SYLLABUS

1. Data about the program of study

1.1	Institution	The Technical University of Cluj-Napoca
1.2	Faculty	Faculty of Electrical Engineering
1.3	Department	Electrical Machines and Drives
1.4	Field of study	Electrical Engineering
1.5	Cycle of study	Bachelor of Science
1.6	Program of study/Qualification	Electrical Systems
1.7	Form of education	Full time
1.8	Subject code	42

2. Data about the subject

2.1	Subject name			Electrical Drives			
2.2	Course responsible/lecturer			Prof. dr. ing. Iulian Birou (birou@edr.utcluj.ro). S.l. dr. ing. Szabo Csaba (Csaba.Szabo@emd.utcluj.ro)			
2.3	Teachers in charge of seminars			S.l. dr. ing. Szabo Csaba (Csaba.Szabo@emd.utcluj.ro) Asist. drd. ing. Mihai Suciu (Mihai.Suciu@emd.utcluj.ro)			
2.4 Year of study	III	2.5 Semester	2	2.6 Assessment		E	
2.7 Subject category	Formative category					DD	
	Optionality					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	2	3.3 Project	1
3.4 Total hours in the curriculum	70	of which	3.5 Course	28	3.6 Seminar		3.6 Laboratory	28	3.6 Project	14

3.7 Individual study: 44	
(a) Manual, lecture material and notes, bibliography	16
(b) Supplementary study in the library, online and in the field	8
(c) Preparation for seminars/laboratory works, homework, reports, portfolios, essays	26
(d) Tutoring	2
(e) Exams and tests	3
(f) Other activities	
3.8 Total hours of individual study (summ (3.7(a)...3.7(f)))	55
3.9 Total hours per semester (3.4+3.8)	125
3.10 Number of credit points	5

4. Pre-requisites (where appropriate)

4.1	Curriculum	General knowledge on System Theory, Electrotechnics, Electrical Machines, Power Electronics
4.2	Competence	Specific competences related to System Theory, Electrical Machines, Power Electronics

5. Requirements (where appropriate)

5.1	For the course	
5.2	For the applications Seminar /Laboratory/Project	Mandatory presence

6. Specific competences

Professional competences	C6. Design and control of electrical drive systems C6.1. Identification of fundamental aspects specific related to system theory and automated control, and of the investigation methods of an electrical drive system. C6.3. Application of control principles and specific procedures used for optimization of working parameters of a control system, for evaluation of the working limits of an electrical drive system. C6.4. Development of digital control based electrical drives fed by power electronic converters controlled by dedicated microprocessor or DSP based systems. C6.5. Development of a control system of reduced complexity of an industrial process using specific techniques and procedures.
Cross competences	CT1 Identification of the main objectives, available resources, completion conditions, work steps, work times, terms and related risks. CT3 Efficient use of documentation and communication resources and assisted professional training (on-line database, specific software and hardware solutions.

7. Discipline objectives (as results from the *key competences gained*)

7.1	General objective	To know the electrical drive systems with DC and AC machine fed by power converters. To know the scalar control, vector control and direct torque control of induction and synchronous machines, both in motor and generator regime.
7.2	Specific objectives	After the completion of this course, students will be able: – To chose and to control an electrical drive system for a specific application; – To integrate the electrical drive system in a motion control process or in a power generating process. – To identify, to design and to assembly the components of an adjustable speed electrical driving system (electrical machine, power converter, mechanical process, control system, digital computer); – To measure the parameters of an electrical drive system

8. Contents

8.1. Lecture (syllabus)	Number of hours	Teaching methods	Notes
The structure of a performant electreical drive system. Power flow componets and information Flow components.	2	Multimedia presentatio	
Basic principals of electrical drives. Mechanical elements and power efficiency of electrical drives, stability criteria and applications of electrical drives	2		
Electrical drive systems with DC machines feded by rectifiers nd choppers; control functions	4		
Control diagram of DC drive system	2		
Basic principals of three-phase AC electrical machines (IM and SM); rotating field, equations, characteristics	2		
Scalar control (U/f =ct) of AC drives	2		

Vector control of AC drives. Principals, equivalence with DC drive control, power converters for AC drives, control strategies.	8	n, group projects, case studies	
Direct torque control of AC drives	2		
Electrical drive systems with AC machines used for producing electrical energy. Constant speed generating systems and variable speed generating systems (renewable energy generating systems)	2		
Transducers and digital computing systems used for performant electrical drive systems. Modern control strategies	2		

Bibliography

. Kelemen, A.: *Acţionări electrice*. Ed. Didactică şi Pedagogică, Bucureşti, 1979.

2. Iulian Birou - *Metode performante de control in actionari electrice de curent alternativ*. Editura Casa cartii de stiinta, 1999.

3. Kelemen, A., Imecs, M.: *Sisteme de reglare cu orientare după câmp ale maşinilor de curent alternativ*. Lito I.P.C.N. 1987 sau Editura Academiei Române, Bucureşti, 1989.

4. Iulian Birou – Actionari electrice; Sisteme de reglare si control. Editura Mediamira, 2003

5. Kelemen, A., Imecs, M.: Electronică de putere. Ed. Didactică şi Pedagogică, Bucureşti, 1983.

8.2. Laboratory	Number of hours	Teaching methods	Notes
1.a. DC drive system with PM excitation, fed by power converter 1.b. Drive system with DC machine fed in both in rotor and stator by power converters	4		
2a. Drive system with DC machines for elevators (2 quadrant) 2b. Drive system with DC machines for 4 quadrant applications	4		
3a Control of a DC drive system fed by 4 quadrant rectifier 3b. Control of a DC drive system fed by 4 quadrant chopper	4		
4a. Electrical drive system with three-phase rotor winding induction machine. 4b. Scalar control of three-phase squirel-cage induction machine (DSP based open loop U/f=ct.)	4		
5a. AC drive system with induction machine fed by a current convertor 5b. Scalar control of three-phase induction machine (DSP based close-loop control U/f=ct. With initial boost voltage).	4		
6a. Vector control of an induction machine based on rotor field orientation fed by PWM voltage converter. 6b. Vector control of a permanent-magnet synchronous fed by PWM voltage converter.	4		
Final presentation and evaluation	4		

Bibliography

Acţionări electrice - Îndrumător pentru lucrări de laborator, versiune electronica, 2019

8.2 Project	Number of hours	Teaching methods	Notes
Specific project to design and compute an electrical drive application with DC or AC machine.	14		

Bibliography

Biroi I., Szabo Cs., Suciu V., Iuoras A., Szekely N.: Acţionări electrice – Elemente de teorie şi aplicaţii practice, UTPRESS Cluj-Napoca, 2024, ISBN 978-606737-726-2

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

5. Evaluation

Activity type	10.1 Assessment criteria	10.2 Assessment methods	10.3 Weight in the final grade
10.4 Course	Evaluation of the acquired knowledge during the course activities: theoretical and application-based exam	Written and oral exam (3h)	55%
10.5 Seminar/ Laboratory/Project	Evaluation of the acquired competences based on: - Activity during lab - theoretical and practical tests - portfolio	- portfolio presentation - tests	45%
10.6 Minimum standard of performance			
Completion and presentation of laboratory activities, laboratory portfolio presentation. Final examination. Minimum final grade for lab and project: 5. Minimum final grade for exam: 4.5			

Date of filling in:		Title Surname Name	Signature
27.08.2024	Lecturer	Prof. dr. ing. Iulian Birou	
		S.l. dr. ing. Szabo Csaba	
	Teachers in charge of application	S.l. dr. ing. Szabo Csaba	
		Asist. drd. ing. Mihai Suciu	

Date of approval in the department .....

September 2024

Head of Department:
Prof. Eng. MICU Dan Doru, PhD

Date of approval in the faculty .....

September 2024

Dean
Assoc. Prof.dr.Eng. Andrei CZIKER