Università degli Studi di L'Aquila - Dipartimento di Ingegneria e Scienze dell'Informazione e Matematica

Course catalogue

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Programme of Course "Antennas and Microwaves"

- Code: I0267
- Type of course unit: Compulsory (Laurea Magistrale in Ingegneria delle Telecomunicazioni curriculum Comune), Elective (Laurea in Ingegneria dell'Informazione curriculum Telecomunicazioni)
- Level of course unit: Postgraduate Degrees, Undergraduate Degrees
- Semester: 1

Number of ects credits: (Laurea Magistrale in Ingegneria delle Telecomunicazioni) 9 (workload 225 hours), (Laurea in Ingegneria dell'Informazione) 9 (workload 225 hours)

Teachers: Emidio Di Giampaolo

1	**Course objectives**	The objective of this course is to introduce to the students the basics of radiating elements and passive microwave circuits. On successful completion of this module, the student should be able to analyze antennas and radiating system, to calculate fields from antennas and antenna systems and to manage scattering parameters of a passive microwave junction
2	**Course content and learning outcomes (dublin descriptors)**	Topics of the module include: • Antenna Fundamentals: basic antenna parameters, radiation pattern, radiation power density, radiation intensity, directivity, aperture concept, effective height, polarization, input impedance, radiation resistance, gain, radiation efficiency, beam width, bandwidth, near field and far field radiation, FRIIS transmission equation, dual equations for electric and magnetic current sources. • Antenna matching: power matching, uniformity matching, reflection coefficient, mismatch coefficient, depolarization coefficient • Linear wire antennas: infinitesimal dipole, near field, far field, directivity, radiation from arbitrary current distribution, finite length dipole, half wave length dipole, Antenna impedance: experimental and theoretical considerations, method of moments, Hallen's integral equation, coupled dipoles, mutual impedance, wire in fron of metallic ground, monopole antennas, folded dipoles, biconical antennas, short dipole antenna, baluns, T-match, gamma-match • Arrays: linear arrays, planar arrays and circular arrays, principle of pattern multiplication, uniform one-dimensional arrays, broadside, endfire, radiation pattern, directivity, beamwidth and null directions, array factor. Parasitic array: Yagi-Uda antenna. Frequency Independent and Self Complementary Antennas: log periodic, spiral antennas • Microstrip antennas: Rectangular patch • Aperture Type Antennas: radiation from planar aperture, the Fourier transform method, application of the field-equivalence principles to aperture radiation, radiation from rectangual aperture, uniform aperture field with a linear phase variation, tapered aperture field, open rectangular waveguide, hoen antennas, E-plane horn, H-plane horn, pyramidal horn • Reflector Antennas: paraboloidal reflector antennas, aperture efficiency, directivity, basic of offset paraboloidal reflectors, dual reflector antenna systems, shaped dual reflector systems. • Microwave circuit: power, energy and attenuation of modes in waveguides, actual conductors losses and surface impedance, coaxial cable, basics of resonant cavity, microwave junctions, reciprocal and lossless junctions, scattering matrix, one-port and two-port junctions • Exercitations: design and analysis of some models of antennas by means of electromagnetics CAD. • Laboratory Activity: measurements of return loss and insertion loss of some antennas and microwave circuits On successful completion of this module, the student should : • have profound knowledge of fundamentals of antennas; have knowledge and understanding of the theory and models of a large set of antennas and microwave

		junctions • demonstrate skill in analyzing antennas models and ability to determine antennas parameters • be able to select the appropriate antenna design for a given application • understand and explain the electromagnetic behavior of antennas and passive microwave circuits • acquire capacity to read and understand texts of relevant scientific and technical literature on antennas and related topics
3	**Course prerequisites**	The student must know the theory of electromagnetic fields, transmission lines, field theory for guided waves and electric circuits
4	**Teaching methodsand language**	Lectures and exercises. A report is required for the laboratory activity **Language**: English **Reference textbooks** • Costantine Balanis, ***Antenna Theory: Analysis and Design***. Wiley. • Robert Collin, ***Antennas and Radiowave Propagation***. McGraw-Hill. • David Pozar, ***Microwave Engineering***. Wiley.
5	**Assessment methods**	Written and oral exam