UNIVERSITÀ DI PAVIA

Anno Accademico 2020/2021

MICROWAVES

Enrollment year	2020/2021
Academic year	2020/2021
Regulations	DM270
Academic discipline	ING-INF/02 (ELECTROMAGNETIC FIELDS)
Department	DEPARTMENT OF ELECTRICAL,COMPUTER AND BIOMEDICAL ENGINEERING
Course	ELECTRONIC ENGINEERING
Curriculum	PERCORSO COMUNE
Year of study	1°
Period	2nd semester (08/03/2021 - 14/06/2021)
ECTS	9
Lesson hours	84 lesson hours
Language	English
Activity type	ORAL TEST
Teacher	PERREGRINI LUCA (titolare) - 9 ECTS
Prerequisites	Basic concepts in electromagnetics, telecommunications and mathematics. In particular knowledge of principles of electromagnetic fields, antennas, guided wave propagation in waveguides and transmission lines.
Learning outcomes	The course aims to address the theoretical aspects and applications of microwave engineering. In particular, at the end of the course the student should have acquired the theoretical and practical knowledge about microwave circuits and microwave junctions; must understand the principle of operation and design criteria of the most important passive components (attenuators, phase shifters, directional couplers, power dividers, circulators, isolators, filters, etc..). He should also be able to use dedicated matrix representations in the analysis of more complex passive circuits realized in microstrips and/or waveguides, and to design simple active circuits (e.g. amplifiers, oscillators, mixers). He should

	learn to use actual design and optimization tools based on CAD packages, being aware of their limitations, and critically discussing their results.
Course contents	The first part of course is dedicated to theoretical considerations about guided propagation in transmission lines and waveguides, circuit representation of passive microwave junctions and resonant cavities. The second part consists in an overview of passive microwave components, considering their principle of operation and design criteria, followed by an examination of the main issues in the design of active, nonlinear circuits. More specifically, the course program is structured as follows: - Mode representation of e.m. fields in waveguides and transmission lines; modal vectors and definition of equivalent voltages and currents. Spectral representation of e.m. field in closed regions: solenoidal and irrotational eigensolutions for a closed region (ideal resonant cavity); free oscillations in a real cavity; forced oscillation in a real cavity. - Theory of microwave junctions: Theoretical basis for matrix representation of a linear, passive microwave junction; impedance-, admittance- and scattering-matrix representation; general properties of matrices according to physical characteristics of the junction; equivalent circuits, Foster representation. - Principle of operation and design criteria of microwave components: waveguide and microstrip attenuators and phase-shifters, impedance matching circuits, isolators and circulators, power dividers and combiners, directional couplers, microwave filters. - Design of active and/or nonlinear circuits: study of small signal solid-state amplifiers(stability conditions, Rollet parameter, broadband amplifiers, gain equalization methods); power amplifiers (nonlinear analysis in time domain, harmonic balance methods, characteristic parameters of power amplifiers); balanced mixers and image rejection mixers; negative impedance/admittance oscillators. - Computer aided design techniques: full-wave e.m. solvers and CAD packages based on equivalent circuits derived from electromagnetic analysis.
Teaching methods	Lectures (hours/year): 50 Practical class (hours/year): 10 Practicals / Workshops (hours/year): 26
Reccomended or required readings	Robert E. Collin. Foundation for Microwave Engineering. McGraw–Hill, 1994.
Assessment methods	Oral examination, possibly including the discussion of a simple project.
Further information	==

Sustainable development goals - Agenda 2030	$lbl_legenda_sviluppo_sostenibile