



COMILLAS

UNIVERSIDAD PONTIFICIA

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CIHS

Syllabus
2025 - 2026

GENERAL INFORMATION

Data of the subject	
Subject name	Industrial Installations
Subject code	DIE-MII-524
Main program	Official Master's Degree in Industrial Engineering
Involved programs	Grado en Administración y Dirección de Empresas y Máster Universitario en Ingeniería Industrial [Fifth year] Grado en Administración y Dirección de Empresas y Máster Universitario en Ingeniería Industrial [Fifth year] Grado en Administración y Dirección de Empresas y Máster Universitario en Ingeniería Industrial [Fifth year] Máster Universitario en Ingeniería Industrial + Máster en Industria Conectada / in Smart Industry [First year] Máster Universitario en Ingeniería Industrial y Máster Universitario en Administración de Empresas [First year] Máster Universitario en Ingeniería Industrial + Máster in Motorsport, Mobility and Safety [First year] Máster Universitario en Ingeniería Industrial [First year] Máster Universitario en Ingeniería Industrial + Máster en Medioambiente y Transición Energética [First year] Máster Universitario en Ingeniería Industrial + Máster in Motorsport, Mobility and Safety [First year] Máster Universitario en Ingeniería Industrial + Máster in Smart Grids [First year] Máster Universitario en Ingeniería Industrial y Máster Universitario en Administración de Empresas [First year] Máster Universitario en Ingeniería Industrial y Máster Universitario en Sector Eléctrico [First year] Máster Universitario en Ingeniería Industrial y Máster Universitario en Sistemas Ferroviarios [First year] Máster Universitario en Ingeniería Industrial [First year] Máster Universitario en Ingeniería Industrial y Máster Universitario en Sector Eléctrico [First year] Máster Univ. en Ingeniería Industrial + Máster en Tecnologías Financieras: Pagos y Banca Digital [First year] Máster Universitario en Ingeniería Industrial y Máster en Industria Inteligente [First year]
Level	Posgrado Oficial Master
Quarter	Semestral
Credits	7,5 ECTS
Type	Obligatoria
Department	Department of Electrical Engineering Department of Mechanical Engineering
Coordinator	Álvaro Ortega Manjavacas

Teacher Information	
Teacher	
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DESCRIPTION OF THE SUBJECT

Contextualization of the subject

Prerequisites

The professional profile of the Master's Degree in Industrial Engineering requires a comprehensive knowledge of Electrical Engineering. This course builds upon the concepts covered in the undergraduate modules *Electric Circuits*, *Electrotechnics*, *Electromagnetic Fields*, and *Electrical Machines*.

As the degree grants professional engineering qualifications, Electrical and Mechanical Installations are a key pillar in the student's professional development, since a significant share of projects in the field of industrial engineering are carried out in the area of building and industrial facilities.

This is a professionally-oriented course. By the end of the semester, students will be capable of designing the most common types of medium-voltage (MV) and low-voltage (LV) electrical installations, as well as mechanical systems (plumbing, fire protection, thermal and acoustic insulation, etc.) in buildings and industrial environments.

Course contents

Contents

Topic 1: Principles of Electrical Installation Design

- 1.1 Regulations, standards, and design guidelines
- 1.2 Symbolism and interpretation of electrical diagrams
- 1.3 Electrical loads: types and characteristics
- 1.4 Installed, demanded, and contracted power

Topic 2: Design of Electrical Installations

- 2.1 Design process
- 2.2 Load forecasting and inventory of loads
- 2.3 Main characteristics of the electrical installation
- 2.4 Equipment selection criteria and construction details
- 2.5 Structure of industrial networks: single-line diagrams, power and lighting installations
- 2.6 Power factor correction and harmonic filtering
- 2.7 Electrical energy saving in industrial plants. Measurement devices. Supply supervision and control
- 2.8 Methods for verifying correct operation of the installation

Topic 3: Lighting

- 3.1 Fundamentals and general concepts
- 3.2 Lamps and luminaires
- 3.3 Indoor lighting
- 3.4 Lighting calculations: indoor, street and sports lighting
- 3.5 Emergency lighting and signage

Topic 4: Transformer Substations



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- 4.1 High-voltage supply
- 4.2 Procedure for setting up a new substation
- 4.3 Types of substations (underground, surface-mounted, pole-mounted)
- 4.4 Utility-owned and customer-owned substations. Electrical diagrams
- 4.5 Main components of a substation
- 4.6 Connection installations
- 4.7 Installation conditions for substations

Topic 5: Low Voltage Electrical Networks

- 5.1 Characteristics of the installation
- 5.2 General considerations: voltage drop, overheating, mechanical strength
- 5.3 Minimum cable sizing: voltage drop, thermal criteria, short-circuit conditions
- 5.4 Conductors: types and configurations
- 5.5 Electrical conduits: design criteria, types and materials
- 5.6 DC network calculations: single load, distributed loads, uniformly distributed loads, ring networks, split-end, branched loads, etc.
- 5.7 AC network calculations (single-phase and three-phase): capacitance between conductors, self-inductance, mutual inductance
- 5.8 Public distribution networks

Topic 6: Electrical Protections

- 6.1 Electrical hazards. Damage caused by electricity. Effects of electric current on the human body
- 6.2 Protection against electric shocks: direct and indirect contact
- 6.3 Protection of materials due to insulation faults
- 6.4 Electric shock protection systems
- 6.5 Neutral connection systems: TT, TN, and IT grounding schemes
- 6.6 Neutral and protective conductors
- 6.7 Short-circuit current calculation
- 6.8 Switchgear: functions, classifications, and general characteristics
- 6.9 Characteristic parameters of switching, control, and protection devices
- 6.10 Equipment selection
- 6.11 LV switchboards: control and protection boards, protection degrees
- 6.12 Grounding of exposed conductive parts
- 6.13 Protection with residual current devices
- 6.14 Surge protection: types of surges, surge protectors in LV and HV, lightning protection, shielding

Topic 7: Design of Special Electrical Installations

- 7.1 Design considerations for wet and damp locations
- 7.2 Design considerations for fire- and explosion-risk areas
- 7.3 Design considerations for public buildings
- 7.4 Installations in operating rooms and medical spaces
- 7.5 Electric vehicle charging installations
- 7.6 Batteries and rectifiers
- 7.7 Uninterruptible power supply systems (UPS)
- 7.8 Smart buildings, home automation
- 7.9 Network disturbances: problems and solutions

Topic 8: Fluid Transport Installations

- 8.1 Pipes, flanges, and anchors
- 8.2 Materials



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- 8.3 Valves
- 8.4 Expansion
- 8.5 Insulation
- 8.6 Water hammer

Topic 9: HVAC and Ventilation Systems

- 9.1 Pipes and ducts
- 9.2 HVAC systems
- 9.3 Types of equipment
- 9.4 Methodology for thermal load calculations

Topic 10: Acoustic Insulation Installations

- 10.1 Noise sources
- 10.2 Transmission
- 10.3 Insulating materials
- 10.4 Insulation methods
- 10.5 Noise measurement

Topic 11: Fuel Handling Installations

- 11.1 Connections
- 11.2 Storage, refueling, and dispensing
- 11.3 Pumping systems
- 11.4 Environmental treatment
- 11.5 Boiler rooms
- 11.6 Smoke evacuation

Topic 12: Safety and Fire Protection Installations

- 12.1 Materials
- 12.2 Equipment
- 12.3 Evacuation plans

Topic 13: Energy Efficiency Installations

- 13.1 Residential and commercial cogeneration
- 13.2 Solar thermal energy
- 13.3 Energy audits
- 13.4 Energy service companies (ESCOs)

EVALUATION AND CRITERIA

The use of AI to produce full assignments or substantial parts thereof, without proper citation of the source or tool used, or without explicit permission in the assignment instructions, will be considered plagiarism and therefore subject to the University's General Regulations.

Evaluation activities	Evaluation criteria	Weight
	• Conceptual understanding	



Midterm Exam	• Application of concepts to solve practical problems • Analysis and interpretation of results • Written presentation and communication	20 %
Class Attendance and Participation	• Active attendance and participation in class	15 %
Final Exam	• Final examination	30 %
Group Project Work	• Conceptual understanding • Application of concepts to solve practical problems • Analysis and interpretation of results • Written presentation and communication	35 %

Grading

Ordinary Examination Session

- **Final Grade** = 20% Midterm Exam + 30% Final Exam + 35% Group Project + 15% Class Attendance and Participation (if **Midterm Exam** ≥ 5.0)
- **Final Grade** = 0% Midterm Exam + 50% Final Exam + 35% Group Project + 15% Class Attendance and Participation (if **Midterm Exam** < 5.0)

Resit (Extraordinary) Examination Session

- **Final Grade** = 50% Resit Exam + 50% Group Project

In both sessions, the **overall weighted average** will only be calculated if:

- the weighted average of the exams (3/5 Electrical + 2/5 Mechanical), and
- the weighted average of the group projects (3/5 Electrical + 2/5 Mechanical) are both equal to or above 5.0 out of 10.

Missing more than **15% of classes** may disqualify the student from sitting the final exam in the ordinary session.

The use of AI to generate full assignments or substantial parts of them—without citing the source or tool used, or when not explicitly allowed in the assignment instructions—will be considered plagiarism and handled according to the University's General Regulations.

WORK PLAN AND SCHEDULE

Activities			Date of realization	
ELECTRICAL PART				
IN-PERSON ACTIVITIES	OUT-OF-CLASS ACTIVITIES	LEARNING RESULTS		



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WEEK							
	h/w	In Class Theory/Problems	Evaluation	h/w	Self-study of theoretical concepts	Problem solving	Mini- projects
		Introduction, Theory Topic 1 (2,5h)+					
1	3	Problems Topic 1 (0,5h)		1	Reading and study of theoretical content Topic 1 (1h)		1
2	3	Theory Topic 2 (2h)+ Problems Topic 2 (1h)		3	Reading and study of theoretical content Topic 2 (2h)	Completing assigned exercises Topic 2 (1h)	
							1, 2
3	3	Theory Topic 2 (2h)+ Problems Topic 2 (1h)		5	Reading and study of theoretical content Topic 2 (3h)	Completing assigned exercises Topic 2 (1h)	Mini- project Topics 1, 2, 3 (1h)
							1, 2
4	3	Theory Topic 3 (2h)+		5	Reading and study of theoretical content Topic 3 (2h)	Completing assigned exercises Topic 3 (1h)	Mini- project Topics 1, 2, 3 (2h)
		Problems Topic 3 (1h)					1, 2,4



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5	3	Theory Topic 3 (1h)+ _____	4,5	Reading and study of theoretical content Topic 3 (1,5h)	Completing assigned exercises Topic 3 (1h)	Mini- project Topics 1, 2, 3 (2h)	_____
		Problems Topic 3 (2h)					1, 2,4
6	3	Theory Topic 4 (2h)+ Problems Topic 4 (1h) _____ _____	5	Reading and study of theoretical content Topic 4 (3h)	Completing assigned exercises Topic 4 (2h)		_____ 1, 3
7	3	Performance Evaluation Test Topics 1 -4	5	Reading and study of theoretical content Topic 5 (3h)	Completing assigned exercises Topic 5 (2h)		_____ _____ _____ 1, 2
8	3	Theory Topic 5 (2h)+ Problems Topic 5 (1h)	7	Reading and study of theoretical content Topic 5 (3h)	Completing assigned exercises Topic 5 (2h)	Mini- project Topics 4, 5, 6 (2h)	_____ 1, 2
		Theory Topic 6 (1h)+ Problems Topic 6 (2h)		Reading and study of theoretical	Completing assigned exercises Topic 6 (1h)	Mini- project Topics 4, 5, 6 (2h)	



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9	3		4.5	content Topic 6 (1.5h)				
							1, 6	
10	3	Theory Topic 6 (1h)+ Problems Topic 6	5.5	Reading and study of theoretical content Topic 6	Completing assigned exercises Topic 6 (2h)	Mini- project Topics 4, 5, 6 (2h)		
							1, 6	
		(2h)		(1,5h)				
11	3	Theory Topic 7 (2h)+ Problems Topic 7	6	Reading and study of theoretical content Topic 7 (3h)	Completing assigned exercises Topic 7 (3h)			
							1, 4	
		(1h)						
12	3	Theory Topic 8 (2h)+ Problems Topic 8	2	Reading and study of theoretical content Topic 8 (1h)	Completing assigned exercises Topic 8 (1h)			
							1, 4	
		(1h)						
13	3	Theory Topic 9 (2h)+	6	Reading and study of theoretical content Topic 9 (3h)	Completing assigned exercises Topic 9 (2h)	Mini- project Topics 7, 8, 9 (1h)		
							1, 5	
		Problems Topic 9 (1h)						
14	3	Theory Topic 9 (1h)+	7	Reading and study of theoretical content Topic 9 (2h)	Completing assigned exercises Topic 9 (3h)	Mini- project Topics 7, 8, 9 (2h)		
							1, 5	
		Problems Topic 9 (2h)						



4	2	Theory Topic 11 (2h)		3	(3h)			1, 8			
					Reading and study of theoretical content Topic 11						
		Theory Topic 11 (2h)			(3h)			1, 8			
5	2	Problems Topic 11 (2h)		2,5	Completing assigned exercises Topic 11 (1,5h)	Mini-project Topic 11 (1h)	1, 8				
		Performance Evaluation Test									
6	2	Theory Topic 12 (1h)	Topics 10 and 11 (1h)	4	Reading and study of theoretical content Topic 12 (1,5h)	Completing assigned exercises Topic 11 (1,5h)	Mini-project Topic 11 (1h)	1, 9			
7	2			3							
		Theory Topic 12 (2h)					1, 9				
		Problems Topic 12 (1h)+ Theory Topic 13 (1h)			Reading and study of	Completing assigned exercises	Mini-project Topic 12				



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8	2	4,75	theoretical content Topics 12 (1,5h) y 13 (1,5h)	Topic 12 (0,75h)	(1h)		1, 9, 10
9	2	4,75	Reading and study of theoretical content Topic 13 (3h)	Completing assigned exercises Topic 12 (0,75h)	Mini-project Topic 12 (1h)		1, 10
10	2		Prueba Evaluation Rendimiento Topics 12 y 13				
		1,75	Problems Topic 13 (1h)	Completing assigned exercises Topic 13 (0,75h)	Mini-project Topic 13 (1h)	1, 10	
11	2	3,75	Reading and study of theoretical content Topic 14	Completing assigned exercises Topic 13 (0,75h)	Mini-project Topic 13 (1h)		1, 10
			Theory Topic 14 (2h)				
			Reading and study of				



12	2		2	theoretical content Topic 14 (2h)		1, 10	
		Theory Topic 14 (2h)					
13	2	Problems Topic 14 (2h)	2,5		Completing assigned exercises Topic 14 (1,5h)	Mini-project Topic 14 (1h)	1, 10
14	2		5,5	Reading and study of theoretical content Topic 15	Completing assigned exercises Topic 14 (1,5h)	Mini-project Topic 14 (1h)	
		Theory Topic 15 (2h)		(3h)			1, 11, 12, 13
15	2	Theory Topic 15	5	Reading and study of theoretical content Topic 15 (1,5h)	Completing assigned exercises Topic 15 (1,5h)	Mini-project Topic 15 (2h)	
		(1h)+ Problems Topic 15 (1h)					1, 11, 12, 13

BIBLIOGRAPHY AND RESOURCES

Basic References

Basic Resources

- Topic presentations available on Moodle
- Regulations and Technical Codes:
 - *Reglamento de Baja Tensión (RBT)*
 - *Reglamento de Alta Tensión (RAT)*
 - *Código Técnico de la Edificación (CTE)*
 - *Reglamento de Instalaciones Térmicas de Edificios (RITE)*
- Technical Documents and Catalogues:
 - *Guía de diseño de instalaciones eléctricas*, Schneider Electric
 - *Manual Teórico-Práctico de Instalaciones de BT*, Schneider Electric



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- *Lighting Manuals (Residential – Offices – Commercial)*, CEAC
- *Enclosure Fire Dynamics*, CRC Press
- *Fundamentos de climatización*, ATECYR
- *Fluid Mechanics*, McGraw Hill
- *ISOVER Guide to Thermal and Acoustic Insulation*
- *Energy Efficiency Publications*, IDAE
- Schneider Electric catalogues and technical notebooks

Additional References

- Schneider Electric – *Guía de diseño de instalaciones eléctricas*
- Schneider Electric – *Manual Teórico-Práctico de Instalaciones de BT*
- Jiménez, C. – *Lighting Manuals*, CEAC (1998)
- Karlsson, B., Quintiere, J.G. – *Enclosure Fire Dynamics*, CRC Press
- ATECYR – *Fundamentos de climatización*
- White, F.M. – *Fluid Mechanics*, McGraw Hill
- ISOVER – *Thermal and Acoustic Insulation Guide*
- IDAE – *Energy Efficiency and Saving Publications*

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