SYLLABUS

1. Program Information

1.1 Higher education institution	Technical University of Cluj-Napoca
1.2 Faculty	Faculty of Automation and Computer Science
1.3 Department	Department of Automation
1.4 Field of study	Automation, Applied Informatics and Intelligent Systems
1.5 Cycle of studies	Bachelor
1.6 Study Programme/Qualification	Intelligent Automation Systems (dual, in English language)
1.7 Form of education	IF – full-time education
1.8 Course code	10.00

2. Course information

2.1 Course title	**Electrical Systems**					
2.2 Course lecturer	*Prof. Dan Doru Micu – Dan.Micu@ethm.utcluj.ro*					
2.3 Seminar / Laboratory / Project Lecturer	*Prof. Dan Doru Micu – Dan.Micu@ethm.utcluj.ro* *Ing. Adrian Mudure (Emerson)* *Ing. Navnith Ravindran (Emerson)*					
2.4 Year of study	1	2.5 Semester	2	2.6 Type of assessment		E
2.7 Course status	Formative category *(DF, DS, DC)*					DF
	Optionality *(DOB, DOP, DFac)*					DOB

3.Total estimated time

3.1 Number of hours per week	5	of which:	HEI	Lecture	3	Seminar	0	Laboratory	1	Project	0
			CO		0		0		0		1
3.2 Number of hours per semester	70	of which:	HEI	Lecture	42	Seminar	0	Laboratory	14	Project	0
			CO		0		0		0		14

3.3 Distribution of time allocation (hours per semester) for:	HEI	CO
(a) Study based on textbook, course support, bibliography, and notes	10	20
(b) Additional documentation in library, specialized electronic platforms, and fieldwork	-	5
(c) Preparation of seminars/laboratories, assignments, papers, portfolios and essays	8	5
(d) Tutoring	-	5
(e) Examinations	1	1
(f) Other activities:	-	-
3.4 Total individual study hours (sum (3.3(a)... 3.3(f)))	19	36
3.5 Total hours per semester (3.3+3.4)	75	50
3.6 Number of credits per semester	3	2

(HEI = Higher Education Institution, CO = Company)

4. Prerequisites (where applicable)

4.1 Curriculum Prerequisites	Physics, Linear Algebra, Mathematical Analysis, Fundamentals of Electronic circuits
4.2 Competency Prerequisites	Recognizing and understanding basic concepts specific to basics of electrotechnics; Developing skills and abilities for the analysis and synthesis of electromagnetic fields, electrical circuits, electrical energy

5. Conditions (where applicable)

5.1. Course Organization Conditions	Onsite at HEI

5.2. Seminar / Laboratory / Project organization conditions	-/Onsite at HEI / Onsite at CO/

6. Specific Competencies Acquired

Professional Competencies	• PC02 Analyse test data • PC08 Design automation components • PC10 Develop electronic test procedures • PC20 Record test data • PC25 Use technical drawing software
Transversal Competencie	• TC01 Apply knowledge of science, technology and engineering • TC02 Think analitically

7. Learning outcomes

Knowledge	The student/graduate describes, identifies, and summarizes concepts and methods related to systems in general, as well as to measurement techniques, graphics, mechanical, chemical, electrical, and electronic engineering, and their application to concrete problems, using specific mathematical and physical tools
Skills	The student/graduate explains the assigned topics, justifies solutions in systems engineering based on mathematical principles and physical laws, and utilizes fundamental components in the field along with techniques for measuring electrical and non-electrical quantities. The student/graduate applies appropriate techniques, physical principles, and mathematical methods to solve typical problems in systems engineering, with a focus on numerical computation methods. The student/graduate selects and applies specific scientific methods and techniques in the development and implementation of systems engineering projects, and analyzes the level of scientific documentation as well as the potential advantages and disadvantages of the proposed methods and procedures
Responsibility and autonomy	The student/graduate carries out processes related to project management in systems engineering, assuming various team roles and clearly and concisely communicating results both verbally and in writing

8. Course Objectives

8.1 General objective of the course	Provide fundamental knowledge of electric, magnetic fields, electromagnetic waves and electrical circuits, in a structured manner, to understand the working principles of electric and electronic devices and the functionality of an electrical system.
8.2 Specific objectives	• Recognizing and understanding concepts specific to electromagnetic field theory and electrical circuits and systems; • Developing skills and abilities necessary to solve electromagnetic field problems and design electrical circuits and systems;

	• Developing skills and abilities to use in practical applications the fundamental theorems of electromagnetic fields and electrical circuits and systems

9. Contents

9.1 Lectures	No. of hours	Teaching methods	Obs.
L1. Mathematics and Physics Review for Electrotechnics Vector Analysis and Coordinate Systems in engineering. Electric and magnetic quantities. Static electric and magnetic fields (the electric and magnetic field in free space and in material, electric current density, energy conservation)	3	Slides presentation, explanations and demonstrations on blackboard, discussions	Use of projector, smart board, blackboard
L2-3. Laws and theorems of electromagnetic field. Time-Varying Fields. The ideal transformer; The Electromagnetic generator, Displacement current; Maxwell Equations; Electromagnetic Potentials, Practical Applications Electrical capacitance, energy and forces. Magnetic circuits. Self-inductance and mutual inductance. Magnetic energy and forces. Practical Applications	6		
L4. Plane Waves Propagation. Plane Wave propagation in Good Conductors (perfect conductors); Poynting's theorem and Electromagnetic Wave Power; Plane wave reflection and dispersion; Basics of Antennas; Practical Applications.	3		
L5. AC electric circuits. Basic concepts, units and laws of circuit theory (characteristic values, sinusoidal functions by vectors and complex numbers, power in sinusoidal regime, energy transfer). The characterization of the linear circuits in complex plane, the complex form of some theorems. Practical Applications.	3		
L6. Equivalent impedances (connection, mutual inductance, real capacitance, real inductance, air core transformer). **Resonance** (in series, parallel, real, inductively coupled circuits, power factor improvement). Practical Applications	3		
L7. Network theorems (topology, diagrams, superposition theorem, Thevenin-Norton theorem, mesh or loop analysis, node analysis, matrix methods, active-reactive-apparent power, power flow). Practical Applications.	3		
L8-9. Poly Phase Circuits. Examples of two, three, four-loop circuits and their solutions, unbalanced poly phase circuits, determination of phase sequence, star/delta connections, and power measurement in poly phase circuits.	6		
L10. Transient regime of linear circuits. Continuity conditions, transient behavior of the RL, RC and RLC, the Laplace transform, Duhamel integral, state variable method)	3		
L11-12. Non – sinusoidal ideal wave forms. Common non-sinusoidal waveforms, Fourier series, analytical evaluation of Fourier coefficients, exponential form of Fourier series, frequency spectra of periodic waveforms, Semi graphical method of analysis, effective value and equivalent power factor solution of circuits with non sinusoidal currents and	6		

voltages, harmonic resonance and harmonics in poly phase circuits. Practical Applications.			
L13-14. Transmission Lines. Propagation modes; Lumped element model; Transmission line equations; Wave propagation on Transmission Lines; The Lossless Transmission Line; Wave impedance of lossless line; Lossless Microstrip line; Special cases of the lossless line; Power flow on a lossless TL; Impedance matching; Transients on Transmission lines (Transient response; Lattice (bounce) diagram). Practical Applications	6		

Bibliography

1. Fawwaz T. Ulaby, Fundamentals of Applied Electromagnetics, 6th Edition, 2020
2. RV Ciupa, V. Ţopa, The Theory of Electric Circuits, CCS Publishing House, 2003
3. M. Sadiku, Elements of Electromagnetics, 7th Edition, 2018
4. Ch. K. Alexander, M.N.O. Sadiku, Fundamentals of Electric Circuits, Mc Graw Hill, 2012
5. W. Hayt, J. Buck, Engineering Electromagnetics, 8th Edition, 2011
6. Gh. Mîndru, Teoria circuitelor electrice, Ed. UTPRESS Cluj-Napoca, 2004
7. J. Edminister, Schaum's easy outline of electromagnetics and electrical cirsuits, McGraw, 2016
8. J.M. Jin, Theory and Computation of Electromagnetic Fields, Ed. Wiley, IEEE Press, 2010.
9. M.A. Salam, Electromagnetic Field Theories for Engineering, ed. Springer, 2014.
10. Dan Doru Micu, Laura Darabant, Denisa Stet, Mihaela Cretu, Andrei Ceclan, Levente Czumbil, Teoria circuitelor electrice. Probleme, UT Press, Cluj-Napoca, 978-606-737-140-6, 2016, 280 pagini;
11. .A. Ceclan, L. Czumbil, Dan D. Micu, Ill-Posed Inverse Problems in Electrical Engineering Applications, Publisher Springer International Publishing, 2021
12. Denisa Ștef, Levente Czumbil, Dan D. Micu, Evaluation of Electromagnetic Interferences, Ed. Intech, ISBN: 978-1-83768-000-9, 2022

On-line references

13. Dan D. Micu, Electromagnetic Field Theory - Lecture Notes, Technical University of Cluj-Napoca, Electrical Engineering Department https://lcmn.utcluj.ro/dan-doru-micu/
14. http://ocw.mit.edu/resources/res-6-002-electromagnetic-field-theory-a-problem-solving-approach-spring-2008/textbook-contents/, last visited 11.11.2025
15. http://nptel.ac.in/courses/117103065/, last visited 11.11.2025

9.2 Seminar / laboratory / project	Hours HEI	Hours CO	Teaching methods	Obs.
Laboratory			Didactic and experimental proof, didactic exercise, teamwork	Use of computers, smart board, blackboard , laboratory instruments, experimental boards, electrical circuits' simulators
1. Determination of the spectrum and equipotential surfaces of an electric field using a electrokinetic model	2			
2. The study of a magnetic circuit. The measurement of the iron losses using an oscilloscope	2			
3. Representation of sinusoidal functions by vectors and complex numbers	2			
4. Analysis of the R,L,C series and parallel circuits, of the voltage and current resonances	2			
5. Power transfer in inductively coupled circuits	2			
6. The study of a circuit in non-sinusoidal regime	2			
7. The study of the transient regime, methods for solving circuits in transient regime	2			

Bibliography

1. Păcurar Claudia, Giurgiuman Nicoleta-Adina, Crețu Mihaela, Marian-Răzvan Gliga, Andreica Sergiu-Iulian, Bazele electrotehnicii, Îndrumător de laborator, Editura U.T.Press, Cluj-Napoca, România, ISBN 978-606-737-492-6, 2020.
2. Dan Doru Micu, Laura Darabant, Denisa Stet, Mihaela Cretu, Andrei Ceclan, Levente Czumbil, Teoria circuitelor electrice. Probleme, UT Press, Cluj-Napoca, 978-606-737-140-6, 2016.

10. Correlation of course content with the expectations of the epistemic community representatives, professional associations, and major employers in the field related to the program

The discipline content and the acquired skills were discussed with HEI experts and are in agreement with the expectations of the major employers in the field related to the program.

11. Evaluation

Activity Type	Evaluation criteria	Evaluation methods	Weight in final grade
11.1 Lecture	The level of theoretical knowledge and practical skills acquired for the computation of electromagnetic fields and for solving electrical cirsuits and systems	Written exam: problem solving	40%
11.2 Seminar/ Laboratory/Project	The level of the abilities acquired for experimental and projects based analysis of electromagnetic fields and electrical circuits /	Laboratory test and Project evaluation	L, 30% / P, 30%
11.3 Minimum Performance Standard Grade ≥ 5			

Date of completion: 16.05.2025	Lecturers		Signature
	Course	Prof. Dan Doru MICU	
	Applications	Prof. Dan Doru MICU	

Date of approval by the Department of Automation Council 24.11.2025	Director of the Department of Automation Prof.dr.ing. Honoriu VĂLEAN
Date of approval by the Faculty of Automation and Computer Science Council 28.11.2025	Dean Prof.dr.ing. Vlad MUREȘAN