Universitatea Naţională de Ştiinţă şi Tehnologie Politehnica Bucureşti
Facultatea de Electronică, Telecomunicaţii şi
Tehnologia Informaţiei

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)				Bazele vehiculelor electrice Fundamentals of Electric Vehicle Systems			
2.2 Course Lecturer				Conf. Dr. Lucian Andrei PERIŞOARĂ			
2.3 Instructor for practical activities				Conf. Dr. Lucian Andrei PERIŞOARĂ			
2.4 Year of studies	1	2.5 Semester	1	2.6. Evaluation type	E	2.7 Course regime	Ob
2.8 Course type		S	2.9 Course code	4		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	3.3 seminary/laboratory	1
3.4 Total hours in the curricula	28	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.					35
Tutoring					10
Examinations					2
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	Electronic Devices, Fundamental Electronic Circuits, Digital Integrated Circuits, Microcontrollers, Industrial Electronics and Informatics, Power Electronics
4.2 Results of learning	General knowledge of electrical and electronic circuits, measurement techniques, power converters

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

5.1 Course	The lectures will be taken in a classroom with video projector and computer.
5.2 Seminary/ Laboratory/Project	Practical activities will be taken in a specialized laboratory, which will contain: testing platform for electric vehicles, electronic control units for vehicles, vehicles with internal combustion engine, charging stations for electric vehicles, dedicated test and measurement equipments, interfaces and software for automotive diagnosis.

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)*

Electric Vehicles (EVs) has become an essential part in the transition to or incorporation of electric mobility (e-mobility), which will imply significant changes for vehicle manufacturers, governments, companies and individuals. This course covers the most important aspects of the next generation of vehicles, presenting both, the fundamentals and cutting-edge technologies, theory and design of EVs (electric motors, batteries, power converters, and chargers), the integration of EVs in the smart grid infrastructure, world-wide and local business models, and policies for governmental bodies.

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	- To apply fundamental and specialized knowledge to solve complex technological problems which are specific to Automotive Electronics and Applied Electronics; - To develop engineering solutions for solving technological problems in the fields of automotive electronics, power electronics, and renewable energy systems; - To solve problems regarding the automated processes control encountered in automotive systems and to use electronic controllers; - To apply the knowledge from the field of Applied Electronics in order to perform case studies in the field of dedicated systems for Automotive Electronics;
Transversal (General) Competences	- To define the advanced notions of information technology, electronic circuits and automation for performing quality management; - Responsibly working in a multidisciplinary team with abilities to assume roles specific to different hierarchical levels; - Capacity to identify the need for continuous education and efficient use of information sources, communication resources and training assistance (Internet portals, specialized software, databases, online courses) both in Romanian and a foreign language. - Autonomy and critical thinking: the ability to think in scientific terms, to search and analyze data independently, and to draw and present conclusions / identify solutions. - Ability to analyze and synthesize: presents the acquired knowledge in a synthetic way, as a result of a systematic analysis process. - Respects the principles of academic ethics in the documentation activity, correctly cites the bibliographic sources used.

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.* - understanding the role of EVs in the transition to e-mobility; - understanding and applying fundamental concepts of automotive electronics; - understanding basic technologies for electric propulsion, electric motors and power converters; - understanding battery technologies, management systems and chargers.
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).* - installation and configuration of after-market components and systems for conversion of EVs; - creation of business models and developing new strategies in the field of EVs; - assessing policy plans and regulations for e-mobility.
Responsability and autonomy	*The student's capacity to autonomously and responsably apply their knowledge and skills.* - Selection and analyzing of appropriate bibliographic sources. - Respect the principles of academic ethics, correctly citing the bibliographic sources used. - Demonstrates collaboration with other colleagues and teaching staff - Promotes/contributes through new solutions related to the specialized field to improve the quality of social life. - Identifies sustainable solutions to solve problems in social and economic life. - Apply principles of professional ethics/deontology in the analysis of the impact of electric vehicle technologies on the environment. - Analyze and capitalize on business opportunities in the field of electric vehicles.

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.)*

Teaching is carried out through the presentation and questioning methods. Modern teaching methods (video projector) are used for presentation of the course notes, applications notes, videos and demonstrative software applications. The lectures notes and presentations are available to students in pdf format. Teaching is based on the experimentation method, using dedicated hardware equipments and software applications. Students perform experimental measurements, analyzing and interpreting the data.

10. Contents

COURSE		
Chapter	**Content**	**No. hours**
1	A historical introduction in development of Electrical Vehicles (EVs).	1

2	EV architecture: Energy and power analysis for electric propulsion. Hybrid Electric Vehicles (HEV) architecture. EV architecture.	1
3	Power train systems: DC and AC electric motors. DC and AC controllers. Control strategies. Power converters. Regenerative braking.	2
4	Energy storage systems: Batteries and ultracapacitors. Battery modelling. Cell chemistries: NiMH, Li-Ion, LiFePO4, NMC. Battery packs. Battery Management Systems (BMSs). Balancing techniques. Advantages and disadvantages.	2
5	Charging systems: Charging interfaces and protocols (SAE J1772). AC chargers. DC chargers. Fast charging. Smart charging. Wireless charging. On-road charging. Grid infrastructure. Solar powered EVs.	2
6	Communication protocols: Communication networks for vehicles: CAN, LIN. Protocols for on-board diagnosis (OBD): KWP, CAN, SAE J1979. CANOpen protocol.	2
7	EV systems integration: Vehicle overall architecture. Energy consumption budget. HV/LV electrical systems. Other EV systems: steering, ABS, airbags, lights, HVAC, cluster instruments, infotainment.	2
8	Business models for EVs: Total cost of ownership, mass production, value chain thinking, business integration and innovation. World-wide and local business models.	1
9	Policy perspectives and governing bodies: Policy dilemmas and public values. Development and evaluation of effective e-mobility incentive schemes.	1
	Total:	14

Bibliography:

. L. A. Perişoară, “Bazele vehiculelor electrice”, Lecture Notes, pdf format, 2021.
. A. Vasile, I. B. Bacîş, “Bazele Electronicii Auto”, Editia III, Editura Cavallioti, 2018.
. I. B. Bacîş, A. Vasile, “Electrician Electronist Auto”, Editura PIM, 2016.
. I. B. Bacîş, L. A. Perişoară, “Electronică auto. Îndrumar de laborator”, Editura Cavallioti, Bucureşti, Editura PIM, Iaşi, 2019.
. M. P. Brown, S. Prange, “Convert it: a step-by-step manual for converting an internal combustion vehicle to electric power”, Future Books, 1993.
. S. Dhameja, “Electric Vehicle Battery Systems”, Butterworth–Heinemann, 2001.
. J. Larminie, J. Lowry, “Electric Vehicle Technology Explained”, John Wiley & Sons, 2003.
. M. Ehsani, Y. Gao, S. E. Gay, A. Emadi, “Modern Electric, Hybrid Electric, and Fuel Cell Vehicles - Fundamentals, Theory, and Design”, CRC Press, 2005.
. V. Pop, H. J. Bergveld, D. Danilov, P. P. L. Regtien, P. H.L. Notten, “Battery Management Systems - Accurate State-of-Charge Indication for Battery-Powered Applications”, Springer, 2008.
0. S. Leitman, B. Brant, “Build Your Own Electric Vehicle”, 2nd Edition, McGraw-Hill, 2009.
1. D. Andrea, “Battery management systems for large lithium-ion battery packs”, Artech House, 2010.
2. I. Husain, “Electric and Hybrid Vehicles: Design Fundamentals”, 2nd Edition, CRC Press, 2010.
3. T. Muneer, M. Kolhe, A. Doyle, “Electric Vehicles: Prospects and Challenges”, Elsevier, 2017.
4. G. Pistoia, B. Liaw, “Behaviour of Lithium-Ion Batteries in Electric Vehicles: Battery Health, Performance, Safety, and Cost”, Springer, 2018

SEMINARY		
Crt. no.	**Content**	**No. hours**
1	Curtis 1238-7601 controller for the HPEVS AC50 electric motor.	2
2	Orion BMS 48S for a 30S1P LiFePO4 battery pack.	2

3	On-board chargers	2
4	Micro-controller based cluster instruments for EV monitoring.	2
5	Virtual instruments for EV monitoring and diagnosis.	2
6	Charging stations	2
7	Evaluation	2
	Total:	14

Bibliography:

1. Curtis Instruments, “Curtis 1232/34/36/38 Manual, OS 14”, March 2011.
2. Ewert Energy Systems, “Orion BMS Wiring & Installation Manual”, Rev. 4.1.
3. Ewert Energy Systems, “Orion BMS Operation Manual”, Rev. 2.1.
4. TC Chargers, “Instructions for 3.3 kW HK-J Series Charger”.
5. National Instruments, “NI 9862 Getting Started Guide”, June 2015.
6. National Instruments, “NI cDAQ-917x User Manual”, May 2013.
7. National Instruments, “NI-CAN Hardware and Software Manual”, Sept. 2014.
8. SAE International, “SAE J1979: On-Board Diagnostics”, 2006.
9. National Instruments, “Automotive Diagnostic Command Set User Manual”, July 2014.
10. Renault, “Logan X90 Service Manual”, 2006.
11. L. A. Perişoară, D. I. Săcăleanu, A. Vasile, „Instrument Clusters for Monitoring Electric Vehicles”, 23rd International Symposium for Design and Technology in Electronic Packaging (SIITME 2017), Constanţa, Romania, pp. 379-382, DOI 10.1109/SIITME.2017.8259931, WOS 000428032300082, Oct. 26-29, 2017.
12. L. A. Perişoară, A. Vasile, D. I. Săcăleanu, „Vehicles Diagnosis based on LabVIEW and CAN interfaces”, 23rd International Symposium for Design and Technology in Electronic Packaging (SIITME 2017), Constanţa, Romania, pp. 383-386, DOI 10.1109/SIITME.2017.8259930, WOS 000428032300081, Oct. 26-29, 2017.
13. L. A. Perişoară, I. C. Guran, D. C. Costache, „A Passive Battery Management System for Fast Balancing of Four LiFePO4 Cells”, 24th International Symposium for Design and Technology in Electronic Packaging (SIITME 2018), Iaşi, Romania, Oct. 25-28, 2018.
14. L. A. Perişoară, E. M. Stamati, L. R. Chiţu, D. I. Săcăleanu, „Pilot Platform for Remote Monitoring of an Electric Vehicle”, 24th International Symposium for Design and Technology in Electronic Packaging (SIITME 2018), Iaşi, Romania, Oct. 25-28, 2018.
15. B. Anton, A. Florescu, L. A. Perişoară, A. Vasile, R. C. Constantinescu, Ş. G. Roşu, „Methods of Maximizing Power Efficiency for Hybrid Vehicles”, Revue Roumaine des Sciences Techniques – Serie Électrotechnique et Énergétique, Vol. 64, Issue 1, pp. 57–62, ISSN 0035-4066, WOS 000464302300010, Jan.-Mar. 2019.
16. L. A. Perişoară, D. C. Costache, I. C. Guran, Ş. G. Roşu, A. Florescu, „Active Balancing for Efficient Management of a 4S1P LiFePO4 Battery Pack”, in Proc. of the 11th International Symposium on Advanced Topics in Electrical Engineering (ATEE 2019), Bucharest, Romania, ISBN 978-1-7281-0101-9 / 978-1-4799-7514-3, ISSN 2159-3604, DOI 10.1109/ATEE.2019.8724917, WOS 000475904500074, March 28-30, 2019.
17. Ş. G. Roşu, M. Ş. Teodorescu, A. Florescu, L. A. Perişoară, “Study of Operating Conditions Impact on Wireless Power Transfer Systems Performance”, in Proc. of the 11th International Symposium on Advanced Topics in Electrical Engineering (ATEE 2019), Bucharest, Romania, ISBN 978-1-7281-0101-9 / 978-1-4799-7514-3, ISSN 2159-3604, DOI 10.1109/ATEE.2019.8724855, WOS 00047590450013, March 28-30, 2019.
18. L.A. Perişoară, “Bazele Vehiculelor Electrice”, Laboratory Guide, pdf format, 2021.

11. Evaluation

Activity type	11.1 Evaluation criteria	11.2 Evaluation methods	11.3 Percentage of final grade
11.4 Course	- knowledge and understanding of fundamental theoretical notions; - comparative analysis of testing techniques and methods; - capacity to apply the theoretical notions to solve practical problems.	Final examination (1 hour) at the end of the semester. The quiz test covers all lectures and contains 20 questions.	40%
11.5 Seminary/laboratory/project	- acquiring and understanding of taught knowledges; - practical application of testing methods using laboratory equipments; - ability to analyze the testing results.	At the end of each lab session, students answer a quiz with questions from platforms. The total score is obtained by summing all scores obtained in each laboratory.	40%
	- knowledge and understanding of fundamental theoretical notions; - comparative analysis of testing techniques and methods;	Homework, like State-of-Art reports, related to laboratory topics.	20%
11.6 Passing conditions			
Supporting a test for determining the architecture of an electric vehicle and describing the electronic equipments. Accumulating at least 50 points out of 100 points.			

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)

This course prepares graduates for product design, development, manufacturing and testing in different engineering areas: automotive electronics, electrical engineering, power electronics, sustainable transport areas, energy policy, and integration of electric vehicles in smart grids. Students learn how electrical and mechanical engineers must work together in order to meet today’s needs of clean, efficient, and sustainable vehicles.

The lectures present a systematic and comprehensive description on the fundamentals of theory and design of electric vehicle technologies and systems.

The practical activities provide a hands-on look at the research and development involved in the use and integration of electric vehicle technologies, which are reinforced with real-world case studies for conversion of classical vehicles to electric ones that were implemented in Romania.

The master program provides to graduate students appropriate skills and training for the actual needs and scientific and technological qualifications, of high quality and competitively, allowing them rapid employment after graduation. This fact is consistent with the university policies, both in terms of content and structure, but also in terms of skills and international openness offered to students.

Date	Course lecturer	Instructor(s) for practical activities
21.09.2026	Conf. Dr. Ing. Lucian-Andrei PERIŞOARĂ	Conf. Dr. Ing. Lucian-Andrei PERIŞOARĂ

Date of department approval	Head of department
22.09.2026	Conf. Dr. Serban Georgica Obreja

Date of approval in the Faculty Council	Dean
22.09.2026	Prof. Dr. Mihnea Udrea