

SYLLABUS

1. Data about the program of study

1.1 Institution	Technical University of Cluj-Napoca
1.2 Faculty	Electrical Engineering
1.3 Department	Power Systems and Management
1.4 Field of study	Energy Engineering
1.5 Cycle of study	Master of Science
1.6 Study Programme/Qualification	Modern Power Systems
1.7 Form of education	Full-time
1.8 Subject code	1.00

2. Discipline data

2.1 Subject name	Electromagnetic compatibility				
2.2 Course responsible/ lecturer	Prof.dr.eng. Calin Munteanu – Calin.Munteanu@ethm.utcluj.ro				
2.3 Teachers in charge of laboratory	As.dr.eng. Sergiu Andreica – Sergiu.Andreica@thm.utcluj.ro				
2.4 Year of study	I	2.5 Semester	1	2.6 Type of assessment	E
2.7 Subject category	<i>DF – fundamental, DD – in the field, DS – specialty, DC – complementary</i>				DS
	<i>DI – compulsory, DO – elective, Dfac – optional</i>				DI

3. Estimated total time

3.1 Number of hours per week	3	of which:	3.2 Course	1	3.3 Seminar		3.3 Laboratory	2	3.3 Project	
3.4 Number of hours per semester	100	of which:	3.5 Course	28	3.6 Seminar		3.6 Laboratory	14	3.6 Project	
3.7 Individual study:										
(a) Manual, lecture material and notes, bibliography										20
(b) Supplementary study in the library, online and in the field										20
(c) Preparation for seminars/laboratory works, homework, reports, portfolios, essays										10
(d) Tutoring										
(e) Exams and tests										3
(f) Other activities										5
3.8 Total hours of individual study [sum (3.7(a) to 3.7(f))]					58					
3.9 Total hours per semester [sum of 3.4 and 3.8]					100					
3.10 Number of credit points					4					

4. Prerequisites (where applicable)

4.1 Curriculum	Electromagnetic field theory; Theory of electrical circuits
4.2 Competences	

5. Requirements (where appropriate)

5.1 For the course	
5.2 For the applications	Presence at the laboratory is mandatory and is recorded by the titular laboratory teacher.

6. Specific competences

Professional competences	<i>Theoretical knowledge, (What they need to know)</i> Knowledge of the fundamental aspects of standards and regulations in the field of electromagnetic compatibility. Knowledge of the main mechanisms of occurrence and methods of analysis and prediction of electromagnetic interference. Knowledge of the main methods of suppression of electromagnetic disturbances. <i>Acquired skills: (What he knows how to do)</i> Use of standards and regulations in force in the field of electromagnetic compatibility. Preparation of the necessary documentation for testing to obtain the CE marking. Performing EMC measurements and tests in a specialized laboratory. <i>Skills acquired: (What tools he knows how to handle)</i> Use of laboratory instruments that comply with the international EMC standards in force. Use of instruments specific to radiation emission and conduction tests. Use of tools specific to conducted immunity tests.
Cross competences	Responsible execution of professional tasks, in compliance with the values of morality and ethics, in conditions of professional autonomy and independence, with practical applicability and with the assumption of responsibility for the activities undertaken in the spirit of integrating any engineering process with the physical, economic, social, legislative and administrative environment, in the conditions of sustainable production and sustainable development. <i>Ability to work in inter- and multi-disciplinary teams, to communicate effectively and to understand professional and ethical responsibilities</i> Carrying out the activities and carrying out the specific roles of teamwork, showing entrepreneurial spirit, initiative and creativity, but being aware of the limitations imposed, with the recognition of diversity and multiculturalism. <i>Awareness of the need for continuous training; effective use of learning resources and techniques, for personal and professional development</i> Efficient use of information sources and communication resources and assisted professional training (Internet portals, specialized software applications, databases, online courses, etc.) both in Romanian and in an international language. Aware of the need for continuous training.

7. Expected learning outcomes

On completion of the discipline, the student will be able to demonstrate:

Knowledge	Has in-depth knowledge of the architectures, functions and current trends of modern power systems and smart grids. Critically understands the integration of distributed resources, operational flexibility and the impact of digital technologies on the energy system. Correlates advanced domain knowledge with sustainability, resilience and energy efficiency objectives.
Skills	Analyses operating regimes and formulates technically substantiated solutions for the configuration and operation of power systems. Integrates technical, operational and economic data for evaluating system development alternatives. Applies interdisciplinary approaches for optimising operation and modernising energy infrastructure.
Responsibility and autonomy	Manages complex and unpredictable work or study situations requiring strategic decisions. Autonomously grounds professional solutions and assumes their technical and organisational implications. Contributes responsibly to the development of professional practices and to the coordination of activities within technical teams.

8. Discipline objectives (based on specific competencies acquired)

8.1 General objective	Presentation of standards in the field of electromagnetic compatibility and testing of electromagnetic disturbances
8.2 Specific objective	• know the fundamental aspects of standards and regulations in the field of electromagnetic compatibility; • to know the main mechanisms of occurrence and methods of analysis and prediction of electromagnetic interference; • know the main methods of suppressing electromagnetic disturbances; • to use the standards and regulations in force in the field of electromagnetic compatibility; • to develop the necessary documentation for testing to obtain the CE marking; • perform EMC measurements and tests in a specialized laboratory; • to use laboratory instruments that comply with the international standards in force; • use instruments specific to radiation emission and conduction tests; • use tools specific to conducted immunity tests.

9. Contents

9.1 Course (Lectures)	No. of hours	Teaching methods	Additional remarks
Introduction to Electromagnetic Compatibility (EMC). General framework	2	The course will be taught both in classic form (exhibition on the graphic tablet) and using multimedia means, respectively the presentation of the courses in electronic ppt format <i>on-site</i> or <i>online</i> using the <i>Microsoft Teams platform</i>	On-site or online delivery according to the legislation in force
EMC Fundamentals	2		
Specific Sizes and Units in EMC	2		
Regulation and standardization in CEM. Types of standards. Standardization bodies. Development of a European standard.	2		
Classification and numbering of standards. Principles, objectives and advantages of standardisation	2		
Conduction emissions. Standards and regulations.	2		
Conduction emissions. Test procedures and methods	2		
Radiation emissions. Standards and regulations.	2		
Radiation emissions. Test procedures and methods	2		
Study of electric and magnetic field distribution in high and very high voltage substations	4		
Driven immunity. Rapid transient regimes and atmospheric surges. Standards and regulations.	2		
Driven immunity. Test procedures and methods	2		
Testing the immunity of equipment to the occurrence of radiofrequency electromagnetic fields, radiated	2		
Bibliography [1]. Hortopan Gh., Principles and Techniques of Electromagnetic Compatibility, Bucharest, 2005. [2]. Munteanu C., Topa V., Grindei L., Advanced Numerical Computation Methods in EMC, Ed. Casa Cărții de Știință, Cluj-Napoca, 2001. [3]. Ignea A., Introduction to Electromagnetic Compatibility, Timioșoara, 1998. [4]. Schwab A., Electromagnetic Compatibility. Bucharest, 1996. [5]. Radu S., Electromagnetic Compatibility, vol. 1-2-3, Iași, 1995. [6]. Giurgiuman Nicoleta - Adina – Electromagnetic compatibility, standardization and testing - Course Notes, http://users.utcluj.ro/~adina/ [7]. Răcășan Adina, Munteanu C., Techniques for improving the performance of EMI filters, UTPRESS, ISBN 978-606-737-006-5, 2014. [8]. IEC 61000-x-x collection of standards. [9]. Clayton P., Introduction to Electromagnetic Compatibility, Wiley, 2006. [10]. Christopoulos C., Principles and Techniques of Electromagnetic Compatibility, CRC Press, 2007. [11]. Montrose M. I., Nakauchi E. M., Testing for EMC Compliance. Approaches and Techniques, Wiley, 2004. [12]. Williams T., EMC for Product Designers, Newness, Oxford, 1999, ISBN 0-7506-2466-3. [13]. Tsaliovich A., Electromagnetic Shielding Handbook for Wired and Wireless EMC Applications, Kluwer Academic Publishers, 1999.			
9.2 Applications - Laboratory	No. of hours	Teaching methods	Observations
Labor protection. Rules and instructions	2	Didactic demonstration and experiment, didactic exercise, teamwork	Laboratory equipment, experimental set-ups, computer, magnetic board are used.
Testing of electromagnetic disturbances produced by conduction in the power supply network	2		
Electromagnetic Disturbance Testing Produced by Radiation	2		
Electrostatic Discharge (ESD) Immunity Testing	2		
Testing the immunity of equipment to the occurrence of transient signals (EFT/ BURST) and shock waves (SURGE)	2		

Testing the immunity of equipment to the occurrence of voltage drops, short-term interruptions and voltage variations, flicker, harmonic currents	2		
Laboratory colloquium	2		
Bibliography [1]. Giurgiuman Nicoleta - Adina – Electromagnetic compatibility, standardization and testing – Laboratory work, http://users.utcluj.ro/~adina/ [2]. Răcășan Adina, Munteanu C., Techniques for improving the performance of EMI filters, UTPRESS, ISBN 978-606-737-006-5, 2014. [3]. Schwab A., Electromagnetic Compatibility. Bucharest, 1996. [4]. Hortopan Gh., Principles and Techniques of Electromagnetic Compatibility, Bucharest, 2005. [5]. Standard SR EN 55011, SR EN 55014-1, SR EN 55022, SR EN 55025, SR EN 55015. [6]. IEC 61000-x-x collection of standards.			

10. Alignment of course content with expectations of the epistemic community, professional associations,

The content of the discipline, the knowledge, skills, abilities and competences acquired correspond to the expectations of the professional organizations and companies in the field where the students carry out internships and/or take up a job, as well as the national quality assurance bodies (ARACIS).
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11. Assessment

Activity Type	10.1 Assessment criteria	11.2 Assessment	11.3 Weight grade (%)
11.4 Course	Verification of theoretical knowledge Grid Test (C)	On-site or online according to the legislation in force	80 %
11.5 Laboratory	Practical knowledge check Test de laborator (L)	On-site or online according to the legislation in force	20 %
11.6 10.6 Minimum standard of performance: $5 N = (0.8 C + 0.2 L) \geq 5$			

Date of completion:	Lecturers	Title/ Surname/ Name:	Signature
September 2024	Course	Prof.dr.eng. Calin MUNTEANU	
	Applications (Laboratory)	As.dr.eng. Sergiu ANDREICA	

**Date of approval in the council of the Department of Power
Engineering and Management**

September 2024

Head of Department:

Assoc. Prof. Eng. Horia G. BELEIU, PhD

Date of approval in the Faculty of Electrical Engineering Council

September 2024

Dean:

Assoc. Prof. Eng. Andrei C. CZIKER, PhD