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	Electrotechnics and Measurements
1.4	Field of study	Electrical Engineering
1.5	Cycle of study	Bachelor of Science
1.6	Program of study/ Qualification	Electrical System Cluj-Napoca in English language
1.7	Form of education	Full time
1.8	Subject code	57.20

2. Data about the subject

2.1	Subject name			Numerical Modelling of Electric Circuits		
2.2	Course responsible/ lecturer			Assoc. Prof. Dr. Eng. Ec. Mihaela CREȚU Mihaela.Cretu@ethm.utcluj.ro		
2.3	Teachers in charge of Seminars/ Laboratory/ Project			Assoc. Prof. Dr. Eng. Ec. Mihaela CREȚU Mihaela.Cretu@ethm.utcluj.ro		
2.4 Year of study	IV	2.5 Semester	2	2.6 Type of assessment *(E – exam, C – colloquium, V – verification)*		C
2.7 Subject category	*DF – fundamental, DD – in the field, DS – specialty, DC – complementary*					DS
	DI – compulsory, DO – elective, Dfac – optional					DO

3. Estimated total time

3.1 Number of hours per week:	4	of which	3.2 Course	2	3.3 Seminar	-	3.3 Laboratory	2	3.3 Project	-
3.2 Total hours per semester	56	of which	3.5 Course	28	3.6 Seminar	-	3.6 Laboratory	28	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	17
(c) Preparation for seminars/laboratory works, homework, reports, portfolios, essays	14
(d) Tutoring	14
(e) Exams and tests	4
(f) Other activities	

3.8 Total hours of individual study *[sum (3.7(a) to 3.7(f))]*	69
3.9 Total hours per semester *[sum of 3.4 and 3.8]*	125
3.10 Number of credit points	5

4. Prerequisites (where applicable)

4.1	Curriculum	Mathematics, Electric Circuits Theory, Numerical Methods
4.2	Competences	Not applicable

5. Requirements (where appropriate)

5.1	For the course	Classroom/ Multimedia technologies
5.2	For the applications	Classroom/ Multimedia technologies

6. Specific competences

Professional competences	• C4. Analysis, modeling and simulation of electrical systems: Students learn the numerical methods used in the analysis and design of electrical circuits; they learn the physical and mathematical models of electric circuit problems; they learn to use dedicated software for the analysis of electric circuits (ORCAD, MATHCAD, SIMULINK) • C4. Analysis, modeling and simulation of electrical systems: Students learn to evaluate and understand the simulation results provided by the software • C4. Analysis, modeling and simulation of electrical systems: Students learn how to use professional software for the analysis and design of electrical circuits
Cross competences	-

7. Discipline objectives (based on specific competencies acquired)

7.1	General objective	Development of skills in the field of theoretical knowledge and simulation of electrical circuits in order to support vocational training.
7.2	Specific objectives	• Acquiring the theoretical knowledge related to the numerical modeling algorithms of electric circuits and the way to implement them in the development of dedicated software for the analysis of electric circuits. • Acquiring practical skills related to the use of various dedicated software for the analysis of electrical circuits.

8. Contents

8.1. Course (Lectures)		Number of hours	Teaching methods	Additional remarks
1	Fundamentals of modeling and simulation of linear, non-linear and parametric analog electrical circuits. Analysis of reciprocal circuits.	2		
2	Elements of topology for electrical circuits.	2		
3	Topological mathematical models and numerical methods simulation of linear analog circuits in steady state. The use of current and voltage graphs in the analysis of direct current circuits.	2		
4	Topological mathematical models and methods numerical simulation of sinusoidal circuits. The use of current and voltage graphs in the analysis of alternating current circuits.	2		
5	Principles and advanced techniques of numerical modeling of low-frequency electrical circuits. Matrix solution of electrical circuits. Nodal technique for automatic writing of equations.	2		
6	Topological mathematical models and methods numerical simulation of linear analog circuits in transitional regime; methods in the time domain.	2		
7	Topological mathematical models and methods numerical simulation of linear analog circuits in transitional regime; methods in the operational field	2		

8	Strategies for modeling magnetic couplings. Single magnetic couplings, multiple magnetic couplings. Modeling of magnetic couplings in transient regime.	2		
9	Presentation of programs from the OrCAD-PSPICE family. Description of the OrCAD-PSPICE software package for the numerical analysis of electric circuits. Modeling principles, algorithms and numeric calculation, input data, output data. Examples.	2		
10	Frequency response of electrical circuits. Approximation by rational functions using the ORCAD simulator. Examples.	2		
11	The steady state non-sinusoidal regime of electric circuits using ORCAD simulator. Examples.	2		
12	Validation of the results obtained by numerical simulation.	2		
13	Solving nonlinear circuits.	2		
14	Circuit functions. General notions.	2		

Bibliography

1. L. Mandache, D. Topan, „Simularea circuitelor electrice. Algoritmi și programe de calcul”, Editura Universitaria Craiova, 2009.
2. D. Topan, L. Mandache, „Chestiuni speciale de analiză a circuitelor electrice”, Editura Universitaria Craiova, 2007.
3. M. Iordache, L. Dumitriu, „Teoria modernă a circuitelor electrice”, vol. 2, Editura ALL, Bucureşti, 2000.
4. Ş. Kilyeni, „Metode numerice. Aplicaţii în energetică”, Ed. Orizonturi Universitare Timişoara, 2005.
5. M. Iordache, L. Mandache, M. Perpelea, „Analyse numerique des circuits analogiques non lineaires”, Ed. Groupe Genoyer, Marseille, 2006.
6. F.J. Monssen, „OrCAD Pspice with Circuit Analysis”, 1998.
7. G. Chindriș, O. Pop, G. Deak, „Simularea și modelarea avansată a circuitelor electronice”, Editura Casa Cărții de Știință, 2002.

8.2. Applications - Seminar /Laboratory/Project		Number of hours	Teaching methods	Additional remarks
1	Introduction to OrCAD-PSPICE.	2	-	-
2	Direct current analysis. Verification of laws and theorems in direct current (Kirchhoff's Theorems, Theorem of powers conservation, Theorem of superposition, Theorem of reciprocity).	2		
3	Direct current analysis. Parametric analysis (Theorem of Thevenin and Norton, Theorem of the maximum power transfer). Examples	2		
4	Steady state sinusoidal response of RL, RC, RLC series circuit. Phase shifts. Maximum power transfer.	2		
5	Steady state sinusoidal response of electric circuits. Solving an AC circuit.	2		
6	AC circuit analysis. Examples.	2		
7	Series and parallel RLC resonance by variation of circuit reactive elements and by variation of frequency.	2		

8	Analysis of the steady-state non-sinusoidal regime. Fourier analysis. Examples.	2		
9	Passive Filters (High Pass Filter, Low Pass Filter, Band Pass Filter, Band Stop Filter).	2		
10	Transient response of RL, RC and RLC circuits.	2		
11	Transient response of electric circuits. Types of sources. Problems with initial conditions. Examples.	2		
12	Numerical simulation of three-phase circuits. Examples.	2		
13	Phasor analysis and diagrams. Examples.	2		
14	Lab. exam	2		

Bibliography

1. M. Iordache, L. Dumitriu, „Simularea asistată de calculator a circuitelor analogice, Editura Politehnica București, 2002.
2. G. Chindriș, O. Pop, G. Deak, „Simularea și modelarea avansată a circuitelor electronice", Editura Casa Cărții de Știință, 2002.
3. F.J. Monssen, „OrCAD Pspice with Circuit Analysis", 1998.
4. M. Crețu, „Modelarea numerică a circuitelor electrice. Îndrumător de laborator", Edituta UT Press, 2013.
5. D. Șteț, L. Darabant, M. Crețu, „Compatibilitate electromagnetică. Îndrumător de laborator", Editura UT Press, 2016.
6. L. Darabant, M. Crețu, D. Șteț, „Analiza numerică a circuitelor electrice. Îndrumător de laborator", Editura UT Press, 2016.

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

The content of the discipline, the knowledge, skills, abilities and competences acquired correspond to the expectations of the relevant professional organizations and the relevant companies (where students carry out internships and/or take up jobs), as well as the national quality assurance body (ARACIS).
The skills acquired can be used by Electrical Engineers or Designers in the design and maintenance of electrical equipment.

10. Assessment

Activity type	10.1 Assessment criteria	10.2 Assessment methods	10.3 Weight in the final grade (%)
10.4 Course	Solving an electric circuit using the studied matrix methods, modeling and simulating the circuit in Orcad and comparing the obtained results.	The exam consists of the presentation of a project or a study that complements those assimilated in the course.	70 %
10.5 Laboratory	Verification of practical skills - Implementation of an electrical circuit in an operating regime studied in the laboratory (L)	Computer and oral test lasting 2 hours, mixed assessment.	30%
10.5 Project	-	-	-

10.6 Minimum standard of performance:

- ✓ All labs are compulsory;
- ✓ Final grades for the exam and the lab exam are at least 5.

E≥5; L≥5,

Final grade: N= (0.7 C + 0.3 L) ≥ 5

Date of completion	Lecturers	Title/ Surname/ Name:	Signature
September 2024	Course	**Assoc. Prof. Dr. Eng. Ec. Mihaela CREȚU** Mihaela.Cretu@ethm.utcluj.ro	
	Applications Seminar/ Laboratory/ Project	**Assoc. Prof. Dr. Eng. Ec. Mihaela CREȚU** Mihaela.Cretu@ethm.utcluj.ro	-

Date of approval in the ETHM Department Council September 2024	**Head of Department:** Prof. Eng. MICU Dan Doru, PhD
Date of approval in the Faculty of Electrical Engineering Council September 2024	**Dean:** Assoc. Prof. Eng. CZIKER Andrei, PhD