COURSE DETAILS

"FONDAMENTI DI MISURE"

SSD ING-INF/07

DEGREE PROGRAMME: BACHELOR DEGREE IN COMPUTER ENGINEERING

ACADEMIC YEAR: 2023-2024

GENERAL INFORMATION – TEACHER REFERENCES

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GENERAL INFORMATION ABOUT THE COURSE

INTEGRATED COURSE (IF APPLICABLE): N.A.

MODULE (IF APPLICABLE): N.A.

CHANNEL (IF APPLICABLE): N.A.

YEAR OF THE DEGREE PROGRAMME (I, II, III): III

SEMESTER (I, II): I

CFU: 6

REQUIRED PRELIMINARY COURSES (IF MENTIONED IN THE COURSE STRUCTURE "REGOLAMENTO")

Fondamenti di Circuiti, Fisica Generale II.

PREREQUISITES (IF APPLICABLE)

None.

LEARNING GOALS

Provide the basic theoretical foundations of measurement. Inform and train the student on the founding concepts of measurement theory, on the main measurement methodologies and procedures and on the basic tools for the analysis of signals in the time and amplitude domain. Enable the student to understand and use the basic instrumentation for the analysis of signals in the time and amplitude domain, to adequately interpret the technical specifications and to correctly present the measurement results.

EXPECTED LEARNING OUTCOMES (DUBLIN DESCRIPTORS)

Knowledge and understanding

The student must demonstrate knowledge and understanding of the basic problems related to the definition of a measurement procedure, starting from the definition of the measurand to the final expression of the measurement result in accordance with current recommendations. To this end, he must demonstrate that he knows how to elaborate arguments concerning the relationships in order to identify the links between the different sources of uncertainty starting from the concepts learned that are presented during the theoretical lessons.

Applying knowledge and understanding

In the light of the acquired knowledge, the student must demonstrate the ability to implement measurement procedures that are suitable for the specific measuring and the available measurement instrumentation. Particular attention is given to the competence that the student acquires in linking the different theoretical notions in order to enucleate a possible solution to the problem that is presented to him during the lessons in the classroom or in the exam session.

COURSE CONTENT/SYLLABUS

The International System: fundamental and supplementary units. National Reference Standards. Architecture of a generic digital measuring instrument. Classification of signals. Metrological characteristics of measuring instruments. Category A and category B uncertainties. Interpretation of specifications from a measuring instrument manual. Assessment of global uncertainty. Extended uncertainty. Expression of uncertainty in absolute and relative value. The significant figures. Propagation of uncertainties in indirect measurements: Probabilistic and deterministic approach. Compatibility of measures.

Time-domain measurements using numerical counter: direct frequency measurement, direct period measurement, absolute and relative resolution, measurement uncertainty, universal graphs and reciprocal counters; Time interval measurement and phase shift measurement of isofrequency signals.

Measurements in the amplitude domain: simple integration voltmeter, double ramp voltmeter, multi-ramp voltmeter; relationship between measurement time and resolution; metrological characteristics of DC voltmeters; AC voltmeters: peak detector, peak-to-peak detector, voltmeter with true effective value; Features AC voltmeters; Numerical multimeters: resistance measurement with two and four terminals; Current measurement.

Analog-to-digital converters, architecture and operating principle of the main ADCs: FLASH, SAR, Interleaved and pipelined. ADC characterization: static characterization, dynamic characterization; gain and offset error, INL, DNL and ENOB.

Digital-to-analog converters, architecture and operating principle of the main DACs: Weighted resistors and R-2R.

Frequency domain measurement: filter bank spectrum analyzer; variable tuning spectrum analyzer; superheterodyne spectrum analyzer; numerical spectrum analyzer; Resolution and selectivity of a spectrum analyzer.

READINGS/BIBLIOGRAPHY

Ernest O. Doebelin,"*Strumenti e metodi di misura*", McGraw-Hill Education, 2008.
G. Zingales, "*Misure elettriche. Metodi e strumenti*", Utet Università, 1992.
"*JCGM 100:2008 Evaluation of measurement data - Guide to the expression of uncertainty in measurement*", BIPM, 2010
Notes and handouts of the teacher.

TEACHING METHODS

The teacher will use:
a) lectures for about 70% of the total hours,
b) exercises to deepen theoretical aspects for about 20% of the total hours
c) laboratory to deepen the applied knowledge for about 10% of the total hours.

EXAMINATION/EVALUATION CRITERIA

a) Exam type:

Exam type	
written and oral	
only written	X
only oral	
project discussion	
other	

In case of a written exam, questions refer to:	**Multiple choice answers**	
	Open answers	X
	Numerical exercises	

b) Evaluation pattern: