UNIVERSITÀ DEGLI STUDI DI PALERMO

DEPARTMENT	Ingegneria
ACADEMIC YEAR	2023/2024
MASTER'S DEGREE (MSC)	ELECTRONICS ENGINEERING
SUBJECT	ELECTRONIC INSTRUMENTS AND MEASUREMENTS FOR AUTOMATION AND TELECOMMUNICATIONS
TYPE OF EDUCATIONAL ACTIVITY	B
AMBIT	50364-Ingegneria elettronica
CODE	20515
SCIENTIFIC SECTOR(S)	ING-INF/07
HEAD PROFESSOR(S)	ARTALE GIOVANNI Ricercatore a tempo determinato Univ. di PALERMO
OTHER PROFESSOR(S)	
CREDITS	9
INDIVIDUAL STUDY (Hrs)	153
COURSE ACTIVITY (Hrs)	72
PROPAEDEUTICAL SUBJECTS	
MUTUALIZATION	
YEAR	1
TERM (SEMESTER)	2° semester
ATTENDANCE	Not mandatory
EVALUATION	Out of 30
TEACHER OFFICE HOURS	**ARTALE GIOVANNI** Monday 09:00 11:00 Electric and electronical measurement laboratory Wednesday 09:00 11:00 Electric and electronical measurement laboratory

DOCENTE: Prof. GIOVANNI ARTALE

PREREQUISITES	Electrotechnics, electronic and electric and electronic measurements knowledge
LEARNING OUTCOMES	D.1: KNOWLEDGE AND UNDERSTANDING Students are expected to acquire knowledge and understanding basis concerning: data acquisition board,PC-based instruments, digital signa processingi, virtual instruments, frequency analysisi, analog and digital spectral analyser. D.2: APPLYING KNOWLEDGE AND UNDERSTANDING Students are expected to apply their knowledge and understanding skills in order to be able to realise automatic measurement systems and virtal instruments for the analysis in the time and frequency domain. D.3: MAKING JUDGMENTS Students are expected to integrate their knowledge and increase their critical faculties for approaching problems and making judgements concerning the choice of the basic components of a measurement system, starting from the available information, components technical specifications and requirements of the applications being studied. D.4: COMMUNICATION SKILLS Students are expected to clearly communicate their knowledge, analysis and conclusions on electrical and electronics instrumentation and measurement methods of the principal electrical parameters . In doing this, students are expected to address both specialist and non-specialist audiences, with correct use of language. D.5: LEARNING SKILLS Students are expected to develop methodological skills and abilities of connection and reworking of knowledge about electrical and electronic measurements and related interdisciplinary contexts. Thanks to this, students will be able to carry out further studies or professional activities with a high degree of autonomy, in those areas where knowledge and skills gained can be helpfully applied.
ASSESSMENT METHODS	EXAMS OUTLINE Practical test and oral exam, both mandatory. Practical test is on the laboratory experiences developed during the course. Test duration is 1,5 hours. At the end of the test, the student shall describe the developed work with the examiner. Before continuing with the oral exam, the student must pass the practical test. The oral exam is a discussion with essay questions on the whole course programme after the practical test. Practical test looks at: - knowledge and understanding of instrumentations and laboratory experiences. Oral exam looks at: - knowledge and understanding of the course programme; applying such skills for problem solving within the course or related contexts; - correct use of language, clearness, fluency; concepts reinterpretation, critical faculties, and connection skills in disciplinary or interdisciplinary contexts. Marks are out of 30 for both tests. Minimum mark for passing each test: 18/30. Final mark: mean of practical test and oral exam marks. ASSESSMENT CRITERIA For each test, marks are awarded considering to what extent the student has achieved the learning outcomes. The following scheme can be assumed for reference (see learning outcomes section, descriptors D.1-D.5). Best fit applies when learning outcomes are met at different levels. 28-30 / 30 with distinction D.1/D.2: full contents mastery; no errors; self-corrections/integrations of inaccuracies/omissions; correct and rigorous approach to problems; correct, complete and effective solutions; some originality evidence D.3/D.4/D.5: effective concepts reworking, coherent and autonomous approaches and judgments, disciplinary/interdisciplinary connections; very clear presentation, structured arguments, correct use of language. 24-27 D.1/D.2: good knowledge and understanding of course contents; few minor errors, partially fostered self-corrections or integrations; good approach to problems, essentially correct solutions; D.3/D.4/D.5: good coherence in linking concepts and approaching disciplinary or

	related subjects; good presentation, adequate use of language. 18-23 D.1/D.2: sufficient knowledge of contents; feasible approach to problems although with limited autonomy, acceptable solutions; errors or omissions not serious; D.3/D.4/D.5: sufficient concepts links within disciplinary contexts, although tentative and guided; basic presentation and use of language. below 18 (mark not awarded) D.1-D.5: learning outcomes are not sufficiently met.
EDUCATIONAL OBJECTIVES	Knowing the main features and types of automatic measurement systems and digital signal processing in time and frequency domain.
TEACHING METHODS	Video Lectures, exercises and laboratory experiences
SUGGESTED BIBLIOGRAPHY	Dispense del corso fornite dal docente / Lecturer course slides Materiale di consultazione utile / Useful reference material: NI Tutorials, white papers e datasheets (www.ni.com) Keithley Instruments handbook “Understanding New Developments in Data Acquisition, Measurement, and Control” (www.keithley.com) Measurement and Computing “Data Acquisition Handbook” (www.mccdaq.com)

SYLLABUS

Hrs	Frontal teaching
3	Automatic Measurement Systems (AMS). AMS for physical quantities. AMS types, general principles, basic architecture. Measurement chain, AMS components.
10	Signal acquisition and digital processing. Analog-to-digital (A/D) conversion. Signals sampling, quantization and coding. Conversion time. Sample-hold. Single-channel and multi-channel systems. Multiplexed and simultaneous sampling systems. Shannon’s theorem. Aliasing. Harmonic analysis of digital signals. DFT, FFT. Observation window and frequency resolution. Synchronous and asynchronous sampling. Spectral leakage, scallop loss. Window functions.
3	Measurement on passive and active componets with simulation programming (Pspice)
8	Analog spectral analyser.Digital frequency analysis and digital spectral analyser.. Analog modulation techniques (10h)
8	Data acquisition boards (DAQ). Types, features, technical specifications. selection criteria. Analog input/output (AIO): number of channels. Reference single-ended (RSE), differential, pseudo-differential/non reference single-ended (NRSE) channels. Input range and polarity. Resolution. Gain. Accuracy specifications. Sampling frequency. Multiplexed or simultaneous sampling DAQ. Analog triggers. Digital input/output (DIO). Number of lines/ports. Signal level. Open collector and active drive configuration. Counters/timers.

Hrs	Practice
15	Use of digital spectral analyser, Use of analog spectral analyser, Amplitude and frequency modulation measurements with analog spectra analyser and digital oscilloscope.Measurement on passive and active components
14	LabVIEW programming fundamentals.
11	LabVIEW programming: basic exercises. Virtual instruments development in LabVIEW environment for time and frequency domain signal analysis. Development of AMS and PC-based instruments; components choice, AIO and DIO conditioning accessories sizing: case studies development and discussion; datasheets analysis. Examples of measurement instruments control (through GPIB and LabVIEW). Examples of generation and acquisition of analog/digital signals (through DAQ boards and LabVIEW).