

SYLLABUS

1. Information about the program

1.1 Higher education institution	Universitatea Politehnică Timișoara
1.2 Faculty ¹ / Department ²	ELECTRONICS, TELECOMMUNICATIONS AND INFORMATION TECHNOLOGIES / Applied Electronics
1.3 Field of study (name/code ³)	Electronics, Telecommunications and Information Technologies Engineering /202010
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	Digital Control of Electronic Power Converters/DF						
2.1b Name of discipline in Romanian	Comanda digitală a convertoarelor electronice de putere						
2.2 Coordinator (holder) of course activities	Associate Professor Dr. Eng. Adrian Popovici.						
2.3 Coordinator (holder) of applied activities ⁵	Associate Professor Dr. Eng. Adrian Popovici						
2.4 Year of study ⁶	2	2.5 Semester	3	2.6 Type of evaluation	E	2.7 Regime of discipline ⁷	DOB

3. Total estimated time (direct activities (fully assisted), partially assisted activities and unassisted activities⁸)

3.1 Number of hours fully assisted/week	5 ,of which:	course	2	seminar/laboratory/project	0/1/2
3.1* Total number of hours fully assisted/sem.	70 ,of which:	course	28	seminar/laboratory/project	0/14/28
3.2 Number of on-line hours fully assisted/sem	48 ,of which:	course	16	seminar/laboratory/project	32
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	5.71 ,of which:	Additional documentation in the library, on specialized electronic platforms, and on the field			0.7
		Study using a manual, course materials, bibliography and lecture notes			1
		Preparation of seminars/ laboratories, homework, assignments, portfolios, and essays			4
3.4* Total number of hours of unassisted activities/ semester	80 ,of which:	Additional documentation in the library, on specialized electronic platforms, and on the field			10
		Study using a manual, course materials, bibliography and lecture notes			14
		Preparation of seminars/ laboratories, homework, assignments, portfolios, and essays			56
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	• Room with a minimum of 30 seats, equipped with a projector and internet access
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5.2 to conduct practical activities	<ul style="list-style-type: none"> In accordance with activity completion requirements
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6. Learning outcomes acquired through this discipline

Knowledge	<ul style="list-style-type: none"> 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. C4. The student/graduate understands techniques for preparing design sketches and technical documentation, integrated into the approval and validation processes of engineering projects. C8. The student/graduate describes procedures for developing sketches and technical documentation for the design and validation of monitoring equipment. C10. The student/graduate explains design methods and manufacturing techniques employed in the development of electronic, mechanical, and optical microsystems. C13. The student/graduate demonstrates advanced knowledge of power electronics principles, conversion circuits, and their applications in industrial and energy systems.
Skills	<ul style="list-style-type: none"> A1. The student/graduate approves engineering projects, applying quality standards, technical regulations, and sustainability criteria. A2. The student/graduate conducts scientific research in electronics, developing innovative methods and solutions for circuits, semiconductors, and advanced technological applications. A3. The student/graduate designs electronic systems, including circuits, equipment, and applications in fields such as automotive and instrumentation. A4. The student/graduate prepares technical reports and project documentation, integrating testing data, comparative analyses, and implementation recommendations. A9. The student/graduate designs control systems for the monitoring and optimization of industrial processes.
Responsibility and autonomy	<ul style="list-style-type: none"> 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. RA3. The student/graduate ensures quality and professional ethics in the design and testing of electronic systems, in compliance with international and national regulations. RA4. The student/graduate promotes innovation and lifelong learning, integrating scientific and technological progress into research and development activities. RA6. The student/graduate engages in lifelong learning, continuously updating competences in line with scientific and technological progress..

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

<ul style="list-style-type: none"> The course provides fundamental theoretical and practical knowledge on optimizing the digital control of electronic power converters. Presentation of specific digital control methods of electronic power converters. Implementation of specific advanced digital control methods for electronic power converters.
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8. Content

8.1 Course	Number of hours	Of which online	Teaching methods
Introduction	2		Presentation of slides using
Electronic power converters, overview	2		

Use of electronic power systems for automotive applications	2		projector, lecture based on exposed materials, conversation, explanation, example, demonstration, comparative analysis, case study.
Control of systems used in power electronics	2		
Digital control of systems used in power electronics	2	2	
Comparative analysis of analog and digital control systems	2	2	
Applications of digital control systems for power electronic converters	2	2	
Synthesis of digital control algorithms based on PWM modulation	2	2	
Implementation of digital control algorithms based on PWM modulation	2	2	
The structure of digital control systems	2	2	
Characteristic parameters	2	2	
PWM signal generation. Fundamental concepts.	2	2	
Basic techniques and principles	2		
Trends in the development of control systems for electronic power converters	2		
<p>Bibliography¹⁰ A.Popovici, M.Băbăiță, Aplicații ale procesoarelor de semnal în conducerea sistemelor de acționări electrice", Editura Politehnica, Timișoara, 2001,ISBN 973-8247-27-6</p> <p>A Popovici, Digital Control of Electronic Power Converters, Campus Virtual UPT, 2025</p> <p>V.Popescu, I.Bogdanov, A.Popovici, M.Băbăiță, Procesorul de semnal în conducerea sistemelor de acționare electrică, Editura Politehnica, Timișoara, 2001, ISBN 973-8247-28-4</p> <p>M. Kazimierczuk, Pulse-Width Modulated DC–DC Power Converters, Second Edition, Wright State University, Dayton, Ohio, Wiley, 2016</p> <p>C. K. Tse, Complex Behavior of Switching Power Converters, CRC Press, London, 2004</p> <p>A. Emadi, Integrated Power Electronic Converters and Digital Control, CRC Press, London, 2009</p> <p>G. Holmes, T. Lipo, Pulse Width Modulation For Power Converters Principles and Practice, IEEE PRESS, Wiley, 2003</p> <p>N. Sridhar, Power Electronics in Automotive Applications, Texas Instruments, SLYY052, 2013</p> <p>K.Sozański, Digital Signal Processing in Power Electronics Control Circuits, Second Edition, Springer, London, 2017</p> <p>J. Kabziński, Advanced Control of Electrical Drives and Power Electronic Converters, Springer, 2017.</p>			
8.2 Applied activities¹¹	Number of hours	Of which online	Teaching methods
Digital Control of Electronic Power Converters laboratory specific activities	14	8	Conversation, explanation, example, demonstration, comparative analysis, case study, brainstorming. Interactive, with video projector, questions and answers, with adequate support
Digital Control of Electronic Power Converters design specific activities	28	24	

	<p>Bibliography¹² .Popovici, M.Băbăiță, Aplicații ale procesoarelor de semnal în conducerea sistemelor de acționări electrice", Editura Politehnică, Timișoara, 2001, ISBN 973-8247-27-6</p> <p>A Popovici, Digital Control of Electronic Power Converters, Campus Virtual UPT, 2025</p> <p>V.Popescu, I.Bogdanov, A.Popovici, M.Băbăiță, Procesorul de semnal în conducerea sistemelor de acționare electrică, Editura Politehnică, Timișoara, 2001, ISBN 973-8247-28-4</p> <p>M. Kazmierczuk, Pulse-Width Modulated DC–DC Power Converters, Second Edition, Wright State University, Dayton, Ohio, Wiley, 2016</p> <p>C. K. Tse, Complex Behavior of Switching Power Converters, CRC Press, London, 2004</p> <p>J. Kabziński, Advanced Control of Electrical Drives and Power Electronic Converters, Springer, 2017</p> <p>S. Ketsingsoi, An Off-line Battery Charger Based on Buck-Boost Power Factor Correction Converter for Plug-in Electric Vehicles, Energy Procedia 56, Elsevier, 2014</p> <p>N. Mounghum, W. Subsingha, Voltage Control by DQ Frame Technique of SVPWM ACDC Converter, Energy Procedia 34, Elsevier, 2013</p> <p>Z. Xu, An Indirect Space-Vector Modulated Three-Phase AC-DC Matrix Converter for Hybrid Electric Vehicles, Energy Procedia 75, Elsevier, 2015</p> <p>L. Pana, Performance Enhancement of Battery Charger for Electric Vehicles Using Resonant Controllers, Energy Procedia 105, Elsevier, 2017</p> <p>L. Pana, Model Predictive Control of a Single-Phase PWM Rectifier for Electric Vehicle Charger, Energy Procedia 105, Elsevier, 2017</p> <p>W. Wojtkowski, Digital control of a bidirectional DC/DC converter for automotive applications, Elsevier, IFAC, 2018</p>		

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 fundamental notions and concepts. Involvement of students in discussions related to the specifics of the course.	Student participation in discussions related to the specifics of the discipline. Written assessment.	50%
9.5 Applied activities	S:		
	L: Individual work and teamwork to develop a research project based on experimental results. Clarity, coherence, conciseness of presentation, correct problem solving, correct interpretation of results, use of documentation sources, and application of acquired knowledge.	Discussions during the project development and activity report, timely completion of design/research stages, and final presentation of the report.	50%
	P:		
	Pr:		
	Tc-R¹⁴:		

9.6 Minimum performance standard (minimum amount of knowledge necessary to pass the discipline and the way in which this knowledge is verified¹⁵)

- In order to promote the course and activities during the semester, students must be familiar with the main methods of digital control in power electronic systems. Completion of assignments during the semester.

Date of completion

24.09.2025

**Course coordinator
(signature)**

**Coordinator of applied activities
(signature)**

**Head of Department
(signature)**

**Date of approval in the Faculty
Council ¹⁶**

**Dean
(signature)**

7.10.2025