UNIVERSITÀ DEGLI STUDI DI PALERMO

DEPARTMENT	Ingegneria
ACADEMIC YEAR	2022/2023
MASTER'S DEGREE (MSC)	ELECTRONICS AND TELECOMMUNICATIONS ENGINEERING (FULLY ONLINE)
SUBJECT	RADAR THEORY AND TECHNIQUES
TYPE OF EDUCATIONAL ACTIVITY	D
AMBIT	20582-A scelta dello studente
CODE	22084
SCIENTIFIC SECTOR(S)	ING-INF/01
HEAD PROFESSOR(S)	LIVRERI PATRIZIA Professore Associato Univ. di PALERMO
OTHER PROFESSOR(S)	
CREDITS	9
INDIVIDUAL STUDY (Hrs)	162
COURSE ACTIVITY (Hrs)	63
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	Antennas and Wireless Systems
LEARNING OUTCOMES	Knowledge and fundamental skills related to radar systems, remote sensing, inverse scattering, and microwave imaging as well as notions on antenna arrays for radar systems. Knowledge and understanding: Acquisition of basic principles of radar detection and signal processing. Applying knowledge and understanding: Ability to quantitatively solve radar detection problems in different scenarios. Solution of inverse and optimization problems. Making judgements: Ability to identify and compare the most appropriate methods for studying real problems. Communication skills: Ability to present orally. Ability to write a lab report using technical language. Learning skills: Learning assessment may also be carried out on-line depending on specific circumstances required
ASSESSMENT METHODS	Oral discussion of a final work. GRADES 30-30 and laude: Excellent. Full knowledge and understanding of concepts and methods of the discipline, excellent analytical skills even in solving original problems; excellent communication and learning skills. 27-29: Very good. Very good knowledge and understanding of concepts and methods of the discipline; very good communication skills; very good capability of concepts and methods applications. 24-26: Good. Good knowledge of main concepts and methods of the discipline; discrete communication skills; limited autonomy for applying concepts and methods for solving original problems. 21-23: Satisfying. Partial knowledge of main concepts and methods of the discipline; satisfying communication skills; scarce judgment autonomy. 18-20: Acceptable: Minimal knowledge of concepts and methods of the discipline; minimal communication skills; very poor or null judgement autonomy. Non acceptable: Insufficient knowledge and understanding of concepts and methods of the discipline.
EDUCATIONAL OBJECTIVES	The course Principles of Radar will cover the following topics: 1) Basics of radar functioning and radar nomenclature 2) Radar components 3) Radar equation 4) Radar detection theory 5) Coherent and incoherent radar 6) Clutter and detection in clutter 7) Radar target tracking 8) Moving target detector
TEACHING METHODS	Recorded lessons
SUGGESTED BIBLIOGRAPHY	1) Radar Priciples, Peyton Z. Peebles, John Wiley & Sons Inc, United States (1998). ISBN 10: 0471252050 ISBN 13: 9780471252054 2) Radar Principles, Nadav Levanov, Wiley, ISBN-10 : 0471858811, ISBN-13 : 978-0471858812 4) Synthetic Aperture Radar Processing, G. Franceschetti and R. Lanari, CRC Press, ISBN 9781439876275 5) M. A. Richards et al., "Principles of modern radar", Scitech Publishing, 2010, ISBN-10. 1891121529 ; ISBN-13. 978-1891121524 6) Notes from the lecturers

SYLLABUS

Hrs	Frontal teaching
63	Radar Processing and Systems (4 CFU – 28 h) Elements of Wave Propagation. The Radar Equation. Radar Cross Section. Radar Resolution. Doppler Frequency. Monopulse Radar. Radar Signals and Networks. Range Measurements and Tracking in Radar. Radar Measurements-Limiting Accuracy. Radar Equation with Jamming. Effects of the Earth's Surface on the Radar Equation. Atmospheric Attenuation. The Matched Filter techniques and the Ambiguity function. Analog and Discrete Coded Waveforms. Filtering techniques. Radar Antennas, Arrays and Systems. Synthetic Aperture Radar (2 CFU - 14 h) Electromagnetic scattering models for remote sensing: natural surfaces and urban areas. Physical optics (PO) and geometrical optics (GO). Scan mode and spot mode (signal analysis and data processing). Strip Mode Transfer Function and Data Processing. Synthetic Aperture Radar Interferometry. Microwave Imaging Techniques (1 CFU – 7h) Ill-posedness and non-linearity. Regularization and linearized scattering models: Born, Rytov and Kirchhoff approximation. Minimum energy solution and Singular Value Decomposition (SVD). Optimization problems and Gradient based methods. Topics lectures in collaboration with companies, universities and research centers (1 CFU – 7 h) Automotive Radar / Direction Finding (Angle of Arrival) Ground Penetrating Radar / Through-the-Wall Imaging Microwave Medical Imaging / Nuclear Magnetic Resonance Radar / Mw-Mm Waves Diagnostics of Plasma Laboratory (1 CFU – 7 h) RADAR and SAR data processing with Matlab Acquisition and processing of radar signals by means of a compact mm-waves radar prototype RCS measurement of canonical target in anechoic chamber