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	**Telecommunications**
1.4 Domain of studies	Electronic Engineering, Telecommunications and Information Technology
1.5 Cycle of studies	Masters
1.6 Programme of studies	Electric Vehicle Propulsion and Control

2. Date despre disciplină

2.1 Course name (ro) (en)				Energie regenerabilă și sisteme de stocare Renewable Energy and Storage Systems			
2.2 Course Lecturer				Prof. Dr. Adriana FLORESCU			
2.3 Instructor for practical activities				s.l. Mihai.l Stefan TEODORESCU			
2.4 Year of studies	1	2.5 Semester	II	2.6. Evaluation type	E	2.7 Course regime	Ob
2.8 Course type		DA	2.9 Course code	UPB.04.M1.O.24-09		2.10 Tipul de notare	Nota

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

3.1 Number of hours per week	2	Out of which: 3.2 course	1.00	3.3 seminary/laboratory	1
3.4 Total hours in the curricula	28.00	Out of which: 3.5 course	14	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.					29
Tutoring					0
Examinations					18
Other activities (if any):					0

3.7 Total hours of individual study	47.00
3.8 Total hours per semester	75
3.9 Number of ECTS credit points	3

4. Prerequisites (if applicable) (where applicable)

4.1 Curriculum	To pass of the following disciplines: • Power Electronic Converters

4.2 Results of learning	The accumulation of knowledge about renewable energy systems (solar, wind, based on hydrogen, etc) and about energy storage systems, applicable in electric vehicles.

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

5.1 Course	The course will take place in a properly equipped room, which will allow the teaching staff to alternate the classic blackboard presentation with multimedia presentations. Students have access to the course notes on the Internet. During the lectures, as far as is appropriate, interactive debates are encouraged.
5.2 Seminary/ Laboratory/Project	The laboratory will take place in room B235 in the LEU Complex of the ETTI faculty in UPB, with specific hardware and software equipment. The platform sheets for the laboratory are available to the students both on paper and in electronic form on the Moodle website. Attendance is mandatory at the laboratories (according to the Master's University Study Regulations in UPB).

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)*

This discipline is studied within the Electronics Engineering, Telecommunications and Information Technologies field of study within the Electric Vehicle Propulsion and Control (EPIC) advanced master's and aims to familiarize students with the main approaches, models and explanatory theories of the field, used in solving practical applications, with relevance for stimulating the learning process in students.
The general objective of the discipline is the initiation of the students of the Faculty of Electronics, Telecommunications and Information Technology from the first year, the second semester of the EPIC master's degree in the very interesting, useful and dynamic reality of the electronics of renewable (non-conventional) energy sources that have potential applicability in the field of electric vehicles studied within this master. The discipline addresses as a specific topic the main sources of energy: solar, wind, with fuel cells, etc., as well as the electrical energy storage systems applicable to electric vehicles, all of which contribute to the transmission/formation to/of students of an overview of methodological and procedural milestones related to the field.

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	Apply in practice the fundamental and specialized knowledge to solve complex technical problems, specific to the field of Electronics Engineering, Telecommunications and Information Technologies - the EPIC master's degree in English; Correlates knowledge for the development of engineering solutions in order to solve some problems in the field of renewable energy systems and storage systems of multiple types with direct applicability for powering electric vehicles and their infrastructure; Argues and analyzes coherently and correctly the context of application of the basic knowledge of the field, using key concepts of the discipline and the specific methodology. Demonstrates orally and in written communication skills in Romanian: use the scientific vocabulary sspecific to the field, in order to communicate effectively.

Transversal (General) Competences	Demonstrates autonomy and critical thinking: ability to think in scientific terms, search and analyze data independently, and draw and present conclusions / identify solutions. Acquires the capacity for analysis and synthesis: presents the acquired knowledge in a synthetic way, as a result of a process of systematic analysis. Respects the principles of academic ethics: correctly cites the bibliographic sources used in the documentation activity. Performs professional tasks with the exact identification of the objectives to be achieved, potential risk factors, available resources, economic-financial aspects, conditions for their completion, work stages, working time and related deadlines; Executes tasks responsably in a multidisciplinary team and communicates effectively, assuming roles at different hierarchical levels.

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.* • Studies and selects the minimum necessary information about the addressed RESS field • Defines domain-specific notions. • Describes/classifies notions/processes/phenomena/structures. • Highlights consequences and relationships.
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 in a given context. • Uses specific principles with reason. • Works productively in a team. • Elaborates a scientific text. • Experimentally verifies identified solutions. • Solves practical applications. • Adequately interprets causal relationships. • Identifies solutions and develops solution/project plans. • Formulates conclusions to the experiments carried out. • Arguesthe identified solutions/solutions.

Responsability and autonomy	*The student's capacity to autonomously and responsably apply their knowledge and skills.* • Demonstrates collaboration with other colleagues and teaching staff in carrying out teaching activities • Demonstrates autonomy in organizing the learning situation/context or the problem situation to be solved • Demonstrates social responsibility through active involvement in student social life/involvement in academic community events • Promotes/contributes through new solutions related to the specialized field to improve the quality of social life. • Realizes the value of his 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.

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. Course materials are: course notes and presentations, collections of proposed problems (theoretical and with computer solutions), international reference bibliography in the studied field, etc. In the laboratory, students simulate, implement, test and independently evaluate the topic proposed by the teaching staff, using the platforms and software environment. The didactic materials are the laboratory platforms included in the laboratory guide. All course and laboratory materials are available in electronic format, on the Moodle site of the Renewable Energy ans Storage Systems' course.
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 exploration and indirect of reality (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.

10. Contents

COURSE		
Chapter	**Content**	**No. hours**
1	Introduction to renewable energies (definitions, classifications, common types used in industry, national and international regulations, illustrative videos, etc)	2
2	Description and block diagrams of photovoltaic systems	2
3	Analysis of generators and photovoltaic batteries	2
4	DC-DC and DC-AC topologies of converters applicable to electric vehicles	2
5	Presentation of wind resources, with hydrogen fuel cells, geothermal, hydraulic, biomass, etc. usable as infrastructure for electric vehicles	2
6	Design example of a photovoltaic system controlled with a fuzzy regulator	2
7	Design example of a wind system controlled with a PID regulator	2
	Total:	14

Bibliography:
Online course available on Moodle (2021-2022), course responsable: prof.dr.eng. Adriana FLORESCU, Renewable Energy and Storage Systems (RESS): https://curs.upb.ro/2021/course/view.php?id=9893 2. N. Mohan, T.M. Undeland, W. Robbins, "Power Electronics", John Willey & Sons, Inc., 2003 3. Leon Freris, David Infield, "Renewable Energy in Power Systems", John Willey & Sons, Inc., 2008 4. Alireza Nami and Firuz Zare, "Renewable Energy", Ed. INTECH, 2009 5. James Dunlop, "Photovotaic Systems" 3rd Edition, CRC Press, 2010 6. Remus Teodorescu, Marco Liserre, Pedro Rodriguez, "Grid Converters for Photovoltaic and Wind Power Systems", John Willey & Sons, Inc., 2011

LABORATORY

Crt. no.	Content	No. hours
1	Mathematical analysis and PSpice/PSIM/MatLab Simulink simulation of a topology specific to converters used in photovoltaic systems	4
2	Mathematical analysis and PSpice/PSIM/MatLab Simulink simulation of a topology specific to converters used in wind systems	4
3	Analiza matematica si simularea PSpice/PSIM/MatLab Simulink a unei topologii specifice convertoarelor utilizate in sistemele bazate pe celule de combustie cu hidogen	4
4	Prezentarea unui convertor electronic de putere specific surselor de energie regenerabile studiate (tema de casa)	2
	Total:	14

Bibliography:

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;	Check test during the semester	25%
	- knowledge of how to apply the theory to specific problems;	Partial exam during the semester, with the possibility of retaking in the session	25%
	- analysis of techniques and theoretical methods specific to the field of renewable energy systems.	Final test in the session	25%

11.5 Seminary/laboratory/project	- knowledge of the working method of a given problem;	Final laboratory colloquium type grid test, which contains theoretical questions presented in the laboratory works.	5%
	- demonstration of the functioning of an implemented system through simulation.	Final laboratory colloquium type grid test, which contains questions from the simulations performed or given as homework in the laboratory works.	10%
	- knowledge of the operation of the proposed power circuits with applicability in electric vehicles.	Final laboratory colloquium type grid test, which contains questions about the functioning of the power circuits presented in the laboratory works.	10%
11.6 Passing conditions			
• Obtaining 50% of the total score for this discipline. • Obtaining 50% of the score related to the activity during the semester. Pay attention to the applicable study regulations, references can be included here!			

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)

• In the development of the content of the discipline, the current development and evolution requirements of the European economy were taken into account, in the specifics of renewable energy systems in the field of Electronic Engineering, Telecommunications and Information Technologies (ETTI), which has been increasingly emphasized in recent years, considering the energy crisis and global warming.
• In the context of technological progress, the applications are unlimited in fields such as: medical, industrial automation, robotics, automotive, energy, etc.
• Graduates are provided with adequate skills with the needs of current qualifications and a modern, quality and competitive scientific and technical training, which will allow them to be employed quickly after graduation, being perfectly framed in the policy of the Politehnica University of Bucharest, both from the point of view of the content and structure, as well as from the point of view of the skills and international openness offered to students.
• The discipline is studied in many higher education institutions in the European Higher Education Area (EHEA), such as: Institut Politechnique de Paris, Technical University of Denmark, Federal Institute of Technology Lausanne Switzerland, University of Oxford UK etc.
• Through the activities carried out, students develop skills to offer solutions and ideas to improve the existing situation in the field of Electronic Engineering, Telecommunications and Information Technologies.

Date	Course lecturer	Instructor(s) for practical activities
09.10.2024	Prof. Dr. Adriana FLORESCU	s.l. Mihai.l Stefan TEODORESCU

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Date of department approval	Head of department
27.10.2024	Conf. Dr. Serban Georgica Obreja
Date of approval in the Faculty Council	Dean
25.10.2024	Prof. Dr. Mihnea Udrea