Syllabus

1. Data about the program of study

1.1 Institution	Technical University of Cluj-Napoca
1.2 Faculty	Automation and Computer Science
1.3 Department	Automation
1.4 Field of study	Systems Engineering
1.5 Cycle of study	Bachelor of Science
1.6 Program of study/Qualification	Automation and Applied Informatics (English)
1.7 Form of education	Full time
1.8 Subject code	50.10

2. Data about the subject

2.1 Subject name	***Electrical Machines and drives***				
2.2 Course responsible/lecturer	Prof. Eng. Loránd Szabo, PhD				
2.3 Teachers in charge of applications	Lect. Eng. Adrian-Augustin POP				
2.4 Year of study	4	2.5 Semester	1	2.6 Assessment *(E/C/V)*	C
2.7 Type of subject	*DF – fundamental, DID – in the field, DS – specialty, DC – complementary*				DID
	DOB – compulsory, DOP – elective, FAC – optional				DO

3. Estimated total time

3.1 Number of hours per week	4	of which:	Course	2	Seminar		Laboratory	2	Project	
3.2 Number of hours per semester	56	of which:	course	28	Seminar		Laboratory	28	Project	
3.3 Individual study										
(a) Manual, lecture material and notes, bibliography										12
(b) Supplementary study in the library, online, and in the field										12
(c) Preparation for seminars/laboratory works, homework, reports, portfolios, essays										12
(d) Tutoring										5
(e) Exams and tests										3
(f) Other activities:										

3.4 Total hours of individual study (sum of (3.3(a)…3.3(f)))	44
3.5 Total hours per semester (3.2+3.4)	100
3.6 Number of credit points	4

4. Pre-requisites (where appropriate)

4.1 Curriculum	Electrotechnics, Electronic Measurements, and Sensors, Power Electronics in Automatic Control
4.2 Competence	

5. Requirements (where appropriate)

5.1. For the course	
5.2. For the applications	

6. Specific competences

6.1 Professional competences	C1 Operating with basic concepts of mathematics, physics, measurement science, mechanical engineering, chemical engineering, electrical engineering in systems engineering C3 Operating with fundamentals of control engineering, process modeling, simulation, identification and analysis methods, and computer-aided design.
6.2 Cross competences	

7. Course objectives

7.1 General objective	To teach the students about configuration and deployment of industrial process control, of robots and flexible manufacturing lines and choice of equipment, tuning and putting into service of related structures.
7.2 Specific objectives	To offer to the students diverse occupational skills, as: •Understanding of the principles of the energy conversion systems used in automation systems. •Knowledge and ability to apply the concepts, principles, and theories of electrical machines and drives in designing and operating advanced automation systems. •Understanding the implications of the electrical drive system's parameters on the performance of the entire automation systems incorporating those drives. Practical skills: •To be able to select an adequate electrical machine and its control system for wide automation application tasks. •To be able to build up and operate the feeding and/or control circuitry of electrical machines and drives. •To use laboratory equipment to analyze the static and dynamic characteristics of a wide range of electrical machines. Abilities: •To use classical and digital measurement instruments for measuring in the laboratory the electrical machines •To use specific measurement instruments in the field of electrical machines and drives: torque meters speedometers, position encoders, etc. •To connect, to set and ti use frequency converters for feeding electrical machines

8. Contents

8.1 Lecture	No.hours	Teaching methods	Notes
Introduction to electromechanical energy conversion systems	2	Presentation	Power Point and video projector
Physical background of the electrical machines and drives (governing laws, materials, etc.)	2		
Transformers (one-phase and three-phase)	2		
dc machines (construction, working principles, types, main applications, etc.)	2		
Induction machines (construction, working principles, types, main applications, etc.)	2		
Synchronous machines – both types having electromagnetic and permanent magnet excitation – (construction, working principles, types, main applications, etc.)	2		
Special electrical machines (universal motor, spilt-phase induction machine, switched reluctance motor, brushless dc machines, stepper motors, permanent magnet motors, variable reluctance motors, linear motors, electromagnetic actuators, etc.)	6		
Control of electrical machines (starting, speed variation, breaking, and stopping)	4		
Advanced control methods used for electrical drives (voltage control, U/f control, field-oriented control, direct torque control, etc.)	2		
Electric machines and drive systems selection criteria and requirements used for typical automation applications	2		
Mathematical models, simulation, and system integration of electrical machines and drives	2		
Bibliography			

1. Boldea, I., Nasar, S.A., Electric machine dynamics, 1986.
2. El-Hawary, M.E. Principles of electric machines with power electronic applications, 2002.
3. Gottlieb I.M., Electric motors & control techniques, 1994.
4. Kazmierkowski, M., Tunia, H., Automatic control of converter-fed drives, 1994.
5. Viorel, I.A., Henneberger, G., Variable reluctance electrical machines, 2001.
Supplementary course outlines are available at the course's website:
http://users.utcluj.ro/~szabol/Materiale_didactice/Electrical_Machines_&_Drives.htm
and at the Teams group of the course (https://teams.microsoft.com/l/team/19%3asxo5dPfrelOpn2YpHP-eo8FpdfiTGNlJSZ4mql1X4p01%40thread.tacv2/conversations?groupId=db1360e7-e794-4528-b723-778953d05348&tenantId=a6eb79fa-c4a9-4cce-818d-b85274d15305).

8.2 Applications (seminar/laboratory/project)	No.hours	Teaching methods	Notes
Introductive session (safety provisions in the lab, general presentation of the lab, application program presentations)	4	Practical experimentations and demonstrations in the laboratory	Test benches, power supplies, data acquisition systems, analog, and digital measuring devices
Transformers (one-phase transformer operating tests, no-load and symmetrical load operating of the three-phase transformer)	4		
Induction machines (no-load and short circuit operating regimes and general operating characteristics)	4		
Synchronous machines (the characteristics of the autonomous synchronous generator, grid connection, and parallel operation of the synchronous generators)	4		
DC machines (separately and series excited dc machine's operating tests, dc. generator characteristics)	4		
Switched reluctance machines (static characteristics, steady-state working regime)	4		
Frequency converter fed induction machines operating tests	4		

Bibliography
Laboratory practical guide files are available at the course's website:
http://users.utcluj.ro/~szabol/Materiale_didactice/Electrical_Machines_&_Drives.htm
and at the Teams group of the lab
(https://teams.microsoft.com/l/team/19%3atXC8WmpN3ziQefAu6HjSPAK1WxoNMO_oY8PsRLaQjKs1%40thread.tacv2/conversations?groupId=40ac21ad-ac4c-4138-8405-82d94e616457&tenantId=a6eb79fa-c4a9-4cce-818d-b85274d15305).

9. Bridging course contents with the expectations of the representatives of the community, professional associations, and employers in the field

The course offers several skills regarding the selection and analysis of a suitable electric motor and its supply & control system for certain industrial processes.

10. Evaluation

Activity type	Assessment criteria	Assessment methods	Weight in the final grade
Course	Answering a quiz test (7 questions) regarding the content of the course	Written examination at the end of the semester	7 points (70%)
Laboratory	Solving a test on the performed labs	Laboratory write up	2 points (20%)
10.4 Minimum standard of performance: Exam (E)>2; Lab (L)>0.5 Grade computation formula: N=1 (official)+E+L			

Date of filling in:		**Title Firstname NAME**	**Signature**
02.04.2023	Course	Prof. Eng. Loránd Szabo, PhD	
	Applications	Lect. Eng. Adrian-Augustin POP	

Date of approval by the Department Board ……..

_____

Head of Departament .....
Prof.dr.ing. Honoriu VĂLEAN

Date of approval by the Faculty Council ……

_____

Dean
Prof.dr.ing. Liviu Cristian MICLEA