

**Polytechnic School - Department of Naval, Electrical, Electronic and Telecommunications
Engineering (DITEN)**

Master's degree in Internet and Multimedia Engineering

**Class LM-27
Degree Regulation**

Description of the Master's degree course

Art. 1 Premise and area of competence

This Regulation, in accordance with the Statute and the University Degree Regulation (general part and special part), discipline the organisational aspects of the teaching activity of the Master's degree course in Internet and Multimedia Engineering, as well as any other subject devolved to it by other legislative and regulatory sources.

The Degree Regulation of the Master's degree course in Internet and Multimedia Engineering is resolved, pursuant to article 18, paragraphs 3 and 4 of the University Degree Regulation, general part, by the Degree Programme Board (DPB) of Telecommunications Engineering to the majority of the members and submitted for the approval of the Board of the DITEN Department (and of the Boards of the possible associated Departments), after consultation with the Polytechnic School, with the prior favourable opinion of the Joint Committee of the School.

The resolutions of the DPB can also be taken in telematic mode according to the above-mentioned regulations and, in particular, of Article 14 "meetings with telematic mode" of the current General Regulation of the University (in force since 19/12/2018).

Art. 2 Admission requirements and procedures for verifying individual preparation

Admission to the Master's degree course in Internet and Multimedia Engineering is subject to the possession of specific curriculum requirements and adequate personal preparation.

The curricular requirements for enrolment in the Internet and Multimedia Engineering Master's degree course must be acquired before enrolment and consist of knowledge equivalent to the general training objectives of Information Engineering Classes (Class 9 of DM 509/1999 and Class L-8 of DM 270/2004). With reference to curricular requirements, in order to access to the Master's Degree in Internet and Multimedia Engineering it is required:

- to be in possession of a degree, Master's degree, referred to Ministerial Decree 509/1999 or Ministerial Decree 270/2004, obtained at an Italian University or a five-year degree (prior to Ministerial Decree 509/1999), obtained at an Italian University or equivalent qualifications;
- to be in possession of at least 36 ETCS, acquired in any university course (bachelor's degree, master's degree, five-year degree, first and second level university master's degree) in the disciplinary-scientific sectors (SSD) indicated for the basic training activities of Engineering degrees of L-8 class Information Engineering;
- to be in possession of at least 45 ETCS acquired in any university course (bachelor's degree, master's degree, five-year master's degree, first and second level university master's degree) in the disciplinary-scientific sectors indicated for the training activities characterising Engineering degrees of L-8 class Information Engineering, in the disciplinary fields of Automation Engineering, Biomedical Engineering, Electronic Engineering, Computer Engineering, Telecommunications Engineering.

The following degrees awarded by University of Genoa meet the curricular requirements of the Master's Degree:

- Electronic Engineering and Information Technology
- Telecommunications Engineering
- Computer Engineering
- Biomedical Engineering

In the case of degrees other than those indicated in this Degree Regulation and mentioned above, the DPB will verify the presence of the curricular requirements or equivalent knowledge, based on the exams taken by the student in the degree course of origin, as well as the presence of any extracurricular exams, internship activities and work experience.

In order to be admitted to the Master's degree course, students in possession of the curriculum requirements must successfully undergo a test to verify their personal preparation, except in the cases provided for in the last paragraph.

The test will be carried out in the form of a public interview or written test and will be aimed at ascertaining the general preparation of the student with particular reference to basic engineering subjects specific to telecommunications engineering and with particular reference to:

- mathematical/physical sciences;
- computer architectures, data structures and algorithms;
- analogue and digital electronics;
- signal processing and transmission;
- telecommunications networks and systems;

The ability to use the English language fluently, in both written and oral form, is also the subject of this test. In particular, since in this specific case the teaching units are delivered completely in English, a level of knowledge not lower than level B2 is required. This knowledge may be certified by means of appropriate certificates in the student's possession or, in the absence thereof, it must be verified by the Committee during the interview.

The test will be held in front of a Committee appointed by the DPB and composed of professors belonging to the DPB.

The composition of the Examination Committee, the methods of the test, the place and date of the test, the subjects to be examined and the evaluation criteria of the candidates are indicated in the Notice of Admission to the Polytechnic School's Master's degree courses and on the website of the Master's degree course.

For the purposes of student assessment, the Committee will also take into account the curriculum obtained in the three-year degree course. The result of the test shall only include the words "passed", "not passed".

The adequacy of personal preparation is automatically verified for those who have obtained a Bachelor's degree, Italian or foreign, or a qualification judged equivalent according to what has been indicated about the assessment of curricular requirements, with a final grade of at least 9/10 of the maximum grade provided for by their degree or who have obtained a final grade corresponding at least to the "A" classification of the ECTS system.

Art. 3 Training activities

The list of teaching units and other possible training activities, in the cohort 2020-2022, is given in the appropriate annex (Annex 1) which constitutes an integral part of this regulation. A responsible professor is identified for each teaching unit. A professor is responsible for teaching whoever is in charge of teaching according to the law, i.e. the one to whom the relative Department Board has attributed the responsibility itself when assigning teaching tasks to professors.

The language used to provide training activities (lessons, exercises, workshops) shall be Italian or another EU language, where expressly decided by the DPB.

Annex 1 to this regulation specifies the language in which each training activity is carried out.

Art. 4 Enrolment in individual training activities

In accordance with Article 6 of the University Regulations for students, in order to enrol in individual training activities you must have a qualification which allows access to the university.

Art. 5 Curricula

The Master's degree course in Internet and Multimedia Engineering is not structured in curricula.

Art. 6 Total time commitment

The definition of the hourly fraction dedicated to lessons or equivalent teaching activities is established, for each teaching unit, by the DPB and specified in the special part of the regulation. In any case the following intervals of variability of the correspondence classroom/ETCS hours are assumed: 8 ÷ 12 hours of lesson or assisted teaching activity.

The definition of the assumed total time commitment, reserved for personal study or other training activities of an individual type, is laid down, for each teaching unit, in the annex (Annex 1) to this regulation.

The director of the DITEN Department and the coordinator of the DPB shall be responsible for verifying compliance with the above requirements, including for the publication of course programmes.

Art. 7 Study plans and prerequisites

Students can enroll full-time or part-time; for the two types of student there are different rights and duties.

The student chooses the type of registration simultaneously with the presentation of the study plan. The full-time student carries out his training activity considering the study plan prepared by the Master's degree course, which is distinguished by years of the course programme and published in the Degree Programme Table of the Master's degree course. The study plan formulated by the student must contain an indication of the training activities, with the relative credits that he intends to achieve, provided by the official study plan for this teaching period, up to a maximum of 65 credits provided in each year, except in cases of transfer from other universities which will be evaluated individually.

The part-time student is required to submit an individual study plan specifying the number of credits he intends to enter.

In the absence of the completion of the study plan by the due date, a standard plan will be uploaded ex officio, except in cases where it is planned to complete an individual study plan (e.g. change of course of study, previous part-time individual study plan).

The enrolment of full-time and part-time students is regulated by the University Regulations for students considering the operational provisions resolved by the Central government bodies and indicated in the Student Guide (published annually on the University's website). The educational path of the student can be bound by a system of propaedeuticity, indicated for each teaching unit in the special part of this Regulation (Annex 1).

The Course of Study may, by express and reasoned resolution, authorise students who have demonstrated particularly high academic performance in the previous academic year to include in their study plan more than 65 credits, but in any case, not more than 75.

The study plan, which has a shorter duration than the normal one, is approved by the Degree Programme Board.

The method and deadline for the presentation of the study plan are established annually by the Polytechnic School and reported in the Degree Programme Table.

Art. 8 Attendance and methods of carrying out teaching activities

The teaching units may take the form of: (a) lectures, including distance learning by telematic means; (b) practical exercises; (c) laboratory exercises.

The articulated profile and the demanding nature of the lessons taught in the various Courses of Study offered make the attendance to the training activities strongly recommended for an adequate understanding of the topics and therefore for a good success in the exams.

The schedule of classes is divided into semesters. As a rule, the semester is divided into at least 12 weeks of lesson plus at least 4 weeks overall for verification tests and profit exams.

The period for profit exams ends with the beginning of the lessons of the following semester. In the middle of the semester, the normal teaching activity (lessons, exercises, laboratories) can be interrupted for the conduct of graduation exams, intermediate tests, seminars, tutoring activities and didactic activities of recovery.

The lesson schedule for the entire academic year is published on the Course of Study's website before the start of the lessons of the academic year. The schedule of classes guarantees the possibility of attendance based on the years of the course programme provided for by the current Degree Programme Table of the Master's degree course. For practical reasons, the compatibility of the timetable for all formally possible optional teaching choices is not guaranteed. Students must then formulate their study plan taking into account the time of the lessons.

Art. 9 Examinations and other profit exams

Profit exams can be carried out in written, oral, or written and oral, according to the methods indicated in the teaching sheets published on the website of the Master's degree course.

On request, specific learning verification arrangements may be provided which take into account the needs of disabled students and students with specific learning disorders (D. S. A.), in accordance with art. 29 paragraph 4 of the University Degree Regulation.

In the case of teaching units structured in modules with several professors, they participate collegially in the overall evaluation of the student's profit which cannot, however, be split into separate evaluations on the individual modules.

The calendar of profit exams is established by September 30th for the following academic year and is published on the website of the Degree Course. The calendar of any intermediate verification tests is established by the DPB and communicated to the students at the beginning of each teaching cycle.

Examinations are held in periods of interruption of classes. Examinations may be planned during the period of the classes only for students who, in the current academic year, have not included training activities in their study plan.

All profit examinations of training activities must be passed by the student at least twenty days before the expected date for taking the graduation exam.

The result of the examination, with the vote obtained, is verbalized in accordance with art. 29 of the University Degree Regulation.

Art. 10 Recognition of credits

The Degree Programme Board decides on the approval of applications for change or transfer from another degree course of the university or other universities in accordance with the rules provided for in the University Degree Regulation, art. 21. It also decides the recognition, as training credits, for a maximum number of 12 ETCS, of professional knowledge and skills certified in accordance with the current legislation.

The evaluation of applications for change will take into account the didactic specificities and the actuality of the educational content of the individual exams taken, reserving to establish from time to time any forms of verification and supplementary exams.

Within the framework of the national and regional legislation on alternance education/work, it is possible for the course of study to provide, for selected students, learning paths that also take into account work experience carried out at companies under contract.

Art. 11 Mobility, studies abroad, international exchanges

The DPB strongly encourages internationalisation activities, in particular student participation in mobility and international exchange programmes. For this purpose, it shall ensure, in accordance with the rules in force, the recognition of the training credits obtained within these programmes and shall organise the training activities as appropriate in such a way as to make these activities easier and effective.

The DPB recognizes enrolled students, who have regularly completed a period of study abroad, the exams taken off-site and the achievement of the related credits with which the student intends to replace the exams of his own study plan.

For the purposes of the recognition of these examinations, the student at the time of the compilation of the plan of training activities, he intends to follow at the University abroad, must produce suitable documentation proving the equivalence of content between the teaching unit abroad and the teaching unit that intends to replace taught in the Master's degree course in Internet and Multimedia Engineering. Equivalence shall be evaluated by the DPB.

The conversion of votes will take place according to criteria approved by the DPB, in accordance with the European ECTS system.

Any period of study abroad, lasting a minimum of one semester, which has involved the recognition of training credits, will be evaluated for the purposes of the final examination.

Art. 12 Procedures for the final examination

The final examination consists in the discussion of a written thesis, aimed at ascertaining the candidate's technical-scientific and professional preparation.

For the purposes of obtaining a Master's Degree, the final examination consists of the writing of a thesis, elaborated by the student in an original way under the guidance of one or more supervisors, on a subject defined as relevant to a discipline for which he or she has passed the exam.

The supervisors must include at least one lecturer from the Polytechnic School and/or the reference or associate Department.

The thesis can be carried out also in English; in case of use of another EU language, the authorization of the DPB is required. In these cases the thesis must be accompanied by the title and an extensive summary in Italian.

The thesis, carried out in university laboratories, companies, national or international research bodies, must reveal the student's ability to deal with research and/or application issues. The thesis must consist of a project and/or the development of an application that proposes innovative solutions with respect to the state of the art and demonstrates the student's analytical and design skills.

The thesis must also reveal:

- adequate preparation in the disciplines characterising the Master's Degree;
- adequate engineering preparation;
- correct use of sources and bibliography;
- systematic and argumentative skills;
- clarity in the exposition;
- design and experimental skills;
- critical skills.

The Committee for the final examination is composed of at least five members including the Committee president and is appointed by the Director of the DITEN Department.

The procedure for the final examination consists of the oral presentation of the thesis by the student to the Final Examination Committee, followed by a discussion of any questions raised by the members of the Committee.

The commitment required of the student for the preparation of the final examination must be commensurate with the number of credits assigned to the exam itself.

The evaluation of the final examination by the Committee takes place, in the event of passing the final exam, by assigning an increase, varying from 0 to 6, maximum established by the Polytechnic School in agreement with the Departments, to the weighted average of the marks obtained in the exams relating to

training activities that require a final vote, taking as weight the number of credits associated with the individual training activity.

Any period of study abroad, lasting at least one semester, which has involved the recognition of training credits, will result in an increase of one point to the above weighted average.

Art. 13 Guidance services and tutoring

The Polytechnic School, in agreement with the DITEN Department, organizes and manages a tutoring service for the welcome and support of students, in order to prevent dispersion and delay in studies and to promote a profitable active participation in university life in all its forms.

The DPB identifies within it a number of tutors in proportion to the number of students enrolled. The names of the tutors can be found on the website of the Master's degree course.

Art. 14 Verification of obsolescence of credits

University training credits (ETCS) acquired within the framework of the degree course can be subject to obsolescence verification after 6 years. If the DPB recognizes the obsolescence of even a single part of the relative educational content, the DPB itself establishes the supplementary tests that must be taken by the student, defining the topics, the methods of verification, the composition of the Examination Committee.

Once the required tests have been passed, the DPB validates the credits acquired with a resolution. If the related training activity provides for a vote, it may be varied from the one previously obtained, on a proposal from the Examination Committee which carried out the verification.

Art. 15 Degree Programme Table

The DITEN Department, after consulting the Polytechnic School, approves and publishes annually the Degree Programme Table of the Master's degree course. In the Degree Programme Table are indicated the main provisions of the didactic system and the didactic regulation of the Master's degree course, to which additional information may be added.

The Degree Programme Table of the Master's degree course contains the list of the teaching units activated for the academic year in question. The teaching sheets are published on the website of the degree course.

Annex 1 to the Degree Regulation of the Master's degree course in Internet and Multimedia Engineering
List of training activities and related training objectives

Year	Code	Teaching unit IT	Teaching unit EN	ETCS	SSD	Type	Area	Language	Prerequisites	Training objectives	Hours for assisted teaching activity	Hours for personal study
1	104760	DIGITAL COMMUNICATIONS I	DIGITAL COMMUNICATIONS I	5	ING-INF/03	CORE LEARNING ACTIVITY	Telecommunications Engineering	English		The course is aimed at providing the bases of digital communications: the baseband and bandpass transmissions will be presented, discussed, and compared. The goal is to give the students an adequate knowledge needed to understand the key elements for designing and developing modern telecommunication systems.	50	75
1	104852	MACHINE LEARNING FOR PATTERN RECOGNITION	MACHINE LEARNING FOR PATTERN RECOGNITION	5	ING-INF/03	CORE LEARNING ACTIVITY	Telecommunications Engineering	English		In this course several Machine learning methods applied to pattern recognition are presented and their application to images from real domains are discussed: <ul style="list-style-type: none"> • Decision Theory • Supervised Probability Density Estimate • Feature Reduction • Linear and Nonlinear Classifiers (MDM, k-nn, SVMs) • Neural Networks and Deep Learning • Accuracy of Supervised Classifiers • Unsupervised Classifiers (Clustering) • Fuzzy Classifiers 	50	75

										• Contextual image classification		
1	66202	MATHEMATICAL METHODS AND OPERATIONS RESEARCH	MATHEMATICAL METHODS AND OPERATIONS RESEARCH	10		RELATED OR SUPPLEMENTARY	Related or supplementary learning activity				0	0
1	66204	OPERATIONS RESEARCH	OPERATIONS RESEARCH	5	MAT/09	RELATED OR SUPPLEMENTARY	Related or supplementary learning activity	English		Linear and nonlinear programming. Linear and nonlinear least squares. Optimal control. Optimal filtering.	50	75
1	86829	MATHEMATICAL METHODS	MATHEMATICAL METHODS	5	MAT/07	RELATED OR SUPPLEMENTARY	Related or supplementary learning activity	English		After the first part of the course the students will be able to use mathematical methods to describe real-world phenomena, such as heat diffusion and wave propagation. More specifically, they will be able to classify and manage the main analytical solution methods for linear partial differential equations, together with some techniques for their numerical solution. In the second part, the students will learn to manage multistage optimization problems by means of dynamic programming, which will be employed also to solve classical problems on graphs, such as the shortest path and shortest spanning tree, together with other algorithms.	50	75
1	90138	MOBILE COMMUNICATIONS	MOBILE COMMUNICATIONS	10	ING-INF/03	CORE LEARNING ACTIVITY	Telecommunications Engineering				0	0

1	90139	PHYSICAL LAYER MODELS AND TECHNIQUES FOR SOFTWARE RADIO	PHYSICAL LAYER MODELS AND TECHNIQUES FOR SOFTWARE RADIO	5	ING-INF/03	CORE LEARNING ACTIVITY	Telecommunications Engineering	English	Mathematical models for radio transmission: (20) Radio Channel models; Free space model; Probabilistic rain model; Multipath time-variant general statistical model (Time variant pulse response, First order channel models (Fading (Rayleigh, Rice, Nagakami))); Second order models. Radio transmission system models: Frequency selectivity and temporal fading; Slow and fast fading; Diversity transmission (frequency, time, space); Wideband transmissions as frequency selective channels; Channel models and rake receivers. Wideband Digital radio transmission: systems and techniques (20): Multiple Access techniques overview; Wideband modulations: Spread Spectrum: General concepts, Direct Sequence Spread Spectrum and CDMA, Orthogonal Frequency Division Modulation (OFDM) Software and Cognitive Radio (10) : Software radio architectures;. from software to cognitive radio	50	75
1	90140	PERVASIVE COMMUNICATION AND CONTEXT	PERVASIVE COMMUNICATION AND CONTEXT	5	ING-INF/03	CORE LEARNING ACTIVITY	Telecommunications Engineering	English	The Internet society is based on technological solution for continuative and pervasive connection of persons and objects (IoT). In the course,	50	75

		AWARENES S	AWARENES S							different radio technologies are investigated and compared able to guarantee such global connection, including terrestrial and satellite solutions. Radio coverage strategies will be examined by comparing different cell planning methodologies. Terrestrial mobile telephone standards like GSM/GPRS, WCDMA and LTE will be examined and compared with satellite technologies like Globalstar and Iridium. The smartphone platform will be considered as a multi-standard platform able to connect persons and things beyond the telephone network, including Wifi, Bluetooth, RFID, BLE, NFC. The added value represented by position estimation of terminal, persons and things will be considered with reference to applications for logistics, transportation and health. In such view, methodologies based on terrestrial radio fingerprinting and satellite-based global systems (GPS/Galileo/Egnos) will be introduced.		
1	90147	INTERNET TECHNOLOGIES: ARCHITECTURES AND PROTOCOLS	INTERNET TECHNOLOGIES: ARCHITECTURES AND PROTOCOLS	10	ING-INF/03	CORE LEARNING ACTIVITY	Telecommunications Engineering	English		<ul style="list-style-type: none"> Review of the Internet Architecture and Protocols o IPv4 review (management of IP addresses); IP routing algorithms and protocols review; Multicast; IPv6; UDP/TCP; Flow and congestion control in packet 	100	150

										networks; Application layer <ul style="list-style-type: none"> • Network and Computer Security <ul style="list-style-type: none"> o Basic concepts; Algorithms; Standard protocols; Vulnerability of networks; Summary of the local (Italian) regulations; • Computer security <ul style="list-style-type: none"> • Wireless Network architecture and Protocols <ul style="list-style-type: none"> o Wi-Fi (IEEE 802.11); Bluetooth (IEEE 802.15.1) • Quality of Service (QoS) in IP Networks <ul style="list-style-type: none"> o Introduction to QoS in IP networks; Differentiated Services and Integrated Services IETF Architectures; ReSerVation Protocol (RSVP); Multi Protocol Label Switching (MPLS) • Multimedia services over the Internet <ul style="list-style-type: none"> o Voice and Video over IP; Real Time Protocol (RTP) and Session Description Protocol (SDP) 		
1	90315	ANTENNAS AND ELECTROMAGNETIC PROPAGATION	ANTENNAS AND ELECTROMAGNETIC PROPAGATION	10	ING-INF/02	CORE LEARNING ACTIVITY	Telecommunications Engineering				0	0
1	90316	ANTENNAS	ANTENNAS	5	ING-INF/02	CORE LEARNING ACTIVITY	Telecommunications Engineering	English		The module provides knowledge and skills concerning antennas, with reference to both their working principles and their use in different applicative fields. The following main topics will be addressed. Fundamentals of	50	75

										electromagnetic radiation and antenna parameters. Linear antennas, aperture antennas, reflector antennas, printed antennas. Antenna Arrays. MIMO systems for multimedia communications. Smart and reconfigurable antennas. Wide band antennas for high-speed internet links. Antenna systems for industrial, civil and biomedical applications.		
1	90317	ELECTROMAGNETIC PROPAGATION	ELECTROMAGNETIC PROPAGATION	5	ING-INF/02	CORE LEARNING ACTIVITY	Telecommunications Engineering	English		The module provides knowledge and skills concerning guided electromagnetic propagation, with reference to both their working principles and their use in different applicative fields. The following main topics will be addressed. Fundamentals of guided propagation. Longitudinal-transverse decompositions of Maxwell's equations, TEM, TE, TM modes, rectangular waveguides, higher TE and TM modes, operating bandwidth, power transfer an attenuation, group velocity in waveguides, reflection model of waveguide propagation, dielectric slab guides. Oblique incidence and Snel's laws, Zenneck surface wave, surface plasmons. Plasmonic waveguides, plasmonic and oscillatory modes, MDM and	50	75

										DMD configurations. RFID technology, active and passive RFID tags, plasmonic RFID.		
		5 ETCS ELECTIVE fra										
1	103909	EU LAW AND NEW TECHNOLOGIES	EU LAW AND NEW TECHNOLOGIES	5	IUS/13	ELECTIVE	Student's elective learning activity	English		Provide technical students with the legal framework of Eu intervention in the sector they are approaching from a technical point of view. The interdisciplinary approach will empower graduates with new and useful skills for the job market and it will give students a greater awareness on the consequences deriving from the use and functioning (malfunctioning) of the technology.	50	75
1	104631	FUNDAMENTALS OF TELECOMMUNICATIONS	FUNDAMENTALS OF TELECOMMUNICATIONS	5	ING-INF/03	ELECTIVE	Student's elective learning activity	English		The course is aimed at providing the bases of digital communications: the baseband and bandpass transmissions will be presented and discussed, as well as the main channel coding techniques. The goal is to give the students an adequate knowledge needed to understand the key elements for designing and developing modern telecommunication systems.	50	75
2	104770	SECURITY, 5G AND IOT	SECURITY, 5G AND IOT	10				English				
2	104773	5G, CLOUD AND IOT	5G, CLOUD AND IOT	5	ING-INF/03	CORE LEARNING ACTIVITY	Telecommunications Engineering	English		The course aims at introducing the 5G radio mobile networks and IoT technologies from the point	50	75

										of view of the functional architecture, the definition of protocols and standard procedures, and the Aml related functions.		
2	104781	CYBER SECURITY	CYBER SECURITY	5	ING-INF/05	RELATED OR SUPPLEMENTARY	Related or supplementary learning activity	English		The class aims at giving the students the basic knowledge about the main aspects and technologies involved in the network and telecommunication security, including short summaries about privacy issues, blockchain technologies, and the audit and risk assessment procedures. Although the most substantial part of the course is focused on the network and telecommunication security, most of the introductory concepts and techniques included in this course are relevant also for the computer security contest, which is, in any case, briefly introduced and discussed too.	50	75
2	104761	DIGITAL COMMUNICATIONS II	DIGITAL COMMUNICATIONS II	5	ING-INF/03	CORE LEARNING ACTIVITY	Telecommunications Engineering	English		The course will provide the bases of techniques for transmitting analog signals and for protecting data in digital communications. Specifically, linear block codes and convolutional codes will be covered, as well as basics of Pulse Code Modulation. The aim is to furnish an adequate knowledge to understand the main components to improve the reliability of modern	50	75

										digital telecommunication systems.		
2	60279	COGNITIVE TELECOMMUNICATION SYSTEMS	COGNITIVE TELECOMMUNICATION SYSTEMS	5	ING-INF/03	CORE LEARNING ACTIVITY	Telecommunications Engineering	English		The course aims at providing theory and techniques for architectural and functional design of interactive cognitive dynamic systems. Topics are related to data fusion, multilevel bayesian state estimation and their application to cognitive video and radio domains. Project based learning allows students to acquire design capabilities in the field.	50	75
2	104847	IMAGE PROCESSING AND REMOTE SENSING	IMAGE PROCESSING AND REMOTE SENSING	10		CORE LEARNING ACTIVITY	Telecommunications Engineering				0	0
2	104782	DIGITAL IMAGE PROCESSING	DIGITAL IMAGE PROCESSING	5	ING-INF/03	CORE LEARNING ACTIVITY	Telecommunications Engineering	English		In this course the basic techniques of digital signal and image processing are presented and their application to signals and images from real domains are discussed: <ul style="list-style-type: none"> • Digital Image Representation and Color Spaces • Image Filtering (linear and non-linear) • Edge Detection • Image Segmentation • Texture Analysis • Mathematical Morphology • Moments and Hough Transform • Adaptive Processing, Multiscale, Data Fusion 	50	75

2	104827	REMOTE SENSING AND SATELLITE IMAGES	REMOTE SENSING AND SATELLITE IMAGES	5	ING-INF/02	CORE LEARNING ACTIVITY	Telecommunications Engineering	English	Remote Sensing — Based on the concepts ruling the generation and propagation of electromagnetic wave fields, the objective is to provide the students with basic knowledge about the fundamentals and basic definitions of remote sensing; passive remote sensing in the optical, microwaves, and infrared frequency bands; active remote sensing and radar imaging; instrumentation for remote sensing. Satellite Images — The objective is to provide the students with basic knowledge about past, current, and forthcoming space missions for Earth observation; computational methods for the display, the modeling, and the filtering of satellite imagery; change detection techniques for multitemporal data; and regression techniques for bio/geophysical parameter retrieval from remote sensing. In this framework, machine learning techniques rooted in the areas of ensemble learning, neural networks, and kernel machines will be discussed as well.	50	75
2	90144		QUALITY OF SERVICE	10	ING-INF/03					0	0

		QUALITY OF SERVICE AND PERFORMANCE EVALUATION	AND PERFORMANCE EVALUATION			CORE LEARNING ACTIVITY	Telecommunications Engineering					
2	90145	QUALITY OF SERVICE OVER HETEROGENEOUS NETWORKS	QUALITY OF SERVICE OVER HETEROGENEOUS NETWORKS	5	ING-INF/03	CORE LEARNING ACTIVITY	Telecommunications Engineering	English		The course is aimed at providing the know-how to design and manage advanced interworking technology and investigate technological challenges, still object of research both industrial and academic, as well as QoS over Heterogeneous Networks, Software Defined Networking (SDN), and Delay Tolerant Networking (DTN).	50	75
2	90146	NETWORK PERFORMANCE EVALUATION	NETWORK PERFORMANCE EVALUATION	5	ING-INF/03	CORE LEARNING ACTIVITY	Telecommunications Engineering	English		<ul style="list-style-type: none"> • Methods of network performance evaluation: analytical models, simulation, experimental measurements • Packet-level and flow-level models • Elementary queueing theory: elements of a queue, statistics of input and service, general results on infinite- and finite-buffer queues, Little's Theorem, Kendall's notation • Markovian queues: Poisson arrivals, exponential distribution, stationary distribution of general birth-death systems; M/M/1, M/M/1/K, M/M/m/m, M/M/m • Discrete- and continuous-time Markov Chains 	50	75

										<ul style="list-style-type: none"> • M/G/1 and Pollaczek-Kinchin formula; Pareto distribution; M/G/1 with vacations; priority queueing • Networks of queues: Jackson networks, independence hypothesis, Kleinrock's delay formula 		
2	104778	INTERNET PROGRAMMING AND AUTONOMOUS SYSTEMS	INTERNET PROGRAMMING AND AUTONOMOUS SYSTEMS	5		ELECTIVE	Student's elective learning activity	English			0	0
2	104779	INTERNET PROGRAMMING	INTERNET PROGRAMMING	2,5	ING-INF/03	ELECTIVE	Student's elective learning activity	English		<p>The course is aimed at providing the bases of inter-process communication (IPC) under an Unix operating system: the main system calls for controlling the processes and the socket application programming interfaces (APIs) will be covered. The goal is to give the students an adequate knowledge needed to write client-server applications which are at the base of almost all Internet appliances.</p>	25	35
2	104780	MULTIMEDIA SIGNAL PROCESSING FOR AUTONOMOUS SYSTEMS	MULTIMEDIA SIGNAL PROCESSING FOR AUTONOMOUS SYSTEMS	2,5	ING-INF/02	ELECTIVE	Student's elective learning activity	English		<p>The course is aimed at providing machine learning basic and advanced techniques for data driven signal processing models to be used within autonomous systems design. In particular, perception and control modules in autonomous systems rely more and more on signal</p>	25	35

										processing approaches whose parametrization can be learned from observing multimedia heterogeneous signals produced by the artificial system while performing specific tasks. The course analyses data acquisition and processing tradeoffs between edge and cloud resources on the basis of real-time, computational and energy consumption requirements. Specific attention will be devoted to high dimensional data processing on the edge (with real practical examples in Python), showing how deep learning approaches can be adapted and optimized for working with limited computational capabilities.		
2	104851	SOFT SKILLS	RESEARCH METHODOLOGY	2		OTHER ACTIVITY	Training and Orientation Traineeships	English		The activity is meant to be developed as a preparatory work for the realization of the master thesis. Its target is providing the students with a methodological and scientific approach, to enable a research and development vision toward the final Master of Science project.	0	50
2	66175	MASTER THESIS	MASTER THESIS	18		FINAL EXAMINATION	For the final examination	English		The Master thesis consists of a report on a specific topic investigated under the tutoring of one or more professors. It should provide evidence of the student's ability to carry out independent investigations	0	450

										and to present the results in a clear and systematic form.		
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