UNIVERSITY POLITEHNICA OF BUCHAREST

FACULTY OF ELECTRICAL ENGINEERING

GUIDE OF THE MASTER PROGRAM
Integrated electrical systems engineering in vehicles – ISEIA
(taught in English language)

The guide is written by the Dean's Office of the Faculty of Electrical Engineering from UPB

- 2022 -

WELCOME !

Welcome to Faculty of Electrical Engineering.

Continuing a prestigious intellectual tradition of more than a century, the Faculty of Electrical Engineering is one of the most important institutions of higher education in Romania.

Engineering has the power to transform lives, that's why I became an engineer and that's why our students are eager to receive an education in the field of electrical engineering (the motto of the faculty is "the future is electrical").

Faculty of Electrical Engineering provides its students with the knowledge and skills necessary for a successful career in engineering, as well as the capacity for continuous self-improvement. This is possible through 6 undergraduate study programs, 6 master's programs and a doctoral school, with professors with national and international reputation who, beyond an intense research activity, have been and are part of the relevant national and European structures and organizations in the field of electrical engineering.

All the programs have been designed with a blend of theory, practice, research, and industry-based projects. Your degree will contain the right mixt of theory and practice and with a degree from Faculty of Electrical Engineering, you will be recognized and sought after by employers here and around the world.

If you are looking for a compelling and rewarding career in the increasingly high-tech world of the 21-st century, engineering is the correct option and Faculty of Electrical Engineering is the right place to be.

DEAN,
Assoc. Prof. PhD. Eng. Dragoş Marin NICULAE

CONTENT

1. BRIEF HISTORY OF THE FACULTY OF ELECTRICAL ENGINEERING

The history of the Faculty of Electrical Engineering begins when a school of electricians was founded in 1913. This later became the Institute of Electrotechnics within the University of Bucharest. In 1921 King Ferdinand issues the law setting up the Polytechnic School of Bucharest, which consisted in 4 departments. Among these departments there was also the Electromechanical department. The reform of education introduced in 1948 changed the name of Polytechnics School into the Polytechnics Institute of Bucharest, which included the Faculty of Electrotechnics, later to give birth to the faculties of Electronics, Automatic Control and Power Engineering.

At the beginning of the university year 2005-2006, the name of the faculty became Electrical Engineering. The Faculty of Electrical Engineering is affiliated to the Romanian Consortium of the Faculties of Electrotechnics – a national academic network for all the 17 faculties sharing an electrical profile. The Faculty of Electrical Engineering provides its graduates with the theoretical and practical competences in the field of electrical engineering, by means of developing the technical and informatic skills in view of research, design and development of dedicated software.

Its mission consists in training specialists in acquiring high skills and competences in the field of electrical engineering and other related fields in three stages: bachelor's degree, master's degree and doctoral degree, as well as in conducting theoretical and applied research at the highest level.

The Faculty of Electrical Engineering, with its study programs, meets the necessities of the labour market in our country as well as the overall evolution of this market. The faculty's assets are: a complex curriculum for the undergraduate studies, in-depth master programmes, highly competitive professors, basic and applied scientific research at the highest level, modern facilities, incorporating education and research into the European area.

The faculty has important facilities mainly acquired by means of European programmes, national research programmes and grants, as well as from investment funds from the state budget. Thus, the faculty has competitive laboratories where the activity is carried out for all the 44 subjects involving laboratory work and research work.

The 30 KWp photovoltaic power station is an important achievement, being the largest in the South-East of Europe.

Within the three chairs teaching is carried out in laboratories equipped with computers, electrical and electronic devices, data acquisition devices, which helps the students to build modern and up-to-date knowledge. The most representative laboratories for the faculty are: Electrotechnics, Numerical methods, Electrical measurements, Electrotechnical materials, Static power converters, Electrical equipment, Electric drives, Electrical Engineering for medicine, Applied informatics, Electromagnetic compatibility, Electrical devices and equipment. During the informatics laboratories the students have the opportunity to learn different programming languages: C++, LabVIEW, TESTPOINT and to learn about and use software platforms such as MATLAB, COMSOL, SIMULINK, PSIM, EDSA FLUX 3D, FIDAP+GAMBIT, INFOLYTICA 3D.

The faculty also has its own libraries, with an important number of books – over 7,000 books, the oldest from 1948 – and over 20,000 special magazines which help the students to learn independently.

Worldwide recognized personalities, former teachers of the Faculty of Electrical Engineering:

Nicolae Vasilescu-Karpen (1870-1964), the first rector of the Polytechnic School, eminent professor and scientist in the field of electromagnetic phenomena, with a doctoral thesis on the magnetic field of electrically charged bodies in motion and cited today in the complete bibliographies on the theory of relativity;

Constantin I. Budeanu (1886-1959), renowned professor of Electricity, who developed the theory of reactive and deforming phenomena in electrical networks, imposing it internationally, active and highly appreciated representative of our country in the International Electrical

Engineering Commission (IEC), where he chaired the Subcommittee for reactive phenomena and deforming;

Ion S. Gheorghiu (1885-1968), professor of Electric Cars, author of the first Treaty on Electric Cars in Romanian, the one who elaborated in 1914 -1915 the first project for the electrification of the Ploieşti-Braşov railway;

Cezar Antoni Parteni (1900-1956), professor of Electric Machines at the Polytechnic of Iasi and Polytechnic of Bucharest, former rector of Polytechnic of Bucharest, with numerous contributions to the study of special electric machines;

Alexandru Popescu (1900-1974), professor of Electrical Engineering and Electrical Measurements, the one who designed and built the laboratories of Electrical Machines, Electrical Measurements, Industrial Testing and High Voltage in Polizu building and who endowed the Faculty of Electrical Engineering with a library that it is currently part of the national heritage;

Remus Raduleţ (1904-1985), professor of electromagnetism theory, author of the axiomatization of this science, with remarkable contributions in the theory of relativistic electrodynamics and the theory of primitive physical quantities, initiator of the huge technical encyclopedia entitled "Romanian Technical Lexicon", president of the International Electrotechnical Commission (IEC), creator of the Romanian School of Fundamentals of Electrotechnics (Electrical Engineering).

Deans of the Faculty of Electrical Engineering after 1948:

1948 - 1949 Alexandru Th. POPESCU;
1949 - 1950 Constantin DINCULESCU;
1950 - 1953 Roman STERE;
1953 - 1957 Adolf POLINGER;
1957 - 1960 Marius PREDA;
1960 - 1963 Alexandru FRANSUA;
1963 - 1968 Gheorghe HORTOPAN;
1968 - 1976 Constantin MOCANU;
1976 - 1984 Andrei ŢUGULEA;
1984 - 1986 Constantin MOCANU;
1986 - 1989 Julieta FLOREA;
1990 - 1992 Aurelian CRĂCIUNESCU;
1992 - 1996 Constantin RĂDUŢI;
1996 - 2004 Mihai Octavian POPESCU;
2004 - 2008 Mihai IORDACHE;
2008 - 2012 Claudia Laurenţia POPESCU;
2012 - 2016 Valentin NĂVRĂPESCU;
2016 - Dragoş Marin NICULAE.

2. FACULTY ORGANIZATION

The Faculty of Electrical Engineering ensures the training of engineers through full-time courses and MASTER'S and DOCTORATE programs in the field Electrical Engineering.

- **UNDERGRADUATE FIELDS AND PROGRAMS**

A. FIELD ELECTRICAL ENGINEERING

with the following programs (specializations):

A.1. Electrical Systems (*Sisteme electrice*), taught in Romanian language – **SE**;

A.2. Power Electronics and Electric Drive (*Electronică de putere şi acţionări electrice*), taught in Romanian language – **EA**;

A.3. Instrumentations and Data Acquisitions (*Instrumentaţie şi achiziţii de date*), taught in Romanian language – **ID**;

A.4. Applied Informatics in Electrical Engineering (*Informatică aplicată în inginerie electrică*), taught in Romanian language – **IA;**

A.5. Electrical engineering and computers (*Inginerie electrică şi calculatoare*), taught in English language – **IEC**.

B. FIELD ENGINEERING AND INDUSTRIAL MANAGEMENT

with the following program (specialization):

B.1. Economical Engineering in Electrical, Electronic and Energetic Domain (*Inginerie economică în domeniul electric, electronic şi energetic*), taught in Romanian language – **IE**.

- **MASTER PROGRAMS**

1. Power Electronics and Intelligent Drive Systems (*Electronică de putere şi acționări electrice inteligente*), taught in Romanian language – **EPA**;

2. Electrical Engineering and Applied Informatics (*Inginerie electrică şi informatică aplicată*), taught in Romanian language – **IEIA**;

3. Advanced Electrical Systems (*Sisteme electrice avansate*), taught in Romanian language– **SEA**;

4. Intelligent Systems of Instrumentation and Measurements (*Sisteme inteligente de instrumentaţie şi măsurare*), taught in Romanian language – **SIIM**;

5. Products and Services Engineering in Electrical Engineering (*Ingineria produselor şi serviciilor în electrotehnică*), taught in Romanian language – **IPSE**;

6. Integrated electrical systems engineering in vehicles (*Ingineria sistemelor electrice integrate în autovehicule*), taught in **English language** – **ISEIA**.

- **GENERAL PRESENTATION OF THE FACULTY**

The Faculty of Electrical Engineering has about 1,600 students. Approximately 350 students participate in master's degree programs. About 30 Ph.D. students are admitted each year, under the highly competent guidance of 26 professors, Ph.D. scientific supervisor.

- **GENERAL STRUCTURE OF THE FACULTY**

Structurally, the faculty includes 3 departments:

- **Departament of Electrotechnics** – ELTH;
- **Departament of Electrical Machines, Materials and Drives** – MMAE;

- **Departament of Measurements, Electrical Devices and Static Converters** – MAECS,
  and 6 research centers:
- **Center of Excellence in Technical and Applied Magnetism** – MAGNAT;
- **Computer Aided Electrical Engineering Center**– CIEAC;
- **Electromechanical Energy Conversion Equipment Research Center** – ECEE;
- **Center for Scientific Research in the field of Electrical Devices** – CCSAE;
- **Center for Metrology and Measurement Engineering** – CMIM;
- **Biomedical Engineering Center** – CIB.
  Details about the teachers of the faculty are on the faculty website www.electro.upb.ro.

3. DEANSHIP, SECRETARIAT

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Dean: Assoc. Prof. Ph.D. Eng. **Marin Dragoş NICULAE**

Vice-deans:

Assoc. Prof. Ph.D. Eng. **Mihai Iulian REBICAN**	– master studies; master studies admission; connection with the Doctoral School, continuous training; promotion and quality assurance.
Assoc. Prof. Ph.D. Eng. **Ana-Maria DUMITRESCU**	– undergraduate studies; undergraduate studies admission; internationalization; human resources.
Prof. PhD. Eng. **Octavian Mihai GHIŢĂ**	– social issues, accommodation, guidance and professional guidance of students; promoting connections with the pre-university environment; risks and internal control, labor protection and PSI; faculty image.
Prof. Ph.D. Eng. **George Călin SERIŢAN**	– scientific research; students practice; promoting links with the economic environment; fairs and exhibitions.

Doctoral School Director: Prof. Ph.D. Eng. **Alexandru Mihail MOREGA**
Chief Secretary: Eng. **Sofia Camelia CUCĂ**
Chief Administrator: Ph.D. Eng. **Mihaela Viorica MATEESCU**

4. SPECIALTY DEPARTMENTS

- **DEPARTMENT ELECTROTECHNICS (ELTH)**

Secretariat - room EB-224, phone: 021 402.9144, web: www.elth.upb.ro

Department Director: Assoc. Prof. Ph.D. Eng. **Mihai MARICARU**

Laboratories: Laboratory of Electrical Engineering, Laboratory of Applied Informatics, Laboratory of Numerical Algorithms, Laboratory of Software Analysis of Electrical Circuits, Laboratory of Numerical Modeling, Laboratory of Computer Applications in Electrical Engineering, Laboratory of Design and Numerical Simulation of Electromagnetic Devices, Laboratory of Genomics and Intelligence artificial, Technical Magnetism Laboratory.

The research topic is mainly focused on the fields: numerical analysis tools and scientific calculation in Electrical Engineering; optimal modeling and numerical simulation of electromagnetic systems for wide ranges of dimensions and operating frequencies; the study of the interaction of the electromagnetic field with matter (including in biological systems); solving the coupled problems (electromagnetic-thermal-mechanical) specific to the installations and electrotechnical devices; distributed and parallel calculation specific to problems of high complexity in the field of electrical circuits and electromagnetic field; computer applications and services in the technical field; expertise of electrical installations; creation and use of multidisciplinary software tools for the study of complex electromagnetic systems; study of electromagnetic phenomena in micro- and nano-structures, experimental and numerical analysis of magnetic materials (including nanocomposites and biomaterials); simulation of complex devices (smart screens, sensors and transducers, non-destructive swirling systems by eddy currents, radio frequency microswitches, etc.).

- **DEPARTMENT ELECTRICAL MACHINES, MATERIALS AND DRIVE (MMAE)**

Secretariat - room EA-115, phone: 021 402.9125, web: www.amotion.pub.ro

Department Director: Prof. Ph.D. Eng. **Laurenţiu Marius DUMITRAN**

Laboratories: Laboratory of electrical machines, Laboratory of electrical drives, Laboratory of programmable logic controllers, Laboratory of electrical engineering for medicine, Laboratory of electrotechnical materials, Laboratory of electromagnetic processing of materials and numerical modeling, Laboratory for electromechanical and electronic systems, Laboratory of digital control electrical drive systems, Laboratory of Engineering and Operational Research.

The research topic of the department includes: electromagnetic and thermal phenomena in electrical devices; modeling and numerical experiment in the study of electrotechnical materials; optimizing the operation of electric machines; mathematical modeling of electric machines and drive systems; electric traction; motion control and analysis of drive systems; implementation of advanced digital control techniques; biotechnology and biomedical engineering; unconventional technologies in electrical engineering.

- **DEPARTMENT MEASUREMENTS, ELECTRICAL DEVICES AND STATIC CONVERTERS (MAECS)**

Secretariat - room EB-022, phone: 021 402.9663, web: sites.google.com/site/dmaecs

Director Departament: Prof. Ph.D. Eng. **Sorin Dan GRIGORESCU**

Laboratories: Dielectric Switching and Stability Laboratory, Static Power Converter Laboratory, Electromagnetic Compatibility Laboratory, Electrical Installation Laboratory, Quality, Testing and Diagnostic Laboratory, Metrology Signal Processing Laboratory, Intelligent Power Grid Laboratory - MicroDERLab, Laboratory of electrical and electronic measurements, Laboratory of sensors and transducers - fiber optic measuring systems.

The research topic of the department includes: switching phenomena, device-network interaction; modern switching techniques (SF6, vacuum) and electric arc extinguishing, test techniques, electromagnetic compatibility; static power converters, µP controls, neural networks and fuzzy logic, metrology and measurement methods; scientific instrumentation; electrical installations and electrical lighting, quality assurance systems; sensors and transducers; data acquisition systems, measurement and control systems in electrical distribution networks and microgrids, synchronized measurements, smart metering.

5. CONTACT DETAILS OF TEACHERS

Full-time teachers

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6. MASTER PROGRAMS

• MASTER PROGRAMS OF THE FACULTY

The Faculty of Electrical Engineering prepares master students in the field Electrical Engineering, through 6 programs:

1. **EPA** – Power Electronics and Intelligent Drive Systems – taught in Romanian language (*Electronică de putere şi acționări electrice inteligente*) – M1;

2. **IEIA** – Electrical Engineering and Applied Informatics – taught in Romanian language (*Inginerie electrică şi informatică aplicată*) – M2;

3. **SEA** – Advanced Electrical Systems – taught in Romanian language (*Sisteme electrice avansate*) – M3;

4. **SIIM** – Intelligent Systems of Instrumentation and Measurements – taught in Romanian language (*Sisteme inteligente de instrumentaţie şi măsurare*) – M4;

5. **IPSE** – Products and Services Engineering in Electrical Engineering – taught in Romanian language (*Ingineria produselor şi serviciilor în electrotehnică*) – M5;

6. **ISEIA** – Integrated electrical systems engineering in vehicles – taught in **English language** (*Ingineria sistemelor electrice integrate în autovehicule*) – M6.

Only the master program taught in English language, INTEGRATED ELECTRICAL SYSTEMS ENGINEERING IN VEHICLES (ISEIA) is presented below.

ISEIA – Integrated electrical systems engineering in vehicles – M6

Ingineria sistemelor electrice integrate în autovehicule

(taught in English language)

1. Type: research master, 4 semesters

2. Objectives:

The general objective of the program is to specialize students at a high scientific and technological level, through the formation of competences according to the current requirements of employers in the field of automotive industry, especially the main industrial partner of the program, Renault Romania Group and related companies from automotive domain.

The specific objectives of the program are:

- Assimilation of the specific aspects in the field of electrical systems integrated in vehicles (techniques, technologies, methods, algorithms, concepts, modeling, simulation, optimization, etc.);

- Training skills to approach and solve tasks in the field of electrical systems integrated in vehicles (organization, search, allocation of resources, rational division of an activity into sub-activities);

- Knowledge and use of the hardware tools (equipment for measurements and testing) and the software packages (for programming, modeling, simulation, design, component optimization, systems and project management) from field of electrical systems integrated in vehicles.

3. Specific skills:

- Elaboration of studies, reports and documentation syntheses, respectively technical-economic with topics related to electrical systems (electronic and electromechanical) integrated in vehicles, the properties of advanced composite materials used for the manufacture of specific electrical systems for vehicles and specific manufacturing technologies, the impact on the environment (recycling of materials);

- Solving specific design research problems (virtual testing and validation; control and automation; component heating and cooling management - fluid-solids interaction problems, conjugate heat transfer; electromagnetic compatibility) in the field of electrical systems integrated in vehicles (electronic systems power and electromechanical - electric propulsion) using dedicated professional software and hardware (MATLAB / Simulink, MATLAB GUI, Microsoft Visual Studio.NET, easy Soft CoDeSys, EATON Galileo, MotorCAD, ANSYS, dSpace, Typhoon HIL etc.)

- Solving specific design research problems in the field of integrated electrical systems in vehicles by developing and managing object-oriented software, determining the communication protocol used for a specific interface, applying acquisition and information processing methodologies, considering operating safety principles ;

- Development of the ability to understand the specific concepts of systems engineering with application for the automotive industry (overall / systemic thinking of a vehicle - "systems thinking");

- Knowledge of sensors and transducers for vehicles, functional compatibility criteria, trends on new methods of measuring and analyzing the structure and property of sensors and transducers for vehicles;

- Efficient use of resources for computer modeling and numerical simulation of interactions and communications between different components of automotive electrical systems, transient operation of automotive electrical systems, and electromagnetic field interactions (partial differential equations - PDE , finite element method - FEM / boundary element method - BEM);

- Knowledge of the hardware and software architecture (operating systems) existing in the systems integrated in vehicles;

- Knowledge of the principles of evaluation of traction and braking performance, of the characteristics of tires for vehicles, of the aerodynamics of vehicles, of the technical condition of vehicle systems by computer-assisted diagnostics;

- Designing and developing of some innovative solutions, and critical performance analysis;

- Carrying out of team works in complex projects.

4. Target groups:

- The program is aimed to undergraduates (4 years) in **the fundamental field of "Engineering Sciences"**, especially those in **the field of "Electrical Engineering"**, regardless of specialization, as well as other graduates in related fields, who want to become specialists in engineering electrical systems dedicated to the automotive industry.

7. STUDENT ACTIVITIES

The master students of the Faculty of Electrical Engineering are involved in various professional activities, but not only. They are an active presence at all kinds of student events: seminars, conferences, round tables, proms, internal football championship, etc. The master students are represented in the Faculty Council (1-2 master students) and in the University Senate (1-2 master students), participating in the decision-making.

The Master students will carry out research activities each semester according to the curriculum. The master student must contact the holder of a subject or the person in charge of the respective master program, in order to choose a topic. The research involves an activity supported by the master student together with the scientific supervisor of the paper. The support of the works elaborated in this context is done in the 14th week of each semester, possibly also during the Communication Session of the student scientific circles, from May of each year. This activity is very useful, being necessary to support the dissertation or job interviews.

IMPORTANT: The first year master student cannot pass in the second year without having completed the research situation for both semesters.

Each year the faculty sends a number of approximately 10 of the best students and master students of the faculty, within the ERASMUS programs, in which scholarships are provided. In these programs, master students can study during a semester or a year of study at a university in the European Community, or do their dissertation, with full recognition of the activities carried out, based on the European Credit Transfer System (ECTS Procedure), approved by the UPB Senate in 2002.

8. STUDY PLAN

Only the study plan for the master program taught in English language, **INTEGRATED ELECTRICAL SYSTEMS ENGINEERING IN VEHICLES** (**ISEIA**) is presented here.

1st year – 1st semester – Compulsory subjects

Code	Subject	1st semester - 14 weeks						
		C	S	L	P	Indiv. Prep.	ECTS	Evaluation (E/C)
01.01.O.06-01	Development and Management of Object Oriented Software Projects	2	-	2	-	3	4	E1
01.01.O.06-02	Power Electronics Structures and Controls	2	-	2	-	2	4	E1
01.01.O.06-03	Systems Engineering Management	2	-	1	-	2	4	E1
01.01.O.06-04	Electromagnetic Compatibility in Distributed Systems	2	-	1	-	2	4	C1
01.01.O.06-05	Vehicle Dynamics and Mechanics	2	-	1	-	2	4	E1
01.01.O.06-06	Research/Practice 1	-	-	-	-	12	10	C1
	Total	10	0	7	0	23		
	Total	**10**	**7**			**23**	**30**	
		40 hours/week (of which 17 teaching hours)						

1st year – 2nd semester – Compulsory subjects

Cod	Denumirea disciplinei	2nd semester - 14 weeks						
		C	S	L	P	Indiv. Prep.	ECTS	Evaluation (E/C)
01.02.O.06-07	Interconnecting Devices and Interfaces	2	-	2	-	3	5	E2
01.02.O.06-08	Sensors and Transducers for Vehicles	2	-	2	-	4	5	E2
01.02.O.06-09	Electric Propulsion Systems for Vehicles	2	-	2	-	3	5	E2
01.02.O.06-10	Vehicle Architecture	1	-	2	-	3	5	E2
01.02.O.06-11	Research/Practice 2	-	-	-	-	12	10	C2
	Total	7	0	8	0	25		
	Total	**7**	**8**			**25**		
		40 hours/week (of which 15 teaching hours)					**30**	

1st year – 1st semester – Freely chosen subjects (facultative) - taught only in Romanian language

Code	Subject	1st semester - 14 weeks						
		C	S	L	P	Indiv. Prep.	ECTS	Evaluation (E/C)
01.01.L.06-20	Design and Management of Educational Programs	2	1	-	-	2	5	E1
	Total	2	1	0	0	2	5	
	Total	**2**	**1**			**2**	**5**	

1st year – 2nd semester – Freely chosen subjects (facultative) - taught only in Romanian language

Code	Subject	2nd semester - 14 weeks						
		C	S	L	P	Indiv. Prep.	ECTS	Evaluation (E/C)
01.02.L.06-21	Psycho-pedagogy of Adolescents, Young People and Adults	2	1	-	-	2	5	E2
01.02.L.06-22	Counseling and guidance / Multumedia in education (Optional 1)	1	2	-	-	2	5	E2
	Total	3	3	0	0	4	10	
	Total	**3**	**3**			**4**	**10**	

2nd year – 1st semester – Compulsory subjects

Code	Subject	3rd semester - 14 weeks						
		C	S	L	P	Indiv. Prep.	ECTS	Evaluation (E/C)
01.03.O.06-12	Security and Functional Safety of Vehicle Electrical Systems	1	-	1	-	2	4	C3
01.03.O.06-13	Numerical Simulation of Embedded Systems	2	-	2	-	3	4	E3
01.03.O.06-14	Modeling, Simulation, Programming and Testing of Integrated Electromechanical Systems	2	-	2	-	3	4	E3
01.03.O.06-15	Materials, Specific Technologies and Vehicles Environment Impact	2	-	1	-	2	4	E3
01.03.O.06-16	Integrated Data Acquisition Systems	1	-	2	-	2	4	C3
01.03.O.06-17	Research/Practice 3	-	-	-	-	12	10	C3
	Total	8	0	8	0	24		
	Total	40 hours/week (of which 16 teaching hours)					**30**	

2nd year – 2nd semester – Compulsory subjects

Code	Subject	4th semester - 14 weeks						
		C	S	L	P	Indiv. Prep.	ECTS	Evaluation (E/C)
01.04.O.06-18	Ethics and academic integrity	1	-	-	-	-	2	C4
01.04.O.06-19	Research/Practice for the Dissertation	-	-	-	-	27	28	C4
	Total	1	0	0	0	27		
	Total	**1**	**0**			**27**	**30**	
		28 hours/week (of which 1 teaching hour)						

2nd year – 1st semester – Freely chosen subjects (facultative) - taught only in Romanian language

Code	Subject	3rd semester - 14 weeks						
		C	S	L	P	Indiv. Prep.	ECTS	Evaluation (E/C)
01.03.L.06-23	Didactics of the domain and developments in the didactics of the specialization (in High School and Secondary and Tertiary Settings)	2	1	-	-	2	5	E3
01.03.L.06-24	Sociology of education / Intercultural Education (Optional 2)	1	2	-	-	2	5	E3
	Total	3	3	0	0	4	10	
	Total	**3**	**3**			**4**	**10**	

2nd year – 2nd semester – Freely chosen subjects (facultative) - taught only in Romanian language

Code	Subject	4th semester - 14 weeks						
		C	S	L	P	Indiv. Prep.	ECTS	Evaluation (E/C)
01.04.L.06-25	Teaching Practice (in High School and Secondary and Tertiary Settings)	-	-	3	-	2	5	C4
01.04.L.06-26	Graduation exam, Level II	-	-	-	-	6	5	E4
	Total	0	0	3	0	8	10	
	Total	**0**	**3**			**8**	**10**	

9. DESCRIPTION OF THE SUBJECTS IN THE STUDY PLAN

This description includes only the compulsory subjects (O) that appear in the study plan for the master program taught in English language, INTEGRATED ELECTRICAL SYSTEMS ENGINEERING IN VEHICLES (ISEIA). The freely chosen subjects (facultative), L, which are taught only in Romanian language, are not included here.

Compulsory subjects – O

01.01.O.06-01	**Development and Management of Object Oriented Software Projects (ISEIA) – 4 ECTS**

Program of study				Integrated Electrical Systems Engineering in Vehicles - ISEIA	
Department				Electrotechnics	
Course holder				Assoc. Prof. PhD. Eng. Anton DUCA	
Seminar/laboratory/project holder				Assoc. Prof. PhD. Eng. Anton DUCA	
Year of study	I	**Semester**	1	**Evaluation type**	Exam
Subject type	Subject training type				Thoroughgoing
	Compulsory or optional type of subject				Compulsory

Number of hours per week	4	Course	2	Seminar	0	Laboratory	2	Project	0
Number of hours per semester	56	Course	28	Seminar	0	Laboratory	28	Project	0
Number of ECTS credits	4								

Previous subjects required	• Programming languages.
Previously acquired competences	• Procedural programming in C.

Subject general objective	Development and management of object oriented software projects.
Specific objectives	• Learning the object oriented programming concepts.
	• Learning the basic UML concepts.
	• Learning the Agile/Scrum development process.
	• Learning to use the unit testing and the control versioning systems.

Course content
• Introduction to object oriented programming, classes, function parameters passing (references, local copies).
• Constructors, overloading, initializations, vectors.
• Libraries, acces specifiers composition and inheritance.
• Polymorphism (overloading, overriding, abstract classes, constructors and polymorphism).
• Inner classes, interfacces and multiple inheritance.
• Exceptions..
• Generics.
• Lambda expressions and functional programming.
• Unified Modelling Language (UML).
• Agile/Scrum development strategy.
• Unit testing.
• Control versioning systems.
Bibliography
• Official JavaSE tutorial from Oracle, http://docs.oracle.com/javase/tutorial
• Object oriente programming online course, http://itee.elth.pub.ro/~anton.duca/poo.
• Official UML website, tutorials and resources, http://www.uml.org/resource-hub.htm.
• SCRUM , tutorials and resources, https://en.wikipedia.org/wiki/Scrum_(software_development), http://scrummethodology.com/, https://www.scrumalliance.org/.
• Junit and Git , tutorials and resources, http://www.junit.org, https://git-scm.com/.

Applications content (seminar/**laboratory**/project)
• Introduction to object oriented programming, classes, function parameters passing (references, local copies).
• Constructors, overloading, initializations, vectors.
• Libraries, acces specifiers composition and inheritance.
• Polymorphism (overloading, overriding, abstract classes, constructors and polymorphism).
• Inner classes, interfacces and multiple inheritance.
• Exceptions..
• Generics.
• Lambda expressions and functional programming.
• Unified Modelling Language (UML).
• Agile/Scrum development strategy.
• Unit testing: Junit.
• Control versioning systems: Git, SVN, CVS.
Bibliography
• Official JavaSE tutorial from Oracle, http://docs.oracle.com/javase/tutorial
• Object oriente programming online course, http://itee.elth.pub.ro/~anton.duca/poo.
• Official UML website, tutorials and resources, http://www.uml.org/resource-hub.htm.
• SCRUM , tutorials and resources, https://en.wikipedia.org/wiki/Scrum_(software_development), http://scrummethodology.com/, https://www.scrumalliance.org/.
• Junit and Git , tutorials and resources, http://www.junit.org, https://git-scm.com/.

Type of activity evaluated	**Evaluation criterias**	**Evaluation methods**	**Weight in final grade**
Course	Evaluation of the course presented information	Exam	50 %
Laboratory	Software development during the labs, homeworks.	Exam	50 %
Minimal standard of performance			
Obtaining at least 50% of the total numbers of points.			

01.01.O.06-02	**Power Electronics Structures and Controls (ISEIA) – 4 ECTS**

Program of study					Integrated Electrical Systems Engineering in Vehicles - ISEIA
Department					Measurements, Electrical Apparatus and Static Converters
Course holder					Lect. PhD. Eng. Lucian PÂRVULESCU
Seminar/laboratory/project holder					Lect. PhD. Eng. Lucian PÂRVULESCU Lect. PhD. Eng. Cristinel MIHALACHE
Year of study	I	**Semester**	1	**Evaluation type**	Exam
Subject type	Subject training type				Thoroughgoing
	Compulsory or optional type of subject				Compulsory

Number of hours per week	4	Course	2	Seminar	0	Laboratory	2	Project	0
Number of hours per semester	56	Course	28	Seminar	0	Laboratory	28	Project	0
Number of ECTS credits	4								

Previous subjects required	• Power converters
Previously acquired competences	• Proper application of static converter knowledge

Subject general objective	Developing of knowledge in power electronic structures and associated controls to ensure conversion of static electricity with high power factor, optimization of power transfer and waveforms. Approach of these problems is in the context of current preoccupations, the more efficient use of electricity and optimization of static conversion (PWM optimal strategies, multilevel voltage source inverters, multilevel current source rectifiers, power factor correction etc.).
Specific objectives	• Analysis and calculation of power electronics systems

	• Knowledge and use of simulation software for power electronics structures and controls (PSIM, MATLAB, Simulink)
	• Providing dedicated structures of power electronics for electric and hybrid vehicles

Course content
• Basic principles of power electronics
• Mathematical representations for modeling of power electronics structures (examples of hybrid 2L models)
• Optimal PWM strategies with third harmonic injection
• Multilevel (ML) concepts with neutral point clamped
• Voltage source inverters ML
• Current source rectifiers ML
• Modular multilevel converters
• Power electronics structures with active harmonic third injection
Bibliography
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• D.Floricău, *Sisteme de comandă pentru convertoare statice de putere*, Editura Printech, Bucureşti, ISBN 973-98225-0-9, 1997, 150 pagini.
• F.Ionescu, S.Niţu, D.Floricău, C.Mihalache, *Electronică de putere II*, Editura Electra, ISBN 973-8067-15-4, 2004, 290 pagini.
• D.Fodor, P.Delarue, F.Ionescu, D.Floricău, *Convertoare statice de putere speciale*, Editura Printech, Bucureşti, ISBN 973-98225-1-7, 1997, 128 pagini.
• D.Floricău, T.Tudorache, L.Kreindler, *New boost-type PFC MF-Vienna PWM rectifiers with Multiplied switching frequency*, Advances in Electrical and Computer Engineering, ISSN: 1582-7445, 15 (4), pp. 81-86, 2015.
• L.Pârvulescu, D.Floricau, *Analysis of five-level unidirectional rectifiers*, Revue Roumaine des Sciences Techniques-Serie Electrotechnique et Energetique, Vol.61, No.3, Pp: 304-309, 2016.
• D.Floricău, E.Floricău, G.Gateau, *New Multilevel Converters with Coupled Inductors: Properties and Control*, IEEE Transactions on Industrial Electronics, Vol.58, No.12, pp. 5344-5351, Dec.2011.
• D.Floricău, F.Richardeau, *New Multilevel Converters Based on Stacked Commutation Cells with Shared Power Devices*, IEEE Transactions on Industrial Electronics, Vol.58, No.10, pp. 4675 - 4682, Oct.2011.
• D.Floricău, L.Kreindler, *Generalized multilevel inverter topology with stacked coupled inductors, Power Electronics and Applications*, EPE'15 ECCE-Europe, Pp. 1-10, 2015.
• D.Floricău, T.Tudorache, *A novel generalization of boost-type PFC topologies with multiple switching cells connected in series and parallel*, 9th International Symposium on Advanced Topics in Electrical Engineering - ATEE, pp. 674-679, 2015.

Applications content (seminar/**laboratory**/project)
• Basic principles of power electronics. Introduction to PSIM simulation program
• Study and analysis of elementary switching cells. Case studies for 2L structures
• Third harmonic injection through the control for a three-phase 2L buck-type voltage source inverter
• Study and analysis of a ML buck-type voltage source inverter
• Study of a ML boost-type current source inverter with active injection of the third harmonic
• Study, analysis and design of a power factor correction
• Voltage oriented control for a three-phase boost-type PWM rectifier
• Modelling and control of modular multilevel converter
• Examination
Bibliography
• D. Floricău, C. Mihalache, L. Pârvulescu, *Platforme de laborator*.
• D. Floricău, *Modelarea şi comanda convertoarelor statice. Proiectarea şi implementarea FPGA a comenzilor PWM multinivel*, Editura POLITEHNICA PRESS, 2015.

Type of activity evaluated	**Evaluation criterias**	**Evaluation methods**	**Weight in final grade**
Course	Written examination	Based assessment questions	50 %
Laboratory	Written examination	Based assessment questions	50 %
Minimal standard of performance			
Achieve a minimum score of 50p/100p.			

01.01.O.06-03	**Systems Engineering Management (ISEIA) – 4 ECTS**

Program of study				Integrated Electrical Systems Engineering in Vehicles - ISEIA	
Department				Electrical Machines, Materials and Drives	
Course holder				Lect. PhD. Eng. Claudiu Adrian PURDESCU	
Seminar/laboratory/project holder				Lect. PhD. Eng. Claudiu Adrian PURDESCU	
Year of study	I	**Semester**	1	**Evaluation type**	Exam
Subject type	Subject training type				Thoroughgoing
	Compulsory or optional type of subject				Compulsory

Number of hours per week	3	Course	2	Seminar	0	Laboratory	1	Project	0
Number of hours per semester	42	Course	28	Seminar	0	Laboratory	14	Project	0
Number of ECTS credits	4								

Previous subjects required	• It is not necessary.
Previously acquired competences	• It is not necessary.

Subject general objective	Develop knowledge on Systems Engineering (SE) principles and processes with application in Automotive industry to create new project that are best suited to customer needs.
Specific objectives	• Develop the ability to analyze a vehicle (including its electrical system) from assembly point of view (e.g., as connected parts rather than single parts) ("*systems thinking*").
	• Develop the ability to analyze the electrical system of a vehicle as a subsystem (*system of systems*).
	• Develop the ability to fully understand the stakeholders' requirements for an electrical vehicle.
	• Develop the ability to transpose the stakeholder requirements into technical criteria for a vehicle using the QFD matrix.
	• Develop the ability to prioritize the improvements for an electrical vehicle using the QFD matrix.
	• Develop the ability to find the right proportion between have the costs and functions of an electrical vehicle using value engineering approach.
	• Develop the ability to identify the functions of an electrical vehicle and the costs associated to the components needed to fulfill the vehicle functions, by using the value engineering approach.
	• Develop the ability to right establish the proportion between the costs and functions of an electrical vehicle using the value engineering approach.
	• Develop the ability to understand the new vehicle test procedure (WLTP).
	• Develop the ability to understand and operate with systems engineering support activities like acquisitions and supply chain, information management, investment management, cost-effectiveness analysis etc.
	• Develop the ability to understand and operate with system engineer's tools like: modeling and simulations, requirements and design analysis, system analysis and control, project management.

Course content
1. Introduction to Systems Engineering (SE): 1.1 Brief history - Origins of systems engineering 1.2 Definitions. Principles 1.3 Systems of systems 1.4 Value of systems engineering 1.5 Organizations (International Council on Systems Engineering - INCOSE) 1.6 Rules and Regulations: ISO/IEC 15288 standard
2. Automotive industry 2.1 System engineering management in automotive industry 2.2 Manager's competences in automotive industry (the difference between engineering managers and system engineering managers)
3. Stakeholder's analysis in automotive industry

3.1European Union and its regulations regarding car manufacturing process 3.3 Shareholders vision, goals, and profit margins 3.4 Market needs VS market requirements
4. ystems Engineering process: 4.1 Requirements engineering: - Stakeholder Requirements Definition Process - Requirements Analysis Process 4.2 System (logical) architecture: integral architecture vs. modular architecture 4.3 System (physical) design and integration
5. The technological and economical influences over an electrical vehicle system architecture and design 5.1 Electrical vehicle system architecture 5.2 Electrical vehicle system design 5.3 Electrical vehicle main functions 5.4 Electrical vehicle battery
6. The electrical vehicle system life cycle and different stages like: 6.1 Concept 6.2 Development 6.3 Production 6.4 Exploitation 6.5 Support 6.6 Retirement
7. From prototype to the mass production of the electrical vehicles (the decisional process for choosing the configuration of the vehicle that will be manufactured) 7.1 The decisional process 7.2 The main influencing factors
8. Assuring the right materials for the electrical vehicle production 8.1 Supply chain management 8.2 Different supply chains in the automotive industry
9. Supplier's selection 9.1 Types of suppliers 9.2 Different criteria for selecting the right supplier 9.3 Making the right contract with the suppliers
10. The coordination of different teams involved in the design, testing and implementation (production) of the electrical vehicle 10.1 Assuring the right role for each person in the team 10.2 Conflict management
11. Quality assurance in automotive industry 11.1 Instruments 11.2 Standards 11.3 Procedures
12. The replacement of NEDC procedure with WLTP in automotive industry 12.1 The need for change 12.2 The new WLTP procedure
Bibliography
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[2] Jain, R., McKay, M., McGrath, B. and Brockway, D. (2009). Translating systems engineering for high school teachers and students: an exploratory study of implementing some initial SE concepts', *Int. J. Intelligent Defence Support Systems*, Vol.
[3] Chris Elliott, Peter Deasley (editors). (2007). Creating systems that work: Principles of engineering systems for the 21st century. © The Royal Academy of Engineering.
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[9] Steven R. Hirshorn Chief Engineer, Aeronautics Research Mission Directorate (ARMD) - *NASA Systems engineering handbook,* 2007
[10] Jacobs R."Operations and Supply Chain Management", Fifteen edition, McGrawHill, 2018

Applications content (seminar/**laboratory**/project)

Lab. 1: The concept of competitivity. Analyzing the competitivity of an electrical vehicle using the technical level

Lab. 2: Network management models for planning and implementing complex processes (like EV manufacturing)

Lab. 3: Identifying the functions of the electrical vehicle and the main costs of its systems using value engineering approach.

Lab. 4: Establishing the right proportion between the costs and the functions of an electrical vehicle using value engineering approach.

Lab. 5: Forecasting the electrical vehicle battery state of health (SOH) by analyzing different influencing factors that lead to its degradation in time. SOC (state of charge) and other influences of the other electrical vehicle systems

Lab. 6: QFD (quality function deployment). Applying QFD for an electric vehicle. Transposing the voice of the customers in technical requirements

Lab. 7: Establishing the priorities of improvements for an electrical vehicle using the QFD matrix

Bibliography

[1] Cecilia Haskins (ed.). (2006). *Systems engineering handbook. A guide for system life cycle processes and activities.* International Council on Systems Engineering (INCOSE).
[2] Percivall, G. S. (1992). SYSTEMS ENGINEERING IN THE AUTOMOTIVE INDUSTRY. INCOSE International Symposium, 2: 501–508. doi:10.1002/j.2334-5837.1992.tb01533.x

Type of activity evaluated	**Evaluation criterias**	**Evaluation methods**	**Weight in final grade**
Course	• The students must know the Systems Engineering regulation • The students must know the Systems Engineering processes • The students must know the Stakeholder Requirements analysis • The students must know the system architecture concept • The students must know the system life-cycle concept • The students must know how to assure the right materials for the electrical vehicle production • The students must know which are the managers' competences in automotive industry • The students must know how to use the WLTP procedure	Quizzes Final exam	20% 50%
Laboratory	• The students must know the component systems of a vehicle • The students must know to establish the competitivity of an electrical vehicle using the technical level method • The students must know how to transpose the automotive industry stakeholders' requirements in technical criteria • The students must know how to establish the relation between the functions of an electrical vehicle and the associated costs • The students must know how to use network management models for planning and implementing complex processes (like EV manufacturing)	Laboratory applications	30%
Minimal standard of performance			

• Achieve a minimum score of 50p/100p.

01.01.O.06-04	**Electromagnetic Compatibility in Distributed Systems (ISEIA) – 4 ECTS**

Program of study				Integrated Electrical Systems Engineering in Vehicles - ISEIA	
Department				Measurements, Electrical Apparatus and Static Converters	
Course holder				Lect. PhD. Eng. Monica ALEXANDRU	
Seminar/laboratory/project holder				Lect. PhD. Eng. Monica ALEXANDRU	
Year of study	I	**Semester**	1	**Evaluation type**	Colloquy
Subject type	Subject training type				Thoroughgoing
	Compulsory or optional type of subject				Compulsory

Number of hours per week	3	Course	2	Seminar	0	Laboratory	1	Project	0
Number of hours per semester	42	Course	28	Seminar	0	Laboratory	14	Project	0
Number of ECTS credits	4								

Previous subjects required	• Circuit theory and Electromagnetic Field Theory
Previously acquired competences	• 2D modelling software

Subject general objective	Knowledge of the specific phaenomenon of undesired electromagnetic energy transfer and disturbances apparition, coupling mechanisms in distributed electrical systems, of the antiperturbative methods and test specific methods. Knowledge of international and national norms demands in the domain.
Specific objectives	• Knowledge and characterisation of the disturbance sources and physical processes to influence (coupling mechanisms)
	• Knowledge of the antiperturbative methods and technical devices used in the auto domanin
	• Use of modelling and simulation methods for analysis and solving of some case studies
	• Knowledge of measurements techniques of the emmited disturbace signal
	• Knowledge of the immunity test of the auto equipment according to international and national norms

Course content
• Fundamental concepts
• CEM general and specific auto domain Standards
• Disturbance Sources
• Conducted disturbances- common şi diferential mode
• Radiated emmision-unintentional anthenes identification
• Coupling Mechanisms
• Filters
• Screening (Electric and Magnetic Field, against radiations and pentru reducerea emisiilor radiate, screened cables)
• Solutions to earthing and topologies for disturbaces reductions for auto equipments
• Immunity tests–demands for immunity and emitted signals in the auto domain
Bibliography
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• Popescu Claudia, Gavrila H, Popescu M.O., Hantila I.F. s.a , Impactul câmpurilor electromagnetice de natură antropică asupra ecosistemelor, Editura Printech Bucuresti, 2007
• Williams T, EMC for Product Designers , Elsevier 2010
• Popescu M.O, Compatibilitate electromagnetică-Aplicaţii la convertoarele statice de putere, Bucuresti 2001
• Tatu V, Drosu Oana, Popescu Claudia Laurenta, Effectiveness Analysis of Different Screens and Frequency Influence on Electromagnetic Attenuation Proceedings of 2015 13th International Conference on Engineering of Modern Electric Systems (EMES)
• Analyzing Electromagnetic Shielding of Perforated Screens, Popescu Claudia Laurenta, Hantila I.F, Vasilescu G.M,

Maricaru M.,2016 International Symposium on Fundamentals of Electrical Engineering (ISFEE)
• INCOSE System engineering Handbook 2006 v3

Applications content (seminar/**laboratory**/project)
• Disturbances Signal evaluations for some cases
• Conducted disturbances study
• Radiated disturbances study
• EMC Filtres
• Electromagnetic Screening – calculus and experiments
• Tests – Electrostatic Discharges
Bibliography
• Popescu,Cl, Popescu M.O..s.a .: Compatibilitate electromagnetica – studii de caz, Ed.Ars Docendi, Bucuresti, 2004.
• Williams T, EMC for Product Designers , Elsevier 2010
• DIRECTIVA 2014/30/UE A PARLAMENTULUI EUROPEAN ȘI A CONSILIULUI din 26 februarie 2014 privind armonizarea legislațiilor statelor membre cu privire la compatibilitatea electromagnetică

Type of activity evaluated	**Evaluation criterias**	**Evaluation methods**	**Weight in final grade**
Course	Exam	Written work evaluation	20%
Laboratory	Test plans and documents	Written test and calcul	80%
Minimal standard of performance			
• Case study solving using dedicated professional software • Analisis and optimisation of a system from EMC point of view • Conception of the EMC test programme in the auto domain			

01.01.O.06-05	**Vehicle Dynamics and Mechanics (ISEIA) – 4 ECTS**

Program of study				Integrated Electrical Systems Engineering in Vehicles - ISEIA	
Department				Automotive Engineering	
Course holder				Lect. PhD. Eng. Dan Alexandru MICU	
Seminar/laboratory/project holder				Lect. PhD. Eng. Dan Alexandru MICU	
Year of study	I	**Semester**	1	**Evaluation type**	Exam
Subject type	Subject training type				Complementary
	Compulsory or optional type of subject				Compulsory

Number of hours per week	3	Course	2	Seminar	0	Laboratory	1	Project	0
Number of hours per semester	42	Course	28	Seminar	0	Laboratory	14	Project	0
Number of ECTS credits	4								

Previous subjects required	• Mechanics: statics, cinematics, dynamics • Mathematical analysis
Previously acquired competences	• Appropriate applying of fundamental knowledge on mechanics • Knowledge of the fundamental elements of differential and integral calculus

Subject general objective	Assimilation of fundamental knowledge regarding the mechanics of tire, phenomena generating resistances of vehicle propulsion, traction and braking dynamics of vehicles and verification of their technical condition
Specific objectives	• Study of motor vehicle movement
	• Study of propulsion loads followed by traction modeling taking into account constructive and grip limitations
	• Study of braking performances highlighting the construction and road factors of influence
	• Acquiring of the basic principles of computer-assisted diagnostics

Course content
• The subject of vehicles dynamics. Structure of the man - vehicle - environment system
• The principle of self-propulsion of vehicles on wheels
• Mechanics of tire

• Constructive elements of tires • Interaction between the tire and the deformable path
• Road loads • Rolling resistance • Climbing resistance • Drag • Acceleration resistance
• Reaction of road on a wheel
• Dynamics of vehicle traction
• Dynamics of vehicle braking
• Principles of computer-assisted diagnostics
Bibliography
• Andreeescu, Cr., *Dinamica autovehiculelor pe roți vol. I*, Editura Politehnica Press, București, 2010
• Gillespie, Th. D., *Fundamentals of Vehicle Dynamics*, SAE, Inc., Warrendale, 1992
• Jazar, R., N., *Vehicle Dynamics: Theory and Application*, Springer Science+Business Media , New York, 2008
• *** Bosch *Automotive Handbook*, 7th Edition, SAE, 400 Commonwealth Drive Warrendale, PA, USA, 2008
• Andreescu, C., ș.a., *Diagnosticarea automobilelor* - lucrări practice, Editura PRINTECH, București 2002
• Denton, T. – „Advanced Automotive Fault Diagnosis", Elsevier, Butterworth-Heinemann, Oxford, UK, 2006

Applications content (seminar/**laboratory**/project)
• General architecture of road vehicles; dimensional and mass characteristics
• Constructive and geometrical characteristics of tires
• Modelling and simulation of vehicle traction
• Determining the braking capacity parameters
• Diagnosing the vehicle systems by connecting the diagnose system to the onboard computer using the OBD connector
• Labor protection and final evaluation of the students' activity
Bibliography
• Stoicescu, A. P., *Proiectarea performanțelor de tracțiune și de consum ale automobilelor*, Editura Tehnică, București, 2007
• Andreeescu, Cr., *Dinamica autovehiculelor pe roți vol. I*, Editura Politehnica Press, București, 2010

Type of activity evaluated	**Evaluation criterias**	**Evaluation methods**	**Weight in final grade**
Course	• Assimilation level of basic knowledge regarding the vehicle dynamics • The ability of solving numerical applications concerning the vehicle traction/braking dynamics • The ability of solving a homework regarding the study of vehicle traction	Final Exam – Written paperwork Homework evaluation	50% 15%
Laboratory	Lab final test (5 points). Lab projects averaged grades and/or lab workout fulfillment (10 points).	Written and oral evaluation for each lab session	35%
Minimal standard of performance			
• Demonstration of acquiring basic concepts and understanding the fundamental phenomena regarding the dynamics of road vehicles; • Solving and explaining issues of average complexity related to vehicle dynamics; • Handling the homework within the deadline set by the course holder in agreement with the students; • It is mandatory to attend at least five of the seven laboratory sessions and to prepare all the papers; • Achieve a minimum score of 50p/100p.			

01.01.O.06-06	**Research/Practice 1 (ISEIA) – 10 ECTS**

Program of study			Integrated Electrical Systems Engineering in Vehicles - ISEIA		
Research/Practice activities holder			Dissertation supervisor		
Year of study	I	**Semester**	1	**Evaluation type**	Colloquy
Subject type	Subject training type				Thoroughgoing

	Compulsory or optional type of subject	Compulsory

Number of ECTS credits	10

Previous subjects required	It is not necessary.
Previously acquired competences	It is not necessary.

Subject general objective	• Assimilation by the student of the specific tools of the scientific reseaech and practice: documentation techniques, acquisition techniques, experimental processing and interpretation, principles of development of research reports, multimedia presentation techniques, etc.
Specific objectives	• Elaboration of studies, reports and synthesis of documentation, respectively technical-economic
	• Solving specific design research problems in the field of integrated electrical systems engineering in vehicles
	• Achievement of experimental research with the use of modern equipment
	• Elaboration of the practical works being part of a team in the frame of complex projects

Research/Practice activities content
• Choosing the topic and the coordinator of the dissertation thesis
• Independent realization of a documentary on a theme related to the subject of the dissertation
• Performing models, simulations, experiments related to the given theme
• Writing a research report
• Making a public presentation of the work
Bibliography
Recommended by the dissertation supervisor, completed with the one searched, found and sought by the master student.

Evaluation methods
The evaluation is done by supporting the research report in front of a commission. The grade awarded will also take into account the supervisore's assessment of the research activity during the semester.
Minimal standard of performance
• Achieve a minimum score of 50p/100p.

01.02.O.06-07	**Interconnecting Devices and Interfaces (ISEIA) – 5 ECTS**

Program of study				Ingineria sistemelor electrice integrate în autovehicule - ISEIA	
Department				Electrotechnics	
Course holder				Lect. PhD. Eng. Mihai Eugen MARIN	
Seminar/laboratory/project holder				Lect. PhD. Eng. Mihai Eugen MARIN Lect. PhD. Eng. Victor Emilian BUCATĂ	
Year of study	I	**Semester**	2	**Evaluation type**	Exam
Subject type	Subject training type				Thoroughgoing
	Compulsory or optional type of subject				Compulsory

Number of hours per week	4	Course	2	Seminar	0	Laboratory	2	Project	0
Number of hours per semester	56	Course	28	Seminar	0	Laboratory	28	Project	0
Number of ECTS credits	5								

Previous subjects required	• Mathematical analysis, Linear Algebra, Basics of Electrical Engineering
Previously acquired competences	• Identification, definition, use of the fundamental notions of engineering

Subject general objective	Acquiring basic knowledge on information transmission. Acquiring basic knowledge on information transmission systems through wired and wireless interfaces used to connect automobiles.

Specific objectives	Develop the ability to use the analysis techniques of communication protocols used to connect cars;
	Use dedicated computer programs dedicated to analyze messages;
	Use devices for measuring electrical signals: oscilloscope, logic analyzer;
	Develop the ability to communicate in written essays.

Course content
• Basics of digital data transmission
• Serial protocols RS232, I2C, SPI. Connecting devices
• Communication protocols for vehicles, connecting with the outside
• Wireless data transmission protocols. Connecting deices
• Charging electric vehicles.
Bibliography
18-649 Distributed Embedded Systems, Philip Koopman, Carnegie Mellon University, note curs

Applications content (seminar/**laboratory**/project)
• Training of safety in the laboratory. Paper presentation: general rules of safety, labor protection rules specific to the laboratory. Establishing working subgroups, presenting papers and experimental facilities. Measurement of waveforms and decoding of serial RS232 signals.
• Measurement of waveforms and decoding of I2C and SPI serial signals
• Testing of a data connection via CAN interface
• Testing of data connection using WiFi and NFC
• Testing of data connections using Bluetooth and Bluetooth LE
• Testing the signaling circuit for electric car chargers
• Check of accumulated knowledge and end the situation at the lab.
Bibliography

Type of activity evaluated	**Evaluation criterias**	**Evaluation methods**	**Weight in final grade**
Course	Acquiring theoretical and presented in the course	Final examination Homework	50% 10%
Laboratory	Activity in laboratory and quality of the elaborated papers. Carrying out a practical work.	Laboratory papers for the laboratory themes. Laboratory colloquium.	20% 20%
Minimal standard of performance			
• Achieve a minimum score of 50p/100p.			

01.02.O.06-08	**Sensors and Transducers for Vehicles (ISEIA) – ECTS**

Program of study				Integrated Electrical Systems Engineering in Vehicles - ISEIA	
Department				Measurements, Electrical Apparatus and Static Converters	
Course holder				Lect. PhD. Eng. Bogdan-Adrian ENACHE	
Seminar/laboratory/project holder				Lect. PhD. Eng. Bogdan-Adrian ENACHE	
Year of study	I	**Semester**	2	**Evaluation type**	Exam
Subject type	Subject training type				Thoroughgoing
	Compulsory or optional type of subject				Compulsory

Number of hours per week	4	Course	2	Seminar	0	Laboratory	2	Project	0
Number of hours per semester	56	Course	28	Seminar	0	Laboratory	28	Project	0
Number of ECTS credits	5								

Previous subjects required	• It is not necessary.
Previously acquired competences	• It is not necessary.

Subject general objective	The application of fundamental and technical knowledge for solving problems relating to the measurement of physical quantities with sensors and transducers included in the structure of motor vehicles. Knowledge of the concepts and methods of implementation of sensors and transducers and measurement implementation in specific ranges of motor vehicles.
Specific objectives	• The presentation of the mechanical, physico-chemical and technological properties of sensors and transducers that are specific to the automotive industry.
	• The presentation of main types of sensors in the vehicle technologies .
	• Development and use of structural diagrams, schemes, graphics and technical documents specific to sensors and transducers in the vehicle industry.
	• Technical support regarding the integration of the sensors in the instrumentation subsystems and maintenance opportunities.

Course content
• Present situation of sensors and transducers in the automotive industry.
• Complex control systems of the vehicle and the role of sensors and transducers.
• Physical principles in technology sensors for motor vehicles.
• Major areas of application for sensors in cars: Powertrain, chassis, safety and comfort. Representative types of sensors.
• Static and dynamic characterization of sensors and transducers for automotive applications.
• Temperature sensors: integrated circuits, thermistor, RTD. Applications in vehicle: control of gas temperature, air, fluids, catalytic monitoring.
• Pressure sensors: piezoresistive element, polysilicon, piezoelectric crystal, ceramic capacitive sensor modules. Applications in automotive: dynamic suspension control, fuel injection, barometric and absolute pressure.
• Linear and angular position sensors: variable resistance, Hall effect, optical encoder, reluctance encoder. Applications in vehicles: fuel level, accelerator pedal position, the position of the gearbox, valves, active suspension systems.
• Rotary sensors: variable reluctance, Wiegand effect, Hall effect on chip, resolver, AMR, GMR. Applications in automotive: motor speed control, injection, fuel systems, navigation systems.
• Inertial sensors and combination angular/ position.
• Smart sensors for automotive.
Bibliography
• CEPISCA,C, LEFTER,E, Traductoare pentru vehicule, Ed. ELECTRA, Bucuresti, 2003
• CEPISCA,C , STEFLEA,D.,JULA,N.,Traductoare în sistemele de măsurare, Ed.CONPHYS, Rm.Vâlcea, 2003
• DOGARU V, CEPISCA, C, Măsurarea electrică a mărimilor neelectrice, Ed. Electra, Bucuresti, 2007
• J. TURNER, Automotive Sensors, Momentum Press, 2009
• ASCH,G, Acquisition de donnees. Du capteur a l'ordinateur, Ed. Dunod, Paris, 2004

Applications content (seminar/**laboratory**/project)
Presentation of laboratory. Functional blocks in instrumentation.
Static and dynamic characteristics of the sensors and transducers dedicated to automotive technology.
Study of temperature sensors on digital platform: RTD, PTC, NTC.
Study of pressure sensors on digital platform.
Study of force sensors on digital platform.
Study of position sensors on digital platform.
Selection criteria for sensors and transducers in automotive technology.
Sensors for vehicle lighting system.
Diagnosis of the system sensors on the vehicle.
Final test.
Bibliography
• VLAICU,C, CEPISCA, C, Senzori si traductoare, Ed. SECOREX, Bucuresti, 2001
•CEPISCA,C.,Condiţionarea semnalelor specifice senzorilor şi traductoarelor. UPB,2013
•*** Vehicle Sensor Technology. Physical Principles, Volkswagen Group 2013, wwwebsource.com
• *** Automotive electronic Sensors, www.cvel.clemson.edu
• *** documentatii ÅAC Microtec, Altheris, Analog Devices, Bosch, Continental, CTC, Freescale, GE, Honeywell, Kionix, Memsic, Mitsubishi Electric, McLaren Electronics, Murata, Omega, Panasonic, PCB, Rieker, Sensata, Silicon Designs, STMicroelectronics, TRW

Type of activity evaluated	**Evaluation criterias**	**Evaluation methods**	**Weight in final grade**

Course	An understanding of the theoretical aspects and specific methods of implementation technologies of sensors and transducers for insertion in automotive installations. Ability of solving some specific application with sensors and transducers.	Grid knowledge tests on the Moodle platform. Final grid exam on the Moodle platform.	10% 50%
Laboratory	Understanding the principles of practical work. Taking all laboratory works and general laboratory average over grade 5.	Essay 1 - teaching after the first 7 weeks. Essay 2 - Teaching in Week 14. Moodle platform grid-type laboratory knowledge test.	10% 10% 20%

Minimal standard of performance

- Getting a minimum of 50% of the total score.
- Minimum knowledge set for passing the exam:
  - Knowledge of the main systems in a car
  - Choosing the main types of sensors according to their role
  - Knowledge of the operating principle for temperature measuring sensors
  - Knowledge of the operating principle for pressure measuring sensors
  - Knowledge of the operating principle for position sensors
  - Knowledge of the operating principle for sensors of measuring angular displacements.

01.02.O.06-09	**Electric Propulsion Systems for Vehicles (ISEIA) – 5 ECTS**

Program of study					Integrated Electrical Systems Engineering in Vehicles - ISEIA		
Department					Mașini, Materiale si Acționări electrice		
Course holder					Prof. PhD. Eng. Aurelian CRĂCIUNESCU		
Seminar/laboratory/project holder					Prof. PhD. Eng. Aurelian CRĂCIUNESCU		
Year of study	I	**Semester**	2	**Evaluation type**	Exam		
Subject type	Subject training type				Thoroughgoing		
	Compulsory or optional type of subject				Compulsory		

Number of hours per week	4	Course	2	Seminar	0	Laboratory	2	Project	0
Number of hours per semester	56	Course	28	Seminar	0	Laboratory	28	Project	0
Number of ECTS credits	5								

Previous subjects required	• Dynamics and mechanics of the vehicle, The architecture of the vehicle, Numerical simulation of integrated systems, Power electronics, Structures and commands.
Previously acquired competences	• Appropriate application of fundamental knowledge of electrical circuits, electromagnetic field, electrical machines, power electronics and systems theory.

Subject general objective	Acquiring fundamental elements regarding to the operating principles, construction parts and specific performances of the electric powertrain systems for vehicles.
Specific objectives	• Acquiring knowledge about the main sources of energy used on electric vehicles and methods of charging and recovering braking energy.
	• Acquiring knowledge about the main types of traction motors that equip modern electric cars: induction motors, synchronous motors with electromagnetic excitation, synchronous motors with permanent magnets, synchronous motors with variable reluctance and synchronous motors with hybrid excitation
	• Acquiring specific knowledge about forced cooling of traction motors fed from battery through power electronics.
	• Acquiring knowledge about the optimal control principles for traction motors and control methods for braking energy recovery.
	• Acquiring knowledge about the energy efficiency of traction motors and of the whole powertrain system based on standardized driving cycles.

Course content

1. Power sources for electrical vehicles:
1.1. Traction batteries;

1.2. Charging systems for electric vehicles; 1.3. Fuel cells; 1.4. Brake energy recovery systems; 1.4.1 Supercapacitors; 1.4.2 Storage flywheel systems.
2. Electric traction motors: 2.1. DC motors; 2.2. Induction motors; 2.3. Synchronous type motors; 2.4. Cooling of traction motors; 2.5. Optimal control of traction motors; 2.6. Brake energy recovery; 2.7. Electrical machines for hybrid vehicles
3. Mathematical models for simulating the dynamics of electric vehicles; 3.1. Thrust force and resistant forces; 3.2. Driving diagrams associated with standardized driving cycles; 3.3. Determination of the operating points of the traction motors based on the driving diagrams.
4. Energy performance of electric powertrain systems: 4.1. Losses in the electric powertrain systems; 4.2. Powertrain system efficiency; 4.3. Energy efficiency for standardized driving cycles.
Bibliography
• Larminie J., Lowry. J, Electric Vehicle Technology Explained, John Wiley & Sons Ltd, ISBN: 978-0-470-09069-5
• Moraru A., Mașini electrice. Teorie, încercări si exploatare, Ed. A.G.I.R., București 2010, ISBN: 978-973-720-315;
• GALAN N., Masini electrice, Ed. Academiei Romane, București 2011, ISBN: 978-973-27-2077-6.
• Boldea I., Synchronous Generators (The Electric Generators Handbook), CRC Taylor&Francisc Group, 2006.
• Boldea I., Nasar S., The Induction Machine Handbook (Electric Power Engineering Series), CRC Taylor&Francisc Group, 2001.

Applications content (seminar/**laboratory**/project)
1. Numerical models for the traction batteries simulation.
2. Numerical models for DC motors.
3. Simulation of powertrain systems with battery-chopper fed DC motor.
4. Numerical models for simulation the mechanical transmission of the vehicle.
5. Simulation of an electric vehicle with DC motor.
6. Numerical models for induction motors.
7. Simulation of powertrain systems with battery-inverter fed induction motor.
8. Simulation of an electric vehicle with induction motor.
9. Numerical models for synchronous motors.
10. Simulation of powertrain systems with battery-inverter fed permanent magnet synchronous motor.
11. Simulation of powertrain systems with battery-inverter fed field winding synchronous motor.
12. Simulation of powertrain systems with battery-inverter fed permanent magnet reluctance assisted synchronous motor.
13. Simulation of an electric vehicle with synchronous motor.
14. Final test
Bibliography
• MATLAB©, SimPowerSystem 4 User's Guide, The MathWorks, 2007.
• Moraru A., Mașini electrice. Teorie, încercări si exploatare, Ed. A.G.I.R., București 2010, ISBN: 978-973-720-315;
• GALAN N., Masini electrice, Ed. Academiei Romane, București 2011, ISBN: 978-973-27-2077-6.
• Boldea I., Synchronous Generators (The Electric Generators Handbook), CRC Taylor&Francisc Group, 2006.
• Boldea I., Nasar S., The Induction Machine Handbook (Electric Power Engineering Series), CRC Taylor&Francisc Group, 2001.

Type of activity evaluated	**Evaluation criterias**	**Evaluation methods**	**Weight in final grade**
Course	Knowledge of operating principles, constructive parts, energy balance and operating characteristics of traction batteries. Knowledge of operating principles, constructive pars, energy balance and	Oral examination Written test	50%

	operating characteristics of motors used in electric powertrain systems. Knowledge of numerical models to simulate the operation of electric motors in dynamics.		
Laboratory	Knowledge and use of specific software to simulation of the electric powertrain systems (MATLAB, SIMULINK);	Practical test	50%
Minimal standard of performance			
• Getting of minimum 50 points out of 100 points.			

01.02.O.06-10	**Vehicle Architecture (ISEIA) – 5 ECTS**

Program of study				Integrated Electrical Systems Engineering in Vehicles - ISEIA	
Department				Automatic Control and Systems Engineering	
Course holder				Prof. PhD. Eng. Ciprian LUPU	
Seminar/laboratory/project holder				Prof. PhD. Eng. Ciprian LUPU	
Year of study	I	**Semester**	2	**Evaluation type**	Exam
Subject type	Subject training type				Thoroughgoing
	Compulsory or optional type of subject				Compulsory

Number of hours per week	3	Course	1	Seminar	0	Laboratory	2	Project	0
Number of hours per semester	42	Course	14	Seminar	0	Laboratory	28	Project	0
Number of ECTS credits	5								

Previous subjects required	• Attending and / or passing the following subjects: Knowledge of computer programming in evolved languages (C, Pascal, C ++), Programming of Real Time Applications, Data Acquisition Systems.
Previously acquired competences	• Adequate application of computer programming knowledge in high-level languages.

Subject general objective	The course aims to familiarize students with the main theoretical and practical notions of software design and implementation of control algorithms, especially of software applications, generally existing in the automotive systems. The practical aspects of these systems are followed, taking into account the modern solutions existing on the market. Both the classical functions (braking, combustion, etc.) and modern ones (automatic pilot, multimedia connection, IoT, etc.) will be identified. The applications come to complement the notions acquired at the course and to create the right skills in the development of software systems. Several development programs of important companies in the field are used. The laboratories homework requires solving concrete problems that necessitate the fundamentation of the accumulated knowledge.
Specific objectives	After completing this course, students will be able to: - Analyze a hardware and software system on an auto vehicle, - Design an algorithm to control one or more parameters on an auto vehicle, - To implement a control algorithm of one or more parameters on an auto vehicle, - Additionally, students will improve their way of writing and presenting specific documentation.

Course content
Definition and concepts of Software Architectures included in Auto Vehicle Type Systems (SAA). Components and their Functions
Types of ASA system structures.
Acquisition and control level: Data acquisition and parameter control. The notion of real time. Real time systems characteristics. Real-time hardware and software systems. Structure of acquisition and adjustment software applications.
Operator console. Functions of the operator console. Graphical Interface (HMI). Static and mobile elements.
Control algorithms of the functions and components (classic and modern) of Auto Vehicles
Implementation of control algorithms.
Presentation of case studies.
Bibliography
• Handbook of Real-Time and Embedded Systems, editat de Insup Lee,Joseph Y-T. Leung,Sang H. Son,

• AUTOSAR - A standard in the course of time, EUROFORUM Automotive Software Development, September 6th 2016, Munich

Applications content (seminar/**laboratory**/project)
Presentation of the structure of SAA (hardware, software) systems in the laboratory.
Data acquisition using microcontroller systems, acquisition boards, digital, analogue inputs and counters
Operator Interface Construction I.
Operator Interface II.
Implementation and use of adjustment loops.
Complex example of SAA system.
Recuperation (limited) of some laboratories
Bibliography
* Manuale de utilizare, tutoriale (hardware si software)
Lupu C., Dragoicea M., Programarea aplicatiilor pentru conducere in timp real, Editura AOSR, 2011, 100 pag., ISBN 978-606-8371-27-6,
G. R. Goud, N. Sharma, K. Ramamritham and S. Malewar, "Efficient Real-Time Support for Automotive Applications: A Case Study," *12th IEEE International Conference on Embedded and Real-Time Computing Systems and Applications (RTCSA'06)*, Sydney, Qld., 2006, pp. 335-341.

Type of activity evaluated	**Evaluation criterias**	**Evaluation methods**	**Weight in final grade**
Course	Knowledge of the main characteristics of ASA systems. Knowledge of configuration methods and principles of implementation and maintenance of ASA systems.	Written assessment during and at the end of the semester. The subjects cover the whole matter.	50%
Laboratory	Doing homework for each lab Implementation, documentation and demonstration of the final laboratory project	Oral assessment during and at the end of the semester.	50%
Minimal standard of performance			
To obtain a minimum of 50% of the final exam score and obtain at least 50% of the score on the way (for the mark of 5) To fulfil the obligations characteristic of the laboratory activity (to hand in and present the homework and the final project)			

01.02.O.06-11	**Research/Practice 2 (ISEIA) – 10 ECTS**

Program of study					Integrated Electrical Systems Engineering in Vehicles - ISEIA
Research/Practice activities holder					Dissertation supervisor
Year of study	I	**Semester**	2	**Evaluation type**	Colloquy
Subject type	Subject training type				Thoroughgoing
	Compulsory or optional type of subject				Compulsory

Number of ECTS credits	10

Previous subjects required	Research/Practice 1
Previously acquired competences	Getting of minimal points at the subject Research/Practice 1

Subject general objective	• Assimilation by the student of the specific knowledge in the field corresponding to the dissertation theme, ordering, synthesis and critical analysis of this knowledge. The student will learn to work in a team and will be able to identify and formulate the detailed specification of the dissertation.
Specific objectives	• Elaboration of studies, reports and synthesis of documentation, respectively technical-economic
	• Solving specific design research problems in the field of integrated electrical systems engineering in vehicles
	• Achievement of experimental research with the use of modern equipment
	• Elaboration of the practical works being part of a team in the frame of complex

	projects
	• Elaboration of studies, reports and synthesis of documentation, respectively technical-economic

Research/Practice activities content
• Documentation in the field of dissertation
• Sorting, completing and synthesizing information
• Performing models, simulations, experiments related to the given theme
• Writing a research report
• Making a public presentation of the work.
Bibliography
Recommended by the dissertation supervisor, completed with the one searched, found and sought by the master student.

Evaluation methods
The evaluation is done by supporting the research report in front of a commission. The grade awarded will also take into account the supervisore's assessment of the research activity during the semester.
Minimal standard of performance
• Achieve a minimum score of 50p/100p.

01.03.O.06-12	**Security and Functional Safety of Vehicle Electrical Systems (ISEIA) – 4 ECTS**

Program of study				Integrated Electrical Systems Engineering in Vehicles - ISEIA	
Department				Electrotechnics	
Course holder				Assoc. Prof. PhD. Eng. Lucian-Gabriel PETRESCU	
Seminar/laboratory/project holder				Assoc. Prof. PhD. Eng. Lucian-Gabriel PETRESCU	
Year of study	II	**Semester**	1	**Evaluation type**	Colloquy
Subject type	Subject training type				Thoroughgoing
	Compulsory or optional type of subject				Compulsory

Number of hours per week	2	Course	1	Seminar	0	Laboratory	1	Project	0
Number of hours per semester	28	Course	14	Seminar	0	Laboratory	14	Project	0
Number of ECTS credits	4								

Previous subjects required	• It is not necessary.
Previously acquired competences	• It is not necessary.

Subject general objective	Understanding the main subjects in functional security and safety of the automotive electrical systems.
Specific objectives	• Domain glossary
	• Functional safety management
	• Design Failure Mode and Effect Analysis (DFMEA)
	• Development of the AISLs (Automotive Safety Integrity Levels) systems

Course content
• Introduction and international domain standards
• Specific glossary
• Functional safety of the automotive electrical systems
• Functional security management phases
• Functional security according the ISO 26262
• Design Failure Mode and Effect Analysis (DFMEA) Concept
• DFMEA implementing phases
Bibliography
• Systems Engineering Handbook, INCOSE-TP-2003-002-03, Edited by Cecilia Haskins, 2006
• National Strategy for Road Security 2013 – 2020, Romanian Government
• Mark Charlwood, Shane Turner, Nicola Worsell, *A methodology for the assignment of safety integrity levels (SILs) to safety-related control functions implemented by safety-related electrical, electronic and programmable electronic*

control systems of machines, HSE Books, 2004
- Daniel P. Schrage, *Understanding Functional Safety Management Methods Evolution for Tomorrow's Civil and Military Aircraft Development and Safety Assessment*, School of AE, Georgia Tech, 2010

Applications content (seminar/**laboratory**/project)
- Introduction. General overview
- Automotive electric systems analysis
- Development of an AISLs (Automotive Safety Integrity Levels) systems for electrical equipments (MATLAB Simulink 2017a)
- Design Failure Mode and Effect Analysis (causes identification, priority direction establishment and complete analysis)
- Final tests and closing the activities

Bibliography

- Systems Engineering Handbook, INCOSE-TP-2003-002-03, Edited by Cecilia Haskins, 2006
- Failure Mode and Effects Analysis – case study, Quality-One - http://quality-one.com/fmea
- http://www.qualitytrainingportal.com/resources/fmea/fmea_10step_dfmea.htm

Type of activity evaluated	Evaluation criterias	Evaluation methods	Weight in final grade
Course	Evaluation of the presented information	Exam	20%
Laboratory	Develop of the practical work	Exam	80%

Minimal standard of performance
- Obtaining at least 50% of the total numbers of points.

01.03.O.06-13	**Numerical Simulation of Embedded Systems (ISEIA) – 4 ECTS**

Program of study				Integrated Electrical Systems Engineering in Vehicles - ISEIA	
Department				Electrotechnics	
Course holder				Prof. PhD. Eng. Gabriela CIUPRINA	
Seminar/laboratory/project holder				Lect. PhD. Eng. Aurel Sorin LUP	
Year of study	II	**Semester**	1	**Evaluation type**	Exam
Subject type	Subject training type				Thoroughgoing
	Compulsory or optional type of subject				Compulsory

Number of hours per week	4	Course	2	Seminar	0	Laboratory	2	Project	0
Number of hours per semester	56	Course	28	Seminar	0	Laboratory	28	Project	0
Number of ECTS credits	4								

Previous subjects required	• Numerical methods in electrical engineering; Electronics; Signal processing; Digital systems; Electrical actuators.
Previously acquired competences	• Computer skills for simulations, programming, MATLAB, scientific report writing.

Subject general objective	Create working abilities with the newest techniques, methods, models and tools for the development and fabrication of products and services in the context of modern companies where the activities are computer aided. Create knowhow for modeling and simulations of interactions between various components of embedded electronic systems, MEMS, MEMS, HD/SW, mechatronics, multiphysics.
Specific objectives	Efficient use of resources for the modeling and computer simulation of interactions between various components of an embedded system.
	The student will acquire knowhow for the embedded design of a mechatronic system in accordance with the lifecycle of the project/device.
	Modeling and multiphysic simulation is envisaged, from the software tool, electronics used for control, and elements for the mechanical or thermal actuation.
	Various concepts of the embedding concept will be approached: technology and design of integrated circuits, MEMS, hardware/software embedding/co-design, mechatronic systems.

Course content

1. Introduction. Integrated/embedded systems. Steps of multiphysics modeling

2. Conceptual modeling of embedded systems. Multipysics and geometric aspects.
3. Mathematical modeling of distributed systems.
4. Mathematical modeling of lumped systems.
5. Mathematical and numerical modeling of coupled multiphysics systems. Model order reduction.
6. Computational modeling of multiphysics systems on multiprocessor computers. Software environments and frameworks..
7. Verification and validation of models. Optimal design. Study cases.
Bibliography

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- Ciuprina, G., Ioan, D., Lup, A. S., Popescu, M., Barbulescu, R., & Stefanescu, A. (2016, July). Coupled multiphysics-RF reduced models for MEMS. In Power Electronics, Intelligent Control and Energy Systems (ICPEICES), IEEE International Conference on (pp. 1-6). IEEE.
- Ciuprina, G., Lup, A. S., Diţă, B., Ioan, D., Sorohan, Ş., Isvoranu, D., & Kula, S. (2016). Mixed Domain Macromodels for RF MEMS Capacitive Switches. InScientific Computing in Electrical Engineering (pp. 31-39). Springer International Publishing.
- Ciuprina, Gabriela; Ioan, Daniel; Mihalache, Diana; et al. THE ELECTROMAGNETIC CIRCUIT ELEMENT - THE KEY OF MODELLING ELECTROMAGNETICALY COUPLED INTEGRATED COMPONENTS, Revue Roumaine Des Sciences Techniques-Serie Electrotechnique Et Energetique Volume: 54 Issue: 1 Pages: 37-46, JAN-MAR 2009
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- D. Ioan, G. Ciuprina "Reduced Order Electromagnetic Models of On-chip Passive Components and Interconnects, Workbench and Test Structures for Inntegrated passive components", Pages 447-467 in Reduced order modeling, (W.H.A. Schilders, H.A. van der Vorst, J. Rommes, Eds). "Model Order Reduction: Theory, Research Aspects and Applications", Springer series on Mathematics in Industry, Springer-Verlag, Heidelberg, 2008
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- D. Ioan, Modelarea multifizica, UPB, 2012, draft disponibil la http://www.lmn.pub.ro/~daniel/ElectromagneticModelingDoctoral/Tutorials/Ioan12-ModelareMultifizica.pdf).
- D.Ioan, I.Munteanu, B.Ionescu, M.Popescu, R.Popa, M.Lazarescu,G.Ciuprina, Metode numerice in ingineria electrica, Editura MATRIX-ROM, Bucuresti, 1998
- Daniel Ioan, ALGORITMI NUMERICI Calcule stiintifice de inalta performanta (HPSC), UPB 2016 http://an.lmn.pub.ro/slides2016/Calcule_stiintifice_de_inalta_performanta.pdf
- Daniel Ioan, Complexity Reduction in Multiphysics Modeling, COST MORNET, 2015 http://mornet.lmn.pub.ro/pdfs/DanielIoan_COST_MORNET_WG2_Bucharest19mar2015.pdf
- Documentatia Matlab http://www.mathworks.com/access/helpdesk/help/helpdesk.html
- E.Kalisz - Simularea sistemelor, PCREPORT, octombrie 1996
- Eric Peasley, An Introduction to Using Simulink, Department of Engineering Science, University of Oxford version 4.0, 2013 http://www.eng.ox.ac.uk/~labejp/Seminar/Simulink/Simulink_Introduction.pdf
- Gabriela Ciuprina, Algoritmi numerici - UPB, Facultatea de Inginerie Electrica, Master IEIA anul I, 2016/2017 http://an.lmn.pub.ro/slides2016/
- Gabriela Ciuprina, Algoritmi numerici pentru calcule stiintifice in ingineria electrica Editura MatrixROM, 2013,
G.Ciuprina Algoritmi numerici prin exeritii si implementari in Matlab Editura MatrixROM, 2013, http://lmn.pub.ro/~gabriela/books/AlgNrExMatlab_MatrixRom2013.pdf
- Ioan, D; Popescu, S; Spanoche, S; et al. A comparison between two CMOS magnetic sensors for ECTSource: Nondestructive Testing of Materials, E'NDE'95 21-22 September 1995, University College London, UK Volume: 8 Pages: 125-134
- Irina Munteanu, Gabriela Ciuprina, F.M.G.Tomescu, Modelarea numerica a campului electromagnetic prin programe Scilab, Editura Printech, Bucuresti, Romania, 2000 (140 pagini), ISBN 973-652-000-5.
- Lawrence S. Gould , Simulation Makes Vehicles Real Automotive Design & Production, 7/1/2009 http://www.adandp.media/articles/simulation-makes-vehicles-real
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- Sorin Lup, Multiphysics Modelling of Radio Frequency Micro-Electro-Mechanical-Systems, PhD, UPB, 2016. http://www.lmn.pub.ro/~sorin/documents/AS_LUP_PhD_Thesis_RF_MEMS_modelling.pdf
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Applications content (seminar/**laboratory**/project)
1. Modling with MATLAB/Simulink: sources, measuring, interconnecting, mathematical libraries, tables, logical operators, .m files, dynamic continuous systems, ODE, linear systems, discrete systems, discrete transfer functions, hybrid simulations (continuous and discrete), subsystems
2. Modeling a clutch lock-up model.
3. Modeling an anti lock braking-system
4. Modeling of automotive suspension
5. Modeling of vehicle electrical system
6. Simulation of automatic climate control systems
7. COMSOL modeling of an MEMS accelerometer with automotive application
Bibliography
http://users.isr.ist.utl.pt/~alex/micd0506/simulink.pdf
http://www.eng.ox.ac.uk/~labejp/Seminar/Simulink/Simulink_Introduction.pdf
https://classes.soe.ucsc.edu/cmpe242/Fall10/simulink.pdf
http://home.hit.no/~hansha/documents/matlab/training/Introduction%20to%20Simulink/Introduction%20to%20Simulink.pdf
https://faculty.unlv.edu/eelabs/docs/guides/Simulink_Basics_Tutorial.pd
https://www.mathworks.com/help/simulink/examples/building-a-clutch-lock-up-model.html
https://www.mathworks.com/help/simulink/examples/modeling-an-anti-lock-braking-system.html
ttps://www.mathworks.com/help/simulink/examples/automotive-suspension.html
https://www.mathworks.com/help/simulink/examples/vehicle-electrical-system.html
https://www.mathworks.com/help/simulink/examples/simulating-automatic-climate-control-systems.html
https://www.comsol.eu/paper/download/100681/anju_paper.pdf

Type of activity evaluated	**Evaluation criterias**	**Evaluation methods**	**Weight in final grade**
Course	The level of understanding of concepts and modeling procedures	Written examination	50 %
Laboratory	The completeness and the correctitude of the laboratory report, the level of mastering of the software tools used for the modeling, results obtained from the numerical simulations.	Oral presentation of the report.	50%
Minimal standard of performance			
• Correct understanding of the steps of a modeling procedure and their correct use in a study case. • Obtaining at least 50% of the total numbers of points.			

01.03.O.06-14	**Modeling, Simulation, Programming and Testing of Integrated Electromechanical Systems (ISEIA) – 4 ECTS**

Program of study				Integrated Electrical Systems Engineering in Vehicles - ISEIA	
Department				Electrical Machines, Materials and Drives	
Course holder				Assoc. Prof. PhD. Eng. Ioan-Dragoş DEACONU	
Seminar/laboratory/project holder				Assoc. Prof. PhD. Eng. Ioan-Dragoş DEACONU Assoc. Prof. PhD. Eng. Aurel-Ionuț CHIRILĂ	
Year of study	II	**Semester**	1	**Evaluation type**	Exam
Subject type	Subject training type				Thoroughgoing
	Compulsory or optional type of subject				Compulsory

Number of hours per week	4	Course	2	Seminar	0	Laboratory	2	Project	0
Number of hours per semester	56	Course	28	Seminar	0	Laboratory	28	Project	0
Number of ECTS credits	4								

Previous subjects required	• Electric propulsion systems for vehicles • Power electronics. Structures and control methods
Previously acquired competences	• Appropriate applying of fundamental knowledge on modeling and control of electrical machinery and electrical converters. Proper knowledge of microcontrollers programming, commissioning and operation within integrated electromechanical systems.

Subject general objective	• Assimilation of fundamental knowledge regarding the construction, operating and control principles, dynamic performances and standard trials of integrated electromechanical systems. Knowledge of specific engineering software tools related to modeling, simulation, programming and testing of integrated electromechanical systems.
Specific objectives	• Assimilation of specific knowledge regarding the selection of main parts that form an integrated electromechanical system, based on technical and performance criteria from an initial given class of possible alternatives.
	• Assimilation of knowledge related to the operation of integrated electromechanical systems, including specific trials and features.
	• Assimilation of knowledge related to software package types and employment in order to solve specific research and design applications in the field of integrated electromechanical systems.

Course content
• Model development for integrated electromechanical systems ▪ Model-based control development ▪ Conceptual analysis ▪ Modeling approaches ▪ Logic Flow Charts and Finite state machines ▪ Adaptive control and parameter identification ▪ Simulation tools and environments
• User interaction ▪ Graphical User Interfaces (local and remote) ▪ Human Machine Interface (HMI) Concept and Devices ▪ Programming environments
• Data mining for integrated electromechanical systems ▪ Relational databases for monitoring, testing and validation ▪ Data mining approaches for modeling improvement and diagnosing ▪ What if scenarios? for testing and validation
• Control engineering ▪ Conceptual control algorithms (local and remote) ▪ Controllers and embedded systems (hardware, performance and flexibility analysis) ▪ Control software development ▪ Programming environments
• Model validation and verification for integrated electromechanical systems ▪ Virtual prototyping and testing ▪ Hardware in the loop (HIL) concept and approach ▪ Hardware/software deployment platforms
Bibliography
• International Council on Systems Engineering - INCOSE, Systems Engineering Handbook.
• S. V. PAŢURCĂ, D.I. DEACONU, A.I. CHIRILĂ, C*ommand, control and monitoring for embedded systems (in Romanian),* PRINTECH Publishing, 2013.
• D.I. DEACONU, A.I. CHIRILĂ, Digital support of lecture accessible by students on educational Moodle platform of Electrical Engineering Faculty.

Applications content (seminar/**laboratory**/project)
• Introductory elements, laboratory presentation and basic mechanical, thermal and electric safety rules
• Conceptual modeling and analysis of AC integrated electromechanical systems (induction and permanent magnet types)
• Conceptual modeling and analysis of DC integrated electromechanical systems (variable reluctance and permanent magnet types)
• Conceptual modeling application by Logic Flow Charts analysis approach
• Electromechanical parts modeling using controller hardware platforms for HIL systems
• Modeling, testing and validation of a closed-loop integrated hydraulic-electromechanical system

• Thermal analysis software tool application including virtual modeling, simulation and testing of integrated electromechanical system
• Virtual modeling of electromechanical systems and thermodynamic parameter estimation software application
• Integrated electromechanical system parameter identification application
• Graphical User Interface (GUI) development for integrated electromechanical systems applications
• Data mining applications for integrated electromechanical systems
• Control software development applications for controllers and embedded systems
• Controller embedded system software development application for variable reluctance machine type
• Analysis of a hardware in the loop (HIL) system for speed control of a permanent magnet electric motor
Bibliography
• International Council on Systems Engineering - INCOSE, Systems Engineering Handbook.
• S. V. PAŢURCĂ, D.I. DEACONU, A.I. CHIRILĂ, C*ommand, control and monitoring for embedded systems (in Romanian),* PRINTECH Publishing, 2013.
• D.I. DEACONU, A.I. CHIRILĂ, Lab sheets in digital format accessible by students on educational Moodle platform of Electrical Engineering Faculty.

Type of activity evaluated	**Evaluation criterias**	**Evaluation methods**	**Weight in final grade**
Course	3 written subjects (2 x 15 points + 1 x 20 points). 2 assignments as homework (5 points + 10 points).	Final Exam – Written paperwork Homework evaluation	50% 15%
Laboratory	Lab final test (5 points). Lab projects averaged grades and/or lab workout fulfillment (10 points).	Written and oral evaluation for each lab session	35%
Minimal standard of performance			
• Solve and explain issues of medium difficulty level linked to the selection of the main parts that assemble an integrated electromechanical system; • Perform graphical technical representations for mathematical models of medium difficulty level specific to the elements defining an integrated electromechanical system; • Hand out the homework up to the deadline set by the instructor in agreement with the students; • Attendance of half plus one lab sessions.			

01.03.O.06-15	**Materials, Specific Technologies and Vehicles Environment Impact (ISEIA) – 4 ECTS**

Program of study				Integrated Electrical Systems Engineering in Vehicles - ISEIA	
Department				Electrical Machines, Materials and Drives	
Course holder				Prof. PhD. Eng. Laurentiu Marius DUMITRAN	
Seminar/laboratory/project holder				Prof. PhD. Eng. Laurentiu Marius DUMITRAN Lect. PhD. Eng. Alin Alexandru DOBRE	
Year of study	II	**Semester**	1	**Evaluation type**	Exam
Subject type	Subject training type				Review
	Compulsory or optional type of subject				Compulsory

Number of hours per week	3	Course	2	Seminar	0	Laboratory	1	Project	0
Number of hours per semester	42	Course	28	Seminar	0	Laboratory	14	Project	0
Number of ECTS credits	4								

Previous subjects required	• Methods and technologies • Electrical materials • Chemistry • Fundamentals of electrical engineering
Previously acquired competences	• Knowledge of the structure and properties of the materials that are used in dedicated systems of vehicles. Knowledge of the specific technologies of vehicles systems, their impact on the environment and the methods used for material recycling.

Subject general objective	• Acquiring fundamental elements regarding the properties of materials used in the manufacture of electrical systems for motor vehicles, specific technologies, lifetime estimation, their impact on the environment and materials recycling methods.

Specific objectives	• Acquiring the specific knowledge needed to select the main materials that make up an integrated electrical system, from a known initial set of possible variants, based on technical and performance criteria
	• Acquiring knowledge about the requirements of the components of the integrated electromechanical systems, as well as their tests and characteristics
	• Acquiring knowledge about existing technologies, determining material properties, laboratory testing, lifetime estimation and recycling, and their environmental impact.

Course content

- Materials used in integrated electrical systems
  - Conductive materials; Properties and manufacturing technologies;
  - Insulating materials; Properties and manufacturing technologies;
  - Semiconductor materials; Properties and manufacturing technologies;
  - Composite materials with ordered properties;
- Specific requirements for materials that are part of the electrical systems for motor vehicles
  - Electrical requests;
  - Mechanical applications;
  - Thermal demand;
  - Environmental demands;
  - Combined requests;
- Degradation of materials used in electrical systems for motor vehicles
  - Physical and chemical degradation phenomena of materials;
  - Estimation of degradation states and lifetime;
- Electrotechnologies specific to the motor vehicle industry
  - General principles;
  - Electrotechnologies specific to the main manufacturing stream;
  - Electrotechnologies specific to components and sub-assemblies;
  - Impact on the environment;
- The impact of vehicles on the environment and recycling technologies
  - Impact of vehicles on the environment;
  - Technologies to reduce the impact of vehicles on the environment;
  - Sorting and recycling of materials;

Bibliography

- International Council on Systems Engineering - INCOSE, Systems Engineering Handbook.
- L.M. Dumitran, *Sisteme de izolaţie electrică*, Editura PRINTECH, 2008.
- L.M. Dumitran, Materiale electrotehnice, Editura MatrixRom, 2014.

Applications content (seminar/**laboratory**/project)

- Introductory elements, laboratory presentation, safety and protection rules
- Using software resources to select and characterize materials (MatWeb, MatDan, MPDB, etc.)
- International environmental protection standards specific to the motor vehicle industry
- Experimental determination of the main electrical properties of the insulating materials
- Electrical conduction in metals and semiconductors. Numerical applications.
- Estimating the thermal lifetime of the electrical insulation materials
- Methods of air filtration in automotive industry
- Electrostatic filtration of industrial gases; experimental study and numeric models.
- Electrostatic separation of granular mixture; experimental study and numerical models.
- Homework presentation

Bibliography

- International Council on Systems Engineering - INCOSE, Systems Engineering Handbook.
- L.M. Dumitran, Dépoussiérage électrostatique des fines particules, Editura Presse Académique Francophone (PAF), 194 pag., ISBN 978-8381-4655-3, 2014.
- L.M. Dumitran, Foi de platformă pentru laborator, în format electronic, puse la dispoziția studenților pe platforma educațională Moodle a Facultății de Inginerie Electrică.

Type of activity evaluated	**Evaluation criterias**	**Evaluation methods**	**Weight in final grade**
Course	3 questions (2 x 15 + 1 x 20 points) Homework	Final exam Presentation	50 % 20 %

Laboratory	The average of the grades obtained in the papers and / or the laboratory work	Laboratory applications	30 %

Minimal standard of performance

- Knowledge of the general properties of the materials used to manufacture the electrical systems specific to the vehicles and the way of choosing and dimensioning the main elements that make up an integrated electrical system;
- Knowing the electrotechnologies specific to the motor vehicle industry and assessing their impact on the environment;
- Knowing the methods and technologies for mitigating the impact of vehicles on the environment and the basic principles regarding the sorting and recycling of used materials;
- Presence at least half plus one of the laboratory hours.

01.03.O.06-16	**Integrated Data Acquisition Systems (ISEIA) – 4 ECTS**

Program of study				Integrated Electrical Systems Engineering in Vehicles - ISEIA	
Department				Measurements, Electrical Apparatus and Static Converters	
Course holder				Assoc. Prof. PhD. Eng. Felix Constantin ADOCHIEI	
Seminar/laboratory/project holder				Assoc. Prof. PhD. Eng. Felix Constantin ADOCHIEI	
Year of study	II	**Semester**	1	**Evaluation type**	Colloquy
Subject type	Subject training type				Thoroughgoing
	Compulsory or optional type of subject				Compulsory

Number of hours per week	3	Course	1	Seminar	0	Laboratory	2	Project	0
Number of hours per semester	42	Course	14	Seminar	0	Laboratory	28	Project	0
Number of ECTS credits	4								

Previous subjects required	• Numerical measurements
Previously acquired competences	•

Subject general objective	Developing of knowledge in integrated DAQ systems and architecures. Approach of these problems is in the context of current preoccupations, with implementation of general CanBus protocols.
Specific objectives	• Knowledge and use of simulation software for integrated DAQ systems (PSIM, MATLAB, Labview)
	• Design and implementation of dedicated structures for DAQ using dedicated microcontrollers for electric and hybrid vehicles

Course content

- Basic principles of data acquisitions
- Architecture of integrated DAQ systems
- Industrial protocols of data acquisition
- Signal conversion in integrated DAQ
- Virtual instrumentation for integrated DAQ systems
- Data processing
- Data storage, data sharing

Bibliography

- Instrumentatie Virtuala si distribita –S. Grigorescu, O. Ghita, P. Neascu Ed. Electra 2006
- Pantelimon B., GHIŢĂ O.M., Iliescu C. „Les principes theoriques des mesures electriques et des transducteurs” Editura MatrixRom Bucureşti 2011 310 pag. ISBN 978-973-755-682-0
- GHIŢĂ, O. M. Comunicaţii în sisteme distribuite, Ed. Matrix Rom, Bucureşti, 2006, 180 pg. ISBN (10) 973-755-063-3

Applications content (seminar/**laboratory**/project)

- AD signal conversion
- DAQ protocols
- Integrated comunication drivers
- Data storage, data sharing

• Examination
Bibliography
• GHIŢĂ, O.M, Pantelimon, B „Mesures electriques et tranducteurs” Indrumar laborator, Editura Matrixrom, Bucureşti 2014,

Type of activity evaluated	**Evaluation criterias**	**Evaluation methods**	**Weight in final grade**
Course	Written examination	Based assessment questions	20 %
Laboratory	Written examination	Based assessment questions	80%
Minimal standard of performance			
• Achieve a minimum score of 50p/100p			

01.03.O.06-17	**Research/Practice 3 (ISEIA) – 10 ECTS**

Program of study					Integrated Electrical Systems Engineering in Vehicles - ISEIA
Research/Practice activities holder					Dissertation supervisor
Year of study	II	**Semester**	1	**Evaluation type**	Colloquy
Subject type	Subject training type				Thoroughgoing
	Compulsory or optional type of subject				Compulsory

Number of ECTS credits	10

Previous subjects required	Research/Practice 1, Research/Practice 2
Previously acquired competences	Getting of minimal points at the subjects Research/Practice 1, Research/Practice 2

Subject general objective	• Training the student as a researcher in the field of dissertation theme. The student will learn to apply the knowledge gained in the previous semesters to solve the dissertation topic, by completing all the necessary steps: problem modeling, system design, project implementation, verification, validation and testing. The student will interact in all phases of the research with the rest of the team, under the coordination of the dissertation coordinator.
Specific objectives	• Elaboration of studies, reports and synthesis of documentation, respectively technical-economic
	• Solving specific design research problems in the field of integrated electrical systems engineering in vehicles
	• Achievement of experimental research with the use of modern equipment
	• Development of innovative solutions and critical performance analysis
	• Elaboration of the practical works being part of a team in the frame of complex projects

Research/Practice activities content
• Documentation in the field of dissertation
• Sorting, completing and synthesizing information
• Performing models, simulations, experiments related to the given theme
• Writing a research report
• Making a public presentation of the work.
Bibliography
Recommended by the dissertation supervisor, completed with the one searched, found and sought by the master student.

Evaluation methods
The evaluation is done by supporting the research report in front of a commission. The grade awarded will also take into account the supervisore's assessment of the research activity during the semester.
Minimal standard of performance
• Achieve a minimum score of 50p/100p.

01.04.O.06-18	**Ethics and academic integrity (ISEIA) – 2 ECTS**

Program of study				Integrated Electrical Systems Engineering in Vehicles - ISEIA	
Department				Measurements, Electrical Apparatus and Static Converters	
Course holder				Prof. PhD. Eng. Mihaela Marilena ALBU	
Seminar/laboratory/project holder				-	
Year of study	II	**Semester**	2	**Evaluation type**	Colloquy
Subject type	Subject training type				Complementary
	Compulsory or optional type of subject				Compulsory

Number of hours per week	1	Course	1	Seminar	0	Laboratory	0	Project	0
Number of hours per semester	14	Course	14	Seminar	0	Laboratory	0	Project	0
Number of ECTS credits	2								

Previous subjects required	• -
Previously acquired competences	• -

Subject general objective	• Recognizing the academic misbehavior and ethical issues in electrical engineering. Ethical aspects in artificial intelligence and automated systems. Putting into context modern ethics, including in human resources management. Conflict of interest and gender bias.
Specific objectives	• Ethics and academic conduct for master students. Issues, solutions, recommendations for writing the master thesis. Citing rules.
	• Ethics and integrity in scientific research. Examples of ethical codes: IEEE, ACM, ERC.
	• Copyright. Gold access, Open Access, github, creative commons. Data protection.
	• Rights and right. Legislation in Romania and Europe.
	• Ethic in a digital society.

Course content
Introduction.. Definitions. Ethics in modern society. Applied ethics. Ethical implications of technology. Example: artificial intelligence and automated systems.
Academic integrity. Ethical codes and codes of conduct in universities. Professional codes (IEEE). Research and academic codes of conduct (ERC).
Professional ethics and integrity in scientific research. Researcher' responsibilities. The four principles of ethical conduct of research. Mis-conduct in research planning. Standards and good practice in research. Principles, rules and hints for responsible dissemination and communication of scientific results.
Researcher' responsibilities to the profession and colleagues. Signalizing ethical misbehavior; Mentorship. Peer-review. European Code of Conduct for Research Integrity.
National (Romanian) legislation. Legea educației naționale nr. 1/2011, (LEN); Legea 206/2004 for research and innovation integrity.
Citation rules. Common knowledge. Plagiarism. Reuse of copyrighted material. Good practice for academic integrity. Copyright - OPEN ACCESS; Creative Commons Licenses.
Ethics and human resources. Gender bias. Principles. HRS4R Code. The European Charter for Researchers. Open, Transparent, Merit-based Recruitment (OTM-R).
Bibliography
• Course material and further reading as posted on moodle (The European Code of Conduct for Research Integrity, Singapore Statement, Montreal Statement, Frascati Manual – Guidelines for Collecting and Reporting Data on Research and Experimental Development; webcast-uri, TEDxTalks etc.).
• Peter Singer, *Tratat de Etica*, Polirom, 2006
• Emanuel Socaciu, Constantin Vică, Emilian Mihailov, Toni Gibea, Valentin Mureșan, Mihaela Constantinescu, *Etică și Integritate Academică*, Ed. Universitatii din Bucuresti, 2018, disponibil si la https://deontologieacademica.unibuc.ro/wp-content/uploads/2018/11/Etica-si-integritate-academica.pdf
• John Brockman (ed.), *Minti posibile. Douazeci si cinci de perspective supra inteligentei artificiale*, Ed. Vellant, 2019

Applications content (seminar/laboratory/project)
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Bibliography
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Type of activity evaluated	**Evaluation criterias**	**Evaluation methods**	**Weight in final grade**
Course	Understanding of the ethics and professional conduct in research and the capacity of recognizing issues related to various ethical and academic integrity cases.	Testing during lecture (Quiz) Written examination during the last course session. Examination will include a set of questions n legislation, codes of conduct, applicability and essays on various topics presented during the course.	20 %
	Homework. Minimum 2 different homework, on individually- selected subjects.	Homework will be in the form of essays and/or infographics presenting a subject (individually allocated) from course material.	80 %
Minimal standard of performance			
• Achieve a minimum score of 50p/100p.			

01.04.O.06-19	**Research/Practice for the Dissertation (ISEIA) – 28 ECTS**

Program of study				Integrated Electrical Systems Engineering in Vehicles - ISEIA
Research/Practice activities holder				Dissertation supervisor
Year of study	II	**Semester**	2	**Evaluation type**	Colloquy
Subject type	Subject training type				Thoroughgoing
	Compulsory or optional type of subject				Compulsory

Number of ECTS credits	28

Previous subjects required	Research/practice 1, Research/practice 2, Research/practice 3
Previously acquired competences	Getting of minimal points at the subjects Research/Practice 1, Research/Practice 2, Research/Practice 3

Subject general objective	• Elaboration of a documented dissertation paper with theoretical knowledge, bibliographic research, numerical calculations, experiments, simulations.
Specific objectives	• The independent realization of a coherent scientific work, to which the personal character of the graduate should be imprinted.
	• Cunoaşterea exigenţelor care trebuie îndeplinite de o asemenea lucrare şi a modului în care ea trebuie susţinută în faţa unei comisii. Knowledge of the requirements to be fulfilled by such a work and how it should be supported before a comission.

Research/Practice activities content
• Realization of the documentation on the dissertation theme
• Performing experiments related to the dissertation theme
• Writing of the disseration paper
• Making a public presentation of the dissertation paper
Bibliography
Recommended by the dissertation supervisor, completed with the one searched, found and sought by the master student.

Evaluation methods
• The evaluation is done by supporting the dissertation paper in front of a commission

• In order to support the public, the graduate must register within the allowed period; to have the topic of the dissertation approved by the competent persons and the report of the scientific supervisor with the grade given after the evaluation of the dissertation. • The grade is awarded by the members of the commission depending on: the quality of the dissertation; the quality of the support of dissertation by the graduate; the answers of the graduate to the questions of the commission, which reflect the level of knowledge of the graduate.
Minimal standard of performance
The minimum promotion average for the dissertation is 7, according to the Regulation on the organization and functioning of the educational process within the Master Degree Studies from the POLITEHNICA University of Bucharest, art. 44, paragraph 3.