



UNIVERSITÀ DEGLI STUDI DI PALERMO

DEPARTMENT	Ingegneria
ACADEMIC YEAR	2021/2022
MASTER'S DEGREE (MSC)	ELECTRONICS ENGINEERING
SUBJECT	MICROWAVE INSTRUMENTS AND MEASUREMENTS
TYPE OF EDUCATIONAL ACTIVITY	B
AMBIT	50364-Ingegneria elettronica
CODE	19698
SCIENTIFIC SECTOR(S)	ING-INF/01
HEAD PROFESSOR(S)	LIVRERI PATRIZIA Professore Associato Univ. di PALERMO
OTHER PROFESSOR(S)	
CREDITS	6
INDIVIDUAL STUDY (Hrs)	102
COURSE ACTIVITY (Hrs)	48
PROPAEDEUTICAL SUBJECTS	
MUTUALIZATION	
YEAR	2
TERM (SEMESTER)	1° semester
ATTENDANCE	Not mandatory
EVALUATION	Out of 30
TEACHER OFFICE HOURS	LIVRERI PATRIZIA Tuesday 12:00 13:00 DEIM

DOCENTE: Prof.ssa PATRIZIA LIVRERI

PREREQUISITES	Electromagnetic fields Microwave Microwave electronics
LEARNING OUTCOMES	At the end of the course, the student will be able to plan and analyze instruments for measurements in the field of Electronics (from RF to Microwave to Millimeter). In particular, the student will be able to understand the problems related to electronic microwave measurements with particular emphasis reference to satellite applications. Ability to apply knowledge and understanding The student will be able to use the knowledge of the instrumentation for the characterization of single components or electronic systems operating at high frequencies. In particular, he will be able to characterize DUT in terms of noise, scattering parameters, linear and non-linear behavior. Judgment autonomy The student will be able to interpret the measurement data, will be able to identify the data necessary for the evaluation of the specifications, to compare them with numerical models to be developed for this purpose; finally he will be able to interpret the effectiveness of the instrumentation and then test it. Communication skills The student will acquire the ability to communicate and express problems concerning the subject of the course, will be able to hold conversations for solve problems and design benches for microwave measurements including considerations on the use of software for computer-aided management of the equipment at his disposal. Learning ability The student will learn the interactions between the functioning of the electronic instrumentation and the characterization of DUT and the use of different methods to communicate effectively.
ASSESSMENT METHODS	Practice Test and Oral Test. The assessment is based on the following criteria: a) excellent (30 - 30 with honors): excellent knowledge of the topics, excellent language property, good analytical ability, the student is able to apply knowledge to solve problems proposed; b) very good (26 - 29): good command of the topics, full language properties, the student is able to apply the knowledge to solve the proposed problems; c) good (24 - 25): basic knowledge of the main topics, fair language property, with limited ability to apply autonomously the knowledge to solve the proposed problems; d) satisfactory (21-23): does not have full command of the topics main teachers but has the knowledge, satisfactory language properties, poor ability to apply independently the knowledge acquired; e) sufficient (18 - 20): minimum basic knowledge of the topics main teaching and technical language, very scarce or no ability to independently apply the knowledge acquired f) insufficient: does not have a minimum acceptable knowledge of contents of the topics covered in the teaching.
EDUCATIONAL OBJECTIVES	This course aims at providing an overview of modern electronic instruments, mainly modeling and simulation, which today are unique elements. By introducing a few unknown notions to match the background culture of the student, who will rearrange them to this end, the student will be able to develop new interpretation mechanisms.
TEACHING METHODS	Lessons and Laboratory
SUGGESTED BIBLIOGRAPHY	Dispense fornite dal docente Microwave Measurements (3rd Edition) ISBN: 9780863417351 e-ISBN: 9780863412523

SYLLABUS

Hrs	Frontal teaching
20	Microwave measurable parameters, recalling of circuits characterisation (scattering parameters) Measurement uncertainty Detectors: operating principles, applications, mixers Power measurements: power standards and sensors, power measurement methods Power measurements: errors and total uncertainty in power measurement, comparison between the different measurement sensors, measurement configuration Attenuation measurements Spectrum analyzers: introduction and properties, resolution, sweep time Radar Systems: from the underground to the outer SpaceRadar Equation, Radar Cross Section, Radar Adaptivity: Antenna Based Signal Processing TechniquesDigital Array RadarPhased Array Radar SystemThe role of multitarget tracking radar in surveillance systemsPhased Array Radar
Hrs	Workshops
36	Power Measurement Spectrum Analyzers: amplitude measurements and visualizations, accuracy of the amplitude measurement, dynamic range, extending the frequency range Measurements with spectrum analyzer network analyzer: analyzer structure of networks, oscillators brushed direct and indirect synthesis, key sections of the network analyzer, errors, calibration procedures Measurements with scalar network analyzer network analyzer: errors, procedures calibration, measurements of linear components noise: noise figure definition of an amplifier, phase noise Measurements with vector network analyzer measuring phase noise: description, operating principle Measurements with vector network analyzer of Field measurements and SAR Measurement of noise figure and phase noise measurements on antennas, definitions and fundamental parameters Measurements of high-power amplifier devices Radar Measurements