UNIVERSITÀ
DEL SALENTO

CORSO DI LAUREA LM65 –

CdLM Communication Engineering and Electronic Technologies

SCHEDE INSEGNAMENTI DIDATTICA EROGATA
a.a. 2020/2021

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SCHEDA INSEGNAMENTO

ELECTRONIC AND PHOTONIC DEVICES

Corso di studio di riferimento	LM65 - CdL Magistrale in Communication Engineering and Electronic Technologies
Dipartimento di riferimento	Dipartimento di Ingegneria dell'Innovazione
Settore Scientifico Disciplinare	ING-INF/01
Docente	Massimo DE VITTORIO
Crediti Formativi Universitari	6
Ore di attività frontale	54
Ore di studio individuale	96
Anno di corso	I anno
Semestre	I
Lingua di erogazione	Inglese
Percorso	PERCORSO COMUNE

Prerequisiti	Background on solid state physics is recommended
Contenuti	The course deals with the working principle of the most important electronic devices (diodes, bipolar junction transistor, CMOS technology ...) and photonic devices (LED, Laser, optical fibers, photovoltaic devices ...). It is organized in the following parts: - Introduction on the solid state physics, energy bands and current transport mechanisms in semiconductors. - Two terminal and three terminal electronic devices (p-n and Schottky junction diodes, bipolar transistors and MOSFETs - light emitting and detecting photonic devices The course also includes lectures on simulation of devices behavior.
Obiettivi formativi	Knowledge and understanding. Students must have a background in electromagnetic fields and waves and basic background in material science: - the students must have the basic cognitive tools to understand semiconductor crystals and their electronic properties and apply this to understand how electrons move and distribute in a semiconductor device; - they must have a solid knowledge of the electromagnetic waves and fields; - they must be able to understand electric fields, potentials and voltages and electrostatic properties of materials; - They must have a basic knowledge of electronic circuits, passive and active two- and three-terminals electronic devices. Applying knowledge and understanding . After the course the student

	should be able to: - understand what are the carrier transport, absorption and recombination mechanisms in semiconductor devices; - understand how an electronic device works and what are the key parameters to design an efficient two terminal or three terminal electronic devices; - design a LED or Laser device for different photonic applications; - understand and design a photodetector. Making judgements. Students are guided to learn critically everything that is explained to them in class, to understand the behavior of the state of the art technologies for electronic and photonic devices and to design new devices. Communication. The students will be stimulated to be able to communicate with a varied and composite audience, not culturally homogeneous, in a clear, logical and effective way, using the methodological tools acquired and their scientific knowledge and, in particular, with and professional and scientific vocabulary. Learning skills. Students must acquire the critical ability to understand the behavior of devices at the nanoscale. They should be able to develop and apply independently the knowledge and methods learnt with a view to possible continuation of studies at higher (doctoral) level or in the broader perspective of cultural and professional self-improvement of lifelong learning.
Metodi didattici	The teaching of the course will make use of both the blackboard and projection of videos and slides. Simulation of devices will be also done by exploiting freely available online tools.
Modalità d'esame	Oral exam. The student is asked theoretical questions on each part of the course. During the discussion the student is asked to elaborate on the purpose of specific technological solutions in the design and fabrication of electronic devices and he/she is also asked to propose a different solution for a device with specific properties.
Programma	Solid State Physics Physics of semiconductor materials, semiconductor technology, metal-semiconductor junction, p-n junction (12 hours). Semiconductor Electronic devices The Bipolar Junction Transistor (BJT), BJT working principle, BJT static and dynamic I-V characteristics, Models for BJT, The MOS Transistors and system, current-voltage characteristics of a MOSFET, MOSFET small and large signal models (22 hours). Photonic devices Optical processes in semiconductors, the LED, the LASER, laser waveguide and resonant cavities, material gain, type of semiconductor lasers, optical detectors and photovoltaic devices (20 hours).

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Testi di riferimento	[1] lecture notes [2] S.M. Sze, Semiconductor Devices: Physics and Technology, Bell Tel.Labs.Inc. [3] R.S. Muller-T.I. Kamins, Dispositivi Elettronici nei Circuiti Integrati, Boringhieri [4] Ghione G., Dispositivi per la Microelettronica, McGraw Hill.
Altre informazioni utili	

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SCHEDA INSEGNAMENTO

MATHEMATICAL METHODS FOR ENGINEERING

Corso di studio di riferimento	LM65 - CdL Magistrale in Communication Engineering and Electronic Technologies
Dipartimento di riferimento	Dipartimento di Ingegneria dell'Innovazione
Settore Scientifico Disciplinare	MAT/05
Docente	Diego P=allara
Crediti Formativi Universitari	9
Ore di attività frontale	81
Ore di studio individuale	144
Anno di corso	I anno
Semestre	I
Lingua di erogazione	Inglese
Percorso	PERCORSO COMUNE

Prerequisiti	Prerequisites: Ordinary differential equations, multiple, line and surface integrals. Complex Analysis, linear algebra, elementary physics.
Contenuti	Measure theory. Theory of distributions. Elements of Functional Analysis. Complements on Ordinary Differential Equations. Equations of Mathematical Physics.
Obiettivi formativi	Aims and Scope: Concepts of advanced mathematical Analysis - Problem solving for ordinary and partial differential equations arising from physics or engineering.
Metodi didattici	Lessons and exercises
Modalità d'esame	Final examination: The final (written) exam consists in solving 2 exercises (8+8 points) and answering 2 theoretical questions (7+7 points) related with the topics of the course.
Programma	Measure theory. (hours: 9) Positive measures. Measurable functions. Integral. Limit theorems in integration theory. Real and vector measures, total variation. Absolute continuity and singularity of measures. Image measure. Lebesgue's Measure in R^n. Product Measures and Fubini's Theorem. Parameters dependent integrals. Functions Gamma and Beta of Euler. Convolution. Functions of bounded variation (BV) and Riemann-Stieltjes Integral. (hours: 9) Pointwise and essential variation. Monotonous functions. Features of bounded variation functions. Absolutely continuous functions. Cantor's function. Definition and existence of the integral of Riemann-Stieltjes. Integral's properties. Hausdorff's measures. Self-similar fractals. Theory of distributions. (hours: 8) Definition and examples. Derivative of a

	distribution. Examples of Differential Equations in D'. Temperate distributions. Support of a Distribution, convolution. Fourier Transform in L^1, L^2, S, S'. Elements of Functional Analysis. (ore: 8) The spaces L^1, L^2. Banach and Hilbert spaces. Scalar products and induced norms, orthonormal bases. Fourier Series in L^2. Linear, continuous, compact Operators. Spectral Theory of Compact Self-adjoint Operators. Complements on Ordinary Differential Equations. (hours: 10) Sturm-Liouville theory for boundary value problems. Connections between boundary value problems and orthogonal developments. Differential Equations with analytical coefficients: regular case; Singular case and Frobenius theorem. Examples of Ordinary Differential Equations Solvable by Series: Equations of Bessel and Legendre. Equations of Mathematical Physics. (hours: 12) Examples of Partial Differential Equations solved by the method of separation of variables, by series developments and Fourier transform. Boundary value problems, initial value problems, and mixed problems. Heat equation in the strip, and in the whole space. Wave equation in one, two and three dimensions. Wave equation in the half-line and in an interval. Eigenvalues of Laplacean in the square, in the disc, in the ball. Hermite polynomials.
Testi di riferimento	References. M. Carriero, L. Anzilli: Introduzione alle Equazioni a Derivate Parziali Lineari, Quaderni di Matematica, 1/2015, ESE - Salento University Publishing. http://siba-ese.unile.it/index.php/quadmat/article/view/15679/13592 S.Fornaro, D.Pallara, Appunti del corso di Metodi matematici per l'Ingegneria, web page of prof. Pallara. F. Tomarelli - Mathematical Analysis tools for Engineering, Società Editrice Esculapio, Bologna, 2019. F.Gazzola, F.Tomarelli, M.Zanotti: Analisi Complessa, Trasformate, Equazioni Differenziali, Società Editrice Esculapio, Bologna, III Ed., 2015. Eng. ver.: Analytic functions, Integral transforms, Differential equations, Esculapio, Bologna, II Ed., 2015. E.Kreyszig: Advanced engineering mathematics, John Wiley Sons, New York, 1993. A.N.Tichonov, A.A.Samarskij, Equazioni della fisica matematica, MIR, Mosca, 1981. A.N.Tichonov, A.A.Samarskij, B.M.Budak, Problemi della fisica matematica, MIR, Mosca, 1981.
Altre informazioni utili	

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SCHEDA INSEGNAMENTO

Statistical Signal Processing

Corso di studio di riferimento	LM65 - CdL Magistrale in Communication Engineering and Electronic Technologies
Dipartimento di riferimento	Dipartimento di Ingegneria dell'Innovazione
Settore Scientifico Disciplinare	ING-INF/03
Docente	Giuseppe Ricci
Crediti Formativi Universitari	9
Ore di attività frontale	81
Ore di studio individuale	144
Anno di corso	I anno
Semestre	I
Lingua di erogazione	Inglese
Percorso	PERCORSO COMUNE

Prerequisiti	Prerequisites: sufficiency in calculus, probability theory, and linear algebra.
Contenuti	Overview. This is a course in estimation and detection theory; it is aimed at providing principles and tools to solve problems in signal processing, radar, sonar, and communication. It will also serve as the necessary prerequisite for more advanced courses in communication engineering.
Obiettivi formativi	Learning Outcomes. Knowledge and understanding After the course the student should understand the main aspects of estimation and detection theory and in particular *classical and Bayesian approaches to estimation; strategies to solve binary hypotheses tests (Neyman-Pearson, GLRT). *The Kalman filter and the extended Kalman filter and their use to solve simplified tracking problems. Applying knowledge and understanding After the course the student should be able to *formulate and solve parameter estimation problems and derive corresponding Cramer-Rao lower bounds. *Formulate and solve detection problems resorting to the optimum (i.e., Neyman-Pearson test or UMP test) if possible or to a suboptimum one (GLRT). *Evaluate the performance parameters and discuss complexity issues associated with different solutions. Making judgements Students should acquire the ability to compare pros and cons of different approaches to the solution of a specific problem through examples and problems. Communication

	The ability to communicate on technical topics should be acquired by discussing in a rigorous way not only concepts and tools of detection and estimation theory, but also the adopted solution to a specific problem. Learning skills Selected problems will be proposed that require elaborating on introduced concepts and methods, also with the help of selected readings suggested by the instructor (from the list of references). Identifying solutions to non trivial problems will be important to be ready for autonomous lifelong learning.
Metodi didattici	Lectures, exercises, and computer projects. Problem--solving skills are of paramount importance and are gained via assigned homeworks.
Modalità d'esame	Written exam. The exam consists of two cascaded parts (maximum overall duration: two hours and a half): the first part is closed book (suggested duration 50 minutes); the student is asked to illustrate two theoretical topics; it is aimed to verify to what extent the student has gained knowledge and understanding of the selected topics of the course and is able to communicate about his/her understanding (the maximum score for illustrating each topic is typically 5/30); the second part, that starts when the student has completed the first part, is open book and requires solving two (or three) problems; it is aimed to determine to what extent the student has: 1) the ability to identify and use data to formulate responses to well-defined problems, 2) problem solving abilities and the capacity to integrate different concepts and tools (the maximum score for the solution of each problem is typically 10/30 or 6-7/30 if the second part of the exam requires solving three problems).
Programma	Course Content. Introduction: examples of statistical reasoning (7 hours). Review of probability theory and rudiments of multivariate normal theory (7 hours). Solution to assigned problems (3 hours). Estimation Theory: Classical and Bayesian Parameter Estimators (ML, LS, WLS, ILS, MAP, MMSE, and LMMSE estimators). How to measure the performance of an estimator. Cramer-Rao bounds (17 hours). Solution to assigned problems (18 hours). Computer generation of random vectors and moment estimation (3 hours). Direction of arrival estimation: CML and MUSIC algorithm (3 hours). Matlab implementation of the MUSIC algorithm (3 hours). Application of LMMSE estimation to filtering and beamforming. Minimum variance and minimum power distortionless beamformers. Linearly constrained minimum variance and minimum power beamformers. Generalized sidelobe canceler (5 hours). Discrete-Time Kalman Filter. Extended Kalman Filter. Applications of Kalman Filter to tracking (8 hours). Steepest-descent algorithm: derivation and analysis. Least-mean-square algorithm: derivation and analysis (4 hours). Detection Theory: Neyman-Pearson Lemma, Testing of composite binary hypotheses, UMP tests, GLRT, Constant False Alarm Rate property (6 hours). Solution to assigned problems (2 hours).

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Testi di riferimento	[1] Handouts (in progress). [2] L. L. Scharf, ``Statistical Signal Processing: Detection, Estimation, and Time Series Analysis,'' Addison-Wesley, 1991. [3] H. L. Van Trees, ``Detection, Estimation and Modulation Theory,'' Part. 1, John Wiley & Sons, 1968. [4] H. L. Van Trees, ``Optimum Array Processing. Part. 4 of Detection, Estimation, and Modulation Theory," John Wiley & Sons, 2002. [5] S. M. Kay: ``Fundamentals of Statistical Signal Processing: Estimation Theory,'' Volume I, Prentice-Hall, 1993. [6] S. M. Kay: ``Fundamentals of Statistical Signal Processing: Detection Theory,'' Volume II, Prentice-Hall, 1998. [7] Y. Bar-Shalom, T. E. Fortmann, ``Tracking and Data Association, Academic Press'', 1988. [8] Y. Bar-Shalom, X., Rong Li, T. Kirubarajan, ``Estimation with Applications to Tracking and Navigation. Theory Algorithms and Software,'' John Wiley & Sons, 2001. [9] S. Haykin, ``Adaptive Filter Theory,'' Prentice-Hall, 1996.
Altre informazioni utili	Per ulteriori informazioni si rimanda all'url: https://www.unisalento.it/scheda-utente/-/people/giuseppe.ricci

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SCHEDA INSEGNAMENTO

DIGITAL TRANSMISSION THEORY

Corso di studio di riferimento	LM65 - CdL Magistrale in Communication Engineering and Electronic Technologies
Dipartimento di riferimento	Dipartimento di Ingegneria dell'Innovazione
Settore Scientifico Disciplinare	ING-INF/03
Docente	Francesco BANDIERA
Crediti Formativi Universitari	9
Ore di attività frontale	81
Ore di studio individuale	144
Anno di corso	I anno
Semestre	II
Lingua di erogazione	Inglese
Percorso	PERCORSO COMUNE

Prerequisiti	Sufficiency in Statistical Signal Processing
Contenuti	The course aims to provide students with the necessary knowledge about the systems for transmission and reception of information in digital form and over a real communication channel.
Obiettivi formativi	Learning Outcomes . Knowledge and understanding After the course the student should understand the following aspects of digital communication systems * Performances of modulation formats. * Channel capacity and channel coding techniques. * Equalization techniques for band-limited channels. * Countermeasures against Fading channels Applying knowledge and understanding After the course the student should be able to * Compute the probability of error of a digital modulation scheme. * Design optimum and sub-otimum receivers for digital communications. * Design adaptive equalizers to combat intersymbol interference and fading. Making judgements Students should acquire the ability to compare pros and cons of different approaches to the solution of a specific problem through examples and problems. Communication The ability to communicate on technical topics should be acquired by discussing in a rigorous way not only concepts and tools of digital communications, but also the adopted solution to a specific problem. Learning skills

	Selected problems will be proposed that require elaborating on introduced concepts and methods, also with the help of selected readings suggested by the instructor (from the list of references). Identifying solutions to non trivial problems will be important to be ready for autonomous lifelong learning.
Metodi didattici	Classroom lectures given by the instructor using the board.
Modalità d'esame	Oral. The student must answer to 3 questions about the entire course syllabus; each question is worth 10/30 for a total of 30/30. Examination time is between 30 and 60 minutes.
Programma	Course Contents Part I Introduction. Summary about digital modulation schemes. Linear modulations (PAM, PSK, QAM) and orthogonal modulations (FSK, PPM). Bandwidth efficiency, power efficiency, comparisons. Probability of error of M-PAM and M-FSK. Union bound on the probability of error. Non coherent FSK: optimum receiver design and bandwidth requirements. Qualitative performance assessment. (11 hours). Part I - Channel Capacity and Channel Coding. Channel models and capacity. Channel coding theorem. Linear block codes. Hamming codes. Cyclic codes. Performance analysis of coded systems. Hard and soft decoding. Interleaving. Convolutional Codes. Block-diagram of the encoder. Representations: tree, trellis, state-diagram, transfer function. Decoding: maximum likelihood sequence detector and Viterbi algorithm. Performance analysis with soft and hard decisions decoding. (30 hours) Part III - Digital Transmission over real channels. Design of communication systems for the bandlimited channel. Channel models. Inter Symbols Interference (ISI). Nyquist criterion and eye diagram. Equalization. The optimum receiver for channels with ISI: maximum likelihood sequence detector and Viterbi algorithm revisited. Performance analysis. Linear equalization methods: zero forcing (ZF) and minimum mean squared error (MMSE). Performance analysis. Non linear equalizers (decision-feedback). Adaptive Equalization. Adaptive linear equalizers: ZF, least mean squares (LMS), recursive least squares (RLS). Convergence properties and performance analysis. Blind equalization: maximum likelihood, per survivor processing, multiple signals classification (MUSIC). Digital Transmission over Multipath Fading Channels. Channel Models and classification. Channel selectivity in time and/or frequency. Transmission of digitally-modulated signals over the flat/flat channel: diversity reception techniques and performance analysis. Digital transmission over the frequency-selective fading channel: RAKE receiver and its performance. Adaptive implementations. (40 hours)
Testi di riferimento	[1] J. G. Proakis, Digital Communications , McGraw Hill, 4th Ed., 2004. [2] J. M. Wozencraft, I. M. Jacobs, Principles of Communication Engineering, Waveland Press (reprint 1990). Other useful references - J. G. Proakis M. Salehi, Digital Communications, McGraw Hill, 5th Ed., 2008. - T. M. Cover, J. A. Thomas, Elements of Information Theory, Wiley, 1991. - A. H. Sayed, Fundamentals of Adaptive Filtering, John Wiley and Sons,

	2003. - V. Pless, Introduction to the Theory of Error-Correcting Codes, Wiley, 1998. - Scientific papers highlighted by the instructor.
Altre informazioni utili	Office Hours: By appointment; contact the instructor by E-Mail (<a href="mailto:francesco.bandiera@unisalento.it"> francesco.bandiera@unisalento.it), Telegram (@francescobandiera) or at the end of class meetings.

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SCHEDA INSEGNAMENTO

Microwaves

Corso di studio di riferimento	LM65 - CdL Magistrale in Communication Engineering and Electronic Technologies
Dipartimento di riferimento	Dipartimento di Ingegneria dell'Innovazione
Settore Scientifico Disciplinare	Ing-Inf/02
Docente	Luca Catarinucci
Crediti Formativi Universitari	9
Ore di attività frontale	81
Ore di studio individuale	144
Anno di corso	I anno
Semestre	II
Lingua di erogazione	Inglese
Percorso	PERCORSO COMUNE

Prerequisiti	Electromagnetic Fields
Contenuti	Microwave course is aimed at providing both theoretical and practical knowledge on the main aspects of microwave engineering. It also serves as the necessary prerequisite for more advanced courses in communication engineering.
Obiettivi formativi	after the course, the student should be able to - Apply microwave analysis methods to determine the main properties of high-frequency circuits. - Apply knowledge on transmission lines and waveguides particularly for their use as elements in impedance matching and filter circuits. - Design an impedance matching network with either distributed or lumped elements through the Smith Chart. - Evaluate both analytically and experimentally the scattering parameters of N-Port microwave devices - Illustrate the main aspects of N-Port networks, microwave filters, and resonant cavities.
Metodi didattici	Frontal lessons, practical exercises, laboratory activities.
Modalità d'esame	Oral exam. The oral exam is aimed at verifying the knowledge and understanding of the course topics acquired by the student (maximum overall duration: 45 minutes).
Programma	(81 hours, of which 61 as frontal lessons, 12 as practical exercitations, and 8 as laboratory activities) Introduction: the main differences between low-frequency and hi-frequency circuits (2 hours frontal lesson). Transmission lines and waveguides: transmission lines theory. Smith chart. Line-Load matching through single and double stub techniques using the

	Smith chart. Quarter-wave matching. Properties of the most PERCORSO COMUNE transmission lines: coaxial cable, microstrip line, coplanar stripline. Properties of the most PERCORSO COMUNE waveguides: rectangular, circular, and "ridge" (24 hours frontal lesson). Solutions of assigned exercises and practical examples of use of the Smith Chart. (12 hours practical exercitations). Microwave junctions. N-port junctions. Scattering matrix. 2-port, 3-port and 4-port cases. (8 hours frontal lesson) Microwave devices: functional description of the main passive components used in microwave circuits. Attenuators. Circulators. Dividers and combiners (Resistive, T-junction, Wilkinson). Directional couplers theory. Two-hole couplers. Branch-Line. Rat-Race. Magic-T. (12 hours frontal lesson) Resonant cavities: brief overview on resonant cavities. Rectangular and circular resonant cavities. Application as filters and frequency meters. (4 hours frontal lesson) Microwave filters: general information on Microwave filters. Main design techniques for a microwave filter. (6 hours frontal lesson) Passive RFID technology : overview on passive RFID technology. The conjugate matching techniques in the design of RFID tags. (5 hours frontal lesson) Microwave circuits analysis (Laboratory Activity): Introduction to microwave CAD programs; analysis of microwave circuits. Examples of design of simple microwave circuits. (5 hours laboratory activity) S-Parameter evaluation (Laboratory Activity): Vector Network Analyzer description. Laboratory measurement of the scattering parameters of various microwave devices (rat race, Wilkinson divider, etc.). (3 laboratory activity)
Testi di riferimento	[1] David M. Pozar, Microwave Engineering, John Wiley & Sons Inc [2] Sorrentino Roberto, Bianchi Giovanni, Microwave and RF Engineering, Wiley [3] E. Collin, Foundation of microwave engineering, McGraw Hill, New York
Altre informazioni utili	

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SCHEDA INSEGNAMENTO

APPLIED ELECTROMAGNETICS

Corso di studio di riferimento	LM65 - CdL Magistrale in Communication Engineering and Electronic Technologies
Dipartimento di riferimento	Dipartimento di Ingegneria dell'Innovazione
Settore Scientifico Disciplinare	ING-INF/02
Docente	Luciano TARRICONE
Crediti Formativi Universitari	6
Ore di attività frontale	54
Ore di studio individuale	96
Anno di corso	II anno
Semestre	I
Lingua di erogazione	Inglese
Percorso	PERCORSO COMUNE

Prerequisiti	Conoscenze approfondite di Campi Elettromagnetici e Microonde
Contenuti	Il corso propone alcuni esempi di applicazioni scientifiche e industriali dell'Eletromagnetismo, con particolare riferimento al BioElettromagnetismo, alle applicazioni biomediche e ai sistemi wireless intelligenti
Obiettivi formativi	Il corso intende formare nello studente una spiccata capacità di applicare le conoscenze teoriche dell'Elettromagnetismo e delle Microonde a casi reali
Metodi didattici	Lezioni frontali, esercitazioni per la soluzione di problemi pratici, esercitazioni al calcolatore, esercitazioni in laboratorio, seminari
Modalità d'esame	Sviluppo e realizzazione di un progetto pratico (verificare la capacità di risolvere problemi pratici) e prova orale (verificare la capacità di analisi, critica, ed esposizione degli argomenti)
Programma	Please see the reference notes in the section related to the reference books/material to identify the materials to be studied for each part of the courses program. - Introduction to the course [1]: Chapter 3, 4 and 5 - Introduction to EMC [1]: Chapter 1 - BioEM [2]: Chapter 1, 2, 3 and 4 [3]: Introduction, Chapter 1, 8 and 9 Professor's notes on EM Exposure Safety Standards and Laws Three Professor's papers on BEM modelling Professor's notes on numerical dosimetry Professor's notes on classification of EM sources Professor's notes on ELF fields emitted by Power lines and their reduction [1], [4], Selected papers by (i) Hodgkin and Huxley, (ii) Colquhoun and

	Hawkes - Wireless Systems and EM enabling technologies Professor's notes on Radiopropagation Professor's notes on RFID Professor's notes on new materials and technologies [5]: Chapter 6 One Professor's paper on the convergence of EM Technologies towards IOT [6], [7] - Radar Systems for meteorology Professor's notes [8], [9] - Shielding and Measurement Environments [1]: Chapter 11 [11]: Chapter 5 and 6 [10], [11] - Measurement Techniques and Instrumentations Professor's notes
Testi di riferimento	Books: [1] C. Paul, Electromagnetic Compatibility (EMC) [2] J. Malmivuo, R. Plomsey, Bioelectromagnetics (BEM) [3] C. Polk, E. Postow, CRC Handbook of Biological Effects of EM Fields [4] B. Hille, Ionic Channels of Eccitable Membranes [5] L. Tarricone, A. Esposito, Grid Computing for EM [6] T. Rappaport, Wireless Communications [7] K. Finkenzeller, D. Muller, RFID Handbook [8] M. A. Richard, J. Scheer and W. Holm, Principles of Modern Radar [9] R. J. Doviak, D. S. Zrnic, Doppler Radar and Weather Observations [10] L. H. Hemming, EM Anechoic Chambers [11] V. P. Kodali, Engineering EMC
Altre informazioni utili	

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SCHEDA INSEGNAMENTO

CAD AND LABORATORY OF HIGH FREQUENCY CIRCUITS AND ANTENNAS

Corso di studio di riferimento	LM65 - CdL Magistrale in Communication Engineering and Electronic Technologies
Dipartimento di riferimento	Dipartimento di Ingegneria dell'Innovazione
Settore Scientifico Disciplinare	ING-INF/02
Docente	Giuseppina Monti
Crediti Formativi Universitari	12
Ore di attività frontale	108
Ore di studio individuale	192
Anno di corso	II anno
Semestre	I
Lingua di erogazione	Inglese
Percorso	PERCORSO COMUNE

Prerequisiti	microwaves, electromagnetic field theory
Contenuti	The goal of this course is to provide the basic knoweledge of the main numerical techniques and software tools for the Computer Aided Design (CAD) of microwave circuits and antennas. Through problem-solving and design activities, the course will introduce students to conventional passive microwave devices and antennas, as well as to cutting-edge electromagnetic technologies such as wireless power transfer, energy harvesting and metamaterials.
Obiettivi formativi	Knowledge and understanding During the course the students will acquire the ability to face and solve a generic problem of electromagnetism (design of microwave antennas / components, problems concerning human-antenna interaction, propagation in artificial media, etc.) using commercial or proprietary CAD tools. In particular, the main learning outcomes are: * knowledge of the major issues and possible technological solutions related to the design of microwave components and antennas, * knowledge of the main numerical methods for electromagnetic problems, * basic knowledge of PERCORSO COMUNE commercial software for circuital and full-wave electromagnetic simulations, * laboratory experiments relative to at least one cutting-edge electromagnetic technology. Applying knowledge and understanding. After the course the student should be able to: * select the most suitable numerical method for solving a specific electromagnetic problem,

	* use at least two commercial instruments (at least one simulator for the analysis of lumped elements circuits and one for full-wave simulations) for solving electromagnetism problems, * apply the theoretical knowledge acquired during the course to the resolution of a real problem such as, for example, the design of an antenna or a microwave device that satisfies specific requirements. Autonomy of judgment Students are guided to critically learn everything that is explained to them in class, to compare the different methods for analyzing electromagnetic problems and the different design strategies of microwave devices and antennas. The goal is to ensure that at the end of the course students are able to identify and propose, in an autonomous way, the most efficient solution for solving an electromagnetism problem. Communication skills It is essential that students are able to communicate with a diverse and composite audience, not culturally homogeneous, in a clear, logical and effective way, using the acquired methodological tools and their scientific knowledge. In this regard, the course promotes the development of the following skills of the student: ability to expose in precise and formal terms the salient characteristics of a problem of electromagnetism; ability to describe and analyze an efficient solution for the problem under consideration. Learning ability Students must acquire the ability to deal with originality and autonomy, with the typical problems of the analysis and design of components and microwave antennas and in general of complex electromagnetic conditions. They must be able to re-elaborate and autonomously apply the knowledge and methods learned in view of a possible continuation of studies at a higher level (doctorate) or in the broader perspective of cultural and professional self-updating of lifelong learning.
Metodi didattici	The course consists of lectures, some of which make use of slides made available to students, laboratory lessons and the development of a project. The lectures are intended to deepen the theory of propagation in cylindrical structures and to expose the theory of the main numerical methods for the analysis of electromagnetic problems. The laboratory lessons are aimed at introducing students to the use of the main commercial software for the analysis and design of microwave circuits. Finally, the project aims to assess students' ability to face and solve a real problem.
Modalità d'esame	Oral exam and development of a project concerning the design and/or the realization of a microwave device. The objective of the oral exam is to verify the knowledge of the theory underlying: - the analysis of real cylindrical structures, - the main numerical methods for electromagnetism problems,

	- microstrip planar antennas, - the emerging technologies presented during the course. The objective of the project is to verify the student's ability to apply the theoretical skills acquired during the course to the solution of real problems.
Programma	Introduction Introduction to numerical methods for electromagnetics, the computer aided design of microwave devices. (6 hours) Cylindrical structures Classification, propagation in open cylindrical structures, resolution methods for cylindrical structures with real conductors. (8 hours) Numerical methods for electromagnetic problems The Finite Difference Time Domain (FDTD) numerical method; the Method of the Moments (MoM); the Mode-Matching. (15 hours) Software tools for microwave circuit design Commercial software tools for the design and optimization of microwave devices and antennas: introduction and classification of the most widely used commercial software (full-wave simulators and circuital simulators). (6 hours) Antennas Theory and applications of planar antennas. (6 hours) Microwave devices Microwave resonators, dividers and couplers (3 hours) Emerging technologies and design strategies for microwave circuits and antennas Devices for energy harvesting and wireless power transfer; metamaterials; nanomaterials; design and realization of microwave devices on non conventional materials. (18 hours) Laboratory Design techniques for microwave passive devices (filters, resonators, couplers, antennas, etc.). Scattering parameters measurements. Computer aided design of microwave devices and antennas: introduction to the use of some of the most widely adopted commercial software (CST Microwave Studio, AWR, etc.). (30 hours) Project How to solve a real problem. (16 hours)
Testi di riferimento	[1] R. Collin, Foundations for Microwave Engineering, Mc Graw-Hill. [2] Conciauro, Guglielmi, Sorrentino, Advanced Modal Analysis, Wiley. [3] Peterson, Ray, Mittra, Computational Methods for Electromagnetics, IEEE Press. [4] A. Paraboni, Antenne, Mc Graw-Hill, 1999. [5] Johnson I. Agbinya, Wireless Power Transfer, 2nd edition. [6] Alessandro Lipparini, Vittorio Rizzoli, Propagazione elettromagnetica guidata: parte prima. [7] Girish Kumar, K.P. Ray, Broadband Microstrip Antennas, ISBN-13: 978-1580532440. [8] Handouts provided by the teacher
Altre informazioni	

utili	

UNIVERSITÀ DEL SALENTO

SCHEDA INSEGNAMENTO

Measurementes for Telecommunications

Corso di studio di riferimento	LM65 - CdL Magistrale in Communication Engineering and Electronic Technologies
Dipartimento di riferimento	Dipartimento di Ingegneria dell'Innovazione
Settore Scientifico Disciplinare	ING-INF/07
Docente	Andrea Cataldo
Crediti Formativi Universitari	6
Ore di attività frontale	54
Ore di studio individuale	96
Anno di corso	II anno
Semestre	I
Lingua di erogazione	Inglese
Percorso	PERCORSO COMUNE

Prerequisiti	Electronics, Signal Theory, Electromagnetic fields, Electronic Measurements
Contenuti	The course provides the basic concepts for a correct use of measurement instrumentation adopted in testing, diagnostics and metrological characterization of components, devices and telecommunication systems. Instrumentation and measurement methods mainly adopted in the field of TLC applications will be presented, analysed and used. The course also includes several practical laboratory sessions.
Obiettivi formativi	1) Knowledge and understanding The course describes methods and models in the field of measurement systems and apparata with a specific focus on TLC. Students must have basic knowledge related to electronics, electronic components, signal theory. They should know the main electronic architectures and signal acquisition systems operating both in time and frequency domains. They should be able to deal efficiently with practical applications and measurement issues with a specific skill to cope with the intrinsic limitation between theoretical models and practical cases. 2) Applying knowledge and understanding At the end of the course, the student should be able to apply rigorously the basic and most important concepts related to metrology for a generic measurement process. Specifically, the student should be able to correctly use measurement instrumentations adopted in testing, diagnostics and characterization of components, devices and telecommunication systems. 3) Making judgements Students will possess the ability to identify the operating modalities for correlating a theoretical concept or model with the most appropriate practical context. The course promotes the development

	of independent judgment suitable to appropriately choose the measurement technique as well as the critical ability to interpret the goodness of the results of the models/methods applied to the datasets under examination. 4) Communication Through the methodologic tools provided in the course and, in particular, those addressed during the laboratory sessions, students will be able to communicate with an appropriate technical terminology so as to proficiently deal with all the issues related to measurements, data acquisition and processing, testing activity and results. Additionally, thanks to the laboratory sessions, the students will have the opportunity to draft autonomously a technical report describing the practical and theoretical issues related to the discussed topics. 5) Learning skills Students must acquire the critical ability to relate, with originality and autonomy, to the typical problems of measuring a quantity, characterizing a TLC signal and testing electronic devices and components. They will also be able to use instrumentation and measurement methods largely adopted in the field of TLC applications and they should be able to apply autonomously the knowledge and methods learned in view both of a possible PhD courses as well as of a professional carreer.
Metodi didattici	The course is highly characterised by a practical approach thus, in addition to traditional lessons, several practical laboratory sessions are carried out.
Modalità d'esame	Oral and practical exam, including the production of a technical report describing the laboratory xperiments.
Programma	Theory 1) Basic principles of measurement and metrology - Measurement definitions - Measurement concepts of errors, uncertainty, metrologic characterization - Probabilistic approach to measurement theory - Uncertainty definitions and evaluation methods - Metrological characterization of instrumentation - Instrument specifications, errors and uncertainties 2) Sampling and AD/DA Conversion - Theoretical principles of sampling - Sampling in real cases and practical issues - Sampling of one-shot and periodic signals - Errors and non-idealities in sampling - Theoretical principles of A/D and D/A conversion - Quantization, errors and non-idealities - A/D and D/A signal characteristics - Principles, characteristics and architectures of main A/D Converters 3) Oscilloscopes and time-domain measurements - Basics, functionalities and architectures of DSO (Digital Storage Oscilloscopes)

	- Equivalent-time sampling (sequential and syncronous modality) - Issues on practical use of instruments operating in time domain 4) Spectrum analyzers and frequency-domain measurements - Basics, functionalities and architectures of spectrum analyzers - Frequency-domain analysis of generic signals, modulated signals and related parameters - Noise analysis, characterizaion and related parameters 5) Networks and transmission line measurements - Time and frequency domain reflectometry - Vector network analyzers and scattering parameters Laboratory 1) Oscilloscopes and time-domain measurements - Measurements and characterization of various components, devices and systems (i.e.: impedances, passive and active filters, amplifiers, oscillators). 2) Spectrum analyzers and frequency-domain measurements - Basic measurements on sample signals (sinusoidal signals, distorted signals, etc.) - Measurements of typical parameters TLC signals (THD, SNR, signal tracking, etc.) - Measurements of typical parameters in modulated signals 3)Networks and transmission lines measurements - TDR measurement examples and estimation of parameters in transmission lines - Scattering parameters measurements in time and frequency domains
Testi di riferimento	[1] Notes directly provided by the Lecturer [2] A. Cataldo, n. giaquinto, E. De Benedetto, A. Masciullo, G. Cannazza et al."Basic Theory and Laboratory Experiments in Measurement and Instrumentation. A Practice-Oriented Guide" Lecture Notes in Electrical Engineering, Springer Verlag, 2020 [3] A. Cataldo, E. De Benedetto, G. Cannazza, "Broadband Reflectometry for Enhanced Diagnostics and Monitoring Applications", Lecture Notes in Electrical Engineering,Springer Verlag, 2011
Altre informazioni utili	On appointment; contact the professor by email.

UNIVERSITÀ DEL SALENTO

SCHEDA INSEGNAMENTO

Microelectronic design c.i.

Corso di studio di riferimento	LM65 - CdL Magistrale in Communication Engineering and Electronic Technologies
Dipartimento di riferimento	Dipartimento di Ingegneria dell'Innovazione
Settore Scientifico Disciplinare	ING-INF/01
Docente	Stefano D'AMICO
Crediti Formativi Universitari	9
Ore di attività frontale	81
Ore di studio individuale	144
Anno di corso	II anno
Semestre	I
Lingua di erogazione	Inglese
Percorso	PERCORSO COMUNE

Prerequisiti	Fundamental bases of Analog Electronics are required.
Contenuti	The course is aimed at providing principles and tools to analyze and design analog circuits in CMOS integrated technology.
Obiettivi formativi	After the course the student should be able to: 1) Describe the basic analog circuits (bandgap reference, current mirrors, differential couple, Miller opamp, class A and class AB output stages, etc). 2) Evaluate the performance parameters and discuss complexity issues associated with different basic analog circuits. 3) Demonstrate circuit analysis capability of not standard circuits. 4) Understand the technology limits in circuit design. 5) Use the simulator to analyse performance of analog circuits. 6) Express properly the results of the analysis and the design of analog circuits.
Metodi didattici	The Course forecasts 33 hours of theoretical lectures about technology description and fundamental circuit analysis. The theoretical concepts are verified in laboratory by using state of the art circuit simulator. 36 hours of laboratory are forecast. Moreover, 12 lectures about manual analysis and design of circuit examples are proposed.
Modalità d'esame	The final (oral) exam consists of two cascaded parts: 1. the first part is based on the discussion about a report on the assigned circuit. The circuit must be simulated at the calculator. The student is asked to learn using the simulator, to illustrate the circuit design, to evaluate the performance parameters, and to define the operation of each part of the circuit. it is aimed to verify to what extent the student has gained knowledge and understanding of the use of the circuit simulator and the circuit analysis. 2. the second part is on circuit analysis of one of the basic circuits studied during the course; it is aimed to determine to what extent the student the

	circuit analysis capability, ability to identify and use data to formulate responses to well-defined problems, problem solving abilities and the capacity integrate different concepts and tools.
Programma	- The MOS transistor1,2,3,4,5,6 (6 ore) -Description of the NMOS transistor -Second order effects: velocity saturation of carriers and variation of the threshold voltage -Noise in MOS device -MOS transistor layout - Passive components1,7 (6 ore) -Integrated capacitors: implementation, accuracy and layout issue -Integrated resistors: implementation, accuracy and layout issue - Analog switches1,8 (6 ore) -Analog switches implementation -Charge injection and clock feedtrough - Bias circuits1,9,10 (6 ore) -CMOS current mirrors -Current reference -Voltage reference - Basic gain stages1,11 (9 ore) -Gain stages -Output stages -Level shifter

	- Exercitation -Analysis and design of circuit examples1 (12 ore) - Laboratory -Design experiences by using the circuit simulator 12 (36 ore): - - Transistor Behaviour: Coarse MOS parameter extraction MOS behaviour worst case variation Channel length modulation effects Low-voltage current mirror design VTH dependence on MOS gate length (L) VTH dependence on MOS gate width (W) Velocity saturation effects - - Circuit design A Low-voltage bandgap A two-stage opamp
Testi di riferimento	1. Baschirotto, Slides del corso (http://microel_group.unisalento.it/) 2. S. DAmico Chapter 4: The MOS transistor (http://microel_group.unisalento.it/) 3. Johns Martin Analog Integrated circuits design , John Wiley and Sons, Inc., pages 7-45. 4. Johns Martin Analog Integrated circuits design , John Wiley and Sons, Inc., pages 102-107. 5. Johns Martin Analog Integrated circuits design , John Wiley and Sons, Inc., pages 116-130. 6. Johns Martin Analog Integrated circuits design , John Wiley and Sons, Inc.,

	pages 187-226. 7. Johns Martin Analog Integrated circuits design , John Wiley and Sons, Inc., pages 108-115. 8. Johns Martin Analog Integrated circuits design , John Wiley and Sons, Inc., pages 401-451. 9. Johns Martin Analog Integrated circuits design , John Wiley and Sons, Inc., pages 131-175. 10. Gray, Hurst, Lewis, Mayer Analysis and design of integrated circuits Fourth edition, John Wiley and Sons, Inc. pages 299-332 11. Johns Martin Analog Integrated circuits design , John Wiley and Sons, Inc., pages 227-310. 12. A. Baschirotto, S. DAmico IDESA Advanced tutorial series (http://microel_group.unisalento.it/)
Altre informazioni utili	

UNIVERSITÀ DEL SALENTO

SCHEDA INSEGNAMENTO

Electromagnetic Solutions for Hi-Tech

Corso di studio di riferimento	LM65 - CdL Magistrale in Communication Engineering and Electronic Technologies
Dipartimento di riferimento	Dipartimento di Ingegneria dell'Innovazione
Settore Scientifico Disciplinare	Ing-Inf/02
Docente	Luca Catarinucci
Crediti Formativi Universitari	6
Ore di attività frontale	54
Ore di studio individuale	96
Anno di corso	II anno
Semestre	II
Lingua di erogazione	Inglese
Percorso	PERCORSO COMUNE

Prerequisiti	Contents of “Fisica II” related to Maxwell's equations are needed.
Contenuti	The course aims at introducing and deeply investigating some of the applicative aspects of Electromagnetics which are more appealing to the student and more relevant from the point of view of their use in the labour market. Starting from general projects focused on RF aspects of new wireless technologies, the basic concepts functional to their development will be deepened, the final projects will be executed and skills useful for the practical realization and tests of the designed devices will be developed. "Electromagnetic Solutions for Hi-Tech" focuses on various topics in PERCORSO COMUNE with other courses belonging to the same scientific sector, but it remains a self-consistent course not bound by any prerequisites. Strategically, in "Electromagnetic Solutions for Hi Tech" qualitative and applicative aspects are highlighted and stressed, even though the approach keeps on being extremely rigorous.
Obiettivi formativi	At the end of the course the student should be able to: - Apply the basic concepts of electromagnetism. - Set up high frequency device designs based on requirements. - Master (among others) the concepts of impedance matching, radiation diagram, gain, polarization, image theorem, filiform antennas, aperture antennas. - Enrich the knowledge (from the point of view of Electromagnetics) of consolidated (e.g. Wi-Fi and GSM), emerging (RFID UHF and HF, NFC, Bluetooth Low Energy), and approaching technologies (mm-Wave Wi-Fi , 5G).
Metodi	Frontal lessons, practical exercitations, laboratory activities.

didattici	
Modalità d'esame	Oral exam. The oral exam is aimed at verifying the knowledge and understanding of the course topics acquired by the student (maximum overall duration: 45 minutes).
Programma	PART 1 (25 hours, of which 16 hours of frontal lesson and 9 hours of laboratory activity). Design, construction and test of waveguide antennas for Wi-Fi communication (each student will design and realize his own antenna): Notes on Wi-Fi technology. Preliminary design of a waveguide antenna for Wi-Fi links. Qualitative introduction of the basic concepts of electromagnetics useful for the project: distributed constant circuits, transmission lines; line-load matching; filiform antennas (dipole in l/2 and in l/4); method of images; radiation diagrams; directivity and gain; circular waveguides; TE and TM modes in waveguides. Vector Network Analyzer. Use of the Vector Network Analyzer for the measurement of some antenna properties. Final design, simulation, laboratory realization, measurement with Vector Network Analyzer and possible optimization. Test system design. Performance verification. PART 2 (6 hours, of which 4 hours of frontal lesson and 2 hours of laboratory activity) Analysis of panel antennas for GSM base radio stations: characteristics of GSM from the point of view of the antenna designer. Guidelines for the general design of a panel antenna for GSM base radio stations. Depth study of the basic concepts of electromagnetics useful for the project, including: linear arrays and planar arrays. 2D FDTD for GSM antennas. PART 3 (9 hours, of which 5 hours of frontal lesson and 4 hours of laboratory activity) Basic theory and examples about horn antennas, slotted waveguide antennas, and parabolic reflectors. The basic theory for analyzing aperture antennas will be presented, including Principle of Equivalence and radiated field derivation through 2D Fourier transform. Some examples of aperture antennas will also be analyzed by introducing the basic design equations. A full-wave simulator commercial software will be used for analyzing some examples of aperture antennas. An experiment will be also developed. PART 4 (8 hours, of which 6 hours of frontal lesson and 2 hours of laboratory activity) Design, implementation and test of an electric field meter for UHF RFID signals. RFID technology: main aspects of the technology. Examples of application of RFID technology. Preliminary design of an electric field meter for the UHF band. Depth study of the basic concepts of electromagnetics useful for the project, including antenna reciprocity theorem, linear, circular and elliptical polarization, measurement of low and high frequency electromagnetic fields, conjugate matching, link budget, and measurement of the radiation pattern. Test of the meter in a practical case: checking RFID coverage in a real environment. PART 5 (6 hours of scientific seminars) Seminars from the business and research world. One to three seminars

	dealing with the design and use of emerging technologies are planned.
Testi di riferimento	Main reference book: [1] Huang, Kevin Boyle, Antennas: From Theory to Practice, Wiley Other suggested bibliography: [2] G. Gerosa, P. Lampariello, Lezioni di Campi Elettromagnetici, Edizioni Ingegneria 2000 [3] A. Paraboni, Antenne, Mc Graw-Hill [4] J. D. Kraus, Antennas, Mc Graw-Hill
Altre informazioni utili	Il corso può essere selezionato come esame a scelta anche dagli studenti del terzo anno di Ingegneria dell'Informazione.

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SCHEDA INSEGNAMENTO

RF Microelectronics

Corso di studio di riferimento	LM65 - CdL Magistrale in Communication Engineering and Electronic Technologies
Dipartimento di riferimento	Dipartimento di Ingegneria dell'Innovazione
Settore Scientifico Disciplinare	ING-INF/01
Docente	Stefano D'Amico
Crediti Formativi Universitari	6
Ore di attività frontale	54
Ore di studio individuale	96
Anno di corso	II anno
Semestre	II
Lingua di erogazione	Inglese
Percorso	PERCORSO COMUNE

Prerequisiti	It is recommended to overcome the exam of Analog Electronics preliminarly.
Contenuti	This is a course in RF Microelectronic: it is aimed at providing principles and tools to analyze and design RF analog circuits in CMOS integrated technology.
Obiettivi formativi	After the course the student should be able to: 1) Describe the basic RF analog circuits (LNA, Mixer, etc…) and wireless transceiver architectures. 2) Evaluate the performance parameters and discuss complexity issues associated with different basic RF analog circuits and wireless transceiver architecture. 3) Demonstrate circuit analysis capability of not standard circuits. 4) Understand the technology limits in circuit design. 5) Use the simulator to analyse performance of RF analog circuits. 6) Correctly expose a RF circuit study or a wireless transceiver architecture description.
Metodi didattici	The Course forecasts 33 hours of theoretical lectures about technology description and fundamental RF circuit analysis and wireless architectures. The theoretical concepts are verified in laboratory by using state of the art circuit simulator. 36 hours of laboratory are forecast. Moreover, 12 lectures about manual analysis and design of circuit examples and wireless transceiver architectures are proposed.
Modalità d'esame	The final (oral) exam consists of two cascaded parts: 1. the first part is based on the discussion about a report on the assigned RF circuit. The circuit must be simulated at the calculator. The student is asked to learn using the simulator, to illustrate the circuit design, to evaluate the performance parameters, and to define the operation of each part of the circuit. It is aimed to verify to what extent the student has gained knowledge and understanding of the use of the circuit simulator and the circuit analysis.

	2. the second part is on circuit analysis of one of the RF basic circuits studied during the course or a wireless RF architecture; it is aimed to determine to what extent the student the circuit analysis capability, ability to identify and use data to formulate responses to well-defined problems, correct exposure of the circuit analysis, problem solving abilities and the capacity integrate different concepts.
Programma	• Introduction to the RF and Wireless Technology -Complexity Comparison -Design Bottleneck -Applications -Analog and Digital systems -Choice of Technology • Basic Concepts in the RF Design -Nonlinearity and time Variance -Intersymbol Interference -Random process and noise -Sensitivity and Dynamic range -Passive Impedance Transformation • Transceivers Architectures -General Considerations -Receivers architectures -Transmitters architectures • Low-Noise Amplifier and Mixers -Low-noise Amplifier -Downconversion Mixers • Oscillators -General considerations -Basic LC oscillator Topologies -Voltage-Controlled oscillators -Phase noise • Frequency Synthesizers -General Considerations -Phase Locked Loops -Architectures of the Frequency Synthesizers Exercitation • Design of a Homodyne Receiver The exercitation consists in the synthesis of a homodyne receiver and its functional blocks starting from the systems specifications. The software to be used is Excel.
Testi di riferimento	Behzad Razavi “RF Microelectronics”
Altre informazioni utili	contact the instructor by email for questions or to have an appointment (stefano.damico@unisalento.it).

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SCHEDA INSEGNAMENTO

SIGNALS ACQUISITION AND ELECTRONIC DESIGN

Corso di studio di riferimento	LM65 - CdL Magistrale in Communication Engineering and Electronic Technologies
Dipartimento di riferimento	Dipartimento di Ingegneria dell'Innovazione
Settore Scientifico Disciplinare	ING.INF./01
Docente	Paolo Visconti
Crediti Formativi Universitari	9
Ore di attività frontale	81
Ore di studio individuale	144
Anno di corso	II anno
Semestre	II
Lingua di erogazione	Inglese
Percorso	PERCORSO COMUNE

Prerequisiti	Knowledge in analog and digital electronic, C++ programming.
Contenuti	Overview This course embraces themes of sensing and transduction, signal acquisition, design of analog/digital circuital blocks, analysis of embedded systems and an overview on rapid prototyping solutions for advanced electronic design. These are vital subjects for any system which extracts signals from the real world and processes the information digitally. The course comprises information on signals, sensor and transducer principles, related applications, embedded electronic design for signal acquisition and finally design and testing, by using a specific software, of an electronic acquisition board managed by a microcontroller.
Obiettivi formativi	Learning Outcomes After the course the student should be able to: * Understand the principles of operation of PERCORSO COMUNEly used sensors, transducers, and instruments. * Define technical specifications and to select sensors and transducers for a given application. * Understand terminologies associated with instrumentation systems (e.g., range, sensitivity, dynamic response, calibration, hysteresis, error, accuracy, precision, data uncertainty, mean and standard deviation). * Use data acquisition software and hardware to collect and analyze data from a physical system. * Analyze and understand the operation of computerized instrumentation systems for industrial processes using multiple sensors, electronic interfaces, data acquisition boards based on microcontrollers. * Use commercial software for the design and simulation of electronic

	boards managed by a microcontroller * Gain experience in developing computerized instrumentation systems for industrial processes using multiple sensors, interface electronics, data acquisition smart boards. * Acquire an experience in designing an electronic acquisition system of physical quantities.
Metodi didattici	The course consists of lectures by using the slides provided to the students and laboratory activities related to the design and simulation of electronic solutions by the Proteus software. Also the teacher makes available on the website in addition to the slides of the lessons, further handouts to facilitate the understanding of the topics and the designing of the electronics systems. The final exam consists of an oral question on the theoretical topics of the course and in the presentation of a project realized by the student with the Proteus software.
Modalità d'esame	Examination: oral and project discussion related to Proteus software. The exam consists of an oral examination related the theoretical and practical contents of the course. In addition, the student has to present a circuital project realized with Proteus software and discuss its contents showing operation modes of designed electronic board managed by a microcontroller and related simulation results (maximum overall duration: two hours).
Programma	Course Contents - Introduction: sensors, transducers, processing devices and smart units. - Block scheme of channel for signal and information acquisition and processing. - Physical principles of sensors and transducers. Fundamental concepts: sensitivity, resolution, accuracy, linearity, offset, gain, signal-to-noise ratio, standard deviation, measurement error. - Sensors: strain gauge, piezo-electric sensors, temperature sensors, light and radiation sensors, accelerometers, proximity sensors, magnetic field sensors, sensors of displacement, angle, speed, level, force, pressure, flow rate. Industrial and automotive applications of commecial sensors. - Electronic sensing circuits, new generation intelligent (smart) sensors. - Digital to analogue converters – internal structure and design. Analogue to digital converters - principal methods. - Internal scheme, operation and programming of a microcontroller (PIC). - Proteus software for the design and simulation of smart boards for signals acquisition/processing. - Introduction to Arduino platform - circuital scheme, embedded microcontroller, board pinout - Analog and Digital pins. - Arduino Integrated Development Environment and firmware structure. - Arduino board interfacing with sensors, transducers, actuators, processing devices and smart units with related firmware implementation. - Prototypes realization and testing on proto-boards.
Testi di riferimento	Teaching materials: teacher handouts.
Altre informazioni utili	


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SCHEDA INSEGNAMENTO

Telecommunication Systems

Corso di studio di riferimento	LM65 - CdL Magistrale in Communication Engineering and Electronic Technologies
Dipartimento di riferimento	Dipartimento di Ingegneria dell'Innovazione
Settore Scientifico Disciplinare	ING-INF/03
Docente	Angelo Coluccia
Crediti Formativi Universitari	9
Ore di attività frontale	81
Ore di studio individuale	144
Anno di corso	II anno
Semestre	II
Lingua di erogazione	Inglese
Percorso	PERCORSO COMUNE

Prerequisiti	Communications, Networks, Statistical Signal Processing.
Contenuti	The course provides an overview of modern communication principles and techniques, and how they are composed into "systems". The focus is on multiuser wireless systems, in particular mobile cellular networks from 2G (GSM) to 4G (LTE) and next-generation (5G), and (geo)localization systems.
Obiettivi formativi	Knowledge and understanding. Students must have a solid background with a broad spectrum of basic knowledge of digital communications and systems: · Describe the characteristics of advanced digital communication techniques and discuss the principles of modern system design; · Understand the different types of diversity that can be exploited to improve the performance of a communication system; · Illustrate data-aided and non-data-aided synchronization techniques for timing recovery in baseband and passband; · Describe how surveillance and (geo)localization can be performed via radio signals, and illustrate satellite-based navigation system. Applying knowledge and understanding. After the course the student should be able to: · Work with analytical models and solve optimization, detection, and estimation problems related to the course topics; · Describe the peculiar aspects and main challenges of (mobile) multiuser systems, and how advanced digital communication techniques can be adopted to efficiently cope with them; · Discuss the evolution of cellular networks from a system perspective, state-of-the-art technologies and security, and the ongoing trends; · Understand the differences among several techniques addressing the same problem and recognize the main trade-offs.

	· Recognize and understand the tendencies and innovations in the ICT field, with awareness of related privacy, security, and ethical issues. Making judgements. Students are guided to learn critically what is taught during classes, comparing different approaches to address modern telecommunication needs, and to have a clear view of the big picture. Communication. It is essential that students are able to communicate with a varied and composite audience, not culturally homogeneous, in a clear, logical and effective way, using the methodological tools acquired, their scientific knowledge, and the specialty vocabulary. The course promotes the development of the following skills: ability to highlight and expose in precise terms the characteristics or a variety of telecommunication systems, identifying their salient features without getting lost into protocol/standard details; ability to describe and analyze the different options available for a given application scenario or use case, and illustrate the main trade-offs. Learning skills. Students must acquire the critical ability to discuss, with originality and autonomy, the most important aspects in the design of telecommunication systems and, in general, cultural issues linked to related areas within the ICT domain. They should be able to develop and apply the knowledge learned in the continuation of their studies and in the broader perspective of cultural and professional self-improvement of lifelong learning. Therefore, students are explicitly asked to refer to and compare different sources and textbooks, also by autonomously selecting authoritative materials from the vast amount of information available (libraries, online repositories, and the Web at large), summarizing them for an effective study.
Metodi didattici	The course aims at enabling students to understand and be able to solve design issues in telecommunications systems, keeping an unified view and being able to navigate the complexity of modern scenarios. This will be done using the following teaching method. Every system will be introduced in terms of motivations, technical peculiarities, and application scope. The presentation of each topic will be linked to the background studied in previous courses, and continuously connected to the preceding and subsequent topics within the present course. The discussion will be organized into four parts: 1. Description of the main characteristics of the system. 2. Comparison with previous technology addressing the same communication needs, and analysis of the additional requirements. 3. Derivation of selected algorithms and optmization/detection/estimation techniques relevant to the addressed system. 4. Analysis of the implications in terms of user experience, applications to contemporary/future contexts, and security. The course consists of frontal lessons with slides and blackboard, together with class exercises and labs using MATLAB and software-defined radio

	equipment. There will be theoretical lessons, qualitative discussion on system aspects, and examples about how knowledge is put into practice in real systems. A part of the lessons will be also devoted to illustrate related ongoing research directions in the field.
Modalità d'esame	Written and/or oral. The final (typically written) exam consists of five open questions aimed at verifying to what extent the student 1) has gained knowledge and understanding of the selected topics of the course, 2) is able to discuss complex aspects in a synthetic way, and 3) has gained adequate degree of maturity in linking concepts within a system view. Small exercises may be included in the questions so that the student can demonstrate his/her ability to 1) correctly adopt formal techniques for solving well-defined problems, and 2) integrate different concepts and tools.
Programma	Advanced digital communication techniques and modern systems (hours: 28 + 4 lab/exercise) Recapitulation of fundamental principles of digital communications; diversity, combining techniques and MIMO systems; multiuser systems: multiplexing, multiple access, optimality and fairness in resource allocation, link adaptation functions (power control, Adaptive Modulation and Coding, tradeoffs), error recovery (ARQ, FEC and Hybrid-ARQ); overview on spread-spectrum and multi-carrier systems (CDMA, OFDM), multiuser detection. Telecommunication networks and mobile cellular systems (hours: 20 + 4 lab/exercise) Historical development of data and voice networks, PSTN; general principles of cellular networks. The GSM system: architecture, burst structure, overview on signaling and mobility procedure. Evolution towards GPRS/EDGE. 3G: UMTS overview and evolution towards HSPA. 4G technologies and next generation systems: LTE, main ideas towards 5G (cooperation, smart antennas, cognitive radio). Introduction to Network Security and intrusion detection. Security in GSM/3G (scanning, attacks, DDoS). Synchronization techniques (hours: 9 + 2 lab/exercise) Maximum Likelihood, data-aided and non-data aided techniques for timing recovery; joint phase and time recovery; synchronization in flat fading channels, low-complexity (ad-hoc) schemes. Localization and positioning systems (hours: 10 + 4 lab/exercise)> Introduction to surveillance through radio signals; (geo)localization and satellite-based positioning systems. GPS: principles, signal structure, augmentation, modernization. Current trends and topics in localization.
Testi di riferimento	Textbooks. (other specific references are provided during the course) A. Goldsmith: "Wireless Communications", Cambridge University Press, 2005 J.G. Proakis: "Digital Communications" (4th ed.), McGraw Hill, 2000 T.S. Rappaport: "Wireless Communications: principles and practice" (2nd ed.), Prentice Hall, 2002 S. Sesia, I. Toufik, M. Baker: "LTE: The UMTS Long Term Evolution - from theory to practice", Wiley, 2009 U. Mengali, A.N. D'Andrea: "Synchronization techniques for digital receivers", Springer, 2007 J. Bao-Yen Tsui: "Fundamentals of Global Positioning System Receivers: A Software Approach", Wiley, 2000

Altre informazioni utili	