Course guide
340101 - LIEL-E5O09 - Electrical Power Lines

Last modified: 04/06/2024

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 ELECTRONICS AND AUTOMATIC CONTROL ENGINEERING (Syllabus 2009). (Optional subject).
BACHELOR'S DEGREE IN MECHANICAL ENGINEERING (Syllabus 2009). (Optional subject).

Academic year: 2024 **ECTS Credits:** 6.0 **Languages:** Catalan, English

LECTURER

Coordinating lecturer: Josep Font i Mateu

Others: Josep Font i Mateu

PRIOR SKILLS

It is recommended to have basic knowledge in the subjects of physics, mathematics and electricity; of circuit analysis methods, electromagnetic field theory and circuit analysis in sinusoidal permanent regime, and computer calculation tools.
It is highly recommended to study the subjects of Electrical Machines and Circuit Theory.

REQUIREMENTS

Subjects: Fonaments matemàtics, Informàtica, Física 1, Física 2, Anàlisi de circuïts.

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
1. CE24. Knowledge of electrical power systems and its applications.
2. CE23. Ability to calculate and design power lines and electrical energy transport.

Transversal:
3. SUSTAINABILITY AND SOCIAL COMMITMENT - Level 3. Taking social, economic and environmental factors into account in the application of solutions. Undertaking projects that tie in with human development and sustainability.
4. EFFICIENT ORAL AND WRITTEN COMMUNICATION - Level 3. Communicating clearly and efficiently in oral and written presentations. Adapting to audiences and communication aims by using suitable strategies and means.

TEACHING METHODOLOGY

Theoretical, problem and practical classes with projection teaching material. The theoretical aspects of the proposed topics will be presented and developed in the theoretical classes. Participation, discussion, and critical analysis will be encouraged through active student participation in individual and group discussion and presentation activities.

In the problem classes, the approach and resolution of exercises corresponding to the subjects of the subject will be done, partly by the teacher and also by the students, individually and/or in groups.

Specific software for the subject will be applied to the practical classes. The students will prepare the subject of each session in advance, carry out the proposed studies and deliver a report of the activity with the calculations, results and conclusions.

As a directed activity, the students will do a group project during the course that they will choose from among those proposed by the teacher. They will present the results of the work to the rest of the students in class.

The subject's tasks are based on individual study, the student's search for information, and group work.

LEARNING OBJECTIVES OF THE SUBJECT

Parts and functions of the Electrical Power System (EPS). Modeling of Electrical Transport and Distribution Power Systems (ETDPS). Electrical lines parameters. ETDPS permanent sinussoidal analisys. ETDPS Project.

STUDY LOAD

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

Total learning time: 150 h

CONTENTS

Unit 1 - Electrical Power Systems, Introduction to the transport and distribution of electrical energy.

Description:
1. Electrical Power Systems (S.E.P.). Fundamental characteristics.
2. Historical evolution of the SEP.
3. Generation systems: Classic. Renewables
4. Evolution of the transmission of electrical energy.
5. DC and AC transmission.
6. Classification of electric lines. Lines with overhead cables and insulated cables.
8. Applications: Aerial, underground and submarine

Specific objectives:
Know the different types of S.E.P. , its fundamental parts, its functions and applications. Learn about the historical evolution of S.E.P. Learn how electrical energy is generated, classic non-renewable and renewable systems. Know the definitions and fundamental parameters of electric energy transport.

Related competencies :
. CE24. Knowledge of electrical power systems and its applications.
02 SCS N3. SUSTAINABILITY AND SOCIAL COMMITMENT - Level 3. Taking social, economic and environmental factors into account in the application of solutions. Undertaking projects that tie in with human development and sustainability.
04 COE N3. EFFICIENT ORAL AND WRITTEN COMMUNICATION - Level 3. Communicating clearly and efficiently in oral and written presentations. Adapting to audiences and communication aims by using suitable strategies and means.

Full-or-part-time: 6h
Theory classes: 2h
Guided activities: 2h
Self study : 2h

Unit 2 - Modeling of Electric Energy Transport and Distribution Systems.

Description:
Analysis of lines in permanent mode.

1. Per unit method applied to Electrical systems.
2. Models of homogeneous lines with concentrated parameters.
3. Models of homogeneous lines with uniformly distributed parameters.
4. Permanent alternating current lines. Hyperbolic equations.
5. Classification of lines according to their length.
6. Equivalent 4-pole circuits, pi & T models.
7. Calculation of electrical quantities in an elementary line-load system. Voltage drop and performance.

Related competencies :
. CE23. Ability to calculate and design power lines and electrical energy transport.

Full-or-part-time: 12h
Theory classes: 6h
Practical classes: 2h
Self study : 4h

Unit 3 - Calculation of the parameters of lines with aerial cables.

Description:
Calculation of airline parameters.
1. Parameters of an airline, definitions.
2. Resistance. Skin and proximity effects.
3. Magnetic field of an electric line
4. Inductance. Self-inductance and mutual inductances.
5. DMG, RMG, transpositions.
6. Electric field of a power line.
7. Capacity, with and without the influence of the ground.
8. Conductances, insulation and corona effect.

Full-or-part-time: 12h
Theory classes: 6h
Practical classes: 2h
Self study : 4h

Unit 4 - Calculation of the parameters of lines with insulated cables.

Description:
Topic 4: Calculation of the parameters of lines with underground cables.
1. Insulated cables, definition, types.
2. Isolations. Type and conditions of service.
3. Electrical parameters, in unipolar cables.
4. Electrical parameters in multipolar cables.
5. Thermal study of an insulated cable. Permanent thermal analysis. Thermal analysis in cc.
6. Thermal study of a buried cable. Terrain characteristics.
7. Comparison between air transport and underground transport.

Full-or-part-time: 12h
Theory classes: 6h
Laboratory classes: 2h
Self study : 4h

Topic 5 - Analysis of the Electrical Systems of Transport and Distribution in a permanent regime.

Description:
Analysis of distribution networks in permanent mode.

1. Distribution networks
2. Radial networks
3. Ring networks
4. Transformers and generators in distribution networks
5. Calculation programs

Related competencies :
. CE23. Ability to calculate and design power lines and electrical energy transport.

Full-or-part-time: 10h
Theory classes: 4h
Practical classes: 2h
Self study : 4h

Unit 6 - Introduction to the project of transport and distribution lines.

Description:
Introduction to the regulations for lines and networks, transport and distribution projects.

1. Low Voltage Electrotechnical Regulations.
1.1 Safety conditions in low voltage lines
2. Regulation of High Voltage Lines.
2.1 Safety conditions in high voltage lines
3. Choice of tension.
4. Calculation of the section of the conductors.
5. Mechanical calculation of airline lines. Calculation of chains of insulators.
9. Topography of the line

Full-or-part-time: 29h
Theory classes: 6h
Laboratory classes: 2h
Guided activities: 15h
Self study : 6h

GRADING SYSTEM

Exams.: E1 (PARCIAL), E2 (FINAL)
Practice: PR
Works: TR
QUALIFICACIÓ = 0.3*E1+0.5*E2+0.15*PR+0.05*TR
Re-evaluation: there will be a re-evaluation test for the part corresponding to the exams, according to the re-evaluation criteria set out in the regulations of the EPSEVG

EXAMINATION RULES.

Theory: individual writing exam.
Practic work : practic work + report + exam.
Activitat dirigida: presentation + exam.

BIBLIOGRAPHY

Basic:
- Grainger, John J.; Stevenson, William D., Jr. Análisis de sistemas de potencia [on line]. México [etc.]: McGraw-Hill, 1996 [Consultation: 29/01/2024]. Available on: https://ebookcentral.proquest.com/lib/upcatalunya-ebooks/detail.action?pq-origsite=primo&docID=3196480. ISBN 9701009088.

Complementary:
- Nasar, Syed A. Sistemas eléctricos de potencia. México, [etc.]: McGraw-Hill, 1991. ISBN 9684227973.
- Weedy, B. M. Sistemas eléctricos de gran potencia. Barcelona [etc.]: Reverté, 1978. ISBN 8429130942.
- Ong, Chee-Mun. Dynamic simulation of electric machinery : using MATLAB/SIMULINK. Upper Saddle River, N.J: Prentice Hall PTR, 1998. ISBN 0137237855.
- Ras Oliva, Enrique. Teoría de líneas eléctricas : de potencia, de comunicación, para transmisión en continua. 2a ed. Barcelona: Universidad Politécnica de Catalunya. ETS Ingenieros Industriales : Marcombo, 1985. ISBN 8460058921.

RESOURCES

Audiovisual material:
- Ordinador PC pràctiques
- Canó, projector + Pc aules

Computer material:
- MATLAB - SIMULINK
- Programa-Soft
- Programa