# SYLLABUS

**1. Data about the program of study**

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| 1.1 Institution | Technical University of Cluj-Napoca |
| 1.2 Faculty | 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 | 52.00 |

**2. Data about the subject**

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| 2.1 Subject name | | | | Power system protection and automation | |
| 2.2 Course responsible/lecturer | | | | Prof. Eng. Radu-Adrian TÎRNOVAN, PhD | |
| 2.3 Titular of applications | | | | Assoc. Prof. Eng. Aurel Botezan, PhD | |
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| 2.4 Year of study | 4 | 2.5 Semester | 1 | 2.6 Assessment type | E |
| 2.7 Discipline regime | Subject category | | | | DS |
| | Optionality | | | | DI |

**3. Estimated total time**

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|---|---|---|---|---|---|---|---|---|---|---|
| 3.1 Number of hours per week | 4 | of which: | 3.2 Course | 2 | 3.3 Seminar | | 3.3 Laboratory | 1 | 3.3 Project | - |
| 3.4 Number of hours per semester | 42 | din care: | 3.5 Course | 28 | 3.6 Seminar | | 3.6 Laboratory | 14 | 3.6 Project | - |

| 3.7 Distribution of time fund (hours per semester) for: | |
|---|---|
| (a) Study by textbook, course support, bibliography and notes | 20 |
| (b) Additional documentation in the library, on specialized electronic platforms and in the field | 10 |
| (c) Preparation of seminars / laboratories, homework, reports, portfolios and essays | 20 |
| (d) Tutorial | 3 |
| (e) Examinations | 4 |
| (f) Other activities: | 1 |

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| 3.8 Total of individual study hours (sum of (3.7(a)…3.7(f))) | 58 |
| 3.9 Total hours per semester (3.4+3.8) | 100 |
| 3.10 Number of credits | 4 |

**4. Prerequisites (**where appropriate**)**

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| 4.1. Compulsory | Knowledge of Electrical Engineering Basics, Electrical Equipment, Electric Power Generation, Transmission and Distribution |
| 4.2. Recommended | No |

**5. Requirements (where appropriate)**

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| 5.1. For the course (where/when) | •Multimedia equipment |
| 5.2. For the applications | • Laboratory attendance is mandatory.<br>• Knowledge and observance of Labor Safety Standards |

**6. Specific competences (**Learning Outcomes**)**

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| Professional Competences | 1. Description of fundamental phenomena, principles and methods in designing and exploiting medium complexity power systems:<br>- acquire knowledge in the field of power engineering, necessary for the training of energy engineers.<br>- acquire knowledge to enable them to understand the importance of protection in the power system in terms of ensuring the quality and security of electricity supply.<br>- to know the main faults that may occur in a power system.<br>- to know the types of relays protection systems.<br>- to know the main types of protection of the components of the power system.<br>2. Elaboration of professional projects of power systems:<br>- calculate the parameters for relay protection setting.<br>- design a relay protection system.<br>3. Developing the capacity to use tools and methods for the management of power systems:<br>- to regulate different types of protection relays.<br>- use software to analyze and adjust relay protection. |
| Cross competences | - Responsible execution of professional tasks under conditions of limited autonomy (realization of themes for independent study);<br>- Awareness of the need for continuous training; efficient use of learning resources and techniques for personal and professional development - efficient use of communication and training resources (Internet, e-mail, databases, on-line courses, etc.), including using foreign languages. |

**7. Discipline objectives** (according to the Specific competences)

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| 7.1 General objective of the discipline | To acquire knowledge that will allow them to understand the importance of protection in the power system in terms of quality assurance and security in power supply |
| 7.2 Specific objectives | To acquire knowledge about the principles of relay protection systems against its operation in abnormal or emergency situations.<br>To acquire knowledge about the main types of protection of the components of the power system.<br>Obtaining knowledge to enable a good understanding of the processes taking place in the production, transport and distribution of electricity. |

**8. Contents**

| 8.1 Course (syllabus) | Nr. of hours | Teaching Methods | Notes |
|---|---|---|---|
| 1. Protections and automation in power systems. General considerations, terminology, definitions. | 2 | Presentation and discussions | |
| 2. Principles of protection in power systems | 2 | | |
| 3. Protection of electrical generators | 2 | | |
| 4. Protection of power transformers | 2 | | |
| 5. Bus-Bar Protection Schemes | 2 | | |
| 6. Protection of electrical lines | 6 | | |
| 7. Protection of electrical motors | 2 | | |
| 8. Digital protection | 2 | | |
| 9. Breaker failure protection function | 2 | | |
| 10. Fast auto-reclose function | 2 | | |
| 11. Automatic transfer switch (ATS) | 2 | | |
| 12. Automatic frequency unloading of the power system | 2 | | |

References (Bibliography)

1. R. Tîrnovan, I. Vadan, H. Bălan, A. Botezan, Relay Protection in Power Systems (in Romanian). Ed. "UT Press" Cluj-Napoca, 2008, ISBN 978-973-662-375-2.
2. Radu-Adrian Tîrnovan, Digital protection in power systems (in romanian), Editura U.T.Press, Cluj-Napoca -

2019, ISBN 978-606-737-370-7
3. Silviu Ștefănescu, Radu-Adrian Tîrnovan, Automation in power systems – Course (in romanian), Editura U.T.Press, Cluj-Napoca - 2019, ISBN 978-606-737-367-7
4. Gers J.M., Holmes E.J. Protection of electricity distribution network. The Institution of Electrical Engineers, London, United Kingdom, 1998.
5. Network Protection & Automation Guide, Edition May 2011, 2011 ALSTOM GRID MAY 2011, ISBN: 978-0-9568678-0-3
Virtual Learning Materials:
1. Tîrnovan R., Relays Protection in Power Systems, Course, (in Romanian) PPT, Word
2. Tîrnovan R., Relays Protection in Power Systems. Laboratory work (in Romanian), PPT, Word

| 8.2 Laboratory | Nr. of hours | Teaching Methods | Notes |
|---|---|---|---|
| 1. Current and voltage measuring transformers | 2 | Presentation, discussions, conclusions | Field conditions, measurements, application of optimal conditions |
| 2. Sequence filters | 2 | | |
| 3. Overcurrent protection of radial power lines | 2 | | |
| 4. Overcurrent directional protection | 2 | | |
| 5. Longitudinal differential protection of power transformers | 2 | | |
| 6. Protection of electric generators | 2 | | |
| 7. Digital protection | 2 | | |

**References**

1. Radu-Adrian Tîrnovan, Aurel Botezan, Maria Cristea, Protection of power systems - Laboratory (in Romanian).

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

The courses and applications take into account the requirements and expectations of the business environment: well-known companies in the field, collaborators from industrial and economic environments, colleagues from other university centers.

**10. Assessment**

| Type of activity | 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. | 70% |
| 10.5 Laboratory | Laboratory activity, conspectus, experimental data processing, homework. | Laboratories examination, experimental data processing (mark L) | 30% |
| 10.6 Minimum standard of performance: E+L ≥ 5. | | | |

| Date of completion | Lecturers | Title/ Surname/ Name: | Signature |
|---|---|---|---|
| September 2024 | Course | Prof. Eng. Radu-Adrian TÎRNOVAN, PhD | |
| | Laboratory | Assoc. Prof. Eng. Aurel Botezan, PhD | |
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| **Date of approval in the ETHM Department Council**<br><br>September 2024 | **Head of Department:**<br>Prof. Eng. MICU Dan Doru, PhD |
| **Date of approval in the Faculty of Electrical Engineering Council**<br><br>September 2024 | **Dean:**<br>Assoc. Prof. Eng. CZIKER Andrei, PhD |