COURSE DESCRIPTION

1. Program identification information

1.1 Higher education institution	**National University of Science and Technology Politehnica Bucharest**
1.2 Faculty	**Electronics, Telecommunications and Information Technology**
1.3 Department	**Applied Electronics and Information Engineering**
1.4 Domain of studies	Electronic Engineering, Telecommunications and Information Technology
1.5 Cycle of studies	Bachelor/Undergraduate
1.6 Programme of studies	Applied Electronics

2. Date despre disciplină

2.1 Course name (ro) (en)				Procesoare electronice de putere Power Electronic Processors			
2.2 Course Lecturer				Prof. Dr. Constantin RĂDOI			
2.3 Instructor for practical activities				Prof. Dr. Adriana FLORESCU			
2.4 Year of studies	4	2.5 Semester	I	2.6. Evaluation type	E	2.7 Course regime	Ob
2.8 Course type		S	2.9 Course code	04.S.07.O.506		2.10 Tipul de notare	Nota

3. Total estimated time (hours per semester for academic activities)

3.1 Number of hours per week	3	Out of which: 3.2 course	2.00	3.3 seminary/laboratory	1
3.4 Total hours in the curricula	42.00	Out of which: 3.5 course	28	3.6 seminary/laboratory	14
Distribution of time:					hours
Study according to the manual, course support, bibliography and hand notes Supplemental documentation (library, electronic access resources, in the field, etc) Preparation for practical activities, homework, essays, portfolios, etc.					46
Tutoring					0
Examinations					12
Other activities (if any):					0

3.7 Total hours of individual study	58.00
3.8 Total hours per semester	100
3.9 Number of ECTS credit points	4

4. Prerequisites (if applicable) (where applicable)

4.1 Curriculum	The attendance and passing of the following disciplines: Fundamentals of electrical engineering, Computer programming, Signals and systems, Electronic devices, Fundamental electronic circuits.

4.2 Results of learning	Accumulation of knowledge about industrial electronics and d.c.-d.c. and d.c.-a.c. power electronics conversion

5. Necessary conditions for the optimal development of teaching activities (where applicable)

5.1 Course	The course will take place in a room equipped with a blackboard and a video projector.
5.2 Seminary/ Laboratory/Project	Mandatory attendance at the laboratory sessions, according to the Regulation of university undergraduate studies in UPB in force.

6. General objective *(Reffering to the teachers' intentions for students and to what the students will be thought during the course. It offers an idea on the position of course in the scientific domain, as well as the role it has for the study programme. The course topics, the justification of including the course in the currcula of the study programme, etc. will be described in a general manner)*

The Power Electronic Processors (PEP) discipline is studied within the field of Electronic Engineering, Telecommunications and Information Technologies, the Applied Electronic Specialization (ELA) specialization and has as course objectives the study by temporal and frequency methods of d.c.-d.c. and d.c.-a.c. processing systems, as well as their main applications in industry.

The Laboratory of Electronic Power Processors has as its general objective the acquisition of the knowledge taught in the course as well as its deepening by performing measurements and simulations on the existing circuits and computers in the Laboratory of Electronic Power Processors of the ETTI Faculty, EAII Department, building B Leu, 1st floor , room B235.

7. Competences *(Proven capacity to use knowledge, aptitudes and personal, social and/or methodological abilities in work or study situations and for personal and proffesional growth. They refflect the empolyers requirements.)*

Specific Competences	- Using of fundamental elements related to electronic devices, circuits and instrumentation. - Applying, in typical situations, of the basic methods of processing electrical and non-electrical signals; implementing procedures of average complexity on signal processors. - Understanding and using fundamental concepts in the field of communications and information transmission. - Applying of elementary knowledge, concepts and methods regarding to the architecture of computing systems, microcontrollers, programming languages and techniques. - Solving electronic technology problems of production processes, maintenance (adjustment, testing, troubleshooting) of equipment and installations in the fields of power electronics, medical electronics, automatic systems and robots and the development of projects of medium complexity in the specialty. - Electrical energy management in electronic devices and installations used in industry, transport and medicine.

Transversal (General) Competences	- The ability to communicate and collaborate with specialists from other fields, other than electronics, in the sense of ensuring an interface between the technical problems encountered by them and the solutions to those problems. - The ability to communicate with higher hierarchical structures and with the subordinate team. - The ability to function as a leader of a team that may consist of people with different specializations and skill levels. - The ability to identify and apply the most appropriate and relevant management strategies for the subordinate team. - The ability to take decisions in order to solve current or unpredictable problems that appear in the process of operating electronic devices. - The ability to ensure the planning and management of projects in the field of applied electronics. - The ability to permanently inform and document for personal and professional development by reading specialized literature. - The ability to communicate and present technical content both in Romanian and in English. - Flexibility in using new systems and technologies within a team where members together achieve a well-defined goal while assuming different roles or tasks.

8. Learning outcomes *(Synthetic descriptions for what a student will be capable of doing or showing at the completion of a course. The learning outcomes reflect the student's acomplishments and to a lesser extent the teachers' intentions. The learning outcomes inform the students of what is expected from them with respect to performance and to obtain the desired grades and ECTS points. They are defined in concise terms, using verbs similar to the examples below and indicate what will be required for evaluation. The learning outcomes will be formulated so that the correlation with the competences defined in section 7 is highlighted.)*

Knowledge	*The result of knowledge aquisition through learning. The knowledge represents the totality of facts, priciples, theories and practices for a given work or study field. They can be theoretical and/or factual.* • Defines domain-specific notions. • Describes/classifies notions/processes/phenomena/circuits/systems built with the studied electronic power converters. • Understand the analytical methods and techniques used in the studied field of PEP. • Knows the operation of d.c.-d.c. and d.c.-a.c. power circuits specific to the studied PEP field.
Skills	*The capacity to apply the knowledge and use the know-how for completing tasks and solving problems. The skills are described as being cognitive (requiring the use of logical, intuitive and creative thinking) or practical (implying manual dexterity and the use of methods, materials, tools and intrumentation).* • Selects and groups relevant information about the studied field in a given context • Experimentally verifies the identified solutions. • Solves concrete practical applications of the studied PEP field. • Analyzes and compares studied d.c.-d.c. and d.c.-a.c. converters in order to evaluate the performances and to choose the best solutions for a given concrete practical application. • Argues the solutions identified and the ways to solve them for a concrete application. • Formulates conclusions to the experiments carried out. • Synthesizes future development directions for the initial proposed solution, in order to perfect it • Applies the learned knowledge and the acquired skills, using the know-how in order to carry out and solve similar issues.

Responsability and autonomy	*The student's capacity to autonomously and responsably apply their knowledge and skills.* • Realizes the value of its contribution in the field of engineering to the identification of viable/sustainable solutions to solve problems in social and economic life (social responsibility). • Applies principles of professional ethics/deontology in the analysis of the technological impact of the proposed solutions in the specialized field on the environment. • Analyzes and capitalizes on business/entrepreneurial development opportunities in the specialized field • Demonstrates real-life situation management skills (collaborative vs. conflict time management). • Responsably and autonomously applies the aquired knowledge and skills

9. Teaching techniques *(Student centric techniques will be considered. The means for students to participate in defining their own study path, the identification of eventual fallbacks and the remedial measures that will be adopted in those cases will be described.)*

The teaching methods are based on the use of the blackboard and the video projector, both in the course and in the laboratory. The oral communication methods used are the expository method and the problematization method, used head-on. The course materials are: course notes and presentations, collections of proposed problems (theoretical and solved on the computer). In the laboratory, students independently simulate, implement, test and evaluate the same problems through the continuous use of platforms and software environments. All the didactic materials are the laboratory platforms included in the laboratory guide. All course and lab materials are available electronically on the Power Electronics Processors (PEP) course Moodle site:

https://curs.upb.ro/2021/course/view.php?id=9122.

Starting from the analysis of students' learning characteristics and their specific needs, the teaching process explores both expository (lecture, exposition) and conversational-interactive teaching methods, based on discovery learning models facilitated by direct and indirect reality exploration (experiment, demonstration, modelling), but also on action-based methods, such as exercise, practical activities and problem solving. In the teaching activity, lectures are used, based on presentations that use images and diagrams, so that the information presented is easy to understand and assimilated by the students.

It is considered the practice of active listening and assertive communication skills, as well as feedback construction mechanisms, as ways of behavioral regulation in various situations of adapting the pedagogical approach to the students' learning needs. Students' teamwork skills are also practiced to solve different learning tasks.

10. Contents

COURSE		
Chapter	**Content**	**No. hours**
1	D.c. electric power processing elements.	2
2	D.c.-d.c. converter processors: open-loop PWM (Pulse Duration Modulation) modulation study and analysis of Buck, Boost, Buck-Boost, and Cuk Converters, galvanically insulated converters, parametric converter topologies with optimal functions. Case study: designing a d.c.-d.c. converter.	4
3	Switching sources: dynamics of conversion systems, time-invariant average model analysis and synthesis in state variable space, SPICE simulation. Case study: calculation of the transfer function and design of the feedback loop elements for a d.c.-d.c. converter. The stability regime.	12
4	D.c.-a.c. conversion processors: conventional and matrix conversion systems with PWM modulation, command and control methods.	4

5	Modern systems and topologies for optimizing d.c.-d.c. and d.c.-a.c. conversion: Zero Voltage Switching and Zero Current Switching switching processes. Case study: the design of a converter with zero voltage switching (ZVS).	4
6	Applications of d.c.-d.c. and d.c.-a.c. processors in uninterruptible power supplies (UPS) used in computer systems, medical, automotive, military equipment etc., as well as in other electronic equipments.	2
	Total:	28

Bibliography:

1. The course in electronic format from Moodle:
Lecturer: Prof. Dr. Eng. Adriana Florescu, subject name: Power Electronics Processors, course support and laboratory in electronic format, course link in Moodle:https://curs.upb.ro/2021/course/view.php?id=9122
2. Surugiu, A. Florescu, "Electronica de putere in comutatie (Switching Power Electronics) – vol.I" (195 pages), Editura Printech, ISBN 978-606-23-0280-1 (general for both volumes) and ISBN 978-606-23-0281-8 (specific for vol.I), Bucuresti, 2014
3. A. Florescu, I. Surugiu, "Electronica de putere in comutatie (Switching Power Electronics) – vol.II" (175 pages), Editura Printech, ISBN 978-606-23-0280-1 (general for both volumes) and ISBN 978-606-23-0282-5 (specific for vol.II), Bucuresti, 2014
4. Muhammad H. Rashid, "Power Electronics Handbook", 4th edition, Elsevier Printing House, 2018
5. Fang Lin Luo, Hong Ye, „Power Electronics: Advanced Conversion Technologies", 2nd edition, CRC Press, 2017
6. N. Mohan, T.M. Undeland, W. Robbins, "Power Electronics", John Willey & Sons, Inc., 2003
7. M. S. Teodorescu, S.G. Rosu. A. Florescu, „Analiza asistata de calculator a circuitelor electronice de putere. Indrumar de laborator (Computer-Aided Analysis for Power Electronics Circuits)", cod CNCSIS 54, ISBN 976-606-23-0896-4, Editura Printech, Bucuresti, Romania, 2018 (112 pages)

LABORATORY

Crt. no.	Content	No. hours
1	SPICE modeling of dc sources. in commutation. Regulated switching voltage source	4
2	One time operation hyristor chopper	4
3	Inverter with voltage synthesis controlled with IBM-PC computer	4
4	Laboratory colloquium	2
	Total:	14

Bibliography:
1. The course in electronic format from Moodle:
Lecturer: Prof. Dr. Eng. Adriana Florescu, subject name: Power Electronics Processors, course support and laboratory in electronic format, course link in Moodle:https://curs.upb.ro/2021/course/view.php?id=9122
2. C.Radoi, V.Drogoreanu, V.Grigore, A.Florescu ș.a. - Electronică și informatică industrială. Aplicații practice (Industrial Electronics and Informatics. Practical Applications), Editura Tehnică, București, 1997.
3. Surugiu, A. Florescu, "Electronica de putere in comutatie (Switching Power Electronics) – vol.I" (195 pages), Editura Printech, ISBN 978-606-23-0280-1 (general for both volumes) and ISBN 978-606-23-0281-8 (specific for vol.I), Bucuresti, 2014
4. A. Florescu, I. Surugiu, "Electronica de putere in comutatie (Switching Power Electronics) – vol.II" (175 pages), Editura Printech, ISBN 978-606-23-0280-1 (general for both volumes) and ISBN 978-606-23-0282-5 (specific for vol.II), Bucuresti, 2014
5. Muhammad H. Rashid, "Power Electronics Handbook", 4th edition, Elsevier Printing House, 2018
6. N. Mohan, T.M. Undeland, W. Robbins, "Power Electronics", John Willey & Sons, Inc., 2003
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11. Evaluation

Activity type	11.1 Evaluation criteria	11.2 Evaluation methods	11.3 Percentage of final grade
11.4 Course	Knowledge of fundamental theoretical notions;	Verifying test during the semester	25%
	Knowing how to apply the theory to specific problems;	Partially during the semester, with the possibility of retaking in the session	25%
	Analysis of techniques and theoretical methods specific to the field of power electronics processors.	Final test in the session	25%

11.5 Seminary/laboratory/project	Knowing the working strategy for a given problem;	Final laboratory colloquium grid test type, which contains theoretically questions presented in the laboratory sessions.	5%
	Knowledge of the operation of the proposed power circuits	Final laboratory colloquium grid test type, which contains questions from the simulations performed or given as homework in the laboratory sessions.	10%
	Demonstration of the operation by simulation of an implemented system.	Final laboratory colloquium grid test type, which contains questions about the functioning of the power circuits presented in the laboratory seesions.	10%
11.6 Passing conditions			
The Power Electronics Processors (PEP) discipline includes the switching, command, regulation and conversion of electricity from direct current (d.c.) to direct current (d.c.) or to alternating current (a.c.) but with other parameters, using electronic devices together with their measurement and control circuits. Inverters (d.c.-c.a. converters) and d.c.-d.c. converters represent the fundamental building blocks of modern electronic applications used in telecommunications and mobile telephony, multimedia equipment, medical technology, etc. The course and laboratory curriculum content meet the requirements of this modern and current field of electrical power processing, which gathers and promotes the information available in the electronics of the electrical power conversion, so that the future electronics engineer to have immediate access to the basic knowledge, concepts and methodologies in the field. Thus, the graduates of the National University of Science and Technology Politehnica Bucharest, the Faculty of Electronics, Telecommunications and Information Technology, the field of Electronic Engineering, Telecommunications and Information Technologies, the Applied Electronics specialization, are provided with the appropriate skills correlated with the needs of current qualifications and a modern scientific and technical training, qualitative and competitive, which will allow them to be quickly employed after graduation, being perfectly aligned with the policy of the National University of Science and Technology Politehnica Bucharest, both from the point of view of content and structure, as well as from the point of view of skills and international openness offered to the students by international scholarships offered if they are willing to work in the field of applied electronics.			

12. Corroborate the content of the course with the expectations of representatives of employers and representative professional associations in the field of the program, as well as with the current state of knowledge in the scientific field approached and practices in higher education institutions in the European Higher Education Area (EHEA)

• Obtaining 50% of the total score awarded to the laboratory, according to the ETTI Undergraduate Studies Regulations in force.

• Obtaining 50% of the exam score (partial plus final exam).

Date Course lecturer Instructor(s) for practical activities

Universitatea Națională de Știință și Tehnologie Politehnica București

Facultatea de Electronică, Telecomunicații și

Tehnologia Informației

09.10.2024 Prof. Dr. Constantin RĂDOI Prof. Dr. Adriana FLORESCU

Date of department approval Head of department

Conf.dr.ing. Bogdan Cristian FLOREA

Date of approval in the Faculty Council Dean

Prof.dr.ing. Radu Mihnea UDREA