Course guide
340030 - SIEL-N - Electrical Systems

Last modified: 09/07/2026

Unit in charge: Vilanova i la Geltrú School of Engineering
Teaching unit: 709 - DEE - Department of Electrical Engineering.

Degree: BACHELOR'S DEGREE IN ELECTRICAL ENGINEERING (Syllabus 2009). (Compulsory subject).
BACHELOR'S DEGREE IN INDUSTRIAL DESIGN AND PRODUCT DEVELOPMENT ENGINEERING (Syllabus 2009). (Compulsory subject).
BACHELOR'S DEGREE IN MECHANICAL ENGINEERING (Syllabus 2009). (Compulsory subject).

Academic year: 2026 **ECTS Credits:** 6.0 **Languages:** Catalan

LECTURER

Coordinating lecturer: JOSEP FONT MATEU

Others: Primer quadrimestre:
Professors de Pràctiques:
FRANCISCO JOSÉ BALDERAS UYÁ - N3211, N3212, N3213, N3214,
JORDI BOADA RAFECAS - N3221, N3222
RAMON CAUMONS SANGRA - N3021, N3022,
JOSEP FONT MATEU - N3011, N3012.
Professors de teoria:
JOSEP FONT MATEU - N3011, N3012, N3021, N3022,N3211, N3212, N3213, N3214, N3221, N3222

PRIOR SKILLS

It is recommended to have completed the subjects of mathematics and physics.

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
1 Industri. CE10. Theoretical knowledge and use of circuits and electrical machines.
1 Disseny. D11. Knowledge of beginning of electric and electronic systems and its application to resolve engineering problems.
2 Disseny. D12. Knowledge of parts and function of basic electric power systems and its application to resolve engineering problems.
3 Disseny. D13. Knowledge of elements, laws and basic methods of electric circuit analysis and its application to resolve engineering problems.
4 Disseny. D14. Knowledge of electric machines constitutions and function and its application to resolve engineering problems.
5 Disseny. D15. Knowledge of constitution of electric installations and LUMINOTECNICAS

Transversal:
T1. EFFECTIVE USE OF INFORMATI0N RESOURCES - Level 2. Designing and executing a good strategy for advanced searches using specialized information resources, once the various parts of an academic document have been identified and bibliographical references provided. Choosing suitable information based on its relevance and quality.
T2. SELF-DIRECTED LEARNING - Level 2: Completing set tasks based on the guidelines set by lecturers. Devoting the time needed to complete each task, including personal contributions and expanding on the recommended information sources.

TEACHING METHODOLOGY

- In the theory and problem classes, the theoretical foundations of the programmed subjects will be exposed and developed. They will consist of theoretical explanations complemented with activities aimed at stimulating participation, discussion and critical analysis by students. Exercises corresponding to the subjects covered will be proposed and solved.
- During the laboratory hours, students will carry out the programmed practical exercises related to the theoretical topics. The laboratory activities will be evaluated through specific tests.
An assessable monographic work will be carried out regarding a topic of the subject.

LEARNING OBJECTIVES OF THE SUBJECT

To familiarize the student with the components, devices, machines and systems of Electrical Engineering.
To know the main forms of electricity generation from conventional and renewable sources.
To familiarize the student with the practice of electrical measurements.
To present the basic elements that form part of electrical circuits.
To use the equations that relate voltage and current.
To analyze direct and alternating current electrical circuits in permanent, single-phase and three-phase regimes.
To know the basic models of power transformers.
To identify the different components of an electrical installation.
To select the basic device for an electrical installation.
To know the principles of electrical pricing.
To introduce the basic aspects of lighting.
To know the main industrial applications of the different electrical machines.

STUDY LOAD

Type	Hours	Percentage
Hours large group	45,0	30.00
Hours small group	15,0	10.00
Self study	90,0	60.00

Total learning time: 150 h

CONTENTS

-Topic 1: Introduction to electrical systems.

Description:
1.1.- Introduction to Electrical Power Systems.
1.2.- Basic concepts of the generation, transport, distribution and use of electrical energy.
1.3.- Basic topological concepts of electrical circuits. Graphs.
1.4.- Topological laws of circuits. Matrix formulation
1.5.- Tellegen's theorem.

Specific objectives:
Introduce the student to the knowledge of the basic concepts of electrical systems.

Full-or-part-time: 9h 30m
Theory classes: 4h
Self study : 5h 30m

- Topic 2: Fundamentals of electrical circuits analysis.

Description:
2.1.- Constituent elements of electrical circuits. Linear and nonlinear models.
2.3.- 2-terminal LTI elements: Resistances, inductances and capacitances.
2.4.- Simple resistive circuits: series circuits. Parallel circuits. Series-parallel circuits.
2.5.- Independent voltage and current sources.
2.6.- Singular circuits.
2.7.- Analysis of simple circuits.
2.8.- Voltage divider and current divider
2.9.- Study of power in dc circuits.
2.10.- Equivalent Schemes.

Practice 1: Measurements in electrical circuits. Measuring devices.

Specific objectives:
- Study the constituent elements of electrical circuits.
- Solve simple direct current circuits with resistors.

Full-or-part-time: 17h
Theory classes: 5h
Laboratory classes: 2h
Self study : 10h

title english

Description:
3.1.- LTI Circuits with Resistances and Independent Current Sources.
3.2.- Generalized Formulation of Kirchhoff's Laws and OHM's Law
3.3.- General Circuit Analysis: Node Method.
3.4.- LTI Circuits with Resistances and Independent Current Sources and Independent Voltage Sources.
3.5.- General Circuit Analysis: Modified Node Method (MNA).

Practice 2: DC circuits.

Full-or-part-time: 9h
Theory classes: 3h
Self study : 6h

Topic 4: Single-phase alternating current circuits.

Description:
4.1.- Periodic waveforms.
4.2.- Sinusoidal waveforms.
4.3.- Analysis of single-phase circuits in sinusoidal steady state.
4.4.- Magnetic couplings.
4.5.- Application of theorems.
4.6.- Power in sinusoidal steady state.
4.7.- Power factor correction.

Practice 3 - AC Single-phase circuits.

Full-or-part-time: 20h
Theory classes: 6h
Laboratory classes: 2h
Self study : 12h

-Topic 5: Three-Phase Circuits

Description:
5.1.- Polyphasic Circuits.
5.2.- Three-Phase Circuits.
5.3.- Analysis of three-phase circuits in sinusoidal permanent regime.
5.4.- Millman's Theorem.
5.5.- Powers and power factor correction.
5.6.- Per unit method.

Practice 4 - AC three-Phase Circuits.

Full-or-part-time: 17h
Theory classes: 5h
Laboratory classes: 2h
Self study : 10h

-Topic 6: Transformers.

Description:
6.1.- The ideal and actual transformer.
6.2.- The single-phase transformer.
6.3.- The three-phase transformer.
6.4.- Autotransformer.
6.5.- Measurement transformers.

Specific objectives:
- Known about the main applications of transformers.
- Known the basic models of transformers.

Full-or-part-time: 12h
Theory classes: 4h
Self study : 8h

-Topic 7: Basic concepts of electrical installations.

Description:
7.1.- General ideas.
7.2.- Basic parts in an electrical installation.
7.3.- Low voltage electrical equipment.
7.4.- Safety in electrical installations.
7.5.- Calculation of the conductor cross-section.
7.6.- Pricing of electrical energy.

Practice 5 - Protection elements in LV electrical installations.

Specific objectives:
- Know the basic concept of electrical installation in BT (IEBT).
- Recognize the applicable legal regulations and how to find it.
- Know, identify and select the protection elements.
- Carry out calculations of conductor sections.

Full-or-part-time: 26h
Theory classes: 8h
Laboratory classes: 2h
Self study : 16h

-Topic 8: Lighting technology

Description:
8.1- Basic principles of lighting technology.
8.2- Fundamental quantities.
8.3.- Light generation. LED lamps.
8.4.- Photometry.
8.5.- Interior lighting. Regulations.
8.6.- Energy efficiency.

Full-or-part-time: 22h
Theory classes: 6h
Guided activities: 4h
Self study : 12h

-Topic 9: Introduction to electrical machines.

Description:
9.1.- Rotating electrical machines. Definition, constitution and classification.
9.2.- Losses. Torque. Efficiency.
9.3.- Rotating magnetic fields.
9.4.- Three-phase asynchronous motor. Constitution and operating principle.
9.5.- Power balance and characteristic curves of the three-phase asynchronous motor.
9.6.- Speed â□□â□□variation of the three-phase asynchronous motor.
9.7.- Direct current motor. Constitution and operating principle.

Practice 6.- Three-phase asynchronous motor. Starting and regulation methods.

Specific objectives:
- Provide the basic technological aspects of electrical machines and the service selected for specific applications.

Full-or-part-time: 14h
Theory classes: 4h
Laboratory classes: 2h
Self study : 8h

GRADING SYSTEM

Exams: E1 (PARTIAL), E2 (FINAL)
Practices: PR
Works: TR
QUALIFICATION = 0.31*E1+0.49*E2+0.15*PR+0.05*TR
Re-evaluation: Of the part corresponding to the E1 and E2 exams, according to the re-evaluation criteria fixed in the EPSEVG regulations.
The minimum requirement on the QUALIFICATION for assisting reavaluació is 2.

EXAMINATION RULES.

- The written tests are face-to-face and individual.
- In the laboratory practices, the previous preparation, the face-to-face work, the results and the knowledge achieved will be evaluated.

BIBLIOGRAPHY

Basic:
- Chua, Leon O; Desoer, Charles A; Kuh, Ernest S. Linear and nonlinear circuits . New York [etc.] : McGraw-Hill, cop. 1987. ISBN 0070108986.
- Salichs Vivancos, Miquel. Electrotècnia [Recurs electrònic] : teoria, problemes i exàmens resolts . Barcelona : CPDA, Publicacions d'Abast, Escola Tècnica Superior d'Enginyeria Industrial de Barcelona, Universitat Politècnica de Catalunya, 2007. ISBN 8496616215.
- Ras i Oliva, Enric. Teoría de circuitos : fundamentos . 3a ed. renovada. Barcelona : Ediciones Técnicas Marcombo, S.A., de Boixareu Editores, DL 1977. ISBN 8426702147.
- Ras i Oliva, Enric. TRANSFORMADORES. Barcelona : MARCOMBO, 1988. ISBN 8426706908.
- Fitzgerald, A. E; Kingsley, Charles; Kusko, Alexander. Teoría y análisis de las máquinas eléctricas . 2a ed. Barcelona : Hispano Europea, 1980. ISBN 8425505623.

Complementary:
- Johnson, David E. Análisis básico de circuitos eléctricos . 5a ed. México [etc.] : Prentice-Hall Hispanoaméricana, cop. 1996. ISBN 0130597597.
- Gago Calderón, Alfonso; Fraile, Jorge. Iluminación con tecnología LED. Madrid: Paraninfo, 2012. ISBN 9788428333689.
- Reglamento electrotécnico para baja tensión RD 842/2002 de 2 de agosto de 2002 actualizado según DR 560/2010, RD 1053/2014, Reglamento Delegado 364/2016 (CPR), RD 244/2019, RD 542/2020, RD 298/2021, RD-ley 29/2021, RD 450/2022, RD 145/2023, Instrucciones Técnicas Complementaria (ITC-BT) y Guía técnica de aplicación del REBT / Benilde Bueno. 8a ed.. Barcelona: Marcombo, 2024. ISBN 9788426738714.