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				EMS and SCADA Measurement Systems	Course code	10.20
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		1	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*				DA	
		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	15
(b) Supplementary study in the library, online and in the field	10
(c) Preparation for seminars/laboratory works, homework, reports, portfolios, essays	15
(d) Tutoring	12
(e) Exams and tests	6
(f) Other activities	0

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	Production, transmission and distribution of electrical energy, Use of Electricity, 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 types of control systems. • Mastering the operating mechanisms of energy measuring systems. • Knowledge of devices used for metering. • Knowledge of SCADA (supervised control and data acquisition) applied for industrial processes, DMS/EMS and renewable energy. • Knowledge of SCADA devices • Knowledge of SCADA functions • Knowledge of SCADA – communications • Knowledge of SCADA protocols • Develop a practical application by implementing a programble relay and a PLC in a automated electric cabinet. • Develop a practical application by implementing a power analyser in a automated electric cabinet. • Build a SCADA HMI (GUI) in Labview to underline the functions of SCADA systems.
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 measuring systems integrated in SCADA, including aspects of the technical operation of power grids and the power market. Expectations may vary depending on the sector (buildings, industry, utilities, policy), but SCADA functions and implementation steps are considered important by the industry. This course is expected to provide reliable, quantified and practical recommendations that help the students implement SCADA systems, evaluate 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, and Academic or regulatory studies in energy.
Skills	Upon completion of the SCADA 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 SCADA implementation 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	Development of SCADA systems dedicated to solving energy systems issues.
7.2	Specific objectives	• Building SCADA applications, • Development HMI applications

9. Contents

9.1. 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	Types of control	2		
3	Electricity metering systems	2		
4	Applicability of SCADA systems.	2		
5	Communication networks.	2		
6	SCADA system architecture.	2		
7	Functions of SCADA systems.	2		
8	Terminal equipment for data acquisition.	2		
9	Communication protocols. IEC 61850 standard.	2		
10	Principles of organization and operation of SCADA systems.	2		
11	Programming of SCADA applications.	2		
12	Aspects regarding the implementation of SCADA systems in electric grod - Distribution Management Systems (DMS)	2		
13	Aspects regarding the implementation of SCADA systems in electric grod - Energy Management Systems (EMS)	2		
14	SCADA applications for the management of renewable energy sources.	2		

Bibliography

[1]. Green, J. N, Wilson, R. Control and Automation of Electric Power Distribution Systems, Taylor and Francis, 2007.
[2]. Lupşa, R-L. Reţele de calculatoare, Casa Cărţii de Ştiinţă, 2008
[3]. Bailey, D., Wright, E. Practical SCADA for Industry, Elsevier, 2003
[4]. Mesaric, P. Supervisory control and data acquisition for energy management systems, Contemporary Issues in Economy & Technology - CIET, 2014
[5]. IEC 61850 Communication Protocol Manual (650 series), ABB, 2011

9.2. Applications - Laboratory		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 – virtual instrument for simulation of a HMI SCADA for the grid connection of an industrial consumer	2		
3	Laboratory 3. Labview – virtual instrument for simulation of a HMI SCADA – electric power calculations	2		
4	Laboratory 4. PLC application – using a PLC to start a 3 phase motor – making all connections, installation on DIN Rail and PLC programming	2		
5	Laboratory 5. PLC application – using a PLC to automate the cooling of an electric cabinet based on a thermocouple reading – making all connections, installation on DIN Rail and PLC programming	2		
6	Laboratory 4. PLC application – using a PLC to read a power analyser and build a database – making all connections, installation on DIN Rail and PLC programming	2		

Bibliography

[1]. Green, J. N, Wilson, R. Control and Automation of Electric Power Distribution Systems, Taylor and Francis, 2007.
[2]. Lupşa, R-L. Reţele de calculatoare, Casa Cărţii de Ştiinţă, 2008
[3]. Bailey, D., Wright, E. Practical SCADA for Industry, Elsevier, 2003
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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 automation industrial applications and in the field of power and energy systems efficiency.

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:			

Understanding of basic concepts and terminology; Problem solving Correct answer for at least 6 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 June 2026	**Head of Department:** Assoc. Prof. Eng. Horia G. BELEIU, PhD
Date of approval in the Faculty of Electrical Engineering Council June 2026	**Dean:** Assoc. Prof. Eng. Andrei C. CZIKER, PhD