SYLLABUS

1. Data about the program of study

1.1	Institution	Technical University of Cluj-Napoca
1.2	Faculty	Faculty of Electrical Engineering
1.3	Department	Power Engineering and Management
1.4	Field of study	Energy Engineering
1.5	Cycle of study	Master of Science
1.6	Program of study/ Qualification	Modern Power Systems - Cluj-Napoca in English language
1.7	Form of education	Full time

2. Data about the subject

2.1	Subject name			Energy Efficiency Technologies	Course code	9.10
2.2	Course responsible/ lecturer			Lecturer Eng. Stefan Ungureanu, PhD		
2.3	Teachers in charge of Seminars/ Laboratory/ Project			Lecturer Eng. Stefan Ungureanu, PhD		
2.4 Year of study	2	2.5 Semester	1	2.6 Type of assessment *(E – exam, C – colloquium, V – verification)*		E
2.7 Subject category	*DF – fundamental, DD – in the field, DS – specialty, DC – complementary*					DS
	DI – compulsory, DO – elective, Dfac – optional					DI

3. Estimated total time

3.1 Number of hours per week:	3	of which	3.2 Course	2	3.3 Seminar	0	3.3 Laboratory	1	3.3 Project	
3.2 Total hours per semester	42	of which	3.5 Course	28	3.6 Seminar	0	3.6 Laboratory	14	3.6 Project	

3.7 Individual study:	
(a) Manual, lecture material and notes, bibliography	7
(b) Supplementary study in the library, online and in the field	5
(c) Preparation for seminars/laboratory works, homework, reports, portfolios, essays	5
(d) Tutoring	10
(e) Exams and tests	6
(f) Other activities	0

3.8 Total hours of individual study *[sum (3.7(a) to 3.7(f))]*	33
3.9 Total hours per semester *[sum of 3.4 and 3.8]*	75
3.10 Number of credit points	3

4. Prerequisites (where applicable)

4.1	Curriculum	Production, transmission and distribution of electrical energy, Use of Electricity, SCADA Systems, and knowledge of programming and computer science
4.2	Competences	Basic electrical engineering knowledge

5. Requirements (where appropriate)

5.1	For the course	Basic electrical engineering knowledge
5.2	For the applications	Basic knowledge of operating PC

6. Specific competences

Professional competences	Theoretical competences: • Knowledge of basic aspects concerning energy management. • Knowledge of basic aspects concerning data acquisition and metering systems. • Knowledge of basic concepts related to power quality. • Knowledge of energy efficiency concepts. • Knowledge of SCADA (supervised control and data acquisition) applied for industrial processes, DMS/EMS and renewable energy. • Knowledge of types of consumers • Knowledge of heating/cooling systems used in industry • Knowledge of industrial processes used in manufactoring, commercial centers and buildings • Knowledge of energy efficiency applied for electric motors • Knowledge of the implications of harmonic distortion operation for consumer and power grid • Knowledge of energy efficiency standards • Develop a practical application by implementing a programble relay and VFD drive in a automated electric cabinet to compare the operation of a three phase motor. • Develop a practical application by installing a power analyser in a automated electric cabinet.
Cross competences	The students can choose and use correctly the bibliographical data, regulatory normative, standards and specific methods, as well as to apply the knowledge in order to solve different problems in the field of electrical energy management using artificial intelligence techniques. The students will develop competences that help them in team working, to communicate orally and written easier, using professional and ethical values.

7. Expected learning outcomes

Knowledge	In general, this course is expected to prepare students to answer some key industry questions regarding energy use, including identifying losses, what can be improved and at what cost. Expectations may vary depending on the sector (buildings, industry, utilities, policy), but the main ones are quite consistent. This course is expected to provide reliable, quantified and practical recommendations that reduce energy consumption, costs and environmental impact, while remaining technically and economically feasible. At the end of the study program, students will be able to apply the knowledge in: Electrical and thermal systems serving commercial/public buildings, Industrial installations, Energy systems, EU-funded projects, Academic or regulatory studies in energy.
Skills	Upon completion of the energy efficiency course, students are generally expected to have a combination of technical, analytical, regulatory, and practical skills. These skills prepare students to evaluate, design, and implement solutions that reduce energy consumption while maintaining performance and comfort.
Responsibility and autonomy	Students should acquire the need for accountability in the field, which means being responsible for how energy-related decisions, analyses and actions affect costs, performance, safety and the environment. Accountability in energy efficiency is the duty to ensure that energy saving measures are accurate, safe, ethical, compliant and truly beneficial. Students should acquire the ability to independently apply knowledge, tools and judgment to analyse and improve energy performance. The aim is to encourage the student to learn independently in energy efficiency tasks, using the acquired knowledge and tools, without constant guidance.

8. Discipline objectives (based on specific competencies acquired)

7.1	General objective	Develop a strong understanding of energy efficiency dedicated to solving energy systems issues.
7.2	Specific objectives	• Building simple applications to improve energy efficiency, • Assestment of power quality parameters in energy efficiency

9. Contents

8.1. Course (Lectures)		Number of hours	Teaching methods	Additional remarks
1	Electricity management. Introduction to SCADA.	2	The teaching will use the multimedia means provided in the faculty's classrooms, and through an interactive teaching style, the aim will be to attract students to the teaching process in order to correctly understand the concepts taught. In the case of online teaching, the facilities offered by the Teams platform will be used.	
2	Importance of energy efficiency and international standards	2		
3	Electricity metering systems and power quality	2		
4	Types of electricity consumers (industry, comercial, public, residential)	2		
5	Heating and Cooling systems (HVAC, centralised systems, electric heating)	2		
6	Electric drive systems (compressed air, exhaust systems, production lines)	2		
7	Lighting systems	2		
8	Energy audit and energy management	2		
9	Energy efficiency measures	2		
10	Real energy balance sheet	2		
11	Optimized energy balance sheet	2		
12	Energy efficiency for energy distribution systems	2		
13	Energy efficiency for energy transport systems	2		
14	Recapitulation	2		

Bibliography

[1.] Cziker, A. Politici şi strategii de creştere a eficienţei energetice. Note de curs
[2] Leca,A. (coordonator) ş.a. Managementul energiei. Principii, concepte, politici, instrumente. Editura AGIR, Bucureşti, 2006.
[3]. Ungureanu Mihaela, Chindriş,M. şi Lungu,I. Utilizări ale energiei electrice. EDP, Bucureşti, 2001.
[4]. Ungureanu Mihaela şi Pătraşcu Roxana. Tehnologii curate. Editura AGIR, Bucureşti, 2000.
[5]. Leca, A (coordonator) ş.a. Trăim pe o singură planetă. Dezvoltarea durabilă văzută dintr-o perspectivă energetică. Editura Academiei Romane, Bucureşti, 2003.

8.2. Applications - Seminar /Laboratory/Project		Number of hours	Teaching methods	Additional remarks
1	Laboratory 1. Work safety - Presentation of laboratories. Labview general presentation and specific tools dedicated to data aquisition	2	Theoretical aspects and applications	
2	Laboratory 2. Labview – demonstration of voltage drop and power losses across a power line and the start-up of a single phase motor.	2		

3	Laboratory 3. Labview – demonstration of power losses of direct start-up of a three phase motor and using a VFD drive.	2		
4	Laboratory 4. PLC application – installation of smart meters and real-time data collection	2		
5	Laboratory 5. Energy balance calculation for an industrial consumer	2		
6	Laboratory 4. Assestment of energy efficiency measures for an industrial consumer	2		

Bibliography

[1]. Green, J. N, Wilson, R. Control and Automation of Electric Power Distribution Systems, Taylor and Francis, 2007.
[2]. Bailey, D., Wright, E. Practical SCADA for Industry, Elsevier, 2003
[3]. Mesaric, P. Supervisory control and data acquisition for energy management systems, Contemporary Issues in Economy & Technology - CIET, 2014
[4]. Iliev, Iliya & Kaloyanov, Nikola & Gramatikov, Plamen & Terziev, Angel & Palov, Ivan & Stefanov, Stefan & Sirakov, Kiril & Kamburova, Veselka. (2012). Energy Efficiency and Energy Management Handbook.
[5]. Energy Management and Energy Efficiency in Industry: Practical Examples (Green Energy and Technology), Durmuş Kaya, Fatma Çanka Kılıç, Hasan Hüseyin Öztürk, Springer, 2023

10. Alignment of course content with expectations of the epistemic community, professional associations, and representative employers in the field

The obtained competences will help the future employs to work proficient in industrial applications and in the field of power and energy systems.

11. Assessment

Activity type	10.1 Assessment criteria	10.2 Assessment methods	10.3 Weight in the final grade (%)
10.4 Course	Solving of 14 questions from the lecturers' information	Written examination, 2 hours	100%
10.5 Laboratory			
10.5 Project			
10.6 Minimum standard of performance: Correct answer for at least 8 questions of the written examination, and basic knowledge demonstration			

Date of completion	Lecturers	Title/ Surname/ Name:	Signature
September 2024	Course	Lecturer Eng. Stefan Ungureanu, PhD	
	Laboratory	Lecturer Eng. Stefan Ungureanu, PhD	

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