Subject	ELECTRIC TECHNOLOGY OF PHOTOVOLTAIC SYSTEMS
Credits	6 ECTS (4T+2P)
Character	PV-systems track
Semester	1st
Language	Spanish

Competences

CG5 - Informationmanagement: to search for and manage appropriate bibliographic resources efficiently, to learn to continue studies in a largelyautonomous way as a basis for future research and innovation activity.

CG7 - Work in international contexts: To carry out asubstantial research process with academic seriousness and integrity, integrated in an R+D+i group with international projection.

CG8 - Apply methodologies,procedures, tools and state-of-the-art standards for the creation of new technological components; build new hypotheses andmodels, evaluate them and apply them to problem solving

CG9 - Communicate judgments and knowledge to specialized and non-specialized audiences in a reasoned, clear andunambiguous manner.

CB6 - Possess and understand knowledge that provides a basis or opportunity for originality in the development and/or application of ideas, often in a research context.

CB7 - Students should be able to apply their acquired knowledge and problem-solving skills in new or unfamiliar environments within broader (or multidisciplinary) contexts related to their area of study.

CB8 - That students are able to integrate knowledge and face the complexity of making judgments based on incomplete or limited information, including reflections on the social and ethical responsibilities linked to the application of their knowledge and judgments.

CB9 - Students should be able to communicate their conclusions and the ultimate knowledge and rationale behind them to specialized and non-specialized audiences in a clear and unambiguous manner.

CB10 - That students possess the learning skills that will enable them to continue studying in a manner that will be largely self-directed or autonomous.

CT4 - Team leadership: tocarry out team work (such as those of some of the evaluation activities of the subjects), to integrate into a research group by activelyparticipating in its meetings, collaborating with own initiative in R+D+i works or projects; to interact effectively with the membersof the multidisciplinary work team.

CE1 - Understanding, analyzing and judging the relevance of any contribution in this field, in relation toits social, energetic and scientific-technical environment.

CE5 - Design, analysis, characterization, planning and installation of general purpose, stand-alone orgrid-connected photovoltaic components and systems.

CE7 - Analyze, design and implementphotovoltaic systems of medium-high complexity

CE9 - Apply the services andtools available in the market to the design of photovoltaic systems

Outcomes

RA01 - Knowing how a photovoltaic systems engineering project is carried out.

RA2 - General training on the applications, the practical use of photovoltaic systems and a perspective on photovoltaic technology.

RA13 - Know the specific engineering tools for the design, analysis and evaluation of grid-connected photovoltaic buildings.

RA19 - Know the practical aspects of the installation.

RA21 - Apply the knowledge acquired in electrical engineering of photovoltaic systems.RA30 - Knowledge of safety measures in photovoltaic power plants.

RA31 - Knowledge of the particularities of the PV energy in the network.

RA48 - Apply the services and tools available on the market to the design of photovoltaic systems.

Description and syllabus

The objective of the course is to provide students with the key concepts of electrical engineering that they will need to be able to develop solar photovoltaic installation projects, both at the level of self-consumption and at the level of local energy communities and large photovoltaic power plants. Throughout the course there will be laboratory practices that will complement the concepts learned in the classroom. Schematically, the syllabus includes:

1. Power system

    Electric power generation subsystem. Power plants.

    Transmission network

    MV distribution network

    LV distribution network

    Transformer substations

2. LV distribution

    Applicable regulations (REBT, UNE standards, CTE, etc.).

    Types of distribution lines. Overhead, subway, mixed.

    Distribution systems. TT, TN and IT diagrams.

    Connections

    Interconnection Installations

3. Calculation of the section of conductors

    Types of AC and DC electrical conductors.

    Conductor cross-section calculation using the maximum admissible current criterion.

    Conductor cross-section drop using the voltage drop criterion.

4. Electrical protections

    Protections against overloads and short circuits. Fuses and circuit breakers. Selectivity

    Protection against direct and indirect contacts. Differential protection

Protection against overvoltage.

5. Grounding

Contact and step voltage.

Parts of a grounding installation.

Electrodes. Protective conductors. Derivations of the main line.

Calculation of ground resistance and measurements

6. Modeling of generators and transformers. The system per unit.

Principle of alternator operation.

Alternator model.

Isolated network operation

Infinite power network operation

Operating principle of the transformer.

Transformer equivalent circuit

System per unit.

7. Transmission line parameters

Line parameters

8. Power flow in electrical systems

Admittance matrix

Solving the flow equations (Newton-Raphson)

9. Power system stability, P-f control and voltage control

Transient stability

Power-frequency control

Secondary regulation

Voltage and reactive power control

Practical and laboratory

1. Visit to the ETSIT transformer station

2. Practices of electrical protections

3. Measurement of grounding resistance.

4. Design and dimensioning of an electrical installation of a house with photovoltaic self-consumption.

5. Simulation of the load flow of an electrical power system.

6. Simulation of the stability of the electrical system. Control actions