



DEMec - Dep. of Mechanical Engineering

SAIC- Automation, Instrumentation and Control Section

Master in Mechanical Engineering

Plan of curricular unit

Electromechanical Systems

1st Year - 2nd Semester

2025/2026

Paulo Abreu

2026

Timetable

Hours	Monday	Tuesday	Wednesday	Thursday	Friday
10:30 - 11:00	SE (PL) 10:30 - 12:00 1MEM-A02 PFA L004				
11:00 - 11:30					
11:30 - 12:00					
12:00 - 13:00					
13:00 - 14:00					
14:00 - 14:30				SE (PL) 14:00 - 15:30 1MEM-PM01 MPB L004	
14:30 - 15:00					
15:00 - 15:30					
15:30 - 16:00	SE (PL) 15:30 - 17:00 1MEM-A01 MPB L004			SE (TP) 15:30 - 17:00 1MEM-EMG01 1MEM-PM01 1MEM-PM02 1MEM-A01 1MEM-A02 PFA B017	
16:00 - 16:30					
16:30 - 17:00					
17:00 - 17:30	SE (PL) 17:00 - 18:30 1MEM-PM02 MPB L004			SE (PL) 17:00 - 18:30 1MEM-EMG01 PFA L004	
17:30 - 18:00					
18:00 - 18:30					

Moodle page:

<https://moodle2526.up.pt/course/view.php?id=4964>

Curricular unit

En: https://sigarra.up.pt/feup/en/UCURR_GERAL.FICHA_UC_VIEW?pv_ocorrencia_id=558569

PT https://sigarra.up.pt/feup/pt/UCURR_GERAL.FICHA_UC_VIEW?pv_ocorrencia_id=558569

Work plan

2025-2026				Eletromechanical Systems (SE) Code: M.EM010	
Week.	Class	Class type	2026		Classes
1	1	TP	19	Feb.	Presentation of the curricular unit and its mode of operation. Structure of electromechanical drive systems. General principles of electromagnetism. Operating principles of electric motors.
		PL	19	Feb.	No class
2	1	PL	23	Feb.	PL1 - Power supply in electromechanical circuits. Presentation and functioning of PL classes.
	1	PL	26	Feb.	Production and distribution of electrical energy. DC and AC power sources. Identification of the circuit's electrical power requirements. Characterization of the main parameters of DC power supplies. Specification of a power supply for an electro-pneumatic circuit.
	2	TP	26	Feb.	DC brushed electric motors: working principle. Types of DC brushed motors: permanent magnet motors, series and parallel motors. Operating characteristics of DC motors: speed-torque curves.
3	2	PL	2	Mar.	PL2-DC motors with brushes. Demonstration of the operation and identification of the main components of DC motors with brushes; characteristic curves; circuits for reversal of the direction of rotation of dc motors; range of DC motors available on the market.
	2	PL	4	Mar.	
	3	TP	4	Mar.	Synchronous DC motors; BLDC motors. Three-phase induction AC motors: constitution, working principle; characteristics, torque-speed and current-speed curves. Induction AC motors Quiz on induction motors.
4	3	PL	9		PL3-DC Motors with Brushes: Dimensioning. Choosing and sizing permanent magnet DC motors with brushes.
	3	PL	11		
	4	TP	11	Mar	Three-phase induction AC motors. Analysis of rated characteristics. Single-phase induction motors, with capacitor start. Stepper motors. Working principle of permanent magnet stepper motors;
5	4	PL	16	Mar.	PL4-AC induction motors: constituent elements. Demonstration of the operation and identification of the main components of AC induction motors; characteristic curves; reversal of the direction of rotation
	4	PL	18	Mar.	
	5	TP	18	Mar.	Types of stepper motors: permanent magnet, variable reluctance and hybrids. Working principle;
6	5	PL	23	Mar.	PL5 AC Induction Motors: Dimensioning (1). Identification of the main components of AC induction motors; characteristic curves; electrical power in three-phase star and delta connection systems; nameplate of induction motors
	5	PL	25	Mar.	
	6	TP	25	Mar.	Servo motors and servo systems. Servomotor main components and operating principle. Transducers for angular and linear position measurement Characteristic curve of torque-speed for servomotors. Analysis of data from servomotors; manufacturers.
7		PL	30	Mar	Easter Holidays
		PL TP	2	Abr.	Easter Holidays
8		PL	6	Apr.	Easter Holidays
	6	PL	9	Apr.	PL6 AC Induction Motors: Dimensioning (2). Selection and dimensioning of three-phase induction AC motors: general procedure and particular considerations to be considered; exercise resolution.
	7	TP	9	Apr.	High-performance AC Motors> LSPM motors (line start permanent magnet), Permeant Magnet Synchronous Motor (PMSyncM), Synchronous Reluctance Motors (SyncRM), Permanent Magnet Synchronous Reluctance Motors (PMSyncRM) and Axial flux motors.
9	6	PL	13	Apr.	PL6 AC Induction Motors: Dimensioning (2). Selection and dimensioning of three-phase induction AC motors: general procedure and particular considerations to be considered; exercise resolution.
	7	PL	16	Apr.	PL7. Step-by-step motors: constituent elements. Main components and types of stepper motors. Drive system components. Stepper motors: dimensioning. Control and programming elements for stepper motors; drive to motor connections (unipolar 5/6 wires, bipolar 8 wires, parallel/series); characteristic curves.
	8	TP	16	Apr.	Selection of electric motors. Comparative analysis of electric motors: DC permanent magnet, DC wound, AC induction three-phase, Stepper motors, and Servomotors. Aspects to consider when sizing an electric motor for a given application. Starting and controlling induction motors. Direct on-line and reduced voltage starting methods. Soft starters and Variable frequency drivers (VFD).

10	7	PL	20	Apr.	PL7. Step-by-step motors: constituent elements. Main components and types of stepper motors. Drive system components. Stepper motors: dimensioning. Control and programming elements for stepper motors; drive to motor connections (unipolar 5/6 wires, bipolar 8 wires, parallel/series); characteristic curves.
	8	PL	23	Apr.	PL8 - AC Motors and Frequency Variables (VF): analysis. Analyze the implications of using frequency inverters (i.e., inverters, or variable speed drives) to control AC induction motors, including motor characteristics, functionalities, and choice of VF.
	9	TP	23	Apr	Soft starters and Variable frequency drivers (VFD): operating principle and technical characteristics. Electromechanical equipment for command and protection in electrical circuits. General concepts.
11	8	PL	27	Apr.	PL8 - AC Motors and Frequency Variables (VF): analysis. Analyze the implications of using frequency inverters (i.e., inverters, or variable speed drives) to control AC induction motors, including motor characteristics, functionalities, and choice of VF.
	9	PL	30	Apr.	PL9 - AC Motors and Frequency Variables (VF): selection. Use of frequency inverters
	10	TP	30	Apr	Switchgear components: push buttons, indicators, switches, relays. Features to consider for selection.
12		PL	4	May	Holiday: "Queima Fitas"
		TP	7	May	Holiday: "Queima Fitas"
13	9	PL	11	May	PL9 - AC Motors and Frequency Variables (VF): selection. Use of frequency inverters
	10	PL	14	May	PL10: Synchronous Servomotors (IP) Selection and dimensioning of synchronous, permanent magnet and controller (driver) servomotors.
	11	TP	14	May.	Electromechanical equipment: Contactors, disconnectors, load switches, circuit breakers, motor protection circuit breakers, fuses, thermal overload relays, monitoring relays, and residual current circuit breakers. Features to consider for selection. Trip curves of circuit breakers, thermal overload relays, and fuses.
14	10	PL	18	May	PL10: Synchronous Servomotors (IP) Selection and dimensioning of synchronous, permanent magnet and controller (driver) servomotors.
	11	PL	21	May	PL11 - Analysis of control and power circuits for electric motors. Main components of power circuits and control circuits for induction motors.
	12	TP	21	May	Mechanical transmission systems and feedback devices used with electrical motors.
15	11	PL	25	May	PL11 - Analysis of control and power circuits for electric motors. Main components of power circuits and control circuits for induction motors.
	12	PL	28	May	PL12 - Analysis of control and power circuits for electric motors. Main components of power circuits and control circuits for induction motors.
	13	TP	28	May.	Wiring for electromechanical systems. Electrical cable sizing. Motion and control systems. Analysis of the curricular unit. Clarification of doubts
16	12	PL	1	Jun.	PL12 - Analysis of control and power circuits for electric motors. Main components of power circuits and control circuits for induction motors.
		PL	4	Jun	Holiday
		TP	4	Jun.	Holiday
				Jun - july	Test & Exam

Note: Plan may change

Class TP Thursday	19 feb	26 feb	5 mar	12 mar	19 mar	26 mar	2 apr	9 apr	16 apr	23 apr	30 apr	7 may	14 may	21 may	28 may	4 jun
Ref.	1	2	3	4	5	6	easter	7	8	9	10	holiday	11	12	13	holiday

Class PL Thursday	19 feb	26 feb	5 mar	12 mar	19 mar	26 mar	2 apr	9 apr	16 apr	23 apr	30 apr	7 may	14 may	21 may	28 may	4 jun
Ref.	-	1	2	3	4	5	easter	6	7	8	9	holiday	10	11	12	holiday

Class PL Monday	23 feb	2 mar	9 mar	16 mar	23 mar	30 mar	6 apr	13 apr	20 apr	27 apr	4 may	11 may	18 may	25 may	1 jun
Ref.	1	2	3	4	5	easter	easter	6	7	8	holiday	9	10	11	12