COMILLAS
UNIVERSIDAD PONTIFICIA
ICAI ICADE CIHS

Syllabus
2025 - 2026

GENERAL INFORMATION

Data of the subject	
Subject name	Power System Protection
Subject code	DIE-GITI-433
Mainprogram	Bachelor's Degree in Engineering for Industrial Technologies
Involved programs	Grado en Ingeniería en Tecnologías Industriales [Fourth year]
Credits	6,0 ECTS
Type	Optativa (Grado)
Department	Department of Electrical Engineering

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DESCRIPTION OF THE SUBJECT

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Contextualization of the subject

Prerequisites

Three phase balanced AC electric circuits

Electric machines (transformers, generators, motors)

Electric power systems (equivalent circuit of transmission lines, unbalanced analysis of electric power systems by symmetrical components)

Course contents

Contents

Theory

1. Principles of protection systems

1. Definition of a protection system.
2. Features of a protection system.
3. Components of a protection system.
4. Protective relays. Timing. Measured variable. Logical inputs.
5. Main and back-up protections.

2. Protection of medium voltage distribution power lines

1. Medium voltage power lines and grid.
2. Overcurrent protection. Definite time and inverse time protections. Phase and neutral protections.
3. Directional overcurrent protection. Polarizing magnitude.

3. Protection of power transformers

1. Introduction.
2. Faults in power transformers.
3. Own protection of power transformers.
4. Electrical protections. Differential protection. Overcurrent protection. Ground restrained. Overload. V/Hz.
5. Protection schemes.

4. Protection of high voltage transmission power lines

1. Introduction.
2. Distance protection..
3. Differential protection.
4. Directional ground overcurrent protection.
5. Overload protection of cables.
6. Communications.
7. Reclosers.
8. Protection schemes

5.Busbar protections

1. Substation busbars. Substation configurations.
2. Distance protection. Differential protection. Breaker failure protection.

6. Generator protection

1. Principles of generator protection.
2. Generator control.
3. Fault types.
4. Protection actuation.
5. Ground faults. Stator ground protection. Rotor ground protection.
6. Phase to phase faults. Differential protection. Distance protection. Overcurrent protection.
7. Out-of-range protections. Stator overload. Rotor Overload. Inverse sequence. Overvoltage.
8. Abnormal protections. Loss of excitation. Loss of synchronism. Inverse power. Minimum power. Overfreqauency.Overspeed. Incidental energization.Beaker failure. Shaft currents.
9. Protection schemes.

7. Motor protection

1. Introduction.
2. Common motor protections. Stator ground. Interwinding faults. Overload. Inverse sequence. Blocked rotor. Minimum voltage. Miniimum power.
3. Synchronous motor protection. Rotor overcurrent. Loss of excitation. Minimum frequency.
4. Protection schemes.

Laboratory

1. Introduction

Security. Working table. Injection device PT-50-CET. Verification of the injection device. Synchronization between the injection device and the working table. Confirmation with ampere meters.

2. Protection of medium voltage distribution power lines

AREVA MiCON P125/P126/P127 protection. Settings calculation. Time definite and time inverse overcurrent protection tests. Directional overcurrent gund protection tests.

3. Protection of power transformers

Protection GE T345. Settings calculations. Differential protection characteristic test.

4. Protection of high voltage transmission power lines

AREVA MiCOM P543/P544/P545/P546 protection. Settings calcuation. Three phase, phase-to-phase and phase-to-ground fault tests.

5. Generator protection

GE G60 Protección . Settings calculation. Inverse sequence protection test. Loss of excitation protection test.

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
Final exam	Multichoice test + 2 problems	56
Three intermediate exams	Multichoice test + 1 problem each	24
Laboratory test session and report Final laboratory exam	Laboratory test session and report (50%) Final laboratory exam (50%)	20

Grading

Ordinary call

- The grades of theory and laboratory must be higher than 5.
- Only the part with a grade lower than 5 must be examined in the extraordinary call.
- The absence of more than 15% of the classes may lead to the loss of the opportunity to take the final exam.
- AI cannot be used in any exam or intermediate assessment test.
- 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.

Extraordinary call

- The grades of theory and laboratory must be higher than 5.
- AI cannot be used in any exam or intermediate assessment test.
- 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.

BIBLIOGRAPHY AND RESOURCES

Basic References

P. Montané, "Protecciones en las Instalaciones Eléctricas: Evolución y Perspectivas", Segunda Edición, Marcombo, Barcelona, 1993.

Advanced References

- S. H. Horowitz, A. G. Phake, "Power System Relaying", Second Edition, Research Studies Press Ltd., Tauton, 1995.
- Alstom, "Network Protection & Automation Guide - NEW Edition", disponible en http://www.alstom.com/grid/products-and-services/Substation-automation-system/protection-relays/Network-Protection-Automation-Guide-NEW-2011-Edition/
- ABB, "Protective Relaying. Theory and Applications", Marcel Decker, New York, 1994.