Code: ICAR/05 **Credits: 9**
Course: Electric Power Systems
Main language of instruction: Italian

Teaching Staff

Head instructor
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Prerequisites

To take the exam in "Electrical Systems for Energy," students must have passed the following courses: Analysis II, General Physics I, and Thermodynamics. It should be noted, however, that within the theoretical framework of "Electrical Systems for Energy," concepts and tools from General Physics II and Electrical Engineering are frequently applied. Therefore, it is strongly recommended to have passed at least one of these two exams. Some basic concepts in Electrical Engineering, essential for a proper understanding of the course, will be reviewed in Module I (Electrical Engineering Fundamentals). Additional reviews will be provided in the video lectures as needed.

Objectives

Knowledge and Understanding:
Understanding of the physical quantities used to characterize three-phase alternating current (AC) electrical circuits.
Understanding of the structure of the electrical energy system and the technical and economic characteristics of the electricity supply service.
Knowledge of the main components of medium and low voltage electrical installations.
Knowledge of methodologies for analyzing an electrical installation under normal operating conditions.
Knowledge of methodologies for analyzing an electrical installation under abnormal operating conditions.

• Applying Knowledge and Understanding:
Ability to size an electrical line.
Ability to calculate short-circuit currents in an electrical installation.

• Making Judgements:
Ability to select an appropriate type of switching device for the protection of electrical installations under abnormal operating conditions.
Critical ability to interpret results obtained during numerical exercises, both in terms of physical consistency and in terms of the engineering feasibility of the proposed solution.

• Communication Skills:
Development of a correct and comprehensible scientific language that enables clear and unambiguous expression of technical knowledge acquired in medium and low voltage electrical installations.

Syllabus

1. *Programme of the course:*

Module 1 – Fundamentals of Electrical Engineering
Review of electrical engineering fundamentals: direct current (DC), alternating current (AC), single-phase circuits, three-phase circuits.

Module 2 – Overview of the Electrical Energy System
Technical and economic advantages of three-phase alternating current. Structure of the electrical energy system. Characteristics of the electricity supply service: from generation centers to points of utilization.

Module 3 – Electricity Market
Structure and organization of the Electricity Market.

Module 4 – Electrical Lines
Overview. Representation of the structure of electrical lines. Operating conditions and sizing of electrical lines.

Course organization

The course is delivered through pre-recorded audio-video lectures, which, along with slides, handouts, exercises, and previous exams, constitute the study materials available on the platform. Additionally, asynchronous self-assessment tests are provided to accompany the pre-recorded lectures, enabling students to verify both their comprehension and the knowledge acquired from each lecture. Interactive learning takes place in the "virtual class" forum and includes two e-tivities that apply the theoretical knowledge to solve practical and theoretical problems in electrical installations. These activities require students to develop calculation codes in Matlab/Simulink.

In particular, the Electrical Systems for Energy course grants 9 ECTS credits. The total study load for this module ranges from 200 to 230 hours, distributed as follows: approximately 150 hours for viewing and studying recorded materials (25 hours of recorded theory lectures and 5 hours of exercises), around 40 hours for Interactive Learning dedicated to the completion and submission of 2 e-tivities, and about 10 hours of Interactive Learning for the self-assessment tests. It is recommended to spread the study of the course evenly over an 8-week period, dedicating between 20 and 25 hours of study per week.

Evaluation system and criteria

The exam consists of a written test aimed at assessing the students' ability to analyze and elaborate on acquired concepts, along with a series of *e-tivities* completed during the course in virtual classrooms. The *e-tivities* are evaluated continuously throughout the course, with a score from 0 to 5 points. The final exam is scored from 0 to 25 points and may be taken in written form either at the Rome campus or at other educational centers, subject to student registration.

The written exam includes one exercise on solving an electrical circuit, one exercise on electrical line sizing, and one or two additional exercises covering other course topics. The written test assesses the expected learning outcomes in terms of subject knowledge and the ability to apply it, while the *e-tivities* assess communication skills, the ability to draw conclusions, and self-directed learning ability continuously throughout the course.

Bibliography and resources

COURSE MATERIALS PROVIDED BY THE University

Recommended Texts:

2. *Mangoni V., Carpinelli G., Varilone P., "Elements of Medium and Low Voltage Electrical Installations," University of Cassino Press.*
3. *Gatta F.M., "Electrical Installations," Esculapio Press, 2015.*
4. *Mangoni V., Carpinelli G., "Introduction to Electrical Energy Systems," University of Cassino Press, 2001.*
5. Power Systems: Fundamental Concepts and the Transition to Sustainability" di Daniel S. Kirschen (Autore), John Wiley & Sons Inc, 2024