Universitatea Națională de Știință și Tehnologie Politehnica București
Facultatea de Electronică, Telecomunicații și
Tehnologia Informației

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	**Electronic Devices, Circuits and Architectures**
1.4 Domain of studies	Electronic Engineering, Telecommunications and Information Technology
1.5 Cycle of studies	Masters
1.6 Programme of studies	Advanced Microelectronics

2. Date despre disciplină

2.1 Course name (ro) (en)				Circuite electronice de putere Power Electronic Circuits			
2.2 Course Lecturer				Prof. Dr. Alexandru VASILE			
2.3 Instructor for practical activities				Prof. Dr. Alexandru VASILE			
2.4 Year of studies	1	2.5 Semester	II	2.6. Evaluation type	E	2.7 Course regime	Ob
2.8 Course type		DS	2.9 Course code	UPB.04.M2.O.04-02		2.10 Tipul de notare	Nota

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

3.1 Number of hours per week	4	Out of which: 3.2 course	2.00	3.3 seminary/laboratory	2
3.4 Total hours in the curricula	56.00	Out of which: 3.5 course	28	3.6 seminary/laboratory	28
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.					20
Tutoring					15
Examinations					15
Other activities (if any):					5

3.7 Total hours of individual study	69.00
3.8 Total hours per semester	125
3.9 Number of ECTS credit points	5

4. Prerequisites (if applicable) (where applicable)

4.1 Curriculum	Physics, Basic Electro technique, Elementary Electrical Devices and Circuits, Analog and Digital Integrated Circuits

4.2 Results of learning	-

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

5.1 Course	Video projector with sound system
5.2 Seminary/ Laboratory/Project	Laboratory with specific platforms for checking power circuits in switching

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)*

Assimilation of knowledge related to the special conditions ***power electronics circuits***, the special electronic circuits destined to this field: circuits for the engine control and monitoring, circuits for the supervision and control of the running and environmental systems, the methodology of approaching and designing an electronic system destined to the applied electronics

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	The *power electronics circuits* discipline brings the students to the same level of theoretical knowledge in the field of master studies and prepares practical engineering activities for design and manufacturing practical electronic systems. The accumulated knowledge is required for understanding the other master disciplines with applications in the development of applied electronic modules and systems
Transversal (General) Competences	According to grids 1 and 2 of the study program. CT3 Adaptation to new technologies, professional and personal development, through continuous training, using printed documentation sources, specialized software and electronic resources in Romanian and, at least, in an international language. Details: the ability to adapt to the new CAD approaches and methods intended for current technologies and to document in Romanian and at least one international language, for the purpose of professional and personal development; - methodical analysis of the problems encountered in the activity, identifying the elements for which there are established solutions, thus ensuring the fulfillment of professional tasks; - defining the activities by stages and assigning them to subordinates with a complete explanation of duties, depending on the hierarchical levels, ensuring the efficient exchange of information and interpersonal communication; - honorable, responsible, ethical behavior, in the spirit of the law, to ensure the reputation of the engineering profession.

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.* The Power Electronic Circuits course brings all students to the same level of theoretical knowledge necessary for the design and development of new products and prepares modern engineering activities for the conception and actual realization of electronic systems in the automotive industry
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).* Identification of specific types of power modules in the hybrid vehicle industry and the interconnection method. Specific design with modern circuits produced by automotive companies
Responsability and autonomy	*The student's capacity to autonomously and responsably apply their knowledge and skills.* · Select and group relevant information in a given context. · Work productively in a team. · Elaborate scientific texts. · Experimentally verify identified solutions. · Solve practical applications. · Adequately interpret causal relationships. · Analyze and compare identified solutions. · Identifies solutions and develops resolution plans and projects. · Formulates conclusions to the experiments carried out.

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 is based on the use of the video projector (covering the communication function and demonstrations); the oral communication methods used are the expository method and the problematization method, used head-on. Course materials are: course notes and presentations, All materials are available in format

10. Contents

COURSE		
Chapter	**Content**	**No. hours**
1	DC-to DC Switch-Mode Converters. 1.1. Control of line-Frequency Controlled Rectifiers and Inverters, Control of DC-to DC Converter 1.2. Step-Down (buck) Converter, Buck-Booster Converter 1.3. Full Bridge DC-to DC Converter, DC-to DC converter Comparison	6
2	Switch Mode DC-to-AC Inverters 2.1 Basic Concepts of Switch Mode inverters. Single-Phase Inverters, three-Phase Inverters 2.2 Effect of Blanking Time on Output Voltage in PWM Inverters, Rectifier Mode Operation	4

3	Resonant Converters: Zero-Voltage and/or zero Current Switching 3.1. Basic Resonant circuits Concepts, Load-Resonant Converters, Resonant-Switch Converters 3.2. Zero Voltage Switching Clamped Voltage (ZVS-CV) Topologies, resonant DC-Link Invertors with Zero-Voltage Switching	4
4	Power Electronic circuits: 4.1 Residential and Industrial Applications: (Introduction, Residential Applications, Industrial Applications component parts, characteristic measures, and calculation elements, 4.2. Electrical Utility Applications: component parts, specific electronic circuits, High Voltage DC (HVDC), Static Var Control (SVC), Power Amplifiers, Interconnection of Renewable Energy Sources and Energy Storage. 4.4. Optimizing the Interface with Power Electronic System (Generation of Current Harmonics, Current Harmonics and Power Factor), Improved Single- Phase Utility Interface, Improved Three-Phase Utility Interface	6
5	Semiconductor Devices and Converter Design 5.1 Breakdown Voltage Considerations, Design of Drive Circuits for BJTs, Design of gate Driver Circuits, 5.2 Snubber Circuits for Thyristors for the control of the engine operation: types, advantages, disadvantages, operation limits.	4
6	Emerging Devices and Circuits, Passive Components and Practical Converter Design Considerations 6.1. Field-Controlled Thyristor, JFET- Based Devices Versus Other Power Devices, 6.2. MOS- Controlled Thyristor, High Voltage Integrated Circuits.	4
	Total:	

Bibliography:

Infineon Technologies AG “Semiconductors – Technical information, technologies and characteristic data” Publicis Corporate Publishing 2004 Munchen
Alexandru Vasile, *Industrial electronics*, published by Cavallioti, ISBN 973-9463-75-4, Bucharest 2004
Manea C, Manea A, Mecatronics of the modern vehicles, vol. I, vol. II, published by Matrix-Rom, Bucharest 2000
4. Mohan Tore M. Undeland Power Electronics John Wiley &Sons New York 1995
5. Ali Emadi, Handbook Automotive Power Electronics and Motor Drivers, Taylor & Francis, USA 2005

LABORATORY		
Crt. no.	**Content**	**No. hours**
1	Laboratory equipment, tests, and exercises concerning powering and working with equipment	2
2	Resonant converters	4
3	Mono-fazing PFC circuits	4
4	Matricial converters	2
5	Evaluation colloquium	2
	Total:	14
PROJECT		
Crt. no.	**Content**	**No. hours**

1	The specific theme of a command block in the automotive field	14
	Total:	

Bibliography:

Infineon Technologies AG "Semiconductors – Technical information, technologies and characteristic data" Publicis Corporate Publishing 2004 Munchen
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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	Active participation at the course:		10 %
11.5 Seminary/laboratory/project	Laboratory practice Home work:		60 %
	Final exam		30 %
11.6 Passing conditions			
minim 60 %			

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)

Ability to apply knowledge and use know-how to accomplish tasks and solve problems. Skills are the result of logical, intuitive and creative or practical thinking involving manual dexterity and the use of methods, materials, tools and instruments.

Date	Course lecturer	Instructor(s) for practical activities
10.10.2024	Prof. Dr. Alexandru VASILE	Prof. Dr. Alexandru VASILE

Date of department approval	Head of department
31.10.2024	Prof. Dr. Claudius DAN

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Date of approval in the Faculty Council

01.11.2024

Dean

Prof. Dr. Mihnea Udrea