

DIE-GITI-341 Electrical Measurement

SEMESTER: Spring

CREDITS: 6 ECTS (4 hrs. per week: 2 Theory + 2 Lab, on average)

LANGUAGE: Spanish

DEGREES: GITI

Course overview

This course is an introduction to electrical measurement. The main objectives of the course are: (i) the knowledge and calculations of measurement accuracy both for direct measurements and complex measurements, (ii) the knowledge and practical use of the most relevant electrical measurement devices, and (iii) the practical design and implementation of electrical measurement methods.

Prerequisites

Basic knowledge on electric circuits, including alternating- and direct- currents circuit analysis.

Course contents

Theory:

1. Uncertainty of measurement. Errors and uncertainty. Accuracy of measurement devices. Estimation of uncertainty in measurement.
2. Resistance measurement. Voltage and current method. Comparison method. Wheatstone bridge. Resistance measuring devices.
3. Low resistance measurement. Voltage and current method. Milliohmmeter and microohmmeter
4. Insulation measurement. Voltage and current method. Insulation tester.
5. Earth resistance measurement. Characteristics of an electrical grounding system. Earth/ground resistance tester.
6. Oscilloscope. Fundamentals of oscilloscope. Voltage and current probes and transducers. Vector measurement in AC.
7. Reactance measurement. LCR tester.
8. Measuring transformers. Measuring transformers characteristics and accuracy. Precision class. Ratio error. Phase angle error. Burden.
9. Energy meter. Power metering units / power quality analyzer. Characteristics and use.

10. Digital processing of analogue signals. Sampling. Aliasing. Quantization. Frequency domain analysis.
11. Characteristics of ferromagnetic materials. Hysteresis and Foucault currents. Power losses curve. Dynamic characteristics (B–H, S–H). Dynamic cycle.

Laboratory:

There will be a total nine 2-hour sessions, including the lab exam.

- P1. Resistance measurement
- P2. Low resistance, high resistance and earth resistance measurement
- P3. Oscilloscope
- P4. Measuring transformers
- P5. Energy meter. Power metering units / power quality analyzer.
- P6. Digital processing of analogue signals
- P7. Losses curve of a ferromagnetic material
- P8. Characteristics of ferromagnetic materials in AC
- P9. Exam

Textbook

- Chacón, Francisco J., Medidas eléctricas para ingenieros, Colección ingeniería, Universidad Pontificia Comillas, 2007.
- Tumanski, S., Principles of electrical measurement, Taylor & Francis, 2006.

Grading

The following conditions must be accomplished to pass the course:

- A minimum grade in theory and laboratory of at least 5 over 10 is needed.
- The final grade will be 50% theory grade and 50% laboratory grade.

The theory grade is obtained as follows:

- One–minute paper: 10%.
- Mid–term exam: 30%.
- Final exam: 60%.

The laboratory grade is obtained as follows:

- Pre-lab work: 30%.
- Lab. report: 30%.
- Lab exam 40%.