Course guide
820141 - ASEPE - Analysis of Electrical Power Systems

Last modified: 02/10/2025

Unit in charge: Barcelona East School of Engineering
Teaching unit: 709 - DEE - Department of Electrical Engineering.

Degree: BACHELOR'S DEGREE IN ELECTRICAL ENGINEERING (Syllabus 2009). (Optional subject).
BACHELOR'S DEGREE IN ENERGY ENGINEERING (Syllabus 2009). (Optional subject).

Academic year: 2025 **ECTS Credits:** 6.0 **Languages:** Catalan, Spanish

LECTURER

Coordinating lecturer: JUAN JOSE MESAS GARCIA

Others: Primer quadrimestre:
JUAN JOSE MESAS GARCIA - Grup: M11

PRIOR SKILLS

Students of Bachelor's degree in Electrical Engineering: Those acquired in the subjects CALCULUS, ALGEBRA AND MULTIVARIABLE CALCULUS, NUMERICAL CALCULUS - DIFFERENTIAL EQUATIONS, ELECTRICAL SYSTEMS, CIRCUITS AND SIGNALS, ELECTRICAL MACHINES I / II, LOW AND HIGH VOLTAGE ELECTRICAL INSTALLATIONS I / II, ELECTRIC POWER SYSTEMS.

Students of Bachelor's degree in Energy Engineering: Those acquired in the subjects CALCULUS, ALGEBRA AND MULTIVARIABLE CALCULUS, NUMERICAL CALCULUS - DIFFERENTIAL EQUATIONS, ELECTRICAL SYSTEMS, ELECTRICAL ENERGY GENERATION, ELECTRICAL ENERGY TRANSMISSION AND DISTRIBUTION.

REQUIREMENTS

SISTEMES ELÈCTRICS DE POTÈNCIA - Prerequisit

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
CEELE-24. Understand electrical power systems and their applications.

Transversal:
07 AAT N1. SELF-DIRECTED LEARNING - Level 1. Completing set tasks within established deadlines. Working with recommended information sources according to the guidelines set by lecturers.
07 AAT N2. 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

The teaching methodology used in this subject can be divided into three parts:

- Master classes: theory and problems (30%)
- Laboratory sessions (10%)
- Individual work based learning (60%)

LEARNING OBJECTIVES OF THE SUBJECT

To provide knowledge on the analysis and operation of electric power systems:

- Load flow study.
- Stability analysis.
- Economic operation of power systems.

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

1. Load flow study

Description:
1.1. Introduction.

1.2. Multiport representation of a power system.

1.2.1. Basic concepts.
1.2.2. Bus admittance matrix.

1.3. Formulation of the load flow problem.

1.3.1. Classification of variables.
1.3.2. Power equations.
1.3.3. Classification of buses.

1.4. Resolution of the load flow problem.

1.4.1. General solution of the load flow problem.
1.4.2. Calculation of bus voltages.

1.4.2.1. Gauss-Seidel method.
1.4.2.2. Newton-Raphson method.
1.4.2.3. Fast decoupled method.

1.5. Linearized or DC load flow.

1.6. Power flow control.

Full-or-part-time: 52h 30m
Theory classes: 15h
Laboratory classes: 7h 30m
Self study : 30h

2. Stability analysis

Description:
2.1. Introduction.

2.2. Electrical equations of a synchronous machine.

2.3. Power system response to big disturbances (transient stability).

2.3.1. Motion equations of a synchronous machine.
2.3.2. Generator - infinite power bus systems.
2.3.3. Numerical resolution of the motion equations.
2.3.4. Multimachine systems.

2.4. Power system response to small disturbances (steady-state stability).

2.4.1. Generator - infinite power bus systems.
2.4.2. Multimachine systems.

2.5. Methods to improve power system stability.

Full-or-part-time: 52h 30m
Theory classes: 15h
Laboratory classes: 7h 30m
Self study : 30h

3. Economic operation of power systems

Description:
3.1. Introduction.

3.2. Nonlinear function optimization.

3.2.1. Function optimization without constraints.
3.2.2. Function optimization with equality constraints.
3.2.3. Function optimization with inequality constraints.

3.3. Economic dispatch of generation.

3.3.1. Operating costs of thermal generation.
3.3.2. Economic dispatch neglecting losses.
3.3.3. Economic dispatch neglecting losses and including generator limits.
3.3.4. Economic dispatch including losses.

Full-or-part-time: 45h
Theory classes: 15h
Self study : 30h

GRADING SYSTEM

The final Mark of the Subject (N_Asig) is calculated, rounded to the nearest tenth, using the formula

N_Asig = 0.172 • N_ExPar + 0.494 • N_ExFin + 0.167 • N_TP1 + 0.167 • N_TP2

where

N_ExPar is the Midterm Exam Mark
N_ExFin is the Final Exam Mark
N_TP1 is the Practice Assignment 1 Mark
N_TP2 is the Practice Assignment 2 Mark

IMPORTANT REMARKS:

- IT IS COMPULSORY to carry out the Practice Assignments proposed in the laboratory sessions to pass the subject.
- This subject does NOT have a Re-assessment Exam.

EXAMINATION RULES.

- The Midterm Exam and the Final Exam are individual, in-person and written.
- In addition to writing utensils, it is only permitted to have one sheet with formulas (a single original handwritten A4 sheet) to be delivered to the professor at the end of each of the exams, and a calculator without external connectivity (no mobile phone or tablet can be used as such).
- Maximum punctuality is kindly requested.

BIBLIOGRAPHY

Basic:
- Gómez Expósito, Antonio. Análisis y operación de sistemas de energía eléctrica. Madrid [etc.]: McGraw Hill Interamericana, 2002. ISBN 944813592X.
- Grainger, John J.; Stevenson, William D., Jr.. Análisis de sistemas de potencia [on line]. México [etc.]: McGraw-Hill Interamericana, 1996 [Consultation: 15/04/2020]. Available on: https://ebookcentral.proquest.com/lib/upcatalunya-ebooks/detail.action?docID=3196480. ISBN 9781615028825.
- Barrero, Fermín. Sistemas de energía eléctrica. Madrid: Paraninfo, cop. 2004. ISBN 8497322836.
- Ramírez Rosado, Ignacio J. [et al.]. Problemas resueltos de Sistemas de Energía Eléctrica. Madrid: Paraninfo, cop. 2014. ISBN 8497324083.