual Campus,
Feedforward neural networks (Perceptrons)	4	4	

	Number of hours	Of which online	Teaching methods
Neural networks based on radial basis functions (RBF)	2	2	Videoprojector, laptop
Self-Organizing Neural Networks	2	2	
Deep Learning Paradigm	2	2	
Convolutional Neural Networks (CNNs)	2	2	
Typical CNN Architectures (AlexNet, GoogleNet, VGG, ResNet etc.)	2		
Recurrent Neural Networks (RNNs) (GRU, LSTM etc.)	2		
Autoencoders	2		
Generative Models (GAN, Diffusion, VAE, Transformer)	4		
Graph Neural Networks (GNNs)	2		
Ethics and Interpretability	2		

Bibliography[10]
1. C. D. Căleanu, Rețele neuronale profunde, Note de curs, 2022
2. I. Googfellow, Y. Bengio, A. Courville, Deep learning, MIT Press, 2016, http://www.deeplearningbook.org\
3. N. Buduma, N. Lacascio, „Fundamentales of Deep Learning", O'Relly, 2017
4. V.Tiponuţ, C.D. Căleanu, "Reţele neuronale. Arhitecturi şi algoritmi", Ed. Politehnica, Timişoara, 2001.

8.2 Applied activities[11]	Number of hours	Of which online	Teaching methods
Software packages for implementing neural networks	2	2	Smartboard, Virtual Campus, Video Projector, PC
Neuron and neural network models	4	4	
Simple Perceptron and Multi-Layer Perceptron (MLP)	4	4	
Convolutional Neural Networks (CNNs) for Artificial Vision	4	4	
Recurrent Neural Networks (RNNs) with Long Short-Term Memory (LSTM)	6		
Development of Applications with RNNs	8		

Bibliography[12]
1. Shih-Chia Huang, Trung-Hieu Le, Principles and Labs for Deep Learning, Academic Press, 2021.
2. François Chollet, Deep Learning with Python, Manning Publications 2021.
3. Krishnendu Kar, Mastering Computer Vision with TensorFlow 2.x, Packt, 2020
4. C.D. Căleanu, V. Tiponuţ, "Reţele neuronale. Aplicaţii", Ed. Politehnica, Timişoara, 2002

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 Architectures, Algorithms and Principles related to RNNs	Online Exam through Campus Virtual Platform	2/3
9.5 Applied activities	**S:**		
	L: Ability to Develop Applications with RNNs	Oral exam	1/3
	P:		
	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]
• Knowledge of RNN architectures, algorithms and principles verified through written exam and implementation of an application with RNNs, minimum grade 5 on both exams

Date of completion	**Course coordinator (signature)**	**Coordinator of applied activities (signature)**
24.09.2025	Dr.habil.eng. Catalin Daniel Caleanu, Professor	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