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	37

2. Data about the subject

2.1	Subject name				**Special Electrical Machines**	
2.2	Course responsible/ lecturer				Prof. Eng. Loránd SZABÓ, PhD – *Lorand.Szabo@emd.utcluj.ro*	
2.3	Teachers in charge of Seminars/ Laboratory/ Project				Prof. Eng. Loránd SZABÓ, PhD – *Lorand.Szabo@emd.utcluj.ro*	
2.4 Year of study		3	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*				DD
		DI – compulsory, DO – elective, Dfac – optional				DI

3. Estimated total time

3.1 Number of hours per week:	5	of which	3.2 Course	2	3.3 Seminar	-	3.3 Laboratory	21	3.3 Project	1
3.2 Total hours per semester	70	of which	3.5 Course	28	3.6 Seminar	-	3.6 Laboratory	28	3.6 Project	14

3.7 Individual study:	
(a) Manual, lecture material and notes, bibliography	21
(b) Supplementary study in the library, online and in the field	14
(c) Preparation for seminars/laboratory works, homework, reports, portfolios, essays	28
(d) Tutoring	1
(e) Exams and tests	2
(f) Other activities	-

3.8 Total hours of individual study *[sum (3.7(a) to 3.7(f))]*	80
3.9 Total hours per semester *[sum of 3.4 and 3.8]*	150
3.10 Number of credit points	6

4. Prerequisites (where applicable)

4.1	Curriculum	Theory of the Electromagnetic field, Electrical machines
4.2	Competences	N/A

5. Requirements (where appropriate)

5.1	For the course	N/A
5.2	For the applications	Attendance at laboratory sessions and project hours is mandatory

6. **Specific competences**

Professional competences	The ability to identify, formulate, and solve engineering problems using a systemic approach. The ability to apply knowledge of engineering, engineering sciences, and applied computer science. The ability to use modern engineering techniques, skills, and tools necessary for engineering practice. The ability to design and conduct experiments, as well as to analyse and interpret the obtained information. The ability to approach and manage specific applications of general electrical engineering. The ability to apply the knowledge acquired about power systems, electrical equipment, and their operation and maintenance. Flexibility in approaching and practically using the latest technologies in the assumed areas of competence.
Cross competences	Identifying the objectives to be achieved, the available resources, the conditions for their completion, the work stages, the work times, the corresponding deadlines, and the associated risks. Efficient use of informational sources and communication and professional training resources (Internet portals, specialized software applications, databases, online courses, etc.)

7. **Expected learning outcomes**

Knowledge	The student/graduate identifies, formulates, and analyzes the principles of electrical power circuits and the associated risks.
Abilities	The student/graduate adapts product designs or components to ensure they meet specified requirements. The student/graduate detects faults in electrical circuits and is able to repair them. The student/graduate tests and replaces electrical components and wiring using measuring instruments, soldering equipment, and hand tools. The student/graduate assembles electromechanical equipment and devices in accordance with their specifications. The student/graduate interprets electrical schematics showing connections between devices, including electrical and signal connections.
Responsibility and autonomy	The student/graduate selects and uses relevant bibliographic sources specific to the field. The student/graduate demonstrates autonomy in learning on specific engineering-related topics.

8. **Discipline objectives (based on specific competencies acquired)**

8.1	General objective	Developing competencies in the knowledge, analysis, and applications of special machines used in the industrial environment.
8.2	Specific objectives	N/A

9. Contents

9.1. Course (Lectures)		Number of hours	Teaching methods	Additional remarks
1	Introductory concepts. Specific characteristics of special electric machines. Specific materials used in the construction of special electric machines (permanent magnets, soft magnetic composites – SMC, etc.).	2	Presentation in the classroom	PowerPoint presentations
2	Special induction machines. Three-phase, two-phase, and single-phase induction micromotors (single-phase with auxiliary phase, single-phase with shaded poles, etc.).	2		
3	Special DC machines. DC servomotors. Brushless DC motors. Universal motor. DC tachogenerators.	4		
4	Permanent magnet synchronous machines.	2		
5	Variable reluctance electric machines. Switched reluctance motors. Machines with salient poles on the stator and rotor and excitation with permanent magnets. Transverse flux machines.	4		
6	Stepper motors. Constructive types (variable reluctance, permanent magnets, and hybrid). Control. Operating characteristics.	4		
7	Linear motors (induction, synchronous, variable reluctance).	4		
8	Claw pole synchronous machines (Lundell generators and the version with permanent magnets).	2		
9	Special electric machines with extreme constructions and performances.	2		
10	Use of special electric machines in vehicles and renewable energy conversion systems.	2		

Bibliography

From the UTC-N library:

- Henneberger G., Viorel I.-A., Variable reluctance electrical machines, Shaker Verlag, Aachen, Germania, 2001
- Viorel I.A., Szabó L., Hybrid Linear Stepper Motors, Mediamira, Cluj, 1998.

Virtual teaching materials:

- Course presentations in PDF format accessible via password at the address: http://users.utcluj.ro/~szabol/Materiale_didactice/MES.htm

From other libraries:

- Fitzgerald, A. E., et al., Electric machinery, McGraw-Hill, 2003.
- Yeadon, W.H., Yeadon, A.W., Handbook of small electric motors, McGraw-Hill, 2001.
- Stölting, H.D. et al., Handbook of Fractional-Horsepower Drives, Springer, 2008.
- Krishnan, R., Switched Reluctance Motor Drives: Modeling, Simulation, Analysis, Design and Application, CRC Press, 2001.
- Gieras, J.F. , Wing, M., Permanent magnet motor technology: design and applications, Marcel Dekker, 2002.

9.2 Laboratory		Number of hours	Teaching methods	Additional remarks
1	Laboratory presentation. Work safety and regulation presentation. Presentation of session content.	2	Practical experiments in the laboratory:	Laboratory setups, power supplies, data acquisition systems, measuring instruments.
2	Single-phase induction motor with auxiliary phase.	4		
3	Switched reluctance machine. Parameter determination. Study of dynamic regime.	4		
4	Claw pole permanent magnet synchronous generator (Lundell generator)	4		
5	Stepper motor	4		
6	Doubly excited synchronous machine – generator and motor regime	4		
7	Linear electric machines	4		
8	Final knowledge assessment	2		

Bibliography
Virtual teaching materials:
Teaching materials in PDF format accessible via password at the address:
http://users.utcluj.ro/~szabol/Materiale_didactice/MES.htm

9.3 Project		Number of hours	Teaching methods	Additional remarks
1	General presentation of the project topic (electromagnetic sizing calculation of a variable reluctance motor).	1	Based on a case study and guided progression through successive stages of electromagnetic sizing calculations.	N/A
2	Determination of primary design quantities. Determination of main dimensions, air gap width, and electromagnetic stresses.	1		
3	Sizing of the stator winding, poles, and magnetic yoke.	1		
4	Sizing of the rotor poles and magnetic yoke.	1		
5	Determination of the electromagnetic parameters of the stator windings, as well as the energy efficiency.	1		
6	Determination of operating characteristics.	1		
7	Final knowledge assessment.	1		

Bibliography
Virtual teaching materials:
Teaching materials in PDF format accessible via password at the address: http://users.utcluj.ro/~szabol/Materiale_didactice/MES.htm

From other libraries:
- Krishnan, R., Switched reluctance motor drives: modeling, simulation, analysis, design, and applications. CRC Press, Boca Raton, 2017.

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

The acquired skills will be necessary for those who wish to work in the industrial field.

11. Assessment

Activity type	11.1 Assessment criteria	11.2 Assessment methods	11.3 Weight in the final grade (%)
11.4 Course	Answers to questions from the taught theory.	Written examination (multiple-choice test + answer to a theoretical question).	50% (E=5 points, minimum E>2)
11.5 Laboratory	Evaluation of theoretical knowledge and practical skills during laboratory practical work.	End-of-semester test.	20% (L=2 points, minimum L≥0,5)
11.5 Project	Evaluation of the completed project, taking into account the activity during project hours throughout the semester.	End-of-semester test considering the points obtained throughout the semester.	20% (P=2 points, minimum L≥0,5)
11.6 Minimum standard of performance: Grade calculation formula: N = 1 + E + L + P. Passing the final tests for the laboratory and project (which require attendance at all laboratory and project hours), and obtaining the minimum scores for E, L, and P.			

Date of completion	Lecturers	Title/ Surname/ Name:	Signature
January 2026	Course	Prof. Eng. Loránd SZABÓ, PhD	
	Laboratory	Prof. Eng. Loránd SZABÓ, PhD	
	Project	Prof. Eng. Loránd SZABÓ, PhD	

Date of approval in the ETHM Department Council	Head of Department:
January 2026	Prof. Eng. MICU Dan Doru, PhD
Date of approval in the Faculty of Electrical Engineering Council	**Dean:**
February 2026	Assoc. Prof. Eng. CZIKER Andrei, PhD