COMILLAS
UNIVERSIDAD PONTIFICIA
ICAI ICADE CIHS

Syllabus
2025 - 2026

TECHNICAL SHEET OF THE SUBJECT

Data of the subject

Subject name	Power Systems Analysis
Subject code	DIE-GITI-431
Mainprogram	Bachelor's Degree in Engineering for Industrial Technologies
Involved programs	Grado en Ingeniería en Tecnologías Industriales [Fourth year]
Level	Reglada Grado Europeo
Quarter	Semestral
Credits	6,0 ECTS
Type	Optativa (Grado)
Department	Department of Electrical Engineering
Coordinator	Francisco Miguel Echavarren Cerezo
Schedule	Check official timetables
Office hours	monday to friday de 9 a 19, c/ Francisco de Ricci 3

Teacher Information

Teacher

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Teacher

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SPECIFIC DATA OF THE SUBJECT

Contextualization of the subject

Contribution to the professional profile of the degree

In the professional profile of the graduate in Engineering in Industrial Technologies with an electrical option, this subject expands the electrical knowledge acquired in the subjects of "Electrotechnics" (2nd year) and "Electric Energy Systems" (3rd year).

Students must acquire a general knowledge of the EES structure, the physical laws that govern its operation and the models and methods for analyzing them, both in equilibrium and imbalance conditions.

At the end of the course, students should be able to calculate and design power lines from the point of view of their ability to transport

electricity and their role in the electrical system. They will have fundamental knowledge about electrical power systems and their applications. They will finally be able to perform analysis under unbalanced and short-circuit conditions.

Prerequisites

Related subjects: “Electrotechnics” (2nd year); “Electric Power Systems” (3rd year).

Competencies - Objectives

Competences

GENERALES	
CG01	Capacidad para el desarrollo de proyectos en el ámbito de la Ingeniería Industrial.
CG03	Conocimiento en materias básicas y tecnológicas, que les capacite para el aprendizaje de nuevos métodos y teorías, y les dote de versatilidad para adaptarse a nuevas situaciones.
CG04	Capacidad de resolver problemas con iniciativa, toma de decisiones, creatividad, razonamiento crítico y de comunicar y transmitir conocimientos, habilidades y destrezas en el campo de la Ingeniería Industrial.
ESPECÍFICAS	
CEE06	Conocimiento sobre sistemas eléctricos de potencia y sus aplicaciones

Learning outcomes

RA1	Conocer los elementos que componen un Sistema Eléctrico de Potencia y saber asociar a cada elemento el modelo adecuado para cada tipo de análisis.
RA2	Calcular los diferentes parámetros y modelos de líneas eléctricas en sus diferentes configuraciones
RA3	Conocer y saber aplicar las técnicas de análisis de los Sistemas Eléctricos de Potencia en régimen permanente, en especial las orientadas a la resolución del flujo de cargas
RA4	Conocer las técnicas de análisis de desequilibrios en sistemas trifásicos y saber aplicarlas a la resolución de averías y cortocircuitos en Sistemas Eléctricos de Potencia.

THEMATIC BLOCKS AND CONTENTS

Contents - Thematic Blocks

1 - Parameters and models of power lines: Basic model of a line, series impedance and parallel admittance; model simplification, elimination of passive conductors, reduction to equivalent conductors, reduction to equivalent single-phase; line modeling, distributed parameters, characteristic impedance and propagation constant, equivalent models.

2 - Unbalanced three-phase networks: Symmetrical components, Fortescue's theorem, application to three-phase circuits; sequence modeling of loads, generators, lines and transformers; Simulation of unbalanced circuits, phase-to-ground fault, phase-to-phase fault, phase-to-ground fault; Introduction to matrix techniques.

3 - Load flow: Operation of electrical energy systems in permanent regime; charge flow equations, nodal admittance matrix; resolution methods, Gauss Seydel, complete Newton Raphson and fast decoupling; simplified DC model of the active equations, fast analysis of contingencies.

4 - Control of electrical energy systems: Description of the different control systems associated with electrical energy systems: power frequency regulation, primary regulation, area control, secondary regulation; reactive voltage control, QV control elements.

TEACHING METHODOLOGY

General methodological aspects of the subject

Con el fin de conseguir el desarrollo de competencias propuesto, tanto las sesiones presenciales como las no presenciales promoverán la implicación activa de los alumnos en las actividades de aprendizaje.

In-class Methodology: Activities	
Lección magistral	CG01, CG03, CG04, CEE06
Resolución de problemas	CG01, CG03, CG04, CEE06
Prácticas laboratorio	CG01, CG03, CG04, CEE06
Evaluación	CG01, CG03, CG04, CEE06

Non-Presential Methodology: Activities	
Estudio autónomo teoría (T)	CG01, CG03, CG04, CEE06
Resolución de Problemas (P)	CG01, CG03, CG04, CEE06
Repaso y profundización (R)	CG01, CG03, CG04, CEE06

SUMMARY STUDENT WORKING HOURS

CLASSROOM HOURS		
Clase magistral y presentaciones generales	Resolución de problemas de carácter práctico o aplicado	Prácticas de laboratorio
28.00	28.00	4.00
NON-PRESENTIAL HOURS		

Trabajos de carácter práctico individual o de grupo	Estudio de conceptos teóricos fuera del horario de clase por parte del alumno
30.00	90.00
	ECTS CREDITS: 6,0 (180,00 hours)

EVALUATION AND CRITERIA

The use of AI to produce full assignments or substantial parts thereof, without proper citation of the source or tool used, or without explicit permission in the assignment instructions, will be considered plagiarism and therefore subject to the University's General Regulations.

Evaluation activities	Evaluation criteria	Weight
Intermediate test topic 1 - Parameters and models of power lines Intermediate test topic 2 - Unbalanced three-phase networks Intermediate test topic 3 - Load flow Final test	15% intermediate test topic 1 15% intermediate test topic 2 15% intermediate test topic 3 35% Final test	80
Simulation lab PSS/E	Two sessions, 5% each	10
Weekly short quiz	Average score will count a 10%	10

Ratings

Ordinary call:

The final qualification of the subject will be carried out considering different evaluation methods. The criteria for calculating the final grade in the ordinary call will be:

Exams 80%

- Intermediate test topic 1 15%
- Intermediate test topic 2 15%
- Intermediate test topic 3 15%

Final test 35% (minimum grade of 5.0 to pass the Exams)

Simulation lab 10%

Weekly quiz 10%

TOTAL 100%

Extraordinary call:

The final mark will be obtained by giving a weight of 70% to the examination of the extraordinary call and 30% to the final grade obtained in the ordinary call.

Class attendance is mandatory according to Article 93 of the General Regulations (Reglamento General) of Comillas Pontifical University and Article 6 of the Academic Rules (Normas Académicas) of the ICAI School of Engineering. Not complying with this requirement may have the following consequences: students who fail to attend more than 15% of the lectures may be denied the right to do the final exam (and even the retake exam)

WORK PLAN AND SCHEDULE

Activities	Date of realization	Delivery date
Intermediate test topic 1 - Parameters and models of power lines	13/10/2022	13/10/2022
Intermediate test topic 2 - Unbalanced three-phase networks	10/11/2022	10/11/2022
Intermediate test topic 3 - Load flow	1/12/2022	1/12/2022
Simulation lab PSS/E session 1	30/11/2022	30/11/2022
Simulation lab PSS/E session 2	7/12/2022	7/12/2022

BIBLIOGRAPHY AND RESOURCES

Basic Bibliography

A. Gomez-Exposito, A. J. Conejo and C. Canizares, Electric Energy Systems: Analysis and Operation. CRC Press, 2008.

W. D. Stevenson, Elements of Power System Analysis. McGraw-Hill, 1982.

O. I. Elgerd, Electric Energy Systems Theory: An Introduction. Tata McGraw-Hill, 1983.

Complementary Bibliography

1 - Parámetros y modelos de líneas eléctricas:

T. A. Short, Electric Power Distribution Handbook, Second Edition. CRC Press, 2014.

IEC Standard 60287, Electric Cable - Calculation of the Current Rating.

2 - Redes trifásicas desequilibradas:

P. M. Anderson, Analysis of Faulted Power Systems. IEEE Press, 1995.

S. H. Horowitz, A. G. Phadke and J. K. Niemira, Power System Relaying. Wiley, 2013.

3 - Flujo de cargas:

T. van Cutsem, Voltage Stability of Electric Power Systems. Springer Science & Business Media, 2007.

A. J. Wood and B. F. Wollenberg, Power Generation, Operation, and Control. Wiley, 2012.

4 - Control de los sistemas de energía eléctrica

P. Kundur, N. J. Balu and M. G. Lauby, Power System Stability and Control. McGraw-Hill, 1994.

P. M. Anderson, Power System Protection. McGraw-Hill, 1999.

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