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	Modeling and Simulation of Power Systems		Course code	8.00
2.2	Course responsible/ lecturer	Prof. Eng. Radu-Adrian TÎRNOVAN, PhD			
2.3	Teachers in charge of Seminars	Prof. Eng. Sorin PAVEL, PhD			
2.4 Year of study	I	2.5 Semester	2	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	...	3.3 Seminar	1	3.3 Project	
3.2 Total hours per semester	42	of which	3.5 Course	28	3.6 Seminar	...	3.6 Seminar	14	3.6 Project	

3.7 Individual study:	
(a) Manual, lecture material and notes, bibliography	24
(b) Supplementary study in the library, online and in the field	14
(c) Preparation for seminars/laboratory works, homework, reports, portfolios, essays	14
(d) Tutoring	2
(e) Exams and tests	4
(f) Other activities	-

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	...
4.2	Competences	...

5. Requirements (where appropriate)

5.1	For the course	...
5.2	For the applications	...

6. Specific competences

Professional competences	he objective of this course is to provide knowledge on: 1. Structure of power systems; 2. Modeling of the main system elements; 3. Development of mathematical models for power flow calculating; 4. Familiarization with the main methods of analyzing power flow: - Gauss elimination method, Gauss – Jordan method; - Gauss-Seidel method; - Newton-Raphson method; -variants of the Newton-Raphson method (decoupled, fast decoupled, direct current); - unconventional methods based on artificial intelligence techniques. To analyze power system, the PALADIN/EDSA program package will be used. After completing the course, students will be able to: 1. use the PALADIN/EDSA program package to solve the power flow problems; 2. use the MATLAB/Simulink program package for modeling and analyzing power system.
Cross competences	- Responsible execution of professional tasks under conditions of limited autonomy (completion of homework for independent study); - Awareness of the need for continuous training; efficient use of learning resources and techniques for personal and professional development - efficient use of communication and professional training resources (Internet, e-mail, databases, online courses, etc.), including using foreign languages.

7. Expected learning outcomes

Knowledge	- Mathematical modeling of the elements of power system;- Development of equivalent schemes and steady-state mathematical models for radial electrical networks;- Development of equivalent schemes and steady-state mathematical models for complex electrical networks;- Application of numerical mathematical methods for solving steady-state conditions
Skills	- Use of CADs specific to the power system field for the analysis of electrical networks
Responsibility and autonomy	- Responsible execution of professional tasks under conditions of limited autonomy (completion of independent study assignments)

8. Discipline objectives (based on specific competencies acquired)

8.1	General objective	The use of computing systems in the analysis of power systems
8.2	Specific objectives	Acquisition of specific knowledge regarding the principles and methods of analysis of power systems based on the use of numerical methods: - Modeling of system elements; - Preparation of equivalent electrical diagrams;

		- Methods of numerical solution of models for the analysis of steady-state regimes; - Use of programs dedicated to the analysis of power systems (Paladin/EDSA).

9. Contents

9.1. Course (Lectures)		Number of hours	Teaching methods	Additional remarks
1	Introduction - Power System Structure and Functional Elements - Simulation Concept - Mathematical Modeling. Mathematical Model Concept	2	Presentation and discussions	…
2	Network Models – Generators - Lines and Cables – Transformers - Loads	8		
3	Generalities on Power Flow Calculation - - Basic Bus Types - Active and Reactive Power Circulation	4		
4	Basic Power Flow Problem - Formulation of the Power Flow Problem - Topology of Electrical Networks - Nodal Formulation of Network Equations	4		
5	Unified Power Flow Equations	2		
6	Solution of the Power Flow Problem - Solution by Gauss-Seidel Iteration - Newton-Raphson applied to the Power Flow Equations - Pθ – QU Decoupling - Approximate Solutions of the Power Flow Problem. DC Power Flow Model	6		
7	Non-Conventional Methods of Power Flow Study - Fuzzy Logic Method - Artificial Neural Network Method - Other Miscellaneous Methods	2		

Bibliography

1. Radu-Adrian Tîrnovan, Maria Cristea, Modelling and simulation of power systems. Course (in Romanian), U.T.PRESS Cluj - Napoca, 2025 ISBN 978-606-737-821-4, 168/252, https://biblioteca.utcluj.ro/files/carti-online-cu-coperta/821-4.pdf
2. Radu-Adrian TÎRNOVAN, Gheorghe Mircea HORGOȘ, Power systems in steady state Course (in Romanian), U.T.PRESS Cluj - Napoca, 2025 ISBN 978-606-737-824-5, 160/240, https://biblioteca.utcluj.ro/files/carti-online-cu-coperta/824-5.pdf
3. Mihai Talmaciu, Alina-Mihaela Patriciu - Numerical Calculation (in Romanian), PIM Publishing House, Iaşi, 2008, ISBN: 978-606-520-013-5

Virtual teaching materials:

Tîrnovan R., Pavel,S., Modelling and simulation of power systems, Course, PPT, Word

9.2. Applications - Seminar		Number of hours	Teaching methods	Additional remarks
1	1. Implementation of an application in EDSA; modeling of a certain perimeter	2	Presentation of the theory in the form	…
2	2. Study of the steady state; comparisons between methods; contingency analysis.	2		

3	3. Computer-aided analysis of short-circuit regimes	2	of Power Point slides.	
4	4. Implementation of voltage regulation on a network modeled using the EDSA program	2		
5	5. Coordination of protection systems	2		
6	6. Study of dynamic stability using "EDSA power system transient stability"	2		
7	7. Optimization of electricity distribution on a modeled network	2		
Bibliography 1. Paladin/EDSA – Tutorial 2. Pavel,S., Modelling and simulation of power systems, Seminar, PPT, Word, EDSA				

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

The skills acquired will be necessary for employees working in the field of electrical and energy engineering, the possible occupations being specified in the Official Gazette of Romania, Part I, no. 561/8.VIII.2011

11. Assessment

Activity type	10.1 Assessment criteria	10.2 Assessment methods	10.3 Weight in the final grade (%)
10.4 Course	Understanding criteria and phenomena, engaging in discussions, formulating questions, participating in consultations, being able to solve concrete applications.	Written exam (E) – grid, applications on aspects from the course.	50%
10.5 Seminar	Seminar activity, conspectus, homework.	Written and oral test	50%
10.6 Minimum standard of performance: The condition for obtaining credits is that the final grade ≥ 5			

Date of completion	Lecturers	Title/ Surname/ Name:	Signature
September 2025	Course	Prof. Eng. Radu-Adrian TÎRNOVAN, PhD	
	Applications Seminar	Prof. Eng. Sorin PAVEL, PhD	

Date of approval in the council of the Department of Power Engineering and Management September 2025	**Head of Department:** Assoc. Prof. Eng. Horia G. BELEIU, PhD
Date of approval in the Faculty of Electrical Engineering Council September 2025	**Dean:** Assoc. Prof. Eng. Andrei C. CZIKER, PhD