

**POLYTECHNIC SCHOOL**  
**Department of IT, Bioengineering, Robotics and Systems Engineering**  
**Master's Degree in Bioengineering, Class LM-21**  
**DEGREE REGULATION - General part**

**2022-2024 cohort**

- Art. 1 Premise and area of competence**
- Art. 2 Admission requirements and procedures for verifying individual preparation**
- Art. 3 Training activities**
- Art. 4 Enrolment in individual training activities**
- Art. 5 Curricula**
- Art. 6 Total time commitment**
- Art. 7 Study plans and prerequisites**
- Art. 8 Attendance and methods of carrying out teaching activities**
- Art. 9 Examinations and other profit exams**
- Art. 10 Recognition of credits**
- Art. 11 Mobility, studies abroad, international exchanges**
- Art. 12 Procedures for the final exam**
- Art. 13 Guidance services and tutoring**
- Art. 14 Verification of obsolescence of credits**
- Art. 15 Degree Program Table**

**Art. 1 Premise and area of competence**

This Regulation, in accordance with the Statute and the University Degree Regulation (general part and special part), disciplines the organizational aspects of the teaching activity of the Master's degree Course in Bioengineering, as well as any other subjects devolved to it by other legislative and regulatory sources.

The Degree Regulation of the Master's degree Course in Bioengineering is resolved, pursuant to article 25, sections 1 and 4 of the University Degree Regulation, general part, by the Bioengineering Degree Program Board (CCS) by majority of the members and approved by DIBRIS Department Board, after consultation with the Polytechnic School, with the prior favorable opinion of the Joint Committee of the School and of the Department, where existing.

The resolutions of the CCS 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 Bioengineering is subject to the possession of specific curriculum requirements and adequate personal preparation.

The curricular requirements necessary to enroll in the Master's degree course are indicated in the Degree Regulation and must be acquired and verified before immatriculation. In order to enroll in the Master's Degree in Bioengineering, candidates must possess skills that are equivalent to those needed

by the general course requirements of Information Engineering Degrees (class L-8 of DM 270/2004 or equivalent degrees ex Interministerial Decree of 9 July 2009).

The following curricular requirements will be requested with no exclusions:

- **possession of a Laurea or Laurea Magistrale Degree ex DM 270/2004, obtained at an Italian University (or equivalent Degree ex Interministerial Decree of 9 July 2009), or an equivalent foreign degree;**
- **having at least 36 ECTS**, or equivalent knowledge, acquired during any university course in the disciplinary-scientific sectors as indicated for the basic learning activities required by Class L-8 Information Engineering Degrees;
- **having at least 45 ECTS**, or equivalent knowledge, acquired during any university course in the disciplinary-scientific sectors (SSD) as indicated for the characterizing learning activities of Information Engineering Degrees Class L-8, within the academic fields of Automation Engineering (ING-INF/04, ING-IND/13, ING-IND/32), Biomedical Engineering (ING-INF/06, ING-IND/34), Electronic Engineering (ING-INF/01, ING-INF/02, ING-INF/07), Computer Engineering (ING-INF/05), Telecommunications Engineering (ING-INF/03).

The following Bachelor's Degrees issued by the University of Genoa are deemed to meet the curricular requirements needed for the Master's Degree in Bioengineering:

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

In the case of possession of degrees other than those indicated in the didactic organization of the course, the CCS will verify the presence of the curricular requirements or equivalent knowledge, on the basis of the exams held by the student during their Degree Course of origin, as well as the presence of any extra-curricular exams, internships and work experiences.

For candidates that graduated abroad, the verification of curricular requirements will be carried out with proper equivalence between the successfully attended courses and the courses attributable to the above indicated SSD.

An adequate knowledge of the English language is also required, not lower than level B1 or a CEFR equivalent.

The curricular requirements must be possessed before the individual preparation verification, or in cases where that is not possible, candidates may take the test first and be subject to curricular verification afterwards.

The verification test aims to ascertain the general preparation of the candidate, with particular reference to their knowledge of fundamental notions of engineering and of practical and professional aspects relating to the specific subjects of the following areas:

- Core disciplines (Mathematic, Physics, Chemistry);
- Computer Science (procedural and object-oriented programming);
- Signal processing and elaboration (fundamentals of electrical communications, biomedical signal analysis techniques);
- Electronics (electromagnetism, circuits, instrumentation elements).

The test consists of an exam interview with a Commission appointed by the Coordinator of the Course of study, and cannot be sat more than twice by each candidate.

In the notice for admission to the Master's Degree Courses of the Polytechnic School and on the website of the Degree Program, the following are indicated: the test details, the place and date, the topics that will be assessed, the candidate evaluation criteria. In order to evaluate students, the Commission will also take into account the curriculum obtained over the course of their Bachelor's degree. The outcome of the test will only be the results "pass" or "fail". Candidates must register for the test on the Aulaweb site, dedicated to admission to the course.

The requirement of the adequacy of personal preparation is automatically cleared for students who have obtained a Bachelor's degree, Italian or foreign, or a qualification deemed equivalent when assessing the curricular requirements, with a final grade of at least 88/110, or who have obtained a final grade corresponding at least to the "C" classification of the ECTS system.

All students whose degree was obtained abroad will be tested on their Italian language. The test will be carried out by the University's School of Italian Language of Culture, in order to ascertain the student's possession of level B2 of the CEFR.

Those who fail the test must enroll in the free Italian course organized by the University of Genoa in order to obtain the necessary language level.

For candidates from non-EU countries residing abroad and holders of a foreign degree, the application procedure to verify eligibility is managed through a special online portal, advertised annually on institutional websites and on the Master's Degree websites, following dates and deadlines that are annually established and duly communicated to students.

After uploading the documentation onto the portal, the following verifications will be carried out: completeness of the documents, verification of curricular requirements, verification of knowledge of the English language.

Candidates who pass the requirements check will move on to a double assessment phase:

- Credentials evaluation
- Candidate evaluation

Following these two types of evaluation, students will be deemed eligible or ineligible.

The interview dates established by the Polytechnic School are posted on the Degree Program website, and additional dates may be added if deemed necessary.

### **Art. 3 Training activities**

The list of teaching units and other possible training activities is presented in the appropriate annex (Annex 1) which constitutes an integral part of this regulation.

A coordinating lecturer is identified for each teaching unit. The coordinating lecturer is the person that is in charge of the course by law, i.e. the one to whom the relative Department Board has attributed the responsibility when assigning teaching tasks to professors.

A list of courses and all other activities that can be activated in cohorts 2022-2024 can be found at the end of this document.

The language used to provide training activities (lessons, exercises, workshops) shall be Italian or another European language. Annex 1 provides specifics as to which language each activity will use.

#### **Art. 4 Enrolment in individual training activities**

In accordance with Article 5 of the University Regulations for students, in order to enroll in individual training activities you must have a qualification allowing access to study at university.

#### **Art. 5 Curricula**

The Degree is organized into two tracks, each comprising two educational paths (curricula):

Track T1: Neuroengineering (taught in English)

- Curriculum T1C1: Neuroengineering and neurotechnologies
- Curriculum T1C2: Rehabilitation engineering and interaction technologies

Track T2: Engineering for Personalized Medicine (taught in Italian)

- Curriculum T2C1: Materials and Devices for personalized medicine
- Curriculum T2C2: Information and Communication Technologies for personalized medicine

#### **Track T1: Neuroengineering**

The nervous system both in normal and pathological conditions is a central field of study in modern bioengineering, from an applicational point of view (just think of prosthetics, rehabilitation, humanoid robotics), as well as from a methodological point of view (it requires a multi-level approach, from genes, to neurons, to cognitive and behavioral mechanisms) and requires contributions from various disciplines. The main areas of application include: (i) experimental and analytical technologies and methods to study the human brain and neuron populations; (ii) new tools and papers for neuropharmacology and neurotoxicology; (iii) new assistive or rehabilitation technologies based on advanced neural interfaces and human-machine interfaces; and (iv) artificial systems capable of emulating the sensory, motor and cognitive functions of the brain.

This track aims to train professionals that are capable of translating the advances in neuroscience into the development of advanced technologies for the study of the brain and for the diagnosis, treatment, and prevention of neurological and cognitive disorders.

Two curricula are offered, one leaning more towards neural technologies and the other one leaning more towards rehabilitation applications (rehabilitation, assistance, prosthetics).

- **Curriculum T1C1 Neuroengineering and neurotechnologies** focuses on the study of the molecular, cellular and computational basis of the dynamics of neuron populations, the related instrumentation and techniques of analysis and modeling, also through the construction of biomorphic or neuromorphic artifacts. The objective is twofold: development of technologies for neuro-electronic interfaces and neural and myoelectric controlled prostheses, and development of technologies and design methodologies for the construction of machines, systems and services that are capable of learning and adapting to the environment according to biologically inspired mechanisms.
- **Curriculum T1C2 Rehabilitation engineering and interaction technologies** provides expertise related to the study of sensorimotor perception and control and the use of information

technologies to improve the quality of life of people with neuro-motor and cognitive disabilities. This area includes rehabilitation technologies and technologies and tools for the assessment, promotion of recovery, and/or replacement of sensory, motor, and cognitive functions that may be impaired due to direct or indirect alterations of the nervous system.

### **Track T2: Engineering for personalized medicine**

Technological developments and demographic changes are profoundly changing medicine which, compared to the model traditionally centered on the symptomatic treatment of acute diseases, is increasingly evolving towards a model centered on the identification of individual risks of developing diseases on the basis of genetic profiles and other personal information (prediction); methods and tools to avoid, reduce and monitor the risk of developing diseases (prevention); clinical interventions based on the unique genetic, medical and environmental characteristics of each individual (personalization); patient involvement in the determination of therapeutic paths (participation). These characteristics are often summarized in the term '4P medicine' (predictive, preventive, personalized and participatory) or 'precision' medicine. The prerequisites of personalized medicine are a diagnostic/therapeutic offer and a management model of health systems increasingly based on the integration and processing of large amounts of information of various types (genetics, medical history, advanced diagnostics).

This track aims to train professionals that are able to contribute to this revolution, providing them with the necessary tools to develop innovative therapies, devices, services and processes to support human health in a perspective of predictive, preventive, personalized and participatory medicine.

There are two curricula, one more focused on materials and devices and the other more on data and information technology.

- **Curriculum T2C1 Materials and devices for personalized medicine** focuses on the application of materials technologies and cell and tissue engineering for the design and evaluation of high-tech medical and surgical devices (such as prostheses and artificial organs) and on the development of therapeutic approaches characterized by personalization of treatment and precision in administration.
- **Curriculum T2C2 Information and Communication Technologies for personalized medicine** deals with the use of information technologies for diagnostics, therapy and prevention with the direct involvement of the patient in the care process. This includes the development of tools and devices for diagnosis based on bio-imaging, bio-signals, genetic information; telemedicine, biomedical robotics, wearable devices for monitoring, prevention, treatment and care; the design and management of hospital facilities and health systems centered on the needs of the patient and on the taking care of situations of fragility.

**The teachings of the two curricula of Track T1: Neuroengineering (curricula T1C1 and T1C2) are taught in English.**

### **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 CCS and is specified in the special part of this regulation (Annex 1). In any case the following intervals of variability of the correspondence between classroom/ECTS hours are assumed:  $8 \div 12$  hours of lesson or assisted teaching activity per each ECTS.

The definition of the assumed total time commitment, reserved for personal study or other individual training activities, is laid down, for each teaching unit, in the annex (Annex 1) to this regulation. The director of the DIBRIS Department and the CCS Coordinator shall be responsible for verifying compliance with the above requirements.

#### **Art. 7 Study plans and prerequisites**

Students can enroll either full-time or part-time; different rights and duties apply to the two types of students.

Full-time students carry out their educational activities according to the study plan drawn up by the Master's degree program, divided into years and published in the Study Manifesto. The study plan formulated by the student must contain an indication of the educational activities, with the relative credits that he/she intends to earn, as laid out by the official study plan for that academic period, up to a maximum of 68 credits.

Part-time students are required to submit an individual study plan specifying the number of credits they intend to include, in accordance with the provisions of the University's Regulations for Student Contributions.

The enrollment of full-time and part-time students is governed by the University regulations for students, taking into account the operational provisions approved by the central governing bodies and indicated in the Student Guide (published annually on the University website).

The student's educational path has been organized according to propaedeutic criteria, as indicated in the special part of this regulation (Annex 1).

Study plans that are articulated on a shorter duration than normal need to be approved by the Council of the Course of Study and the Departmental Council.

The modalities and the deadline for the presentation of the study plan are established annually by the Polytechnic School and are reported on the course of study website on the "Students" page.

Students who have completed their plan of study may add "off-plan" courses to their plan for up to a maximum of 12 ECTS. These courses are not taken into consideration for the purpose of graduation, but may be included to count towards an additional degree.

#### **Art. 8 Attendance and methods of carrying out teaching activities**

Teachings can take the form of: (a) lectures, also held online by remote; (b) laboratory activities; (c) laboratory exercises; (d) thematic seminars.

The articulated profile and the demanding nature of the lessons held during the course of study make attendance to the training activities strongly recommended for an adequate understanding of the topics, and therefore for a higher chance of successfully passing the exams.

The lecture calendar is divided into semesters. As a rule, semesters are divided into at least 12 weeks of lessons plus at least 4 weeks for tests and exams.

The exam period ends with the beginning of the lessons of the following semester.

During the middle of the semester, normal teaching activity (lessons, exercises, laboratories) can be interrupted in order to carry out graduation exams, tests reserved to out-of-course students, seminars, tutoring activities and remedial teaching activities.

The timetable of the lessons for the entire academic year is published on the University website and accessible from the course of study website before the beginning of the lessons of each academic year. The timetable of classes guarantees the possibility of attendance for the course years envisaged by the current Manifesto of Studies of the Degree Course.

For practical reasons, timetable compatibility is not guaranteed for all formally possible choices of optional courses. Therefore, students must formulate their study plan taking into account the timetable of classes.

### **Art. 9 Examinations and other profit exams**

The profit examinations can be carried out in written, oral, or both written and oral forms, according to the modalities indicated in the descriptions of each teaching published on the University website and accessible from the website of the course of study.

Upon request, specific learning assessment methods can be provided, which take into account the needs of students with different abilities and students with specific learning disorders (D.S.A.), in compliance with art. 20 paragraph 4 of the University Teaching Regulations.

In the case of courses structured in modules with more than one professor, the professors will participate in the overall assessment of the student's profit, which cannot, regardless, be divided into separate assessments of individual modules.

The calendar of the profit exams is established within the ministerial deadline for the following academic year and is published on the University website and accessible from the course of study website. The exam calendar is established by the CCS and communicated to the students at the beginning of each teaching cycle.

Exams are held during the periods in which classes are interrupted. Appeals may be scheduled during the lecture period only for students who, in the current academic year, have not included any educational activities in their study plan.

All the profit tests related to the educational activities must be passed by students within the deadline set by the student secretariat of the Polytechnic School in view of their final exam, as indicated in the "reminder" published on the University website and accessible from the course of study website.

The outcome of the exam, along with the grade obtained, is put on record according to the provisions of the University didactic regulations.

The exam commissions are appointed by the Director of the Department or by delegation by the Coordinator of the course of study and are composed of at least 3 members. At least 2 members will be present at each exam session. The professor responsible for the teaching is a member with the function of president. Members of the commission must be experts in the subject identified by the council of the course of study on the basis of criteria that ensure the possession of scientific, educational or professional requirements; these requirements can be assumed to be possessed by retired university professors. For each commission, at the moment of appointment, at least one substitute president must be identified. In each examination session, the commissions are chaired by the president or by a substitute.

## **Art. 10 Recognition of credits**

The CCS decides on the approval of transfer applications from another course of study of the University or from other universities, according to the norms of the Didactic Regulations of the University, art. 18. It also decides on the recognition as credit, for a maximum number of 12 ECTS, of professional knowledge and skills certified according to the regulations in force. In the evaluation of the applications for transfer, the specific didactics and the actuality of the training contents of the single exams taken will be taken into account, with the reservation to establish from time to time possible forms of verification and integrative exams.

## **Art. 11 Mobility, studies abroad, international exchanges**

The CCS strongly encourages internationalization activities, in particular student participation in mobility and international exchange programs. To this end it guarantees, according to the modalities foreseen by the norms in force, the recognition of the formative credits achieved within these programs, and organizes its didactic activities in such a way as to make these activities easy and effective.

The CCS recognizes to the enrolled students, who have regularly completed a period of study abroad, the exams taken outside the University, and the achievement of the relative credits, that the student has agreed to take instead of the exams of his/her own study plan, according to the provisions of the learning agreement.

For the purpose of the recognition of these exams, students must, at the time of the compilation of the plan of educational activities that they intend to follow in the foreign university, provide appropriate documentation proving the equivalence of the contents between the course taught abroad and the course that they intend to substitute, taught in the Master's Degree in Bioengineering. The equivalence is evaluated by the CCS.

The conversion of grades will take place according to criteria approved by the CCS, congruently with the European ECTS system.

For periods of study dedicated to the preparation of the final exam, the number of credits recognized, relative to this case, is related to the duration of the period spent abroad.

A period of study abroad which has led to the recognition of training credits will be evaluated for the final exam.

## **Art. 12 Procedures for the final exam**

The final exam consists in the discussion of a written dissertation, prepared by the student, and has the objective of ascertaining the technical-scientific and professional preparation of the candidate. In order to obtain their Master's Degree, students develop their dissertation in an original way under the guidance of one or more advisors, at least one of whom is from the CCS and/or the Department of reference (DIBRIS) and/or from other departments of the Polytechnic School.

The thesis offers are published in a dedicated portal, accessible from the Degree Course website (section Laureandi - Graduating Students). Through the same portal, the supervisor formally assigns the thesis to the student.

The thesis may also be written in English; if another EU language is used, authorization from the CCS is required, to be requested within 30 days prior to the deadline for submitting the degree



application. In these cases the thesis must be accompanied by the title and an extensive summary in Italian.

The thesis should show the student's ability to address issues of research and development and/or innovation that are consistent with the profile of an engineer. 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 and/or development skills.

The thesis must also display:

- adequate preparation in the disciplines characterizing the Master's degree
- correct use of sources and bibliography
- systematic, argumentative and critical skills regarding the topic of the thesis
- clarity of exposition
- planning and experimental capacity
- critical skills.

The Degree Committee is composed of at least five professors from the degree course, the majority of whom must be tenured professors and researchers, and is appointed by the Director of the DIBRIS Department, or, by delegation, by the Coordinator of the Course of Study.

The procedure for the final examination consists in the student's oral presentation of the thesis to the Commission, followed by a discussion of any questions raised by the Commissioners.

The evaluation of the final exam by the Committee, in case of success, is made by assigning a minimum of 0 to a maximum of 6 points, established by the Polytechnic School in agreement with the Departments and reported in the Manifesto of Studies, to the weighted average of the grades reported in the tests related to educational activities that provide for a final grade, taking as weight the number of credits associated with each educational activity. The maximum grade is 110.

The Commission, with a unanimous vote, may award the "Lode" to students whose theses are considered of exceptional quality and which, on the basis of the increases mentioned in the previous paragraphs, has a score equal to or greater than 111, before any rounding.

The Commission, by unanimous vote, may confer the "dignity of publication" if the scientific value of the thesis has been certified by at least one publication in an international journal/conference that provides for peer-review of the manuscript, and officially accepted before the time of the discussion.

The course of study recognizes credits for the thesis carried out abroad, valuing the credits accrued for the activity abroad according to the duration of the stay, up to a maximum of 24 (out of 25), where 25 are the credits attributed to the final exam (thesis). For each month spent abroad for the thesis writing process, 4 ECTS are recognized. As an example, a period of stay abroad of 3 months would correspond to a recognition of 12 ECTS, a period of 6 months or more would correspond to a recognition of 24 ECTS.

In order to obtain the degree, students must possess a minimum level of proficiency in English corresponding to level B2 of the Common European Framework of Reference for Languages. In order to acquire the credits associated with English language proficiency, the student must pass the exam organized by the Language Skills Development Sector or present original certification for level B2, or higher, acquired from an accredited body or institute no more than three academic years before. The list of certificates recognized as equivalent is established by the School and periodically updated. The Polytechnic School, in order to support students in the acquisition of the required level of linguistic competence, organizes, with the support of the Language Skills Development Sector, teaching activities offered to homogeneous classes of students.

### **Art. 13 Guidance services and tutoring**

The Polytechnic School, in agreement with the DIBRIS Department, organizes and manages a tutoring and support service for students, in order to promote the various second-level academic paths and promote a profitable active participation in university life in all its forms.

### **Art. 14 Verification of obsolescence of credits**

Credits acquired within the framework of the Master's degree course are valid for six years.

After the indicated period, the credits must be validated by special resolution if the CCS recognises the non-obsolescence of the related educational contents.

If the CCS recognizes the obsolescence of even a single part of the relative educational content, the CCS itself establishes the supplementary tests that must be taken by the student, defining the topics and the methods of verification.

Once the required tests have been passed, the CCS validates the credits acquired with a resolution. If the related educational activity requires a grade, it may be different from the one previously obtained, upon proposal from the Examination Commission which carried out the verification.

### **Art. 15 Study Manifesto**

The DIBRIS Department, after consulting with the Polytechnic School, approves and publishes annually the Study Manifesto onto the University website and accessible from the course of study. In the Manifesto are indicated the main provisions of the didactic system and the teaching regulation of the Master's degree course, to which additional information may be added.

The Study Manifesto of the Master's degree course contains the list of the teaching courses activated for the academic year in question. The individual course files are published on the University website and are accessible from the course of study website.

<b>Indirizzo</b>	<b>Anno di corso</b>	<b>Codice _ins</b>	<b>Nome_ins</b>	<b>Nome_ins EN</b>	<b>CFU</b>	<b>SSD</b>	<b>Tipologia</b>	<b>Ambito</b>	<b>Lingua</b>	<b>Obiettivi formativi</b>	<b>Ore riservate attività didattica assistita</b>	<b>Ore riservate allo studio personale</b>
INFORMATION AND COMMUNICATION TECHNOLOGIES FOR PERSONALIZED MEDICINE	1	80563	ANALYSIS OF BIOMEDICAL DATA AND SIGNALS	ANALYSIS OF BIOMEDICAL DATA AND SIGNALS	9	ING-INF/06	CARATTERIZZANTI	Ingegneria Biomedica	Inglese	The course provides students with the essential tools and operational skills for quantitative analysis of data and signals of interest for medicine and biology, on a probabilistic perspective	71	153
MATERIALS AND DEVICES FOR PERSONALIZED MEDICINE	1	80563	ANALYSIS OF BIOMEDICAL DATA AND SIGNALS	ANALYSIS OF BIOMEDICAL DATA AND SIGNALS	9	ING-INF/06	CARATTERIZZANTI	Ingegneria Biomedica	Inglese	The course provides students with the essential tools and operational skills for quantitative analysis of data and signals of interest for medicine and biology, on a	72	153

										probabilistic perspective		
NEUROENGINEERING AND NEUROTECHNOLOGIES	1	80563	ANALYSIS OF BIOMEDICAL DATA AND SIGNALS	ANALYSIS OF BIOMEDICAL DATA AND SIGNALS	9	ING-INF/06	CARATTERIZZANTI	Ingegneria Biomedica	Inglese	The course provides students with the essential tools and operational skills for quantitative analysis of data and signals of interest for medicine and biology, on a probabilistic perspective	72	153
REHABILITATION ENGINEERING AND INTERACTION TECHNOLOGIES	1	80563	ANALYSIS OF BIOMEDICAL DATA AND SIGNALS	ANALYSIS OF BIOMEDICAL DATA AND SIGNALS	9	ING-INF/06	CARATTERIZZANTI	Ingegneria Biomedica	Inglese	The course provides students with the essential tools and operational skills for quantitative analysis of data and signals of interest for medicine and biology, on a probabilistic perspective	72	153

NEUROENGINEERING AND NEUROTECHNOLOGIES	1	80564	PERCEPTUAL SYSTEMS AND INTERACTION	PERCEPTUAL SYSTEMS AND INTERACTION	7	ING-INF/06	CARATTERIZZANTI	Ingegneria Biomedica	Inglese	A coherent, up-to-date introduction to the basic facts and theories concerning (human) sensory perception. The course covers the physical and physiological aspects of each sensory modality and its perceptual characteristics. Emphasis is placed on how perceptual experience relates to the physical properties of the world and to physiological constraints in the brain	56	119
REHABILITATION ENGINEERING AND INTERACTION TECHNOLOGIES	1	80564	PERCEPTUAL SYSTEMS AND INTERACTION	PERCEPTUAL SYSTEMS AND INTERACTION	7	ING-INF/06	CARATTERIZZANTI	Ingegneria Biomedica	Inglese	A coherent, up-to-date introduction to the basic facts and theories concerning (human) sensory perception. The course covers the physical and physiological	56	119

									aspects of each sensory modality and its perceptual characteristics. Emphasis is placed on how perceptual experience relates to the physical properties of the world and to physiological constraints in the brain		
INFORMATION AND COMMUNICATION TECHNOLOGIES FOR PERSONALIZED MEDICINE	1	80585	CHEMISTRY AND BIOCHEMISTRY	CHEMISTRY AND BIOCHEMISTRY	9		AFFINIO INTEGRATIVE	Attività Formative Affinive Integrative	The course aims to provide an in-depth chemical culture through the study of the main functional groups and classes of reactions in organic chemistry. It also provides fundamental knowledge on the structure and metabolism of biomolecules, with particular attention to kinetic and	0	0

										thermodynamic aspects		
MATERIALS AND DEVICES FOR PERSONALIZED MEDICINE	1	80585	CHEMISTRY AND BIOCHEMISTRY	CHEMISTRY AND BIOCHEMISTRY	9		AFFINIO INTEGRATIVE	Attività Formative Affinointegrative		The course aims to provide an in-depth chemical culture through the study of the main functional groups and classes of reactions in organic chemistry. It also provides fundamental knowledge on the structure and metabolism of biomolecules, with particular attention to kinetic and thermodynamic aspects	0	0
NEUROENGINEERING AND NEUROTECHNOLOGIES	1	80585	CHEMISTRY AND BIOCHEMISTRY	CHEMISTRY AND BIOCHEMISTRY	9		AFFINIO INTEGRATIVE	Attività Formative Affinointegrative		The course aims to provide an in-depth chemical culture through the study of the main functional groups and classes of	0	0

									reactions in organic chemistry. It also provides fundamental knowledge on the structure and metabolism of biomolecules, with particular attention to kinetic and thermodynamic aspects		
REHABILITATION ENGINEERING AND INTERACTION TECHNOLOGIES	1	80585	CHEMISTRY AND BIOCHEMISTRY	CHEMISTRY AND BIOCHEMISTRY	9		AFFINIO INTEGRATIVE	Attività Formative Affinive Integrative	The course aims to provide an in-depth chemical culture through the study of the main functional groups and classes of reactions in organic chemistry. It also provides fundamental knowledge on the structure and metabolism of biomolecules, with particular attention to kinetic and thermodynamic aspects	0	0



INFORMATION AND COMMUNICATIO N TECHNOLOGIES FOR PERSONALIZED MEDICINE	1	80586	MOD. 1 CHEMISTRY AND ORGANIC CHEMISTRY	MOD. 1 CHEMISTRY AND ORGANIC CHEMISTRY	5	CHIM /07	AFFINI O INTEGRATIV E	Attività Formativ e Affini o Integrativ e	Ingles e	This unit aims to provide students with an in-depth knowledge on topics of chemistry, coordination chemistry and organic chemistry, focusing on the identification of the main classes of organic compounds, on explanation of reaction mechanisms with thermodynamics and kinetic considerations, and on the discussion of structure/propertie s relationship of synthetic and natural macromolecules.	40	85
--	---	-------	---	---	---	-------------	-----------------------------	---	-------------	---	----	----

MATERIALS AND DEVICES FOR PERSONALIZED MEDICINE	1	80586	MOD. 1 CHEMISTRY AND ORGANIC CHEMISTRY	MOD. 1 CHEMISTRY AND ORGANIC CHEMISTRY	5	CHIM /07	AFFINI O INTEGRATIV E	Attività Formativ e Affini o Integrativ e	Ingles e	This unit aims to provide students with an in-depth knowledge on topics of chemistry, coordination chemistry and organic chemistry, focusing on the identification of the main classes of organic compounds, on explanation of reaction mechanisms with thermodynamics and kinetic considerations, and on the discussion of structure/properties relationship of synthetic and natural macromolecules.	40	85
---	---	-------	---	---	---	-------------	-----------------------------	---	-------------	--	----	----

NEUROENGINEERING AND NEUROTECHNOLOGIES	1	80586	MOD. 1 CHEMISTRY AND ORGANIC CHEMISTRY	MOD. 1 CHEMISTRY AND ORGANIC CHEMISTRY	5	CHIM /07	AFFINIO INTEGRATIV E	Attività Formativ e Affini o Integrativ e	Inglese	This unit aims to provide students with an in-depth knowledge on topics of chemistry, coordination chemistry and organic chemistry, focusing on the identification of the main classes of organic compounds, on explanation of reaction mechanisms with thermodynamics and kinetic considerations, and on the discussion of structure/properties relationship of synthetic and natural macromolecules.	40	85
--	---	-------	---	---	---	-------------	----------------------------	---	---------	--	----	----

REHABILITATION ENGINEERING AND INTERACTION TECHNOLOGIES	1	80586	MOD. 1 CHEMISTRY AND ORGANIC CHEMISTRY	MOD. 1 CHEMISTRY AND ORGANIC CHEMISTRY	5	CHIM /07	AFFINIO INTEGRATIVE	Attività Formativ e Affini o Integrativ e	Inglese	This unit aims to provide students with an in-depth knowledge on topics of chemistry, coordination chemistry and organic chemistry, focusing on the identification of the main classes of organic compounds, on explanation of reaction mechanisms with thermodynamics and kinetic considerations, and on the discussion of structure/properties relationship of synthetic and natural macromolecules.	40	85
---	---	-------	---	---	---	-------------	------------------------	---	---------	--	----	----

INFORMATION AND COMMUNICATION TECHNOLOGIES FOR PERSONALIZED MEDICINE	1	80587	MOD. 2 BIOCHEMISTRY	MOD. 2 BIOCHEMISTRY	4	BIO/1 0	AFFINIO INTEGRATIVE	Attività Formative Affin o Integrative	Inglese	One of the professional opportunities for graduates in Bioengineering is the design/implementation of instrumentation for the analysis of metabolites, as possible markers of pathologies. The general objective of the Biochemistry unit is to provide concepts of biochemistry and clinical biochemistry to understand the meaning of metabolite evaluations, as indicators of (dys)metabolism, and to acquire a language that allows the Bioengineer to interact with physician/biotechnologists in the	32	68
--	---	-------	------------------------	------------------------	---	------------	------------------------	--	---------	--	----	----

										<p>design/implement            ation of equipment            for biomedical            diagnosis and/or            research. Specific            objectives include:            1. To recognize            and describe the            main            biomolecules            (lipids, proteins,            carbohydrates,            nucleotides); 2. To            understand and            discuss the role of            enzymatic            regulation (also            through            knowledge of            signaling and            kinetics) in the            different metabolic            pathways; 3. To            distinguish the            main anabolic and            catabolic            pathways,            connecting them            in different            metabolic or            dysmetabolic            conditions, with a            focus on the            (dys)functional</p>		
--	--	--	--	--	--	--	--	--	--	--	--	--

										integration between the different human organs.		
--	--	--	--	--	--	--	--	--	--	--	--	--

MATERIALS AND DEVICES FOR PERSONALIZED MEDICINE	1	80587	MOD. 2 BIOCHEMISTR Y	MOD. 2 BIOCHEMISTR Y	4	BIO/1 0	AFFINI O INTEGRATIV E	Attività Formativ e Affini o Integrativ e	Ingles e	One of the professional opportunities for graduates in Bioengineering is the design/implementation of instrumentation for the analysis of metabolites, as possible markers of pathologies. The general objective of the Biochemistry unit is to provide concepts of biochemistry and clinical biochemistry to understand the meaning of metabolite evaluations, as indicators of (dys)metabolism, and to acquire a language that allows the Bioengineer to interact with physician/biotechnologists in the	32	68
--	---	-------	----------------------------	----------------------------	---	------------	-----------------------------	---	-------------	--	----	----



										<p>design/implement            ation of equipment            for biomedical            diagnosis and/or            research. Specific            objectives include:            1. To recognize            and describe the            main            biomolecules            (lipids, proteins,            carbohydrates,            nucleotides); 2. To            understand and            discuss the role of            enzymatic            regulation (also            through            knowledge of            signaling and            kinetics) in the            different metabolic            pathways; 3. To            distinguish the            main anabolic and            catabolic            pathways,            connecting them            in different            metabolic or            dysmetabolic            conditions, with a            focus on the            (dys)functional</p>		
--	--	--	--	--	--	--	--	--	--	--	--	--

										integration between the different human organs.		
--	--	--	--	--	--	--	--	--	--	--	--	--

NEUROENGINEERING AND NEUROTECHNOLOGIES	1	80587	MOD. 2 BIOCHEMISTRY	MOD. 2 BIOCHEMISTRY	4	BIO/10	AFFINIO INTEGRATIVE	Attività Formative Affin o Integrative	Inglese	One of the professional opportunities for graduates in Bioengineering is the design/implementation of instrumentation for the analysis of metabolites, as possible markers of pathologies. The general objective of the Biochemistry unit is to provide concepts of biochemistry and clinical biochemistry to understand the meaning of metabolite evaluations, as indicators of (dys)metabolism, and to acquire a language that allows the Bioengineer to interact with physician/biotechnologists in the	32	68
--	---	-------	------------------------	------------------------	---	--------	------------------------	--	---------	--	----	----

										<p>design/implement            ation of equipment            for biomedical            diagnosis and/or            research. Specific            objectives include:            1. To recognize            and describe the            main            biomolecules            (lipids, proteins,            carbohydrates,            nucleotides); 2. To            understand and            discuss the role of            enzymatic            regulation (also            through            knowledge of            signaling and            kinetics) in the            different metabolic            pathways; 3. To            distinguish the            main anabolic and            catabolic            pathways,            connecting them            in different            metabolic or            dysmetabolic            conditions, with a            focus on the            (dys)functional</p>		
--	--	--	--	--	--	--	--	--	--	--	--	--

										integration between the different human organs.		
--	--	--	--	--	--	--	--	--	--	--	--	--

REHABILITATION ENGINEERING AND INTERACTION TECHNOLOGIES	1	80587	MOD. 2 BIOCHEMISTRY	MOD. 2 BIOCHEMISTRY	4	BIO/10	AFFINIO INTEGRATIVE	Attività Formative Affinointegrative	Inglese	One of the professional opportunities for graduates in Bioengineering is the design/implementation of instrumentation for the analysis of metabolites, as possible markers of pathologies. The general objective of the Biochemistry unit is to provide concepts of biochemistry and clinical biochemistry to understand the meaning of metabolite evaluations, as indicators of (dys)metabolism, and to acquire a language that allows the Bioengineer to interact with physician/biotechnologists in the	32	68
---	---	-------	------------------------	------------------------	---	--------	------------------------	--	---------	--	----	----

										<p>design/implement            ation of equipment            for biomedical            diagnosis and/or            research. Specific            objectives include:            1. To recognize            and describe the            main            biomolecules            (lipids, proteins,            carbohydrates,            nucleotides); 2. To            understand and            discuss the role of            enzymatic            regulation (also            through            knowledge of            signaling and            kinetics) in the            different metabolic            pathways; 3. To            distinguish the            main anabolic and            catabolic            pathways,            connecting them            in different            metabolic or            dysmetabolic            conditions, with a            focus on the            (dys)functional</p>		
--	--	--	--	--	--	--	--	--	--	--	--	--

										integration between the different human organs.		
--	--	--	--	--	--	--	--	--	--	--	--	--



INFORMATION AND COMMUNICATIO N TECHNOLOGIES FOR PERSONALIZED MEDICINE	1	86744	BIOMEDICAL ROBOTICS	BIOMEDICAL ROBOTICS	6	ING- INF/0 6	CARATTERIZ ZANTI	Ingegneri a Biomedic a	Ingles e	The purpose of this course is to provide a perspective on robotics technologies applied to (and inspired by) themes of biomedical research and practice. Robotics is a multidisciplinary technology, with elements from computer, electrical and mechanical engineering and with an increasing spectrum of biomedical applications. The first part of the course is intended to provide a background of formal instruments for understanding control of biomedical robotic devices. The	48	102
--	---	-------	------------------------	------------------------	---	--------------------	---------------------	---------------------------------	-------------	--	----	-----

										second part is devoted to in-depth analysis of specific applications. These include basic research in sensory-motor systems, advanced surgical and diagnostic techniques, human-machine interfaces, robots for assistance and rehabilitation, biomimetic robotics		
MATERIALS AND DEVICES FOR PERSONALIZED MEDICINE	1	86744	BIOMEDICAL ROBOTICS	BIOMEDICAL ROBOTICS	6	ING-INF/06	CARATTERIZZANTI	Ingegneria Biomedica	Inglese	The purpose of this course is to provide a perspective on robotics technologies applied to (and inspired by) themes of biomedical research and practice. Robotics is a multidisciplinary technology, with elements from	48	102

										<p>computer, electrical and mechanical engineering and with an increasing spectrum of biomedical applications. The first part of the course is intended to provide a background of formal instruments for understanding control of biomedical robotic devices. The second part is devoted to in-depth analysis of specific applications. These include basic research in sensory-motor systems, advanced surgical and diagnostic techniques, human-machine interfaces, robots for assistance and rehabilitation,</p>		
--	--	--	--	--	--	--	--	--	--	--	--	--

										biomimetic robotics		
NEUROENGINEERING AND NEUROTECHNOLOGIES	1	86744	BIOMEDICAL ROBOTICS	BIOMEDICAL ROBOTICS	6	ING-INF/06	CARATTERIZZANTI	Ingegneria Biomedica	Inglese	The purpose of this course is to provide a perspective on robotics technologies applied to (and inspired by) themes of biomedical research and practice. Robotics is a multidisciplinary technology, with elements from computer, electrical and mechanical	55	95

										<p>engineering and with an increasing spectrum of biomedical applications. The first part of the course is intended to provide a background of formal instruments for understanding control of biomedical robotic devices. The second part is devoted to in-depth analysis of specific applications. These include basic research in sensory-motor systems, advanced surgical and diagnostic techniques, human-machine interfaces, robots for assistance and rehabilitation, biomimetic robotics</p>		
--	--	--	--	--	--	--	--	--	--	--	--	--

REHABILITATION ENGINEERING AND INTERACTION TECHNOLOGIES	1	86744	BIOMEDICAL ROBOTICS	BIOMEDICAL ROBOTICS	6	ING-INF/06	CARATTERIZZANTI	Ingegneria Biomedica	Inglese	<p>The purpose of this course is to provide a perspective on robotics technologies applied to (and inspired by) themes of biomedical research and practice. Robotics is a multidisciplinary technology, with elements from computer, electrical and mechanical engineering and with an increasing spectrum of biomedical applications. The first part of the course is intended to provide a background of formal instruments for understanding control of biomedical robotic devices. The</p>	48	102
---	---	-------	---------------------	---------------------	---	------------	-----------------	----------------------	---------	--	----	-----

										second part is devoted to in-depth analysis of specific applications. These include basic research in sensory-motor systems, advanced surgical and diagnostic techniques, human-machine interfaces, robots for assistance and rehabilitation, biomimetic robotics		
INFORMATION AND COMMUNICATION TECHNOLOGIES FOR PERSONALIZED MEDICINE	1	104819	ENGLISH LANGUAGE 2	ENGLISH LANGUAGE 2	3		ALTRE ATTIVITA'	Ulteriori Conoscenze Linguistiche	Inglese		37	38
MATERIALS AND DEVICES FOR PERSONALIZED MEDICINE	1	104819	ENGLISH LANGUAGE 2	ENGLISH LANGUAGE 2	3		ALTRE ATTIVITA'	Ulteriori Conoscenze Linguistiche	Inglese		37	38

NEUROENGINEERING AND NEUROTECHNOLOGIES	1	104819	ENGLISH LANGUAGE 2	ENGLISH LANGUAGE 2	3		ALTRE ATTIVITA'	Ulteriori Conoscenze Linguistiche	Inglese		0	0
REHABILITATION ENGINEERING AND INTERACTION TECHNOLOGIES	1	104819	ENGLISH LANGUAGE 2	ENGLISH LANGUAGE 2	3		ALTRE ATTIVITA'	Ulteriori Conoscenze Linguistiche	Inglese		0	0
NEUROENGINEERING AND NEUROTECHNOLOGIES	1	106727	NEUROENGINEERING RESEARCH TRACK	NEUROENGINEERING RESEARCH TRACK	2	ING-INF/06	ALTRE ATTIVITA'	Tirocini Formativi e di Orientamento	Inglese	Lab internship, focusing on learning specific skills pertinent to the track of choice, and on working on an individual project	40	10
REHABILITATION ENGINEERING AND INTERACTION TECHNOLOGIES	1	106727	NEUROENGINEERING RESEARCH TRACK	NEUROENGINEERING RESEARCH TRACK	2	ING-INF/06	ALTRE ATTIVITA'	Tirocini Formativi e di Orientamento	Inglese	Lab internship, focusing on learning specific skills pertinent to the track of choice, and on working on an individual project	40	10
REHABILITATION ENGINEERING AND INTERACTION TECHNOLOGIES	1	106729	BIOENGINEERING OF HUMAN MOVEMENT	BIOENGINEERING OF HUMAN MOVEMENT	6	ING-INF/06	CARATTERIZZANTI	Ingegneria Biomedica	Inglese	The course covers the technologies, the analytical methods, the modeling approaches used for the analysis	48	102



										and quantification of human movement and its neural correlates. Specific topics include three-dimensional analysis of movements, muscle and body mechanics, physiology and physiological signals in motor control, computational motor control		
INFORMATION AND COMMUNICATION TECHNOLOGIES FOR PERSONALIZED MEDICINE	1	106735	MATHEMATICAL METHODS FOR BIOENGINEERING	MATHEMATICAL METHODS FOR BIOENGINEERING	6	MAT/08	AFFINIO INTEGRATIVE	Attività Formative Affinointegrative	Inglese	The course aims to provide knowledge and operational skills on the main mathematical tools for numerical computation, with particular reference to their application in the field of bioengineering	48	102

MATERIALS AND DEVICES FOR PERSONALIZED MEDICINE	1	106735	MATHEMATICAL METHODS FOR BIOENGINEERING	MATHEMATICAL METHODS FOR BIOENGINEERING	6	MAT/08	AFFINIO INTEGRATIVE	Attività Formative Affinointegrative	Inglese	The course aims to provide knowledge and operational skills on the main mathematical tools for numerical computation, with particular reference to their application in the field of bioengineering	48	102
NEUROENGINEERING AND NEUROTECHNOLOGIES	1	106735	MATHEMATICAL METHODS FOR BIOENGINEERING	MATHEMATICAL METHODS FOR BIOENGINEERING	6	MAT/08	AFFINIO INTEGRATIVE	Attività Formative Affinointegrative	Inglese	The course aims to provide knowledge and operational skills on the main mathematical tools for numerical computation, with particular reference to their application in the field of bioengineering	48	102
REHABILITATION ENGINEERING AND INTERACTION TECHNOLOGIES	1	106735	MATHEMATICAL METHODS FOR BIOENGINEERING	MATHEMATICAL METHODS FOR BIOENGINEERING	6	MAT/08	AFFINIO INTEGRATIVE	Attività Formative Affinointegrative	Inglese	The course aims to provide knowledge and operational skills on the main mathematical tools for numerical	48	102

										computation, with particular reference to their application in the field of bioengineering		
INFORMATION AND COMMUNICATION TECHNOLOGIES FOR PERSONALIZED MEDICINE	1	106736	BIOMEDICAL IMAGING	BIOMEDICAL IMAGING	6	ING-INF/06	CARATTERIZZANTI	Ingegneria Biomedica	Inglese	The course aims to provide the tools for analyzing, understanding and extracting information from biomedical or biological images. During the course the characteristics of the different types of diagnostic imaging will be presented and students will develop small projects (with Matlab and with open source platforms) in working groups	48	102

MATERIALS AND DEVICES FOR PERSONALIZED MEDICINE	1	106736	BIOMEDICAL IMAGING	BIOMEDICAL IMAGING	6	ING-INF/06	CARATTERIZZANTI	Ingegneria Biomedica	Inglese	The course aims to provide the tools for analyzing, understanding and extracting information from biomedical or biological images. During the course the characteristics of the different types of diagnostic imaging will be presented and students will develop small projects (with Matlab and with open source platforms) in working groups	48	102
NEUROENGINEERING AND NEUROTECHNOLOGIES	1	106736	BIOMEDICAL IMAGING	BIOMEDICAL IMAGING	6	ING-INF/06	CARATTERIZZANTI	Ingegneria Biomedica	Inglese	The course aims to provide the tools for analyzing, understanding and extracting information from biomedical or biological images. During the course the characteristics	69	81

										of the different types of diagnostic imaging will be presented and students will develop small projects (with Matlab and with open source platforms) in working groups		
REHABILITATION ENGINEERING AND INTERACTION TECHNOLOGIES	1	106736	BIOMEDICAL IMAGING	BIOMEDICAL IMAGING	6	ING-INF/06	CARATTERIZZANTI	Ingegneria Biomedica	Inglese	The course aims to provide the tools for analyzing, understanding and extracting information from biomedical or biological images. During the course the characteristics of the different types of diagnostic imaging will be presented and students will develop small projects (with Matlab and with open source	48	102

										platforms) in working groups		
NEUROENGINEERING AND NEUROTECHNOLOGIES	1	106737	NEURAL AND BRAIN-COMPUTER INTERFACES	NEURAL AND BRAIN-COMPUTER INTERFACES	8	ING-INF/06	CARATTERIZZANTI	Ingegneria Biomedica	Inglese	Definition of neural interface and state of the art in the field of neuro-electronic systems. Techniques for measuring the electrophysiological activity of excitable cells and tissues. Advance signal processing for neural interfaces. Coding and decoding of information in neural interfaces. Definition of uni- and bi-directional neural interfaces. Invasive and non-invasive Brain Machine/Computer Interfaces and Neural Prostheses for the	78	122

										Central Nervous System: materials, methods and current applications		
REHABILITATION ENGINEERING AND INTERACTION TECHNOLOGIES	1	106737	NEURAL AND BRAIN-COMPUTER INTERFACES	NEURAL AND BRAIN-COMPUTER INTERFACES	8	ING-INF/06	CARATTERIZZANTI	Ingegneria Biomedica	Inglese	Definition of neural interface and state of the art in the field of neuro-electronic systems. Techniques for measuring the electrophysiological activity of excitable cells and tissues. Advance signal processing for neural interfaces. Coding and decoding of information in neural interfaces. Definition of uni- and bi-directional neural interfaces. Invasive and non-invasive Brain Machine/Compute	64	136

										r Interfaces and Neural Prostheses for the Central Nervous System: materials, methods and current applications		
NEUROENGINEERING AND NEUROTECHNOLOGIES	1	106739	NEURAL SIGNAL ANALYSIS	NEURAL SIGNAL ANALYSIS	6	ING-INF/06	CARATTERIZZANTI	Ingegneria Biomedica	Inglese	The course will revise the most common techniques for neural signal analyses. During the course, students will learn about the origin of neuronal signals, how to manipulate signals at different scales (from single to multiple cells, to whole brain activity). the course will be composed of lectures, working-code examples, and hands-on session	48	102



INFORMATION AND COMMUNICATIO N TECHNOLOGIES FOR PERSONALIZED MEDICINE	1	106746	BIOINFORMATI CS	BIOINFORMATI CS	6	ING- INF/0 6	CARATTERIZ ZANTI	Ingegneri a Biomedic a	Italian o (Ingle se a ricchie sta)	Bioinformatics is the study of how information is represented and analyzed in biological systems, especially information derived at the molecular level. The course will focus on the methodological and technological basis of bioinformatics, they include the creation and management of standard terminologies and data representations, the integration of heterogeneous databases, the organization and searching of the biomedical literature, the use of machine learning techniques to	48	102
--	---	--------	--------------------	--------------------	---	--------------------	---------------------	---------------------------------	---	---	----	-----

										extract new knowledge, the simulation of biological processes, and the creation of knowledge-based systems to support advanced practitioners in the field.		
MATERIALS AND DEVICES FOR PERSONALIZED MEDICINE	1	106746	BIOINFORMATICS	BIOINFORMATICS	6	ING-INF/06	CARATTERIZZANTI	Ingegneria Biomedica	Italiano (Inglese arricchito)	Bioinformatics is the study of how information is represented and analyzed in biological systems, especially information derived at the molecular level. The course will focus on the methodological and technological basis of bioinformatics, they include the creation and management of standard	48	102

										terminologies and data representations, the integration of heterogeneous databases, the organization and searching of the biomedical literature, the use of machine learning techniques to extract new knowledge, the simulation of biological processes, and the creation of knowledge-based systems to support advanced practitioners in the field.		
--	--	--	--	--	--	--	--	--	--	---	--	--

INFORMATION AND COMMUNICATIO N TECHNOLOGIES FOR PERSONALIZED MEDICINE	1	106747	BIOSENSORS AND MICROSYSTE MS	BIOSENSORS AND MICROSYSTE MS	6	ING- IND/3 4	CARATTERIZ ZANTI	Ingegneri a Biomedic a	Italian o (Ingle se a ricchie sta)	The aim of the course is to provide the basic concepts of biosensing in terms of sensing elements (suitable biomolecules and their immobilization strategies), recognition mechanisms (biocalattic and affinity based) and transducing principles (focusing on electrochemical and optical transducers). Some design principles based on target specifications will be also given as well as an overview of the main application fields of biosensors. The second part of the course aims at introducing the	55	95
--	---	--------	---------------------------------------	---------------------------------------	---	--------------------	---------------------	---------------------------------	---	--	----	----

										main concepts of microsystems applied to biomedicine and biotechnology, with emphasis on the scaling laws governing miniaturization, the fabrication techniques, and some specific aspects such as microfluidics and integration.		
MATERIALS AND DEVICES FOR PERSONALIZED MEDICINE	1	106747	BIOSENSORS AND MICROSYSTEMS	BIOSENSORS AND MICROSYSTEMS	6	ING-IND/34	CARATTERIZZANTI	Ingegneria Biomedica	Italiano (Inglese arricchito)	The aim of the course is to provide the basic concepts of biosensing in terms of sensing elements (suitable biomolecules and their immobilization strategies), recognition mechanisms (biocatalytic and affinity based) and transducing principles (focusing on electrochemical	55	95

										and optical transducers). Some design principles based on target specifications will be also given as well as an overview of the main application fields of biosensors. The second part of the course aims at introducing the main concepts of microsystems applied to biomedicine and biotechnology, with emphasis on the scaling laws governing miniaturization, the fabrication techniques, and some specific aspects such as microfluidics and integration.		
INFORMATION AND COMMUNICATION	1	106748	ENGINEERING FOR PERSONALIZED MEDICINE	ENGINEERING FOR PERSONALIZED MEDICINE	2	ING-IND/34	ALTRE ATTIVITA'	Tirocini Formativi e di	Italiano (Inglese a	Lab internship, focusing on learning specific skills pertinent to	40	10

TECHNOLOGIES FOR PERSONALIZED MEDICINE			RESEARCH TRACK	RESEARCH TRACK				Orientamento	richiesta)	the track of choice, and on working on an individual project.		
MATERIALS AND DEVICES FOR PERSONALIZED MEDICINE	1	106748	ENGINEERING FOR PERSONALIZED MEDICINE RESEARCH TRACK	ENGINEERING FOR PERSONALIZED MEDICINE RESEARCH TRACK	2	ING-IND/34	ALTRE ATTIVITA'	Tirocini Formativi e di Orientamento	Italiano (Inglese a richiesta)	Lab internship, focusing on learning specific skills pertinent to the track of choice, and on working on an individual project.	40	10
INFORMATION AND COMMUNICATION TECHNOLOGIES FOR PERSONALIZED MEDICINE	1	106753	TECHNOLOGIES FOR PERSONALIZED MEDICINE	TECHNOLOGIES FOR PERSONALIZED MEDICINE	9	ING-IND/34	CARATTERIZZANTI	Ingegneria Biomedica	Italiano (Inglese a richiesta)	Overview of the main aspects of personalized medicine approaches by introducing the clinical impact of individual molecular and lifestyle variability and of environmental factors. In particular the course will cover omics principles enabling greater treatment precision respect to conventional diagnostics and	72	153

										<p>treatment approaches, through the intensive use of informatic resources.</p> <p>The students will address the basics of molecular diagnostics, the role of biomarkers and of genomic and non-genomic factors at the basis of personalized medicine.</p> <p>The course also covers the technological basis of digital health applied to individual patient care and the influence of specific components of the informatic infrastructure (like operating systems, communication and security tools)</p>		
--	--	--	--	--	--	--	--	--	--	--	--	--



										on the performance and applicability of personal digital health.		
--	--	--	--	--	--	--	--	--	--	--	--	--

MATERIALS AND DEVICES FOR PERSONALIZED MEDICINE	1	106753	TECNOLOGIE S FOR PERSONALIZED MEDICINE	TECNOLOGIE S FOR PERSONALIZED MEDICINE	9	ING-IND/34	CARATTERIZZANTI	Ingegneria Biomedica	Italiano (Inglese arricchito)	Overview of the main aspects of personalized medicine approaches by introducing the clinical impact of individual molecular and lifestyle variability and of environmental factors. In particular the course will cover omics principles enabling greater treatment precision respect to conventional diagnostics and treatment approaches, through the intensive use of informatic resources. The students will address the basics of molecular diagnostics, the role of biomarkers and of genomic	72	153
---	---	--------	--	--	---	------------	-----------------	----------------------	-------------------------------	---	----	-----

										and non-genomic factors at the basis of personalized medicine. The course also covers the technological basis of digital health applied to individual patient care and the influence of specific components of the informatic infrastructure (like operating systems, communication and security tools) on the performance and applicability of personal digital health.		
MATERIALS AND DEVICES FOR PERSONALIZED MEDICINE	2	80575	COMPUTATIONAL NEUROSCIENCE	COMPUTATIONAL NEUROSCIENCE	6	ING-INF/06	A SCELTA	A Scelta dello Studente	Inglese	The course offers to students the methodologies, strategies, and tools to model single neurons, synapses, and large-scale	48	102

										neuronal networks. Particular emphasis will be given to the interplay between exhibited patterns of electrophysiological activity and the kind of used model.		
NEUROENGINEERING AND NEUROTECHNOLOGIES	2	80575	COMPUTATIONAL NEUROSCIENCE	COMPUTATIONAL NEUROSCIENCE	6	ING-INF/06	CARATTERIZZANTI	Ingegneria Biomedica	Inglese	The course offers to students the methodologies, strategies, and tools to model single neurons, synapses, and large-scale neuronal networks. Particular emphasis will be given to the interplay between exhibited patterns of electrophysiological activity and the kind of used model.	48	102

INFORMATION AND COMMUNICATION TECHNOLOGIES FOR PERSONALIZED MEDICINE	2	80584	PHYSIOLOGICAL FLUID DYNAMICS	PHYSIOLOGICAL FLUID DYNAMICS	6	ICAR/01	A SCELTA	A Scelta dello Studente	Italiano (Inglese a richiesta)	The course provides the fundamentals for understanding the dynamics of biological motions, with particular reference to the motion of fluids in the human body. The following topics will be covered: blood motion in the cardiovascular system (motion in the heart, arteries, capillaries, veins), fluid dynamics of the ureter and eye.	48	102
MATERIALS AND DEVICES FOR PERSONALIZED MEDICINE	2	80584	PHYSIOLOGICAL FLUID DYNAMICS	PHYSIOLOGICAL FLUID DYNAMICS	6	ICAR/01	AFFINIO INTEGRATIVE	Attività Formative Affinointegrative	Italiano (Inglese a richiesta)	The course provides the fundamentals for understanding the dynamics of biological motions, with particular reference to the motion of fluids in the human body. The following	48	102

										topics will be covered: blood motion in the cardiovascular system (motion in the heart, arteries, capillaries, veins), fluid dynamics of the ureter and eye.		
INFORMATION AND COMMUNICATION TECHNOLOGIES FOR PERSONALIZED MEDICINE	2	80606	CLINICAL ENGINEERING	CLINICAL ENGINEERING	6	ING-INF/06	A SCELTA	A Scelta dello Studente	Inglese	The main purpose of the course is to introduce students to a pragmatic examination of the National Health System (NHS) and its structure (Local Companies, Hospitals, including the study of its various areas and departments). The economic and financial aspects of the NHS are also discussed. The main objectives are: to provide future clinical engineers with an adequate	48	102

										capacity for dialogue with doctors, in order to understand their needs and guide a correct application of clinical /biomedical engineering; teach an adequate approach to hospital planning, paying particular attention to functional and economic aspects; provide the ability to design and operate using modern principles of Health technology assessment (HTA)		
--	--	--	--	--	--	--	--	--	--	---	--	--

MATERIALS AND DEVICES FOR PERSONALIZED MEDICINE	2	80606	CLINICAL ENGINEERING	CLINICAL ENGINEERING	6	ING- INF/0 6	A SCELTA	A Scelta dello Studente	Inglese	<p>The main purpose of the course is to introduce students to a pragmatic examination of the National Health System (NHS) and its structure (Local Companies, Hospitals, including the study of its various areas and departments). The economic and financial aspects of the NHS are also discussed. The main objectives are: to provide future clinical engineers with an adequate capacity for dialogue with doctors, in order to understand their needs and guide a correct application of clinical /biomedical engineering; teach an</p>	48	102
--	---	-------	-------------------------	-------------------------	---	--------------------	----------	-------------------------------	---------	---	----	-----



										adequate approach to hospital planning, paying particular attention to functional and economic aspects; provide the ability to design and operate using modern principles of Health technology assessment (HTA)		
NEUROENGINEERING AND NEUROTECHNOLOGIES	2	80606	CLINICAL ENGINEERING	CLINICAL ENGINEERING	6	ING-INF/06	A SCELTA	A Scelta dello Studente	Inglese	The main purpose of the course is to introduce students to a pragmatic examination of the National Health System (NHS) and its structure (Local Companies, Hospitals, including the study of its various areas and departments). The economic and financial aspects of the NHS are	48	102

										<p>also discussed. The main objectives are: to provide future clinical engineers with an adequate capacity for dialogue with doctors, in order to understand their needs and guide a correct application of clinical /biomedical engineering; teach an adequate approach to hospital planning, paying particular attention to functional and economic aspects; provide the ability to design and operate using modern principles of Health technology assessment (HTA)</p>		
--	--	--	--	--	--	--	--	--	--	--	--	--

REHABILITATION ENGINEERING AND INTERACTION TECHNOLOGIES	2	80606	CLINICAL ENGINEERING	CLINICAL ENGINEERING	6	ING-INF/06	A SCELTA	A Scelta dello Studente	Inglese	<p>The main purpose of the course is to introduce students to a pragmatic examination of the National Health System (NHS) and its structure (Local Companies, Hospitals, including the study of its various areas and departments). The economic and financial aspects of the NHS are also discussed. The main objectives are: to provide future clinical engineers with an adequate capacity for dialogue with doctors, in order to understand their needs and guide a correct application of clinical /biomedical engineering; teach an</p>	48	102
---	---	-------	----------------------	----------------------	---	------------	----------	-------------------------	---------	---	----	-----

										adequate approach to hospital planning, paying particular attention to functional and economic aspects; provide the ability to design and operate using modern principles of Health technology assessment (HTA)		
INFORMATION AND COMMUNICATION TECHNOLOGIES FOR PERSONALIZED MEDICINE	2	80620	APPLIED HYGIENE	APPLIED HYGIENE	6	MED/42	A SCELTA	A Scelta dello Studente	Italiano (Inglese a richiesta)	The course covers functional requirements, spatial interrelationships and links between hospital diagnosis and care services, according to legislation and quality standards of international guidelines. Main hygienic problems in a hospital environment; assessment and risk management	48	102

										(eg Legionella, etc).		
MATERIALS AND DEVICES FOR PERSONALIZED MEDICINE	2	80620	APPLIED HYGIENE	APPLIED HYGIENE	6	MED/42	A SCELTA	A Scelta dello Studente	Italiano (Inglese a richiesta)	The course covers functional requirements, spatial interrelationships and links between hospital diagnosis and care services, according to legislation and quality standards of international guidelines. Main hygienic problems in a hospital environment; assessment and risk management (eg Legionella, etc).	48	102

INFORMATION AND COMMUNICATIO N TECHNOLOGIES FOR PERSONALIZED MEDICINE	2	84341	HOSPITAL ENERGY SYSTEMS	HOSPITAL ENERGY SYSTEMS	6	ING- IND/3 3	A SCELTA	A Scelta dello Studente	Inglese	Students will acquire skills concerning hospital systems useful for job placement in public and private structures and for active participation in teams for the management of complex structures systems and biomedical equipment. Knowledge will cover electricity security and safety (power systems, fault protection, supply continuity, energy efficiency) and subjects related to thermal energy (mass and energy balance, air conditioning, heating and refrigeration).	24	51
--	---	-------	-------------------------------	-------------------------------	---	--------------------	----------	-------------------------------	---------	---	----	----

MATERIALS AND DEVICES FOR PERSONALIZED MEDICINE	2	84341	HOSPITAL ENERGY SYSTEMS	HOSPITAL ENERGY SYSTEMS	6	ING- IND/3 3	A SCELTA	A Scelta dello Studente	Inglese	Students will acquire skills concerning hospital systems useful for job placement in public and private structures and for active participation in teams for the management of complex structures and biomedical equipment. Knowledge will cover electricity security and safety (power systems, fault protection, supply continuity, energy efficiency) and subjects related to thermal energy (mass and energy balance, air conditioning, heating and refrigeration).	48	102
--	---	-------	-------------------------------	-------------------------------	---	--------------------	----------	-------------------------------	---------	---	----	-----

REHABILITATION ENGINEERING AND INTERACTION TECHNOLOGIES	2	84341	HOSPITAL ENERGY SYSTEMS	HOSPITAL ENERGY SYSTEMS	6	ING-IND/33	A SCELTA	A Scelta dello Studente	Inglese	Students will acquire skills concerning hospital systems useful for job placement in public and private structures and for active participation in teams for the management of complex structures systems and biomedical equipment. Knowledge will cover electricity security and safety (power systems, fault protection, supply continuity, energy efficiency) and subjects related to thermal energy (mass and energy balance, air conditioning, heating and refrigeration).	24	51
---	---	-------	-------------------------	-------------------------	---	------------	----------	-------------------------	---------	---	----	----



INFORMATION AND COMMUNICATIO N TECHNOLOGIES FOR PERSONALIZED MEDICINE	2	84344	MASTER THESIS	MASTER THESIS	25		PROVA FINALE	Per la Prova Finale	Inglese	The final exam consists of the discussion in front of a specific commission of a written paper (degree thesis), related to design activities, conduct of experiments, development of methodologies or operational tools of bioengineering interest, with the aim of ascertaining the level of preparation technical-scientific and professional candidate, as well as his / her innovative capacity. The candidate must also demonstrate that they have acquired analysis, processing and communication skills.	0	625
--	---	-------	------------------	------------------	----	--	-----------------	---------------------------	---------	---	---	-----

MATERIALS AND DEVICES FOR PERSONALIZED MEDICINE	2	84344	MASTER THESIS	MASTER THESIS	25		PROVA FINALE	Per la Prova Finale	Inglese	The final exam consists of the discussion in front of a specific commission of a written paper (degree thesis), related to design activities, conduct of experiments, development of methodologies or operational tools of bioengineering interest, with the aim of ascertaining the level of preparation technical-scientific and professional candidate, as well as his / her innovative capacity. The candidate must also demonstrate that they have acquired analysis, processing and communication skills.	0	625
--	---	-------	------------------	------------------	----	--	-----------------	---------------------------	---------	---	---	-----

NEUROENGINEERING AND NEUROTECHNOLOGIES	2	84344	MASTER THESIS	MASTER THESIS	25		PROVA FINALE	Per la Prova Finale	Inglese	<p>The final exam consists of the discussion in front of a specific commission of a written paper (degree thesis), related to design activities, conduct of experiments, development of methodologies or operational tools of bioengineering interest, with the aim of ascertaining the level of preparation technical-scientific and professional candidate, as well as his / her innovative capacity. The candidate must also demonstrate that they have acquired analysis, processing and communication skills.</p>	0	625
--	---	-------	---------------	---------------	----	--	--------------	---------------------	---------	--	---	-----

REHABILITATION ENGINEERING AND INTERACTION TECHNOLOGIES	2	84344	MASTER THESIS	MASTER THESIS	25		PROVA FINALE	Per la Prova Finale	Inglese	<p>The final exam consists of the discussion in front of a specific commission of a written paper (degree thesis), related to design activities, conduct of experiments, development of methodologies or operational tools of bioengineering interest, with the aim of ascertaining the level of preparation technical-scientific and professional candidate, as well as his / her innovative capacity. The candidate must also demonstrate that they have acquired analysis, processing and communication skills.</p>	0	625
---	---	-------	---------------	---------------	----	--	--------------	---------------------	---------	--	---	-----

INFORMATION AND COMMUNICATION TECHNOLOGIES FOR PERSONALIZED MEDICINE	2	84386	SPORTS BIOMECHANICS	SPORTS BIOMECHANICS	6	ING- IND/1 2	A SCELTA	A Scelta dello Studente	Inglese	Knowledge of experimental methods and analytical and numerical techniques for the study of human movement with particular reference to sports activities. Ability to analyze simple motor gestures by integrating models and measures. Elements of ergonomics	48	102
NEUROENGINEERING AND NEUROTECHNOLOGIES	2	84386	SPORTS BIOMECHANICS	SPORTS BIOMECHANICS	6	ING- IND/1 2	A SCELTA	A Scelta dello Studente	Inglese	Knowledge of experimental methods and analytical and numerical techniques for the study of human movement with particular reference to sports activities. Ability to analyze simple motor gestures by integrating models and measures.	48	102

										Elements of ergonomics		
REHABILITATION ENGINEERING AND INTERACTION TECHNOLOGIES	2	84386	SPORTS BIOMECHANICS	SPORTS BIOMECHANICS	6	ING-IND/12	A SCELTA	A Scelta dello Studente	Inglese	Knowledge of experimental methods and analytical and numerical techniques for the study of human movement with particular reference to sports activities. Ability to analyze simple motor gestures by integrating models and measures. Elements of ergonomics	48	102

INFORMATION AND COMMUNICATIO N TECHNOLOGIES FOR PERSONALIZED MEDICINE	2	84391	SOFTWARE TECHNOLOGIE S FOR HUMAN COMPUTER INTERACTION	SOFTWARE TECHNOLOGIE S FOR HUMAN COMPUTER INTERACTION	6	INF/0 1	A SCELTA	A Scelta dello Studente	Inglese	The course introduces the concepts of Human-Computer Interaction (HCI) to design effective systems for user needs both from the point of view of simplicity of interaction and the naturalness of the system's use as a whole. Attendance and active participation in the proposed training activities and individual study will enable the student to: know the theoretical tools to design advanced interaction systems; use the theoretical and practical tools for the realization of advanced interaction systems; develop the skills to	42	102
--	---	-------	---	---	---	------------	----------	-------------------------------	---------	---	----	-----

										operationally apply the concepts learned in the virtual and augmented reality		
NEUROENGINEERING AND NEUROTECHNOLOGIES	2	84391	SOFTWARE TECHNOLOGIES FOR HUMAN COMPUTER INTERACTION	SOFTWARE TECHNOLOGIES FOR HUMAN COMPUTER INTERACTION	6	INF/01	A SCELTA	A Scelta dello Studente	Inglese	The course introduces the concepts of Human-Computer Interaction (HCI) to design effective systems for user needs both from the point of view of simplicity of interaction and the naturalness of the system's use as a whole. Attendance and active participation in the proposed training activities and individual study will enable the student to: know	48	102



										the theoretical tools to design advanced interaction systems; use the theoretical and practical tools for the realization of advanced interaction systems; develop the skills to operationally apply the concepts learned in the virtual and augmented reality		
REHABILITATION ENGINEERING AND INTERACTION TECHNOLOGIES	2	84391	SOFTWARE TECHNOLOGIES FOR HUMAN COMPUTER INTERACTION	SOFTWARE TECHNOLOGIES FOR HUMAN COMPUTER INTERACTION	6	INF/01	A SCELTA	A Scelta dello Studente	Inglese	The course introduces the concepts of Human-Computer Interaction (HCI) to design effective systems for user needs both from the point of view of simplicity of interaction and the naturalness of the system's use as a whole. Attendance and active participation in the	48	102

										proposed training activities and individual study will enable the student to: know the theoretical tools to design advanced interaction systems; use the theoretical and practical tools for the realization of advanced interaction systems; develop the skills to operationally apply the concepts learned in the virtual and augmented reality		
INFORMATION AND COMMUNICATION TECHNOLOGIES FOR PERSONALIZED MEDICINE	2	86775	REHABILITATION ENGINEERING AND PROSTHETIC DEVICES	REHABILITATION ENGINEERING AND PROSTHETIC DEVICES	6	ING-INF/06	A SCELTA	A Scelta dello Studente	Inglese	This is an introductory course to methods and technologies for helping people with disabilities to regain lost cognitive, sensory and/or motor functions. The course is intended to provide the	55	95

										<p>basic knowledge behind technological solutions(i) to evaluate and monitor the impairment, (ii) to assist individuals with disabilities (iii) to promote the recovery of the missing limbs and/or lost functions. The course aims to provide an overview of the most advanced techniques of functional assessment, prosthetics, sensory substitution, neurorehabilitation and assistive technologies.</p>		
--	--	--	--	--	--	--	--	--	--	---	--	--

REHABILITATION ENGINEERING AND INTERACTION TECHNOLOGIES	2	86775	REHABILITATION ENGINEERING AND PROSTHETIC DEVICES	REHABILITATION ENGINEERING AND PROSTHETIC DEVICES	6	ING-INF/06	CARATTERIZZANTI	Ingegneria Biomedica	Inglese	<p>This is an introductory course to methods and technologies for helping people with disabilities to regain lost cognitive, sensory and/or motor functions. The course is intended to provide the basic knowledge behind technological solutions(i) to evaluate and monitor the impairment, (ii) to assist individuals with disabilities (iii) to promote the recovery of the missing limbs and/or lost functions. The course aims to provide an overview of the most advanced techniques of functional assessment, prosthetics,</p>	55	95
---	---	-------	---	---	---	------------	-----------------	----------------------	---------	---	----	----

										sensory substitution, neurorehabilitation and assistive technologies.		
MATERIALS AND DEVICES FOR PERSONALIZED MEDICINE	2	94827	MEDICAL TECHNOLOGIES FOR CLINICAL NEUROSCIENCE	MEDICAL TECHNOLOGIES FOR CLINICAL NEUROSCIENCE	6	MED/50	A SCELTA	A Scelta dello Studente	Inglese	The course covers different methods of investigation of the nervous system for the study of the brain in vivo in humans, from the point of view of its structure and functionality in relation to pathology and / or behavioral data (cognitive or motor). Medical technologies will be presented, mainly associated with advanced methods of quantitative	48	102

										magnetic resonance, applied to the clinic and to research in the healthy subject and in neurological patients		
NEUROENGINEERING AND NEUROTECHNOLOGIES	2	94827	MEDICAL TECHNOLOGIES FOR CLINICAL NEUROSCIENCE	MEDICAL TECHNOLOGIES FOR CLINICAL NEUROSCIENCE	6	MED/50	A SCELTA	A Scelta dello Studente	Inglese	The course covers different methods of investigation of the nervous system for the study of the brain in vivo in humans, from the point of view of its structure and functionality in relation to pathology and / or behavioral data (cognitive or motor). Medical technologies will be presented, mainly associated with advanced methods of quantitative magnetic resonance, applied to the	48	102

										clinic and to research in the healthy subject and in neurological patients		
REHABILITATION ENGINEERING AND INTERACTION TECHNOLOGIES	2	94827	MEDICAL TECHNOLOGIES FOR CLINICAL NEUROSCIENCE	MEDICAL TECHNOLOGIES FOR CLINICAL NEUROSCIENCE	6	MED/50	A SCELTA	A Scelta dello Studente	Inglese	The course covers different methods of investigation of the nervous system for the study of the brain in vivo in humans, from the point of view of its structure and functionality in relation to pathology and / or behavioral data (cognitive or motor). Medical technologies will be presented, mainly associated with advanced methods of quantitative magnetic resonance, applied to the	48	90

										clinic and to research in the healthy subject and in neurological patients		
MATERIALS AND DEVICES FOR PERSONALIZED MEDICINE	2	95614	COMPOSITE MATERIALS FOR BIO-MEDICAL APPLICATION	COMPOSITE MATERIALS FOR BIO-MEDICAL APPLICATION	6	ING-IND/22	A SCELTA	A Scelta dello Studente	Inglese	The course analyzes and describes the Composite Materials used for biomedical realizations based on their types, constituents and properties. Structural prosthetic applications as well as realizations for bio-implants will be illustrated and deepened during the lessons.	48	102



REHABILITATION ENGINEERING AND INTERACTION TECHNOLOGIES	2	95614	COMPOSITE MATERIALS FOR BIO-MEDICAL APPLICATION	COMPOSITE MATERIALS FOR BIO-MEDICAL APPLICATION	6	ING-IND/22	A SCELTA	A Scelta dello Studente	Inglese	The course analyzes and describes the Composite Materials used for biomedical realizations based on their types, constituents and properties. Structural prosthetic applications as well as realizations for bio-implants will be illustrated and deepened during the lessons.	48	102
INFORMATION AND COMMUNICATION TECHNOLOGIES FOR PERSONALIZED MEDICINE	2	98288	HEALTH ECONOMICS	HEALTH ECONOMICS	6	SECS-P/03	A SCELTA	A Scelta dello Studente	Inglese	The course aims at providing students with basic economic concepts to understand health care market and the role played by asymmetric information in affecting market equilibrium. Students will learn how to apply economic analysis	48	102

										to evaluate public and private policies		
MATERIALS AND DEVICES FOR PERSONALIZED MEDICINE	2	98288	HEALTH ECONOMICS	HEALTH ECONOMICS	6	SECS -P/03	A SCELTA	A Scelta dello Studente	Inglese	The course aims at providing students with basic economic concepts to understand health care market and the role played by asymmetric information in affecting market equilibrium. Students will learn how to apply economic analysis to evaluate public and private policies	48	102
NEUROENGINEERING AND NEUROTECHNOLOGIES	2	98288	HEALTH ECONOMICS	HEALTH ECONOMICS	6	SECS -P/03	A SCELTA	A Scelta dello Studente	Inglese	The course aims at providing students with basic economic concepts to understand health care market and the role played by asymmetric information in affecting market equilibrium.	48	102

										Students will learn how to apply economic analysis to evaluate public and private policies		
REHABILITATION ENGINEERING AND INTERACTION TECHNOLOGIES	2	98288	HEALTH ECONOMICS	HEALTH ECONOMICS	6	SECS -P/03	A SCELTA	A Scelta dello Studente	Inglese	The course aims at providing students with basic economic concepts to understand health care market and the role played by asymmetric information in affecting market equilibrium. Students will learn how to apply economic analysis to evaluate public and private policies	48	102
INFORMATION AND COMMUNICATION TECHNOLOGIES FOR PERSONALIZED MEDICINE	2	98463	ADVANCED ARTIFICIAL INTELLIGENCE	ADVANCED ARTIFICIAL INTELLIGENCE	6	ING-INF/05	A SCELTA	A Scelta dello Studente	Inglese		48	102

NEUROENGINEERING AND NEUROTECHNOLOGIES	2	98463	ADVANCED ARTIFICIAL INTELLIGENCE	ADVANCED ARTIFICIAL INTELLIGENCE	6	ING-INF/05	A SCELTA	A Scelta dello Studente	Inglese		48	102
INFORMATION AND COMMUNICATION TECHNOLOGIES FOR PERSONALIZED MEDICINE	2	106728	PROFESSIONAL SKILLS	PROFESSIONAL SKILLS	3	ING-INF/06	ALTRE ATTIVITA'	Altre Conoscenze Utili per l'Inserimento Nel Mondo del Lavoro	Inglese	Professional development course, focusing on ethics in professional and scientific practice, regulations in intellectual property rights and certification of medical devices, management of clinical trials	24	51
MATERIALS AND DEVICES FOR PERSONALIZED MEDICINE	2	106728	PROFESSIONAL SKILLS	PROFESSIONAL SKILLS	3	ING-INF/06	ALTRE ATTIVITA'	Altre Conoscenze Utili per l'Inserimento Nel Mondo del Lavoro	Inglese	Professional development course, focusing on ethics in professional and scientific practice, regulations in intellectual property rights and certification of medical devices, management of clinical trials	37	38

NEUROENGINEERING AND NEUROTECHNOLOGIES	2	106728	PROFESSIONAL SKILLS	PROFESSIONAL SKILLS	3	ING-INF/06	ALTRE ATTIVITA'	Altre Conoscenze Utili per l'Inserimento Nel Mondo del Lavoro	Inglese	Professional development course, focusing on ethics in professional and scientific practice, regulations in intellectual property rights and certification of medical devices, management of clinical trials	24	51
REHABILITATION ENGINEERING AND INTERACTION TECHNOLOGIES	2	106728	PROFESSIONAL SKILLS	PROFESSIONAL SKILLS	3	ING-INF/06	ALTRE ATTIVITA'	Altre Conoscenze Utili per l'Inserimento Nel Mondo del Lavoro	Inglese	Professional development course, focusing on ethics in professional and scientific practice, regulations in intellectual property rights and certification of medical devices, management of clinical trials	24	51
NEUROENGINEERING AND NEUROTECHNOLOGIES	2	106729	BIOENGINEERING OF HUMAN MOVEMENT	BIOENGINEERING OF HUMAN MOVEMENT	6	ING-INF/06	A SCELTA	A Scelta dello Studente	Inglese	The course covers the technologies, the analytical methods, the modeling approaches used for the analysis	48	102

										and quantification of human movement and its neural correlates. Specific topics include three-dimensional analysis of movements, muscle and body mechanics, physiology and physiological signals in motor control, computational motor control		
MATERIALS AND DEVICES FOR PERSONALIZED MEDICINE	2	106730	CELLULAR AND TISSUE ENGINEERING	CELLULAR AND TISSUE ENGINEERING	6	ING-IND/34	CARATTERIZZANTI	Ingegneria Biomedica	Inglese	The course aims to provide knowledge on the fundamental and technological aspects related to tissue engineering and regenerative medicine with particular reference to cell biology, stem cells, biocompatibility, cell culture systems, innovative	48	102

										<p>substrates for cell culture and advanced in vitro models. The main aim is underline the importance of understanding biological phenomena at the cellular and tissue level in order to develop therapeutic strategies that can overcome the limits of conventional therapies. The applicative examples, that will be proposed, will thus have the purpose of stimulating and developing the student's abilities in applying theoretical knowledge to the field of tissue engineering.</p>		
--	--	--	--	--	--	--	--	--	--	---	--	--

NEUROENGINEERING AND NEUROTECHNOLOGIES	2	106730	CELLULAR AND TISSUE ENGINEERING	CELLULAR AND TISSUE ENGINEERING	6	ING-IND/34	A SCELTA	A Scelta dello Studente	Inglese	The course aims to provide knowledge on the fundamental and technological aspects related to tissue engineering and regenerative medicine with particular reference to cell biology, stem cells, biocompatibility, cell culture systems, innovative substrates for cell culture and advanced in vitro models. The main aim is underline the importance of understanding biological phenomena at the cellular and tissue level in order to develop therapeutic strategies that can overcome the limits of conventional	48	102
--	---	--------	---------------------------------	---------------------------------	---	------------	----------	-------------------------	---------	---	----	-----



										therapies. The applicative examples, that will be proposed, will thus have the purpose of stimulating and developing the student's abilities in applying theoretical knowledge to the field of tissue engineering.		
INFORMATION AND COMMUNICATION TECHNOLOGIES FOR PERSONALIZED MEDICINE	2	106731	DIGITAL HEALTH	DIGITAL HEALTH	6	ING-INF/06	CARATTERIZZANTI	Ingegneria Biomedica	Inglese	The increasing introduction of computing techniques into biomedical environments will require that well-trained individuals be available not only to teach students, but also to design, develop, select, and manage the biomedical-computing systems of tomorrow. There is a wide range of context-	48	102

									<p>dependent computing issues that people can appreciate only by working on problems defined by the healthcare setting and its constraints. With this aims, the course will present typical application of information sciences to medical issues (like electronical health record systems, public vs consumer health informatics, health information infrastructure, telehealth) considering some basic technologies like: database systems, standard definition both at technical and at semantic level, internet based communication,</p>		
--	--	--	--	--	--	--	--	--	--	--	--

										natural language processing, decision support systems.		
NEUROENGINEERING AND NEUROTECHNOLOGIES	2	106731	DIGITAL HEALTH	DIGITAL HEALTH	6	ING-INF/06	A SCELTA	A Scelta dello Studente	Inglese	The increasing introduction of computing techniques into biomedical environments will require that well-trained individuals be available not only to teach students, but also to design, develop, select, and manage the biomedical-computing systems of	48	102

									<p>tomorrow. There is a wide range of context-dependent computing issues that people can appreciate only by working on problems defined by the healthcare setting and its constraints. With this aims, the course will present typical application of information sciences to medical issues (like electronical health record systems, public vs consumer health informatics, health information infrastructure, telehealth) considering some basic technologies like: database systems, standard definition both at technical and at</p>		
--	--	--	--	--	--	--	--	--	---	--	--

										semantic level, internet based communication, natural language processing, decision support systems.		
INFORMATION AND COMMUNICATION TECHNOLOGIES FOR PERSONALIZED MEDICINE	2	106734	ARTIFICIAL INTELLIGENCE IN MEDICINE	ARTIFICIAL INTELLIGENCE IN MEDICINE	6	INF/01	AFFINI O INTEGRATIVE	Attività Formative Affini o Integrative	Inglese	The course will introduce the fundamental concepts and principles of machine learning and artificial intelligence as it applies to medicine	48	102
MATERIALS AND DEVICES FOR PERSONALIZED MEDICINE	2	106734	ARTIFICIAL INTELLIGENCE IN MEDICINE	ARTIFICIAL INTELLIGENCE IN MEDICINE	6	INF/01	A SCELTA	A Scelta dello Studente	Inglese	The course will introduce the fundamental concepts and principles of machine learning and artificial	48	102

										intelligence as it applies to medicine		
NEUROENGINEERING AND NEUROTECHNOLOGIES	2	106734	ARTIFICIAL INTELLIGENCE IN MEDICINE	ARTIFICIAL INTELLIGENCE IN MEDICINE	6	INF/01	AFFINI O INTEGRATIVE	Attività Formative Affini o Integrative	Inglese	The course will introduce the fundamental concepts and principles of machine learning and artificial intelligence as it applies to medicine	48	102
REHABILITATION ENGINEERING AND INTERACTION TECHNOLOGIES	2	106734	ARTIFICIAL INTELLIGENCE IN MEDICINE	ARTIFICIAL INTELLIGENCE IN MEDICINE	6	INF/01	AFFINI O INTEGRATIVE	Attività Formative Affini o Integrative	Inglese	The course will introduce the fundamental concepts and principles of machine learning and artificial intelligence as it applies to medicine	48	102
INFORMATION AND COMMUNICATION TECHNOLOGIES FOR PERSONALIZED MEDICINE	2	106738	NEUROMORPHIC COMPUTING	NEUROMORPHIC COMPUTING	6	ING-INF/06	A SCELTA	A Scelta dello Studente	Inglese	Neuromorphic models for the representation and distributed processing of multidimensional signals. Computational primitives and architectural	48	102

										schemes. Applications to the development of perceptual engines to enable autonomous behaviors in complex systems and natural environments		
NEUROENGINEERING AND NEUROTECHNOLOGIES	2	106738	NEUROMORPHIC COMPUTING	NEUROMORPHIC COMPUTING	6	ING-INF/06	CARATTERIZZANTI	Ingegneria Biomedica	Inglese	Neuromorphic models for the representation and distributed processing of multidimensional signals. Computational primitives and architectural schemes. Applications to the development of perceptual engines to enable autonomous behaviors in complex systems and natural environments	48	102

REHABILITATION ENGINEERING AND INTERACTION TECHNOLOGIES	2	106739	NEURAL SIGNAL ANALYSIS	NEURAL SIGNAL ANALYSIS	6	ING-INF/06	A SCELTA	A Scelta dello Studente	Inglese	The course will revise the most common techniques for neural signal analyses. During the course, students will learn about the origin of neuronal signals, how to manipulate signals at different scales (from single to multiple cells, to whole brain activity). the course will be composed of lectures, working-code examples, and hands-on session	48	102
MATERIALS AND DEVICES FOR PERSONALIZED MEDICINE	2	106740	NEUROSENSORY ENGINEERING	NEUROSENSORY ENGINEERING	6	ING-INF/06	A SCELTA	A Scelta dello Studente	Inglese	The course explores how sensory interaction works, how it can be used to monitor brain health, and how our sensory abilities can be rehabilitated or augmented. The course will	48	102



										show the students how the current technologies and the knowledge about the sensory mechanisms could 1) help, empower, educate the correct development of sensory faculties, 2) rehabilitate sensory deficits, 3) assist the diagnosis of sensory disfunctions, and 4) lead/promote early diagnosis		
REHABILITATION ENGINEERING AND INTERACTION TECHNOLOGIES	2	106740	NEUROSENSORY ENGINEERING	NEUROSENSORY ENGINEERING	6	ING-INF/06	CARATTERIZZANTI	Ingegneria Biomedica	Inglese	The course explores how sensory interaction works, how it can be used to monitor brain health, and how our sensory abilities can be rehabilitated or augmented. The course will show the students how the current	48	102

										technologies and the knowledge about the sensory mechanisms could 1) help, empower, educate the correct development of sensory faculties, 2) rehabilitate sensory deficits, 3) assist the diagnosis of sensory disfunctions, and 4) lead/promote early diagnosis		
MATERIALS AND DEVICES FOR PERSONALIZED MEDICINE	2	106744	BIOMATERIALS	BIOMATERIALS	6	ING-IND/22	AFFINIO INTEGRATIVE	Attività Formative Affinive Integrative	Inglese	The course presents different typologies of hard and soft materials used for the preparation of prosthesis, focusing on the relationship between the microstructural and functional properties. Different methods to prepare biomaterials as	48	102

										hydrogels and bone cements will be presented, adopting physico-chemical characterization methods like rheometry, calorimetry, surface energies, also focusing over the interactions within natural tissues.		
REHABILITATION ENGINEERING AND INTERACTION TECHNOLOGIES	2	106744	BIOMATERIALS	BIOMATERIALS	6	ING-IND/22	A SCELTA	A Scelta dello Studente	Inglese	The course presents different typologies of hard and soft materials used for the preparation of prosthesis, focusing on the relationship between the microstructural and functional properties. Different methods to prepare biomaterials as hydrogels and bone cements will be presented, adopting physico-	48	102

										chemical characterization methods like rheometry, calorimetry, surface energies, also focusing over the interactions within natural tissues.		
INFORMATION AND COMMUNICATION TECHNOLOGIES FOR PERSONALIZED MEDICINE	2	106825	WEARABLE DEVICES AND INTERNET OF HEALTHCARE THINGS	WEARABLE DEVICES AND INTERNET OF HEALTHCARE THINGS	6	INF/01	AFFINI O INTEGRATIVE	Attività Formative Affini o Integrative			0	0
REHABILITATION ENGINEERING AND INTERACTION TECHNOLOGIES	2	106825	WEARABLE DEVICES AND INTERNET OF HEALTHCARE THINGS	WEARABLE DEVICES AND INTERNET OF HEALTHCARE THINGS	6	INF/01	A SCELTA	A Scelta dello Studente			0	0
INFORMATION AND COMMUNICATION TECHNOLOGIES FOR PERSONALIZED MEDICINE	2	106758	INTERNET OF HEALTHCARE THINGS MOD. 2	INTERNET OF HEALTHCARE THINGS MOD. 2	3	INF/01	AFFINI O INTEGRATIVE	Attività Formative Affini o Integrative	Inglese	This unit covers technologies, protocols, architectures, and platforms for the development of distributed and mobile applications for the Internet of	24	51

										Medical Things, including machine to machine protocols, distributed algorithms for fault tolerance and replication, service oriented architectures platforms, embedded operating systems, real time and streaming data, geolocation, and collaborative framework.		
REHABILITATION ENGINEERING AND INTERACTION TECHNOLOGIES	2	106758	INTERNET OF HEALTHCARE THINGS MOD. 2	INTERNET OF HEALTHCARE THINGS MOD. 2	3	INF/01	A SCELTA	A Scelta dello Studente	Inglese	This unit covers technologies, protocols, architectures, and platforms for the development of distributed and mobile applications for the Internet of Medical Things, including machine to machine protocols, distributed algorithms for fault	24	51

										tolerance and replication, service oriented architectures platforms, embedded operating systems, real time and streaming data, geolocation, and collaborative framework.		
INFORMATION AND COMMUNICATION TECHNOLOGIES FOR PERSONALIZED MEDICINE	2	106824	WEARABLE DEVICES FOR BIOMEDICAL APPLICATIONS MOD. 1	WEARABLE DEVICES FOR BIOMEDICAL APPLICATIONS MOD. 1	3	INF/01	AFFINI O INTEGRATIVE	Attività Formative Affini o Integrative	Inglese	This unit will cover the general principles for design and development of wearable devices for biomedical applications (diagnosis and monitoring of functions). This includes sensors, actuators and micro-controller programming	24	51
REHABILITATION ENGINEERING AND INTERACTION TECHNOLOGIES	2	106824	WEARABLE DEVICES FOR BIOMEDICAL APPLICATIONS MOD. 1	WEARABLE DEVICES FOR BIOMEDICAL APPLICATIONS MOD. 1	3	INF/01	A SCELTA	A Scelta dello Studente	Inglese	This unit will cover the general principles for design and development of wearable devices	24	51

										for biomedical applications (diagnosis and monitoring of functions). This includes sensors, actuators and micro-controller programming		
MATERIALS AND DEVICES FOR PERSONALIZED MEDICINE	2	108682	MECHANICS OF BIOLOGICAL TISSUE	MECHANICS OF BIOLOGICAL TISSUE	6		A SCELTA	A Scelta dello Studente			0	0
NEUROENGINEERING AND NEUROTECHNOLOGIES	2	108682	MECHANICS OF BIOLOGICAL TISSUE	MECHANICS OF BIOLOGICAL TISSUE	6		A SCELTA	A Scelta dello Studente			0	0
MATERIALS AND DEVICES FOR PERSONALIZED MEDICINE	2	95279	MOD. 1 CONTINUUM MODELS FOR BIOLOGICAL TISSUE	MOD. 1 CONTINUUM MODELS FOR BIOLOGICAL TISSUE	3	ICAR/01	A SCELTA	A Scelta dello Studente	Italiano (Inglese a richiesta)		24	51
NEUROENGINEERING AND NEUROTECHNOLOGIES	2	95279	MOD. 1 CONTINUUM MODELS FOR BIOLOGICAL TISSUE	MOD. 1 CONTINUUM MODELS FOR BIOLOGICAL TISSUE	3	ICAR/01	A SCELTA	A Scelta dello Studente	Italiano (Inglese a richiesta)		24	51

MATERIALS AND DEVICES FOR PERSONALIZED MEDICINE	2	108681	MOD. 2 MECHANICS OF SENSORY SYSTEMS	MOD. 2 MECHANICS OF SENSORY SYSTEMS	3	ING- IND/0 6	A SCELTA	A Scelta dello Studiante	Italian o (Ingle se a richie sta)		24	51
NEUROENGINEERING AND NEUROTECHNOLOGIES	2	108681	MOD. 2 MECHANICS OF SENSORY SYSTEMS	MOD. 2 MECHANICS OF SENSORY SYSTEMS	3	ING- IND/0 6	A SCELTA	A Scelta dello Studiante	Italian o (Ingle se a richie sta)		24	51

These Didactic Regulations were approved by resolution of the Teaching Body of the Master's Degree Course in Bioengineering on 06/05/2022



**SCUOLA POLITECNICA**  
**Dipartimento di Informatica, Bioingegneria, Robotica ed Ingegneria dei Sistemi**  
**Corso di Laurea Magistrale in *Bioengineering* Classe LM-21**  
**REGOLAMENTO DIDATTICO – Parte Generale**

**Coorte 2022-2024**

- Art. 1 Premessa e ambito di competenza**
- Art. 2 Requisiti di ammissione e modalità di verifica della preparazione individuale**
- Art. 3 Attività formative**
- Art. 4 Iscrizione a singole attività formative**
- Art. 5 Curriculum**
- Art. 6 Impegno orario complessivo**
- Art. 7 Piano di studio e propedeuticità**
- Art. 8 Frequenza e modalità di svolgimento delle attività didattiche**
- Art. 9 Esami e altre verifiche del profitto**
- Art. 10 Riconoscimento di crediti**
- Art. 11 Mobilità, studi compiuti all'estero, scambi internazionali**
- Art. 12 Modalità della prova finale**
- Art. 13 Orientamento e tutorato**
- Art. 14 Verifica dell'obsolescenza dei crediti**
- Art. 15 Manifesto degli Studi**

**Art. 1. Premessa e ambito di competenza**

Il presente Regolamento, in conformità allo Statuto e al Regolamento Didattico di Ateneo (parte generale e parte speciale), disciplina gli aspetti organizzativi dell'attività didattica del Corso di Laurea Magistrale in Bioingegneria/Bioengineering, nonché ogni diversa materia a esso devoluta da altre fonti legislative e regolamentari.

Il Regolamento Didattico del Corso di Laurea Magistrale in Bioingegneria/Bioengineering è deliberato, ai sensi dell'articolo 25, commi 1 e 4 del Regolamento Didattico di Ateneo, parte generale, dal Consiglio dei Corsi di Studio (CCS) di Bioingegneria a maggioranza dei componenti e sottoposto all'approvazione del Consiglio del Dipartimento DIBRIS, sentita la Scuola Politecnica previo parere favorevole della Commissione Paritetica di Scuola e di Dipartimento, ove esistente.

Le delibere del CCS possono essere assunte anche in modalità telematica ai sensi dei sovraordinati regolamenti e, in particolare, dell'articolo 14 "Riunioni con modalità telematiche" del vigente Regolamento Generale di Ateneo (in vigore dal 19/12/2018).

**Art. 2. Requisiti di ammissione e modalità di verifica della preparazione individuale**

L'ammissione alla Laurea Magistrale in Bioengineering è subordinata al possesso di specifici requisiti curriculari e di adeguatezza della preparazione personale.

I requisiti curriculari necessari per l'iscrizione al corso di Laurea Magistrale sono indicati nell'ordinamento didattico del corso e devono essere acquisiti e verificati prima

dell'immatricolazione.

In riferimento ai requisiti curriculari, per l'accesso alla Laurea Magistrale in Bioengineering si richiedono conoscenze equivalenti a quelle previste dagli obiettivi formativi generali delle Lauree della Classe Ingegneria dell'Informazione (Classe L-8 del DM 270/2004 o Lauree equiparate ex Decreto Interministeriale 9 luglio 2009).

Saranno richiesti, senza esclusione, i seguenti requisiti curriculari:

- **possesso di Laurea o Laurea Magistrale ex DM 270/2004 conseguita presso una Università italiana (o Laurea equiparata ex Decreto Interministeriale 9 luglio 2009), o titoli esteri equivalenti**
- **possesso di almeno 36 CFU**, o conoscenze equivalenti, acquisiti in un qualunque corso universitario nei settori scientifico-disciplinari indicati per le attività formative di base previste dalle Lauree della Classe L-8 Ingegneria dell'Informazione
- **possesso di almeno 45 CFU**, o conoscenze equivalenti, acquisiti in un qualunque corso universitario nei settori scientifico disciplinari (SSD) indicati per le attività formative caratterizzanti delle Lauree della Classe L-8 Ingegneria dell'Informazione, negli ambiti disciplinari Ingegneria dell'Automazione (ING-INF/04, ING-IND/13, ING-IND/32), Ingegneria Biomedica (ING-INF/06, ING-IND/34), Ingegneria Elettronica (ING-INF/01, ING-INF/02, ING-INF/07), Ingegneria Informatica (ING-INF/05), Ingegneria delle Telecomunicazioni (ING-INF/03).

Le seguenti Lauree erogate dall'Ateneo di Genova sono considerate soddisfare i requisiti curriculari richiesti dalla Laurea Magistrale in Bioengineering:

- Ingegneria Biomedica
- Ingegneria Elettronica
- Ingegneria Elettronica e Tecnologie dell'Informazione
- Ingegneria Informatica
- Ingegneria delle Telecomunicazioni

Nel caso di possesso di lauree differenti da quelle indicate nell'ordinamento didattico del corso, il CCS verificherà la presenza dei requisiti curriculari o delle conoscenze equivalenti, sulla base degli esami sostenuti dallo studente nel Corso di Laurea di provenienza, nonché la presenza di eventuali esami extra-curriculari, le attività di stage e le esperienze maturate nell'ambito del mondo produttivo e del lavoro.

Per i laureati all'estero, la verifica dei requisiti curriculari sarà effettuata considerando opportune equivalenze tra gli insegnamenti seguiti con profitto e quelli ascrivibili ai SSD sopra indicati.

Si richiede inoltre un'adeguata conoscenza della lingua inglese, non inferiore al livello B1 o equivalente del Quadro comune europeo di riferimento per la conoscenza delle lingue.

I requisiti curriculari devono essere posseduti prima della verifica della preparazione individuale. Nel caso la verifica dei requisiti curriculari non fosse possibile prima della prova, il candidato potrà svolgere la prova con riserva di verifica curriculare a posteriori.

La prova di verifica è finalizzata ad accertare la preparazione generale del candidato con particolare riferimento alla conoscenza di nozioni fondamentali dell'ingegneria e di aspetti applicativi e professionali relativi alle materie specifiche delle seguenti aree tematiche:

- Discipline di base (matematica, fisica, chimica)
- Informatica (programmazione procedurale e ad oggetti)
- Elaborazione e trattamento dei segnali (fondamenti di comunicazioni elettriche, tecniche di analisi di segnali biomedici)
- Elettronica (elettromagnetismo, circuiti, elementi di strumentazione).

La prova consiste in un colloquio d'esame con una Commissione nominata dal Coordinatore del CdS e non potrà essere sostenuta dai candidati per più di due volte.

Nell'avviso per Ammissione ai Corsi di Laurea Magistrale della Scuola Politecnica e sul sito web del Corso di Studi sono indicati: le modalità della prova, il luogo e la data, gli argomenti oggetto d'esame, i criteri di valutazione dei candidati. Ai fini della valutazione dello studente, la Commissione terrà conto anche del curriculum ottenuto nel percorso di laurea triennale. L'esito della prova prevede la sola dicitura "superato", ovvero "non superato". I candidati dovranno iscriversi alla prova nel sito Aulaweb dedicato all'ammissione al Corso.

Il requisito dell'adeguatezza della preparazione personale è automaticamente verificato per coloro che hanno conseguito la laurea triennale, italiana o estera, o titolo giudicato equivalente in sede di accertamento dei requisiti curriculari, con una votazione finale superiore o uguale a 88/110, o che hanno conseguito una votazione finale corrispondente almeno alla classifica "C" del sistema ECTS.

Tutti gli studenti con titolo di studio conseguito all'estero saranno sottoposti ad una specifica prova di conoscenza di lingua italiana gestita dalla Scuola di lingua e cultura italiana di Ateneo per accertare il possesso del livello B2 del Quadro comune europeo di riferimento per la conoscenza delle lingue.

Chi non supera il test deve seguire dei corsi di italiano gratuiti organizzati dall'Università di Genova per raggiungere il livello di conoscenza dell'italiano richiesto.

Per i candidati provenienti da Paesi Extra EU, con residenza estera e in possesso di titolo di studio estero, la procedura di presentazione della propria candidatura ai fini della verifica dell'ammissibilità viene gestita tramite apposito portale online, pubblicizzato annualmente sui siti web istituzionali e sui siti web del Corso di Laurea Magistrale, secondo un calendario e con scadenze stabilite annualmente e comunicate debitamente agli studenti.

Al seguito del caricamento della documentazione nel portale, verrà effettuata la seguente verifica: completezza dei documenti, verifica requisiti curriculari, verifica della conoscenza della lingua inglese.

I candidati che superano la verifica dei requisiti passano a una doppia fase di valutazione:

- Valutazione dei titoli (credential evaluation)
- Valutazione del candidato

A valle di queste due tipologie di valutazione lo studente verrà ritenuto ammissibile o non ammissibile.

Le date dei colloqui sono definite dalla Scuola Politecnica e pubblicate sul sito del Corso di studio. Il Corso di studio potrà deliberare date aggiuntive rispetto al calendario ufficiale.

### **Art. 3.            Attività formative**

L'elenco degli insegnamenti e delle altre attività formative attivabili è riportato nell'apposito allegato (ALL.1) che costituisce parte integrante del presente regolamento.

Per ogni insegnamento è individuato un docente responsabile. È docente responsabile di un insegnamento chi ne sia titolare a norma di legge, ovvero colui al quale il Consiglio di Dipartimento di afferenza abbia attribuito la responsabilità stessa in sede di affidamento dei compiti didattici ai docenti.

L'elenco degli insegnamenti e delle altre attività formative attivabili nella coorte 2022-2024, è riportato al termine del presente documento.

La lingua usata per erogare le attività formative (lezioni, esercitazioni, laboratori) è l'italiano o un'altra lingua della UE. Nell'allegato (ALL.1) al presente regolamento è specificata la lingua in cui viene erogata ogni attività formativa.

#### **Art. 4. Iscrizione a singole attività formative**

In conformità con l'articolo 5 del Regolamento di Ateneo per gli studenti, per iscriversi a singole attività formative occorre possedere un titolo di studio che permetta l'accesso all'Università.

#### **Art. 5. Curricula**

Il Corso di Laurea è organizzato in due track, comprendenti ciascuno due percorsi formativi (curricula):

Track T1: Neuroengineering (offerto in lingua inglese)

- Curriculum T1C1: Neuroengineering and neurotechnologies
- Curriculum T1C2: Rehabilitation engineering and interaction technologies

Track T2: Engineering for Personalized Medicine (offerto in lingua italiana)

- Curriculum T2C1: Materials and Devices for personalized medicine
- Curriculum T2C2: Information and Communication Technologies for personalized medicine

#### **Track T1: Neuroengineering:**

Il sistema nervoso sia in condizioni normali che patologiche è centrale come ambito di studio nella moderna bioingegneria sia dal punto di vista applicativo (si pensi solo alle protesi, alla riabilitazione, alla robotica umanoide) sia dal punto di vista metodologico (richiede un approccio a più livelli, dai geni ai neuroni fino ai meccanismi cognitivi e comportamentali) e richiede contributi da varie discipline. I principali ambiti di applicazione comprendono: (i) tecnologie e metodi sperimentali e analitici per studiare il cervello umano e le popolazioni di neuroni; (ii) nuovi strumenti e saggi per la neuro-farmacologia e la neuro-tossicologia; (iii) nuove tecnologie di assistenza o riabilitazione, basate su interfacce neurali e interfacce uomo-macchina avanzate; e (iv) sistemi artificiali in grado di emulare le funzionalità sensoriali, motorie e cognitive del cervello.

Questo track si propone di formare professionisti in grado di tradurre i progressi nelle neuroscienze nello sviluppo di tecnologie avanzate per lo studio del cervello e per la diagnosi, il trattamento e la prevenzione dei disturbi neurologici e cognitivi.

Sono previsti due percorsi (curricula), uno più orientato alle tecnologie neurali e l'altro più alle applicazioni riabilitative (riabilitazione, assistenza, protesi).

- **Il Curriculum T1C1 Neuroengineering and neurotechnologies** si concentra sullo studio delle basi molecolari, cellulari e computazionali della dinamica di popolazioni di neuroni, della relativa strumentazione e delle tecniche di analisi e modellizzazione, anche mediante la costruzione di artefatti biomorfi o neuromorfi. L'obiettivo è duplice: sviluppo di tecnologie per le interfacce neuro-elettroniche e le protesi a controllo neurale e mioelettrico, e lo sviluppo di tecnologie e metodologie progettuali per la costruzione di macchine, sistemi e servizi capaci di apprendere e adattarsi all'ambiente secondo meccanismi ispirati dalla biologia.
- **Il Curriculum T1C2 Rehabilitation engineering and interaction technologies** fornisce competenze relative allo studio della percezione e del controllo sensomotorio e all'utilizzo delle tecnologie dell'informazione per il miglioramento della qualità della vita di persone con disabilità neuro-motorie e cognitive. Questo ambito comprende le tecnologie per la riabilitazione e le tecnologie e gli strumenti per la valutazione, la promozione del recupero e/o la sostituzione di funzionalità sensoriali, motorie, e cognitive che possano risultare compromesse a causa di alterazioni dirette o indirette del sistema nervoso.

### **Track T2: Engineering for personalized medicine:**

Gli sviluppi della tecnologia e i cambiamenti demografici stanno modificando profondamente la medicina che, rispetto al modello tradizionalmente centrato sul trattamento sintomatico delle malattie acute, si sta sempre più evolvendo verso una modalità centrata sull'identificazione dei rischi individuali di sviluppare patologie sulla base di profili genetici e altre informazioni personali (predizione); metodi e strumenti per evitare, ridurre e monitorare il rischio di sviluppare patologie (prevenzione); interventi clinici basati sulle caratteristiche genetiche, mediche ed ambientali uniche di ogni singola persona (personalizzazione); coinvolgimento del paziente nella determinazione dei percorsi terapeutici (partecipazione). Tali caratteristiche sono spesso riassunte nel termine 'medicina 4P' (predittiva, preventiva, personalizzata e partecipativa) o 'di precisione'. I presupposti della medicina personalizzata sono una offerta diagnostico/terapeutica e un modello di gestione dei sistemi sanitari sempre più basati sull'integrazione e sull'elaborazione di grandi quantità di informazioni di vario tipo (genetica, storia clinica, diagnostica avanzata).

Questo track si propone di formare professionisti in grado di contribuire a tale rivoluzione, fornendo loro gli strumenti necessari a sviluppare terapie, dispositivi, servizi e processi innovativi a supporto della salute dell'uomo in un'ottica di medicina predittiva, preventiva, personalizzata e partecipativa.

Sono previsti due percorsi, uno più focalizzato su materiali e dispositivi e l'altro più su dati e tecnologie dell'informazione.

- **Il Curriculum T2C1 Materials and devices for personalized medicine** si concentra sull'applicazione delle tecnologie dei materiali, dell'ingegneria delle cellule e dei tessuti per la

progettazione e la valutazione di presidi medico-chirurgici a elevato contenuto tecnologico (quali per esempio protesi e organi artificiali) e sullo sviluppo di approcci terapeutici caratterizzati da personalizzazione del trattamento e precisione nella somministrazione.

- **Il Curriculum T2C2 Information and Communication Technologies for personalized medicine** riguarda l'utilizzo delle tecnologie dell'informazione per la diagnostica, la terapia e la prevenzione con il coinvolgimento diretto del paziente nel percorso di cura. Ciò comprende lo sviluppo di strumenti e dispositivi per la diagnosi basati su bio-immagini, bio-segnali, informazioni genetiche; la telemedicina, la robotica biomedica, i dispositivi indossabili per il monitoraggio, la prevenzione, il trattamento e l'assistenza; la progettazione e la gestione di strutture ospedaliere e di sistemi sanitari centrati sui bisogni del paziente e sulla presa in carico delle situazioni di fragilità.

**Gli insegnamenti dei due curricula del Track T1: Neuroengineering (curricula T1C1 e T1C2) sono offerti in lingua inglese.**

#### **Art. 6. Impegno orario complessivo**

La definizione della frazione oraria dedicata a lezioni o attività didattiche equivalenti è stabilita, per ogni insegnamento, dal CCS e specificata nella parte speciale del presente regolamento (ALL.1). In ogni caso si assumono i seguenti intervalli di variabilità della corrispondenza ore aula/ CFU:  $8 \div 10$  ore di lezione o di attività didattica assistita per ciascun CFU.

La definizione dell'impegno orario complessivo riservato allo studio personale o ad altre attività formative di tipo individuale è stabilita, per ogni insegnamento, nell'allegato (ALL.1) del presente regolamento.

Il Direttore del Dipartimento DIBRIS e il Coordinatore del CCS sono incaricati di verificare il rispetto delle già menzionate prescrizioni.

#### **Art. 7. Piani di studio e propedeuticità**

Gli studenti possono iscriversi a tempo pieno o a tempo parziale; per le due tipologie di studente sono previsti differenti diritti e doveri.

Lo studente a tempo pieno svolge la propria attività formativa tenendo conto del piano di studio predisposto dal corso di Laurea Magistrale, distinto per anni di corso e pubblicato nel Manifesto degli Studi. Il piano di studio formulato dallo studente deve contenere l'indicazione delle attività formative, con i relativi crediti che intende conseguire, previsti dal piano di studio ufficiale per tale periodo didattico, fino ad un massimo di 68 crediti.

Lo studente a tempo parziale è tenuto a presentare un piano di studio individuale specificando il numero di crediti che intende inserire secondo quanto disposto dal Regolamento per la contribuzione studentesca di Ateneo.

L'iscrizione degli studenti a tempo pieno e a tempo parziale è disciplinata dal regolamento di Ateneo per gli studenti tenuto conto delle disposizioni operative deliberate dagli Organi centrali di governo ed indicate nella Guida dello studente (pubblicata annualmente sul sito web dell'Università).

Il percorso formativo dello studente è stato organizzato secondo criteri di propedeuticità, indicate nella parte speciale del presente regolamento (All. 1).

Il piano di studio articolato su una durata più breve rispetto a quella normale è approvato dal Consiglio del Corso di Studio e dal Consiglio di Dipartimento.

La modalità e il termine per la presentazione del piano di studio sono stabiliti annualmente dalla Scuola Politecnica e riportate sul Sito web del CdS alla pagina "Studenti".

Lo studente che ha completato il proprio piano di studio può aggiungere nel proprio piano di studio insegnamenti "fuori piano" fino ad un massimo di 12 CFU. Tali insegnamenti non sono presi in considerazione ai fini del conseguimento della laurea, ma possono essere valutati per il conseguimento di un ulteriore titolo di studio.

### **Art. 8. Frequenza e modalità di svolgimento delle attività didattiche**

Gli insegnamenti possono assumere la forma di: (a) lezioni, anche a distanza mediante mezzi telematici; (b) attività di laboratorio; (c) esercitazioni in laboratorio; (d) seminari tematici.

Il profilo articolato e la natura impegnativa delle lezioni tenute nell'ambito del corso di studio rendono la frequenza alle attività formative fortemente consigliata per una adeguata comprensione degli argomenti e quindi per una buona riuscita negli esami.

Il calendario delle lezioni è articolato in semestri. Di norma, il semestre è suddiviso in almeno 12 settimane di lezione più almeno 4 settimane complessive per prove di verifica ed esami di profitto.

Il periodo destinato agli esami di profitto termina con l'inizio delle lezioni del semestre successivo.

A metà semestre, la normale attività didattica (lezioni, esercitazioni, laboratori) può essere interrotta per lo svolgimento di esami di laurea, prove riservate a studenti fuori corso, seminari, attività di tutorato e attività didattica di recupero.

L'orario delle lezioni per l'intero anno accademico è pubblicato sul sito web di Ateneo e accessibile da quello del CdS prima dell'inizio delle lezioni dell'anno accademico. L'orario delle lezioni garantisce la possibilità di frequenza per anni di corso previsti dal vigente Manifesto degli Studi del Corso di Laurea.

Per ragioni pratiche non è garantita la compatibilità dell'orario per tutte le scelte formalmente possibili degli insegnamenti opzionali. Gli studenti devono quindi formulare il proprio piano di studio tenendo conto dell'orario delle lezioni.

## **Art.9.        Esami e altre verifiche del profitto**

Gli esami di profitto possono essere svolti in forma scritta, orale, o scritta e orale, secondo le modalità indicate nelle schede di ciascun insegnamento pubblicate sul sito web di Ateneo e accessibili da quello del CdS.

A richiesta, possono essere previste specifiche modalità di verifica dell'apprendimento che tengano conto delle esigenze di studenti con abilità diverse e di studenti con disturbi specifici dell'apprendimento (D.S.A.), in conformità all'art. 20 comma 4 del Regolamento Didattico di Ateneo.

Nel caso di insegnamenti strutturati in moduli con più docenti, questi partecipano collegialmente alla valutazione complessiva del profitto dello studente che non può, comunque, essere frazionata in valutazioni separate sui singoli moduli.

Il calendario degli esami di profitto è stabilito entro la scadenza ministeriale per l'anno accademico successivo e viene pubblicato sul sito web di Ateneo e accessibili da quello del CdS. Il calendario delle eventuali prove di verifica in itinere è stabilito dal CCS e comunicato agli studenti all'inizio di ogni ciclo didattico.

Gli esami si svolgono nei periodi di interruzione delle lezioni. Possono essere previsti appelli durante il periodo delle lezioni soltanto per gli studenti che, nell'anno accademico in corso, non abbiano inserito attività formative nel proprio piano di studio.

Tutte le verifiche del profitto relative alle attività formative debbono essere superate dallo studente entro la scadenza prevista dalla segreteria studenti della Scuola Politecnica in vista della prova finale, come indicato nel "promemoria" pubblicato sul sito web di Ateneo e accessibili da quello del CdS.

L'esito dell'esame, con la votazione conseguita, è verbalizzato secondo quanto previsto all'art. del regolamento didattico di Ateneo.

Le commissioni di esame di profitto sono nominate dal Direttore del Dipartimento o su sua delega dal Coordinatore del corso di studio e sono composte da almeno 3 componenti. Ad ogni sessione di esame saranno presenti almeno 2 membri. Il docente responsabile dell'insegnamento è membro con funzione di presidente. Possono essere componenti della commissione cultori della materia individuati dal consiglio del corso di studio sulla base di criteri che assicurino il possesso di requisiti scientifici, didattici o professionali; tali requisiti si possono presumere posseduti da parte di docenti universitari a riposo. Per ogni commissione all'atto di nomina va individuato almeno un presidente supplente. In ogni sessione di esame le commissioni sono presiedute dal presidente o da un supplente.

## **Art. 10.        Riconoscimento di crediti**

Il CCS delibera sull'approvazione delle domande di passaggio o trasferimento da un altro Corso di Studi dell'Ateneo o di altre Università secondo le norme previste dal Regolamento Didattico di Ateneo, art. 18. Delibera altresì il riconoscimento, quale credito formativo, per un numero massimo di 12 CFU, di conoscenze e abilità professionali certificate ai sensi della normativa vigente. Nella valutazione delle domande di passaggio si terrà conto delle specificità didattiche e dell'attualità dei contenuti formativi dei singoli esami sostenuti, con riserva di stabilire di volta in volta eventuali forme di verifica ed esami integrativi.



## **Art. 11. Mobilità, studi compiuti all'estero, scambi internazionali**

Il CCS incoraggia fortemente le attività di internazionalizzazione, in particolare la partecipazione degli studenti ai programmi di mobilità e di scambi internazionali. A tal fine garantisce, secondo le modalità previste dalle norme vigenti, il riconoscimento dei crediti formativi conseguiti all'interno di tali programmi, e organizza le attività didattiche opportunamente in modo da rendere agevoli ed efficaci tali attività.

Il CCS riconosce agli studenti iscritti, che abbiano regolarmente svolto e completato un periodo di studi all'estero, gli esami sostenuti fuori sede, e il conseguimento dei relativi crediti, che lo studente ha concordato di sostituire a esami del proprio piano di studi, secondo quanto disposto nel learning agreement.

Ai fini del riconoscimento di tali esami, lo studente all'atto della compilazione del piano delle attività formative che intende seguire nell'ateneo estero, dovrà produrre idonea documentazione comprovante l'equivalenza dei contenuti tra l'insegnamento impartito all'estero e l'insegnamento che intende sostituire, impartito nel corso di Laurea Magistrale in Bioingegneria. L'equivalenza è valutata dal CCS.

La conversione dei voti avverrà secondo criteri approvati dal CCS, congruenti con il sistema europeo ECTS.

Per periodi di studio dedicati alla preparazione della prova finale, il numero di crediti riconosciuto, relativi a tale fattispecie, è messo in relazione alla durata del periodo svolto all'estero.

L'eventuale periodo di studio all'estero, che abbia comportato riconoscimento di crediti formativi, verrà valutato ai fini della prova finale.

## **Art. 12. Modalità della prova finale e conoscenza della lingua straniera**

La prova finale consiste nella discussione di una dissertazione scritta, preparata dallo studente, e ha l'obiettivo di accertare la preparazione tecnico-scientifica e professionale del candidato.

Ai fini del conseguimento della Laurea Magistrale, lo studente elabora la propria tesi in modo originale sotto la guida di uno o più relatori, di cui almeno uno del CCS e/o del Dipartimento di riferimento (DIBRIS) e/o degli altri dipartimenti della Scuola Politecnica.

Le offerte di tesi sono pubblicate in un portale dedicato, accessibile dal sito del Corso di Laurea (sezione Laureandi). Attraverso lo stesso portale il relatore assegna formalmente la tesi allo studente.

La tesi può essere redatta anche in lingua Inglese; in caso di utilizzo di altra lingua della UE è necessaria l'autorizzazione del CCS, da richiedere entro i 30 giorni precedenti la data di scadenza per la presentazione della domanda di laurea. In questi casi la tesi deve essere corredata dal titolo e da un ampio sommario in lingua italiana.

La tesi dovrà rivelare le capacità dello studente nell'affrontare tematiche di ricerca e sviluppo e/o innovazione coerente con il profilo di un ingegnere. La tesi dovrà essere costituita da un progetto e/o dallo sviluppo di un'applicazione che proponga soluzioni innovative rispetto allo stato dell'arte e dimostri le capacità di analisi e di progetto e/o sviluppo dello studente.

La tesi dovrà altresì rivelare:

- ✓ adeguata preparazione nelle discipline caratterizzanti la Laurea Magistrale
- ✓ corretto uso delle fonti e della bibliografia
- ✓ capacità sistematiche e argomentative e critiche circa il tema trattato nella tesi

- ✓ chiarezza nell'esposizione
- ✓ capacità progettuale e sperimentale
- ✓ capacità critica.

La Commissione di laurea è composta da almeno cinque docenti del corso di laurea, la maggioranza dei quali deve essere costituita da professori di ruolo e ricercatori, ed è nominata dal Direttore del Dipartimento DIBRIS, o, su sua delega, dal Coordinatore del Corso di Studio.

Le modalità di svolgimento della prova finale consistono nella presentazione orale della tesi di laurea da parte dello studente alla Commissione, seguita da una discussione sulle questioni eventualmente poste dai Commissari.

La valutazione della prova finale da parte della Commissione avviene, in caso di superamento della stessa, attribuendo un incremento, variabile da 0 ad un massimo di 6 punti stabilito dalla Scuola Politecnica di concerto con i Dipartimenti e riportato nel Manifesto degli Studi, alla media ponderata dei voti riportati nelle prove di verifica relative ad attività formative che prevedono una votazione finale, assumendo come peso il numero di crediti associati alla singola attività formativa. Il voto massimo attribuibile è comunque pari a centodieci.

La Commissione con voto unanime può attribuire la “Lode” allo studente la cui tesi di laurea sia reputata di eccezionale qualità e che, sulla base degli incrementi di cui ai commi precedenti, abbia riportato un punteggio pari o superiore a centoundici, prima di ogni eventuale arrotondamento.

La Commissione con voto unanime può conferire la “dignità di stampa” se il valore scientifico della tesi è stato certificato da almeno una pubblicazione su rivista/conferenza internazionale che preveda la peer-review del manoscritto, e accettata ufficialmente prima del momento della discussione.

Il CdS riconosce i crediti per la tesi di laurea magistrale svolta all'estero, valorizzando i crediti maturati per l'attività all'estero in base alla durata del soggiorno, sino ad un massimo di 24 (su 25), dove 25 sono i crediti attribuiti alla prova finale (tesi di laurea). Per ogni mese di permanenza all'estero per lo svolgimento dell'attività di tesi vengono riconosciuti 4 CFU. A titolo esemplificativo, un periodo di permanenza all'estero pari a 3 mesi corrisponderebbe ad un riconoscimento di 12 CFU, un periodo di 6 mesi o superiore corrisponderebbe ad un riconoscimento di 24 CFU.

Per il conseguimento della laurea lo studente deve possedere una competenza minima di conoscenza della lingua Inglese corrispondente al livello B2 del Quadro comune europeo di riferimento per la conoscenza delle lingue. Per acquisire i crediti associati alla conoscenza della lingua Inglese, lo studente deve superare la prova d'esame organizzata dal Settore sviluppo competenze linguistiche o esibire certificazione in originale per il livello B2, o superiore, acquisita presso un ente o istituto accreditati non più di tre anni accademici precedenti. L'elenco dei certificati riconosciuti equipollenti è stabilito dalla Scuola e da essa periodicamente aggiornato. La Scuola Politecnica, al fine di supportare gli allievi nell'acquisizione del grado di competenza linguistica richiesto, organizza, con il supporto del Settore sviluppo competenze linguistiche, attività didattiche offerte a classi omogenee di studenti.

### **Art. 13. Orientamento e tutorato**

La Scuola Politecnica, di concerto con il Dipartimento DIBRIS, organizza e gestisce un servizio di orientamento e di sostegno degli studenti, al fine di promuovere i diversi percorsi formativi di secondo livello e incentivare una proficua partecipazione attiva alla vita universitaria in tutte le sue forme.

#### **Art. 14. Verifica dell'obsolescenza dei crediti**

I crediti acquisiti nell'ambito del Corso di Laurea Magistrale hanno validità per 6 sei anni. Trascorso il periodo indicato, i crediti acquisiti debbono essere convalidati con apposita delibera, qualora il CCS riconosca la non obsolescenza dei relativi contenuti formativi. Qualora il CCS riconosca l'obsolescenza anche di una sola parte dei relativi contenuti formativi, lo stesso CCS stabilisce le prove integrative che dovranno essere sostenute dallo studente, definendo gli argomenti delle stesse e le modalità di verifica. Una volta superate le verifiche previste, il CCS convalida i crediti acquisiti con apposita delibera. Qualora la relativa attività formativa preveda una votazione, la stessa potrà essere variata rispetto a quella precedentemente ottenuta, su proposta motivata della Commissione d'esame che ha proceduto alla verifica.

#### **Art. 15 Manifesto degli Studi**

Il Dipartimento DIBRIS, sentita la Scuola Politecnica, approva e pubblica annualmente il Manifesto degli studi del Corso di Laurea sul sito web di Ateneo e accessibili da quello del CdS. Nel Manifesto sono indicate le principali disposizioni dell'ordinamento didattico e del regolamento didattico del corso di laurea, a cui eventualmente si aggiungono indicazioni integrative.

Il Manifesto degli studi del corso di laurea contiene l'elenco degli insegnamenti attivati per l'anno accademico in questione. Le schede dei singoli insegnamenti sono pubblicate sul sito web di Ateneo e accessibili da quello del CdS.

<b>Indirizzo</b>	<b>Anno di corso</b>	<b>Codice _ins</b>	<b>Nome_ins</b>	<b>Nome_ins EN</b>	<b>CFU</b>	<b>SSD</b>	<b>Tipologia</b>	<b>Ambito</b>	<b>Lingua</b>	<b>Obiettivi formativi</b>	<b>Ore riservate attività didattica assistita</b>	<b>Ore riservate allo studio personale</b>
INFORMATION AND COMMUNICATION TECHNOLOGIES FOR PERSONALIZED MEDICINE	1	80563	ANALYSIS OF BIOMEDICAL DATA AND SIGNALS	ANALYSIS OF BIOMEDICAL DATA AND SIGNALS	9	ING-INF/06	CARATTERIZZANTI	Ingegneria Biomedica	Inglese	The course provides students with the essential tools and operational skills for quantitative analysis of data and signals of interest for medicine and biology, on a probabilistic perspective	71	153
MATERIALS AND DEVICES FOR PERSONALIZED MEDICINE	1	80563	ANALYSIS OF BIOMEDICAL DATA AND SIGNALS	ANALYSIS OF BIOMEDICAL DATA AND SIGNALS	9	ING-INF/06	CARATTERIZZANTI	Ingegneria Biomedica	Inglese	The course provides students with the essential tools and operational skills for quantitative analysis of data and signals of interest for medicine and biology, on a	72	153

										probabilistic perspective		
NEUROENGINEERING AND NEUROTECHNOLOGIES	1	80563	ANALYSIS OF BIOMEDICAL DATA AND SIGNALS	ANALYSIS OF BIOMEDICAL DATA AND SIGNALS	9	ING-INF/06	CARATTERIZZANTI	Ingegneria Biomedica	Inglese	The course provides students with the essential tools and operational skills for quantitative analysis of data and signals of interest for medicine and biology, on a probabilistic perspective	72	153
REHABILITATION ENGINEERING AND INTERACTION TECHNOLOGIES	1	80563	ANALYSIS OF BIOMEDICAL DATA AND SIGNALS	ANALYSIS OF BIOMEDICAL DATA AND SIGNALS	9	ING-INF/06	CARATTERIZZANTI	Ingegneria Biomedica	Inglese	The course provides students with the essential tools and operational skills for quantitative analysis of data and signals of interest for medicine and biology, on a probabilistic perspective	72	153

NEUROENGINEERING AND NEUROTECHNOLOGIES	1	80564	PERCEPTUAL SYSTEMS AND INTERACTION	PERCEPTUAL SYSTEMS AND INTERACTION	7	ING-INF/06	CARATTERIZZANTI	Ingegneria Biomedica	Inglese	A coherent, up-to-date introduction to the basic facts and theories concerning (human) sensory perception. The course covers the physical and physiological aspects of each sensory modality and its perceptual characteristics. Emphasis is placed on how perceptual experience relates to the physical properties of the world and to physiological constraints in the brain	56	119
REHABILITATION ENGINEERING AND INTERACTION TECHNOLOGIES	1	80564	PERCEPTUAL SYSTEMS AND INTERACTION	PERCEPTUAL SYSTEMS AND INTERACTION	7	ING-INF/06	CARATTERIZZANTI	Ingegneria Biomedica	Inglese	A coherent, up-to-date introduction to the basic facts and theories concerning (human) sensory perception. The course covers the physical and physiological	56	119

									aspects of each sensory modality and its perceptual characteristics. Emphasis is placed on how perceptual experience relates to the physical properties of the world and to physiological constraints in the brain		
INFORMATION AND COMMUNICATION TECHNOLOGIES FOR PERSONALIZED MEDICINE	1	80585	CHEMISTRY AND BIOCHEMISTRY	CHEMISTRY AND BIOCHEMISTRY	9		AFFINIO INTEGRATIVE	Attività Formative Affinive Integrative	The course aims to provide an in-depth chemical culture through the study of the main functional groups and classes of reactions in organic chemistry. It also provides fundamental knowledge on the structure and metabolism of biomolecules, with particular attention to kinetic and	0	0

										thermodynamic aspects		
MATERIALS AND DEVICES FOR PERSONALIZED MEDICINE	1	80585	CHEMISTRY AND BIOCHEMISTRY	CHEMISTRY AND BIOCHEMISTRY	9		AFFINIO INTEGRATIVE	Attività Formative Affinointegrative		The course aims to provide an in-depth chemical culture through the study of the main functional groups and classes of reactions in organic chemistry. It also provides fundamental knowledge on the structure and metabolism of biomolecules, with particular attention to kinetic and thermodynamic aspects	0	0
NEUROENGINEERING AND NEUROTECHNOLOGIES	1	80585	CHEMISTRY AND BIOCHEMISTRY	CHEMISTRY AND BIOCHEMISTRY	9		AFFINIO INTEGRATIVE	Attività Formative Affinointegrative		The course aims to provide an in-depth chemical culture through the study of the main functional groups and classes of	0	0



									reactions in organic chemistry. It also provides fundamental knowledge on the structure and metabolism of biomolecules, with particular attention to kinetic and thermodynamic aspects		
REHABILITATION ENGINEERING AND INTERACTION TECHNOLOGIES	1	80585	CHEMISTRY AND BIOCHEMISTRY	CHEMISTRY AND BIOCHEMISTRY	9		AFFINIO INTEGRATIVE	Attività Formative Affinive Integrative	The course aims to provide an in-depth chemical culture through the study of the main functional groups and classes of reactions in organic chemistry. It also provides fundamental knowledge on the structure and metabolism of biomolecules, with particular attention to kinetic and thermodynamic aspects	0	0

INFORMATION AND COMMUNICATIO N TECHNOLOGIES FOR PERSONALIZED MEDICINE	1	80586	MOD. 1 CHEMISTRY AND ORGANIC CHEMISTRY	MOD. 1 CHEMISTRY AND ORGANIC CHEMISTRY	5	CHIM /07	AFFINI O INTEGRATIV E	Attività Formativ e Affini o Integrativ e	Ingles e	This unit aims to provide students with an in-depth knowledge on topics of chemistry, coordination chemistry and organic chemistry, focusing on the identification of the main classes of organic compounds, on explanation of reaction mechanisms with thermodynamics and kinetic considerations, and on the discussion of structure/propertie s relationship of synthetic and natural macromolecules.	40	85
--	---	-------	---	---	---	-------------	-----------------------------	---	-------------	---	----	----

MATERIALS AND DEVICES FOR PERSONALIZED MEDICINE	1	80586	MOD. 1 CHEMISTRY AND ORGANIC CHEMISTRY	MOD. 1 CHEMISTRY AND ORGANIC CHEMISTRY	5	CHIM /07	AFFINI O INTEGRATIV E	Attività Formativ e Affini o Integrativ e	Ingles e	This unit aims to provide students with an in-depth knowledge on topics of chemistry, coordination chemistry and organic chemistry, focusing on the identification of the main classes of organic compounds, on explanation of reaction mechanisms with thermodynamics and kinetic considerations, and on the discussion of structure/propertie s relationship of synthetic and natural macromolecules.	40	85
--	---	-------	---	---	---	-------------	-----------------------------	---	-------------	---	----	----

NEUROENGINEERING AND NEUROTECHNOLOGIES	1	80586	MOD. 1 CHEMISTRY AND ORGANIC CHEMISTRY	MOD. 1 CHEMISTRY AND ORGANIC CHEMISTRY	5	CHIM /07	AFFINIO INTEGRATIVE	Attività Formativ e Affini o Integrativ e	Inglese	This unit aims to provide students with an in-depth knowledge on topics of chemistry, coordination chemistry and organic chemistry, focusing on the identification of the main classes of organic compounds, on explanation of reaction mechanisms with thermodynamics and kinetic considerations, and on the discussion of structure/properties relationship of synthetic and natural macromolecules.	40	85
--	---	-------	---	---	---	-------------	------------------------	---	---------	--	----	----

REHABILITATION ENGINEERING AND INTERACTION TECHNOLOGIES	1	80586	MOD. 1 CHEMISTRY AND ORGANIC CHEMISTRY	MOD. 1 CHEMISTRY AND ORGANIC CHEMISTRY	5	CHIM /07	AFFINIO INTEGRATIVE	Attività Formativ e Affini o Integrativ e	Inglese	This unit aims to provide students with an in-depth knowledge on topics of chemistry, coordination chemistry and organic chemistry, focusing on the identification of the main classes of organic compounds, on explanation of reaction mechanisms with thermodynamics and kinetic considerations, and on the discussion of structure/properties relationship of synthetic and natural macromolecules.	40	85
---	---	-------	---	---	---	-------------	------------------------	---	---------	--	----	----

INFORMATION AND COMMUNICATION TECHNOLOGIES FOR PERSONALIZED MEDICINE	1	80587	MOD. 2 BIOCHEMISTRY	MOD. 2 BIOCHEMISTRY	4	BIO/1 0	AFFINIO INTEGRATIVE	Attività Formative Affin o Integrative	Inglese	One of the professional opportunities for graduates in Bioengineering is the design/implementation of instrumentation for the analysis of metabolites, as possible markers of pathologies. The general objective of the Biochemistry unit is to provide concepts of biochemistry and clinical biochemistry to understand the meaning of metabolite evaluations, as indicators of (dys)metabolism, and to acquire a language that allows the Bioengineer to interact with physician/biotechnologists in the	32	68
--	---	-------	------------------------	------------------------	---	------------	------------------------	--	---------	--	----	----

										<p>design/implement            ation of equipment            for biomedical            diagnosis and/or            research. Specific            objectives include:            1. To recognize            and describe the            main            biomolecules            (lipids, proteins,            carbohydrates,            nucleotides); 2. To            understand and            discuss the role of            enzymatic            regulation (also            through            knowledge of            signaling and            kinetics) in the            different metabolic            pathways; 3. To            distinguish the            main anabolic and            catabolic            pathways,            connecting them            in different            metabolic or            dysmetabolic            conditions, with a            focus on the            (dys)functional</p>		
--	--	--	--	--	--	--	--	--	--	--	--	--

										integration between the different human organs.		
--	--	--	--	--	--	--	--	--	--	--	--	--



MATERIALS AND DEVICES FOR PERSONALIZED MEDICINE	1	80587	MOD. 2 BIOCHEMISTR Y	MOD. 2 BIOCHEMISTR Y	4	BIO/1 0	AFFINI O INTEGRATIV E	Attività Formativ e Affini o Integrativ e	Ingles e	One of the professional opportunities for graduates in Bioengineering is the design/implementation of instrumentation for the analysis of metabolites, as possible markers of pathologies. The general objective of the Biochemistry unit is to provide concepts of biochemistry and clinical biochemistry to understand the meaning of metabolite evaluations, as indicators of (dys)metabolism, and to acquire a language that allows the Bioengineer to interact with physician/biotechnologists in the	32	68
--	---	-------	----------------------------	----------------------------	---	------------	-----------------------------	---	-------------	--	----	----

										<p>design/implement            ation of equipment            for biomedical            diagnosis and/or            research. Specific            objectives include:            1. To recognize            and describe the            main            biomolecules            (lipids, proteins,            carbohydrates,            nucleotides); 2. To            understand and            discuss the role of            enzymatic            regulation (also            through            knowledge of            signaling and            kinetics) in the            different metabolic            pathways; 3. To            distinguish the            main anabolic and            catabolic            pathways,            connecting them            in different            metabolic or            dysmetabolic            conditions, with a            focus on the            (dys)functional</p>		
--	--	--	--	--	--	--	--	--	--	--	--	--

										integration between the different human organs.		
--	--	--	--	--	--	--	--	--	--	--	--	--

NEUROENGINEERING AND NEUROTECHNOLOGIES	1	80587	MOD. 2 BIOCHEMISTRY	MOD. 2 BIOCHEMISTRY	4	BIO/10	AFFINIO INTEGRATIVE	Attività Formative Affin o Integrative	Inglese	One of the professional opportunities for graduates in Bioengineering is the design/implementation of instrumentation for the analysis of metabolites, as possible markers of pathologies. The general objective of the Biochemistry unit is to provide concepts of biochemistry and clinical biochemistry to understand the meaning of metabolite evaluations, as indicators of (dys)metabolism, and to acquire a language that allows the Bioengineer to interact with physician/biotechnologists in the	32	68
--	---	-------	------------------------	------------------------	---	--------	------------------------	--	---------	--	----	----

										<p>design/implement            ation of equipment            for biomedical            diagnosis and/or            research. Specific            objectives include:            1. To recognize            and describe the            main            biomolecules            (lipids, proteins,            carbohydrates,            nucleotides); 2. To            understand and            discuss the role of            enzymatic            regulation (also            through            knowledge of            signaling and            kinetics) in the            different metabolic            pathways; 3. To            distinguish the            main anabolic and            catabolic            pathways,            connecting them            in different            metabolic or            dysmetabolic            conditions, with a            focus on the            (dys)functional</p>		
--	--	--	--	--	--	--	--	--	--	--	--	--

										integration between the different human organs.		
--	--	--	--	--	--	--	--	--	--	--	--	--

REHABILITATION ENGINEERING AND INTERACTION TECHNOLOGIES	1	80587	MOD. 2 BIOCHEMISTRY	MOD. 2 BIOCHEMISTRY	4	BIO/10	AFFINIO INTEGRATIVE	Attività Formative Affinointegrative	Inglese	One of the professional opportunities for graduates in Bioengineering is the design/implementation of instrumentation for the analysis of metabolites, as possible markers of pathologies. The general objective of the Biochemistry unit is to provide concepts of biochemistry and clinical biochemistry to understand the meaning of metabolite evaluations, as indicators of (dys)metabolism, and to acquire a language that allows the Bioengineer to interact with physician/biotechnologists in the	32	68
---	---	-------	---------------------	---------------------	---	--------	---------------------	--------------------------------------	---------	--	----	----

										<p>design/implement            ation of equipment            for biomedical            diagnosis and/or            research. Specific            objectives include:            1. To recognize            and describe the            main            biomolecules            (lipids, proteins,            carbohydrates,            nucleotides); 2. To            understand and            discuss the role of            enzymatic            regulation (also            through            knowledge of            signaling and            kinetics) in the            different metabolic            pathways; 3. To            distinguish the            main anabolic and            catabolic            pathways,            connecting them            in different            metabolic or            dysmetabolic            conditions, with a            focus on the            (dys)functional</p>		
--	--	--	--	--	--	--	--	--	--	--	--	--



										integration between the different human organs.		
--	--	--	--	--	--	--	--	--	--	--	--	--

INFORMATION AND COMMUNICATIO N TECHNOLOGIES FOR PERSONALIZED MEDICINE	1	86744	BIOMEDICAL ROBOTICS	BIOMEDICAL ROBOTICS	6	ING- INF/0 6	CARATTERIZ ZANTI	Ingegneri a Biomedic a	Ingles e	The purpose of this course is to provide a perspective on robotics technologies applied to (and inspired by) themes of biomedical research and practice. Robotics is a multidisciplinary technology, with elements from computer, electrical and mechanical engineering and with an increasing spectrum of biomedical applications. The first part of the course is intended to provide a background of formal instruments for understanding control of biomedical robotic devices. The	48	102
--	---	-------	------------------------	------------------------	---	--------------------	---------------------	---------------------------------	-------------	--	----	-----

										second part is devoted to in-depth analysis of specific applications. These include basic research in sensory-motor systems, advanced surgical and diagnostic techniques, human-machine interfaces, robots for assistance and rehabilitation, biomimetic robotics		
MATERIALS AND DEVICES FOR PERSONALIZED MEDICINE	1	86744	BIOMEDICAL ROBOTICS	BIOMEDICAL ROBOTICS	6	ING-INF/06	CARATTERIZZANTI	Ingegneria Biomedica	Inglese	The purpose of this course is to provide a perspective on robotics technologies applied to (and inspired by) themes of biomedical research and practice. Robotics is a multidisciplinary technology, with elements from	48	102

										<p>computer, electrical and mechanical engineering and with an increasing spectrum of biomedical applications. The first part of the course is intended to provide a background of formal instruments for understanding control of biomedical robotic devices. The second part is devoted to in-depth analysis of specific applications. These include basic research in sensory-motor systems, advanced surgical and diagnostic techniques, human-machine interfaces, robots for assistance and rehabilitation,</p>		
--	--	--	--	--	--	--	--	--	--	--	--	--

										biomimetic robotics		
NEUROENGINEERING AND NEUROTECHNOLOGIES	1	86744	BIOMEDICAL ROBOTICS	BIOMEDICAL ROBOTICS	6	ING-INF/06	CARATTERIZZANTI	Ingegneria Biomedica	Inglese	The purpose of this course is to provide a perspective on robotics technologies applied to (and inspired by) themes of biomedical research and practice. Robotics is a multidisciplinary technology, with elements from computer, electrical and mechanical	55	95

										engineering and with an increasing spectrum of biomedical applications. The first part of the course is intended to provide a background of formal instruments for understanding control of biomedical robotic devices. The second part is devoted to in-depth analysis of specific applications. These include basic research in sensory-motor systems, advanced surgical and diagnostic techniques, human-machine interfaces, robots for assistance and rehabilitation, biomimetic robotics		
--	--	--	--	--	--	--	--	--	--	---	--	--

REHABILITATION ENGINEERING AND INTERACTION TECHNOLOGIES	1	86744	BIOMEDICAL ROBOTICS	BIOMEDICAL ROBOTICS	6	ING-INF/06	CARATTERIZZANTI	Ingegneria Biomedica	Inglese	<p>The purpose of this course is to provide a perspective on robotics technologies applied to (and inspired by) themes of biomedical research and practice. Robotics is a multidisciplinary technology, with elements from computer, electrical and mechanical engineering and with an increasing spectrum of biomedical applications. The first part of the course is intended to provide a background of formal instruments for understanding control of biomedical robotic devices. The</p>	48	102
---	---	-------	---------------------	---------------------	---	------------	-----------------	----------------------	---------	--	----	-----

										second part is devoted to in-depth analysis of specific applications. These include basic research in sensory-motor systems, advanced surgical and diagnostic techniques, human-machine interfaces, robots for assistance and rehabilitation, biomimetic robotics		
INFORMATION AND COMMUNICATION TECHNOLOGIES FOR PERSONALIZED MEDICINE	1	104819	ENGLISH LANGUAGE 2	ENGLISH LANGUAGE 2	3		ALTRE ATTIVITA'	Ulteriori Conoscenze Linguistiche	Inglese		37	38
MATERIALS AND DEVICES FOR PERSONALIZED MEDICINE	1	104819	ENGLISH LANGUAGE 2	ENGLISH LANGUAGE 2	3		ALTRE ATTIVITA'	Ulteriori Conoscenze Linguistiche	Inglese		37	38



NEUROENGINEERING AND NEUROTECHNOLOGIES	1	104819	ENGLISH LANGUAGE 2	ENGLISH LANGUAGE 2	3		ALTRE ATTIVITA'	Ulteriori Conoscenze Linguistiche	Inglese		0	0
REHABILITATION ENGINEERING AND INTERACTION TECHNOLOGIES	1	104819	ENGLISH LANGUAGE 2	ENGLISH LANGUAGE 2	3		ALTRE ATTIVITA'	Ulteriori Conoscenze Linguistiche	Inglese		0	0
NEUROENGINEERING AND NEUROTECHNOLOGIES	1	106727	NEUROENGINEERING RESEARCH TRACK	NEUROENGINEERING RESEARCH TRACK	2	ING-INF/06	ALTRE ATTIVITA'	Tirocini Formativi e di Orientamento	Inglese	Lab internship, focusing on learning specific skills pertinent to the track of choice, and on working on an individual project	40	10
REHABILITATION ENGINEERING AND INTERACTION TECHNOLOGIES	1	106727	NEUROENGINEERING RESEARCH TRACK	NEUROENGINEERING RESEARCH TRACK	2	ING-INF/06	ALTRE ATTIVITA'	Tirocini Formativi e di Orientamento	Inglese	Lab internship, focusing on learning specific skills pertinent to the track of choice, and on working on an individual project	40	10
REHABILITATION ENGINEERING AND INTERACTION TECHNOLOGIES	1	106729	BIOENGINEERING OF HUMAN MOVEMENT	BIOENGINEERING OF HUMAN MOVEMENT	6	ING-INF/06	CARATTERIZZANTI	Ingegneria Biomedica	Inglese	The course covers the technologies, the analytical methods, the modeling approaches used for the analysis	48	102

										and quantification of human movement and its neural correlates. Specific topics include three-dimensional analysis of movements, muscle and body mechanics, physiology and physiological signals in motor control, computational motor control		
INFORMATION AND COMMUNICATION TECHNOLOGIES FOR PERSONALIZED MEDICINE	1	106735	MATHEMATICAL METHODS FOR BIOENGINEERING	MATHEMATICAL METHODS FOR BIOENGINEERING	6	MAT/08	AFFINIO INTEGRATIVE	Attività Formative Affinointegrative	Inglese	The course aims to provide knowledge and operational skills on the main mathematical tools for numerical computation, with particular reference to their application in the field of bioengineering	48	102

MATERIALS AND DEVICES FOR PERSONALIZED MEDICINE	1	106735	MATHEMATICAL METHODS FOR BIOENGINEERING	MATHEMATICAL METHODS FOR BIOENGINEERING	6	MAT/08	AFFINIO INTEGRATIVE	Attività Formative Affinointegrative	Inglese	The course aims to provide knowledge and operational skills on the main mathematical tools for numerical computation, with particular reference to their application in the field of bioengineering	48	102
NEUROENGINEERING AND NEUROTECHNOLOGIES	1	106735	MATHEMATICAL METHODS FOR BIOENGINEERING	MATHEMATICAL METHODS FOR BIOENGINEERING	6	MAT/08	AFFINIO INTEGRATIVE	Attività Formative Affinointegrative	Inglese	The course aims to provide knowledge and operational skills on the main mathematical tools for numerical computation, with particular reference to their application in the field of bioengineering	48	102
REHABILITATION ENGINEERING AND INTERACTION TECHNOLOGIES	1	106735	MATHEMATICAL METHODS FOR BIOENGINEERING	MATHEMATICAL METHODS FOR BIOENGINEERING	6	MAT/08	AFFINIO INTEGRATIVE	Attività Formative Affinointegrative	Inglese	The course aims to provide knowledge and operational skills on the main mathematical tools for numerical	48	102

										computation, with particular reference to their application in the field of bioengineering		
INFORMATION AND COMMUNICATION TECHNOLOGIES FOR PERSONALIZED MEDICINE	1	106736	BIOMEDICAL IMAGING	BIOMEDICAL IMAGING	6	ING-INF/06	CARATTERIZZANTI	Ingegneria Biomedica	Inglese	The course aims to provide the tools for analyzing, understanding and extracting information from biomedical or biological images. During the course the characteristics of the different types of diagnostic imaging will be presented and students will develop small projects (with Matlab and with open source platforms) in working groups	48	102

MATERIALS AND DEVICES FOR PERSONALIZED MEDICINE	1	106736	BIOMEDICAL IMAGING	BIOMEDICAL IMAGING	6	ING-INF/06	CARATTERIZZANTI	Ingegneria Biomedica	Inglese	The course aims to provide the tools for analyzing, understanding and extracting information from biomedical or biological images. During the course the characteristics of the different types of diagnostic imaging will be presented and students will develop small projects (with Matlab and with open source platforms) in working groups	48	102
NEUROENGINEERING AND NEUROTECHNOLOGIES	1	106736	BIOMEDICAL IMAGING	BIOMEDICAL IMAGING	6	ING-INF/06	CARATTERIZZANTI	Ingegneria Biomedica	Inglese	The course aims to provide the tools for analyzing, understanding and extracting information from biomedical or biological images. During the course the characteristics	69	81

										of the different types of diagnostic imaging will be presented and students will develop small projects (with Matlab and with open source platforms) in working groups		
REHABILITATION ENGINEERING AND INTERACTION TECHNOLOGIES	1	106736	BIOMEDICAL IMAGING	BIOMEDICAL IMAGING	6	ING-INF/06	CARATTERIZZANTI	Ingegneria Biomedica	Inglese	The course aims to provide the tools for analyzing, understanding and extracting information from biomedical or biological images. During the course the characteristics of the different types of diagnostic imaging will be presented and students will develop small projects (with Matlab and with open source	48	102

										platforms) in working groups		
NEUROENGINEERING AND NEUROTECHNOLOGIES	1	106737	NEURAL AND BRAIN-COMPUTER INTERFACES	NEURAL AND BRAIN-COMPUTER INTERFACES	8	ING-INF/06	CARATTERIZZANTI	Ingegneria Biomedica	Inglese	Definition of neural interface and state of the art in the field of neuro-electronic systems. Techniques for measuring the electrophysiological activity of excitable cells and tissues. Advance signal processing for neural interfaces. Coding and decoding of information in neural interfaces. Definition of uni- and bi-directional neural interfaces. Invasive and non-invasive Brain Machine/Computer Interfaces and Neural Prostheses for the	78	122

										Central Nervous System: materials, methods and current applications		
REHABILITATION ENGINEERING AND INTERACTION TECHNOLOGIES	1	106737	NEURAL AND BRAIN-COMPUTER INTERFACES	NEURAL AND BRAIN-COMPUTER INTERFACES	8	ING-INF/06	CARATTERIZZANTI	Ingegneria Biomedica	Inglese	Definition of neural interface and state of the art in the field of neuro-electronic systems. Techniques for measuring the electrophysiological activity of excitable cells and tissues. Advance signal processing for neural interfaces. Coding and decoding of information in neural interfaces. Definition of uni- and bi-directional neural interfaces. Invasive and non-invasive Brain Machine/Compute	64	136



										r Interfaces and Neural Prostheses for the Central Nervous System: materials, methods and current applications		
NEUROENGINEERING AND NEUROTECHNOLOGIES	1	106739	NEURAL SIGNAL ANALYSIS	NEURAL SIGNAL ANALYSIS	6	ING-INF/06	CARATTERIZZANTI	Ingegneria Biomedica	Inglese	The course will revise the most common techniques for neural signal analyses. During the course, students will learn about the origin of neuronal signals, how to manipulate signals at different scales (from single to multiple cells, to whole brain activity). the course will be composed of lectures, working-code examples, and hands-on session	48	102

INFORMATION AND COMMUNICATIO N TECHNOLOGIES FOR PERSONALIZED MEDICINE	1	106746	BIOINFORMATI CS	BIOINFORMATI CS	6	ING- INF/0 6	CARATTERIZ ZANTI	Ingegneri a Biomedic a	Italian o (Ingle se a richie sta)	Bioinformatics is the study of how information is represented and analyzed in biological systems, especially information derived at the molecular level. The course will focus on the methodological and technological basis of bioinformatics, they include the creation and management of standard terminologies and data representations, the integration of heterogeneous databases, the organization and searching of the biomedical literature, the use of machine learning techniques to	48	102
--	---	--------	--------------------	--------------------	---	--------------------	---------------------	---------------------------------	--	---	----	-----

										extract new knowledge, the simulation of biological processes, and the creation of knowledge-based systems to support advanced practitioners in the field.		
MATERIALS AND DEVICES FOR PERSONALIZED MEDICINE	1	106746	BIOINFORMATICS	BIOINFORMATICS	6	ING-INF/06	CARATTERIZZANTI	Ingegneria Biomedica	Italiano (Inglese arricchito)	Bioinformatics is the study of how information is represented and analyzed in biological systems, especially information derived at the molecular level. The course will focus on the methodological and technological basis of bioinformatics, they include the creation and management of standard	48	102

										terminologies and data representations, the integration of heterogeneous databases, the organization and searching of the biomedical literature, the use of machine learning techniques to extract new knowledge, the simulation of biological processes, and the creation of knowledge-based systems to support advanced practitioners in the field.		
--	--	--	--	--	--	--	--	--	--	---	--	--

INFORMATION AND COMMUNICATIO N TECHNOLOGIES FOR PERSONALIZED MEDICINE	1	106747	BIOSENSORS AND MICROSYSTE MS	BIOSENSORS AND MICROSYSTE MS	6	ING- IND/3 4	CARATTERIZ ZANTI	Ingegneri a Biomedic a	Italian o (Ingle se a ricchie sta)	The aim of the course is to provide the basic concepts of biosensing in terms of sensing elements (suitable biomolecules and their immobilization strategies), recognition mechanisms (biocalattic and affinity based) and transducing principles (focusing on electrochemical and optical transducers). Some design principles based on target specifications will be also given as well as an overview of the main application fields of biosensors. The second part of the course aims at introducing the	55	95
--	---	--------	---------------------------------------	---------------------------------------	---	--------------------	---------------------	---------------------------------	---	--	----	----

										main concepts of microsystems applied to biomedicine and biotechnology, with emphasis on the scaling laws governing miniaturization, the fabrication techniques, and some specific aspects such as microfluidics and integration.		
MATERIALS AND DEVICES FOR PERSONALIZED MEDICINE	1	106747	BIOSENSORS AND MICROSYSTEMS	BIOSENSORS AND MICROSYSTEMS	6	ING-IND/34	CARATTERIZZANTI	Ingegneria Biomedica	Italiano (Inglese a richiesta)	The aim of the course is to provide the basic concepts of biosensing in terms of sensing elements (suitable biomolecules and their immobilization strategies), recognition mechanisms (biocatalytic and affinity based) and transducing principles (focusing on electrochemical	55	95

										and optical transducers). Some design principles based on target specifications will be also given as well as an overview of the main application fields of biosensors. The second part of the course aims at introducing the main concepts of microsystems applied to biomedicine and biotechnology, with emphasis on the scaling laws governing miniaturization, the fabrication techniques, and some specific aspects such as microfluidics and integration.		
INFORMATION AND COMMUNICATION	1	106748	ENGINEERING FOR PERSONALIZED MEDICINE	ENGINEERING FOR PERSONALIZED MEDICINE	2	ING-IND/34	ALTRE ATTIVITA'	Tirocini Formativi e di	Italiano (Inglese a	Lab internship, focusing on learning specific skills pertinent to	40	10

TECHNOLOGIES FOR PERSONALIZED MEDICINE			RESEARCH TRACK	RESEARCH TRACK				Orientamento	richiesta)	the track of choice, and on working on an individual project.		
MATERIALS AND DEVICES FOR PERSONALIZED MEDICINE	1	106748	ENGINEERING FOR PERSONALIZED MEDICINE RESEARCH TRACK	ENGINEERING FOR PERSONALIZED MEDICINE RESEARCH TRACK	2	ING-IND/34	ALTRE ATTIVITA'	Tirocini Formativi e di Orientamento	Italiano (Inglese a richiesta)	Lab internship, focusing on learning specific skills pertinent to the track of choice, and on working on an individual project.	40	10
INFORMATION AND COMMUNICATION TECHNOLOGIES FOR PERSONALIZED MEDICINE	1	106753	TECHNOLOGIES FOR PERSONALIZED MEDICINE	TECHNOLOGIES FOR PERSONALIZED MEDICINE	9	ING-IND/34	CARATTERIZZANTI	Ingegneria Biomedica	Italiano (Inglese a richiesta)	Overview of the main aspects of personalized medicine approaches by introducing the clinical impact of individual molecular and lifestyle variability and of environmental factors. In particular the course will cover omics principles enabling greater treatment precision respect to conventional diagnostics and	72	153



										<p>treatment approaches, through the intensive use of informatic resources.</p> <p>The students will address the basics of molecular diagnostics, the role of biomarkers and of genomic and non-genomic factors at the basis of personalized medicine.</p> <p>The course also covers the technological basis of digital health applied to individual patient care and the influence of specific components of the informatic infrastructure (like operating systems, communication and security tools)</p>		
--	--	--	--	--	--	--	--	--	--	--	--	--

										on the performance and applicability of personal digital health.		
--	--	--	--	--	--	--	--	--	--	--	--	--

MATERIALS AND DEVICES FOR PERSONALIZED MEDICINE	1	106753	TECNOLOGIE S FOR PERSONALIZED MEDICINE	TECNOLOGIE S FOR PERSONALIZED MEDICINE	9	ING-IND/34	CARATTERIZZANTI	Ingegneria Biomedica	Italiano (Inglese arricchito)	Overview of the main aspects of personalized medicine approaches by introducing the clinical impact of individual molecular and lifestyle variability and of environmental factors. In particular the course will cover omics principles enabling greater treatment precision respect to conventional diagnostics and treatment approaches, through the intensive use of informatic resources. The students will address the basics of molecular diagnostics, the role of biomarkers and of genomic	72	153
---	---	--------	--	--	---	------------	-----------------	----------------------	-------------------------------	---	----	-----

										and non-genomic factors at the basis of personalized medicine. The course also covers the technological basis of digital health applied to individual patient care and the influence of specific components of the informatic infrastructure (like operating systems, communication and security tools) on the performance and applicability of personal digital health.		
MATERIALS AND DEVICES FOR PERSONALIZED MEDICINE	2	80575	COMPUTATIONAL NEUROSCIENCE	COMPUTATIONAL NEUROSCIENCE	6	ING-INF/06	A SCELTA	A Scelta dello Studente	Inglese	The course offers to students the methodologies, strategies, and tools to model single neurons, synapses, and large-scale	48	102

										neuronal networks. Particular emphasis will be given to the interplay between exhibited patterns of electrophysiological activity and the kind of used model.		
NEUROENGINEERING AND NEUROTECHNOLOGIES	2	80575	COMPUTATIONAL NEUROSCIENCE	COMPUTATIONAL NEUROSCIENCE	6	ING-INF/06	CARATTERIZZANTI	Ingegneria Biomedica	Inglese	The course offers to students the methodologies, strategies, and tools to model single neurons, synapses, and large-scale neuronal networks. Particular emphasis will be given to the interplay between exhibited patterns of electrophysiological activity and the kind of used model.	48	102

INFORMATION AND COMMUNICATION TECHNOLOGIES FOR PERSONALIZED MEDICINE	2	80584	PHYSIOLOGICAL FLUID DYNAMICS	PHYSIOLOGICAL FLUID DYNAMICS	6	ICAR/01	A SCELTA	A Scelta dello Studente	Italiano (Inglese a richiesta)	The course provides the fundamentals for understanding the dynamics of biological motions, with particular reference to the motion of fluids in the human body. The following topics will be covered: blood motion in the cardiovascular system (motion in the heart, arteries, capillaries, veins), fluid dynamics of the ureter and eye.	48	102
MATERIALS AND DEVICES FOR PERSONALIZED MEDICINE	2	80584	PHYSIOLOGICAL FLUID DYNAMICS	PHYSIOLOGICAL FLUID DYNAMICS	6	ICAR/01	AFFINIO INTEGRATIVE	Attività Formative Affinointegrative	Italiano (Inglese a richiesta)	The course provides the fundamentals for understanding the dynamics of biological motions, with particular reference to the motion of fluids in the human body. The following	48	102

										topics will be covered: blood motion in the cardiovascular system (motion in the heart, arteries, capillaries, veins), fluid dynamics of the ureter and eye.		
INFORMATION AND COMMUNICATION TECHNOLOGIES FOR PERSONALIZED MEDICINE	2	80606	CLINICAL ENGINEERING	CLINICAL ENGINEERING	6	ING-INF/06	A SCELTA	A Scelta dello Studente	Inglese	The main purpose of the course is to introduce students to a pragmatic examination of the National Health System (NHS) and its structure (Local Companies, Hospitals, including the study of its various areas and departments). The economic and financial aspects of the NHS are also discussed. The main objectives are: to provide future clinical engineers with an adequate	48	102

										capacity for dialogue with doctors, in order to understand their needs and guide a correct application of clinical /biomedical engineering; teach an adequate approach to hospital planning, paying particular attention to functional and economic aspects; provide the ability to design and operate using modern principles of Health technology assessment (HTA)		
--	--	--	--	--	--	--	--	--	--	---	--	--



MATERIALS AND DEVICES FOR PERSONALIZED MEDICINE	2	80606	CLINICAL ENGINEERING	CLINICAL ENGINEERING	6	ING- INF/0 6	A SCELTA	A Scelta dello Studente	Inglese	The main purpose of the course is to introduce students to a pragmatic examination of the National Health System (NHS) and its structure (Local Companies, Hospitals, including the study of its various areas and departments). The economic and financial aspects of the NHS are also discussed. The main objectives are: to provide future clinical engineers with an adequate capacity for dialogue with doctors, in order to understand their needs and guide a correct application of clinical /biomedical engineering; teach an	48	102
--	---	-------	-------------------------	-------------------------	---	--------------------	----------	-------------------------------	---------	--	----	-----

										adequate approach to hospital planning, paying particular attention to functional and economic aspects; provide the ability to design and operate using modern principles of Health technology assessment (HTA)		
NEUROENGINEERING AND NEUROTECHNOLOGIES	2	80606	CLINICAL ENGINEERING	CLINICAL ENGINEERING	6	ING-INF/06	A SCELTA	A Scelta dello Studente	Inglese	The main purpose of the course is to introduce students to a pragmatic examination of the National Health System (NHS) and its structure (Local Companies, Hospitals, including the study of its various areas and departments). The economic and financial aspects of the NHS are	48	102

										<p>also discussed. The main objectives are: to provide future clinical engineers with an adequate capacity for dialogue with doctors, in order to understand their needs and guide a correct application of clinical /biomedical engineering; teach an adequate approach to hospital planning, paying particular attention to functional and economic aspects; provide the ability to design and operate using modern principles of Health technology assessment (HTA)</p>		
--	--	--	--	--	--	--	--	--	--	--	--	--

REHABILITATION ENGINEERING AND INTERACTION TECHNOLOGIES	2	80606	CLINICAL ENGINEERING	CLINICAL ENGINEERING	6	ING-INF/06	A SCELTA	A Scelta dello Studente	Inglese	<p>The main purpose of the course is to introduce students to a pragmatic examination of the National Health System (NHS) and its structure (Local Companies, Hospitals, including the study of its various areas and departments). The economic and financial aspects of the NHS are also discussed. The main objectives are: to provide future clinical engineers with an adequate capacity for dialogue with doctors, in order to understand their needs and guide a correct application of clinical /biomedical engineering; teach an</p>	48	102
---	---	-------	----------------------	----------------------	---	------------	----------	-------------------------	---------	---	----	-----

										adequate approach to hospital planning, paying particular attention to functional and economic aspects; provide the ability to design and operate using modern principles of Health technology assessment (HTA)		
INFORMATION AND COMMUNICATION TECHNOLOGIES FOR PERSONALIZED MEDICINE	2	80620	APPLIED HYGIENE	APPLIED HYGIENE	6	MED/42	A SCELTA	A Scelta dello Studente	Italiano (Inglese a richiesta)	The course covers functional requirements, spatial interrelationships and links between hospital diagnosis and care services, according to legislation and quality standards of international guidelines. Main hygienic problems in a hospital environment; assessment and risk management	48	102

										(eg Legionella, etc).		
MATERIALS AND DEVICES FOR PERSONALIZED MEDICINE	2	80620	APPLIED HYGIENE	APPLIED HYGIENE	6	MED/42	A SCELTA	A Scelta dello Studente	Italiano (Inglese a richiesta)	The course covers functional requirements, spatial interrelationships and links between hospital diagnosis and care services, according to legislation and quality standards of international guidelines. Main hygienic problems in a hospital environment; assessment and risk management (eg Legionella, etc).	48	102

INFORMATION AND COMMUNICATIO N TECHNOLOGIES FOR PERSONALIZED MEDICINE	2	84341	HOSPITAL ENERGY SYSTEMS	HOSPITAL ENERGY SYSTEMS	6	ING- IND/3 3	A SCELTA	A Scelta dello Studente	Inglese	Students will acquire skills concerning hospital systems useful for job placement in public and private structures and for active participation in teams for the management of complex structures systems and biomedical equipment. Knowledge will cover electricity security and safety (power systems, fault protection, supply continuity, energy efficiency) and subjects related to thermal energy (mass and energy balance, air conditioning, heating and refrigeration).	24	51
--	---	-------	-------------------------------	-------------------------------	---	--------------------	----------	-------------------------------	---------	---	----	----

MATERIALS AND DEVICES FOR PERSONALIZED MEDICINE	2	84341	HOSPITAL ENERGY SYSTEMS	HOSPITAL ENERGY SYSTEMS	6	ING- IND/3 3	A SCELTA	A Scelta dello Studente	Inglese	Students will acquire skills concerning hospital systems useful for job placement in public and private structures and for active participation in teams for the management of complex structures and biomedical equipment. Knowledge will cover electricity security and safety (power systems, fault protection, supply continuity, energy efficiency) and subjects related to thermal energy (mass and energy balance, air conditioning, heating and refrigeration).	48	102
--	---	-------	-------------------------------	-------------------------------	---	--------------------	----------	-------------------------------	---------	---	----	-----



REHABILITATION ENGINEERING AND INTERACTION TECHNOLOGIES	2	84341	HOSPITAL ENERGY SYSTEMS	HOSPITAL ENERGY SYSTEMS	6	ING-IND/33	A SCELTA	A Scelta dello Studente	Inglese	Students will acquire skills concerning hospital systems useful for job placement in public and private structures and for active participation in teams for the management of complex structures systems and biomedical equipment. Knowledge will cover electricity security and safety (power systems, fault protection, supply continuity, energy efficiency) and subjects related to thermal energy (mass and energy balance, air conditioning, heating and refrigeration).	24	51
---	---	-------	-------------------------	-------------------------	---	------------	----------	-------------------------	---------	---	----	----

INFORMATION AND COMMUNICATIO N TECHNOLOGIES FOR PERSONALIZED MEDICINE	2	84344	MASTER THESIS	MASTER THESIS	25		PROVA FINALE	Per la Prova Finale	Inglese	The final exam consists of the discussion in front of a specific commission of a written paper (degree thesis), related to design activities, conduct of experiments, development of methodologies or operational tools of bioengineering interest, with the aim of ascertaining the level of preparation technical-scientific and professional candidate, as well as his / her innovative capacity. The candidate must also demonstrate that they have acquired analysis, processing and communication skills.	0	625
--	---	-------	------------------	------------------	----	--	-----------------	---------------------------	---------	---	---	-----

MATERIALS AND DEVICES FOR PERSONALIZED MEDICINE	2	84344	MASTER THESIS	MASTER THESIS	25		PROVA FINALE	Per la Prova Finale	Inglese	The final exam consists of the discussion in front of a specific commission of a written paper (degree thesis), related to design activities, conduct of experiments, development of methodologies or operational tools of bioengineering interest, with the aim of ascertaining the level of preparation technical-scientific and professional candidate, as well as his / her innovative capacity. The candidate must also demonstrate that they have acquired analysis, processing and communication skills.	0	625
--	---	-------	------------------	------------------	----	--	-----------------	---------------------------	---------	---	---	-----

NEUROENGINEERING AND NEUROTECHNOLOGIES	2	84344	MASTER THESIS	MASTER THESIS	25		PROVA FINALE	Per la Prova Finale	Inglese	The final exam consists of the discussion in front of a specific commission of a written paper (degree thesis), related to design activities, conduct of experiments, development of methodologies or operational tools of bioengineering interest, with the aim of ascertaining the level of preparation technical-scientific and professional candidate, as well as his / her innovative capacity. The candidate must also demonstrate that they have acquired analysis, processing and communication skills.	0	625
--	---	-------	---------------	---------------	----	--	--------------	---------------------	---------	---	---	-----

REHABILITATION ENGINEERING AND INTERACTION TECHNOLOGIES	2	84344	MASTER THESIS	MASTER THESIS	25		PROVA FINALE	Per la Prova Finale	Inglese	<p>The final exam consists of the discussion in front of a specific commission of a written paper (degree thesis), related to design activities, conduct of experiments, development of methodologies or operational tools of bioengineering interest, with the aim of ascertaining the level of preparation technical-scientific and professional candidate, as well as his / her innovative capacity. The candidate must also demonstrate that they have acquired analysis, processing and communication skills.</p>	0	625
---	---	-------	---------------	---------------	----	--	--------------	---------------------	---------	--	---	-----

INFORMATION AND COMMUNICATION TECHNOLOGIES FOR PERSONALIZED MEDICINE	2	84386	SPORTS BIOMECHANICS	SPORTS BIOMECHANICS	6	ING- IND/1 2	A SCELTA	A Scelta dello Studente	Inglese	Knowledge of experimental methods and analytical and numerical techniques for the study of human movement with particular reference to sports activities. Ability to analyze simple motor gestures by integrating models and measures. Elements of ergonomics	48	102
NEUROENGINEERING AND NEUROTECHNOLOGIES	2	84386	SPORTS BIOMECHANICS	SPORTS BIOMECHANICS	6	ING- IND/1 2	A SCELTA	A Scelta dello Studente	Inglese	Knowledge of experimental methods and analytical and numerical techniques for the study of human movement with particular reference to sports activities. Ability to analyze simple motor gestures by integrating models and measures.	48	102

										Elements of ergonomics		
REHABILITATION ENGINEERING AND INTERACTION TECHNOLOGIES	2	84386	SPORTS BIOMECHANICS	SPORTS BIOMECHANICS	6	ING-IND/12	A SCELTA	A Scelta dello Studente	Inglese	Knowledge of experimental methods and analytical and numerical techniques for the study of human movement with particular reference to sports activities. Ability to analyze simple motor gestures by integrating models and measures. Elements of ergonomics	48	102

INFORMATION AND COMMUNICATIO N TECHNOLOGIES FOR PERSONALIZED MEDICINE	2	84391	SOFTWARE TECHNOLOGIE S FOR HUMAN COMPUTER INTERACTION	SOFTWARE TECHNOLOGIE S FOR HUMAN COMPUTER INTERACTION	6	INF/0 1	A SCELTA	A Scelta dello Studente	Ingles e	The course introduces the concepts of Human-Computer Interaction (HCI) to design effective systems for user needs both from the point of view of simplicity of interaction and the naturalness of the system's use as a whole. Attendance and active participation in the proposed training activities and individual study will enable the student to: know the theoretical tools to design advanced interaction systems; use the theoretical and practical tools for the realization of advanced interaction systems; develop the skills to	42	102
--	---	-------	---	---	---	------------	----------	-------------------------------	-------------	---	----	-----



										operationally apply the concepts learned in the virtual and augmented reality		
NEUROENGINEERING AND NEUROTECHNOLOGIES	2	84391	SOFTWARE TECHNOLOGIES FOR HUMAN COMPUTER INTERACTION	SOFTWARE TECHNOLOGIES FOR HUMAN COMPUTER INTERACTION	6	INF/01	A SCELTA	A Scelta dello Studente	Inglese	The course introduces the concepts of Human-Computer Interaction (HCI) to design effective systems for user needs both from the point of view of simplicity of interaction and the naturalness of the system's use as a whole. Attendance and active participation in the proposed training activities and individual study will enable the student to: know	48	102

										the theoretical tools to design advanced interaction systems; use the theoretical and practical tools for the realization of advanced interaction systems; develop the skills to operationally apply the concepts learned in the virtual and augmented reality		
REHABILITATION ENGINEERING AND INTERACTION TECHNOLOGIES	2	84391	SOFTWARE TECHNOLOGIES FOR HUMAN COMPUTER INTERACTION	SOFTWARE TECHNOLOGIES FOR HUMAN COMPUTER INTERACTION	6	INF/01	A SCELTA	A Scelta dello Studente	Inglese	The course introduces the concepts of Human-Computer Interaction (HCI) to design effective systems for user needs both from the point of view of simplicity of interaction and the naturalness of the system's use as a whole. Attendance and active participation in the	48	102

										proposed training activities and individual study will enable the student to: know the theoretical tools to design advanced interaction systems; use the theoretical and practical tools for the realization of advanced interaction systems; develop the skills to operationally apply the concepts learned in the virtual and augmented reality		
INFORMATION AND COMMUNICATION TECHNOLOGIES FOR PERSONALIZED MEDICINE	2	86775	REHABILITATION ENGINEERING AND PROSTHETIC DEVICES	REHABILITATION ENGINEERING AND PROSTHETIC DEVICES	6	ING-INF/06	A SCELTA	A Scelta dello Studente	Inglese	This is an introductory course to methods and technologies for helping people with disabilities to regain lost cognitive, sensory and/or motor functions. The course is intended to provide the	55	95

										<p>basic knowledge behind technological solutions(i) to evaluate and monitor the impairment, (ii) to assist individuals with disabilities (iii) to promote the recovery of the missing limbs and/or lost functions. The course aims to provide an overview of the most advanced techniques of functional assessment, prosthetics, sensory substitution, neurorehabilitation and assistive technologies.</p>		
--	--	--	--	--	--	--	--	--	--	---	--	--

REHABILITATION ENGINEERING AND INTERACTION TECHNOLOGIES	2	86775	REHABILITATION ENGINEERING AND PROSTHETIC DEVICES	REHABILITATION ENGINEERING AND PROSTHETIC DEVICES	6	ING-INF/06	CARATTERIZZANTI	Ingegneria Biomedica	Inglese	<p>This is an introductory course to methods and technologies for helping people with disabilities to regain lost cognitive, sensory and/or motor functions. The course is intended to provide the basic knowledge behind technological solutions(i) to evaluate and monitor the impairment, (ii) to assist individuals with disabilities (iii) to promote the recovery of the missing limbs and/or lost functions. The course aims to provide an overview of the most advanced techniques of functional assessment, prosthetics,</p>	55	95
---	---	-------	---	---	---	------------	-----------------	----------------------	---------	---	----	----

										sensory substitution, neurorehabilitation and assistive technologies.		
MATERIALS AND DEVICES FOR PERSONALIZED MEDICINE	2	94827	MEDICAL TECHNOLOGIES FOR CLINICAL NEUROSCIENCE	MEDICAL TECHNOLOGIES FOR CLINICAL NEUROSCIENCE	6	MED/50	A SCELTA	A Scelta dello Studente	Inglese	The course covers different methods of investigation of the nervous system for the study of the brain in vivo in humans, from the point of view of its structure and functionality in relation to pathology and / or behavioral data (cognitive or motor). Medical technologies will be presented, mainly associated with advanced methods of quantitative	48	102

										magnetic resonance, applied to the clinic and to research in the healthy subject and in neurological patients		
NEUROENGINEERING AND NEUROTECHNOLOGIES	2	94827	MEDICAL TECHNOLOGIES FOR CLINICAL NEUROSCIENCE	MEDICAL TECHNOLOGIES FOR CLINICAL NEUROSCIENCE	6	MED/50	A SCELTA	A Scelta dello Studente	Inglese	The course covers different methods of investigation of the nervous system for the study of the brain in vivo in humans, from the point of view of its structure and functionality in relation to pathology and / or behavioral data (cognitive or motor). Medical technologies will be presented, mainly associated with advanced methods of quantitative magnetic resonance, applied to the	48	102

										clinic and to research in the healthy subject and in neurological patients		
REHABILITATION ENGINEERING AND INTERACTION TECHNOLOGIES	2	94827	MEDICAL TECHNOLOGIES FOR CLINICAL NEUROSCIENCE	MEDICAL TECHNOLOGIES FOR CLINICAL NEUROSCIENCE	6	MED/50	A SCELTA	A Scelta dello Studente	Inglese	The course covers different methods of investigation of the nervous system for the study of the brain in vivo in humans, from the point of view of its structure and functionality in relation to pathology and / or behavioral data (cognitive or motor). Medical technologies will be presented, mainly associated with advanced methods of quantitative magnetic resonance, applied to the	48	90



										clinic and to research in the healthy subject and in neurological patients		
MATERIALS AND DEVICES FOR PERSONALIZED MEDICINE	2	95614	COMPOSITE MATERIALS FOR BIO-MEDICAL APPLICATION	COMPOSITE MATERIALS FOR BIO-MEDICAL APPLICATION	6	ING-IND/22	A SCELTA	A Scelta dello Studente	Inglese	The course analyzes and describes the Composite Materials used for biomedical realizations based on their types, constituents and properties. Structural prosthetic applications as well as realizations for bio-implants will be illustrated and deepened during the lessons.	48	102

REHABILITATION ENGINEERING AND INTERACTION TECHNOLOGIES	2	95614	COMPOSITE MATERIALS FOR BIO-MEDICAL APPLICATION	COMPOSITE MATERIALS FOR BIO-MEDICAL APPLICATION	6	ING-IND/22	A SCELTA	A Scelta dello Studente	Inglese	The course analyzes and describes the Composite Materials used for biomedical realizations based on their types, constituents and properties. Structural prosthetic applications as well as realizations for bio-implants will be illustrated and deepened during the lessons.	48	102
INFORMATION AND COMMUNICATION TECHNOLOGIES FOR PERSONALIZED MEDICINE	2	98288	HEALTH ECONOMICS	HEALTH ECONOMICS	6	SECS-P/03	A SCELTA	A Scelta dello Studente	Inglese	The course aims at providing students with basic economic concepts to understand health care market and the role played by asymmetric information in affecting market equilibrium. Students will learn how to apply economic analysis	48	102

										to evaluate public and private policies		
MATERIALS AND DEVICES FOR PERSONALIZED MEDICINE	2	98288	HEALTH ECONOMICS	HEALTH ECONOMICS	6	SECS -P/03	A SCELTA	A Scelta dello Studente	Inglese	The course aims at providing students with basic economic concepts to understand health care market and the role played by asymmetric information in affecting market equilibrium. Students will learn how to apply economic analysis to evaluate public and private policies	48	102
NEUROENGINEERING AND NEUROTECHNOLOGIES	2	98288	HEALTH ECONOMICS	HEALTH ECONOMICS	6	SECS -P/03	A SCELTA	A Scelta dello Studente	Inglese	The course aims at providing students with basic economic concepts to understand health care market and the role played by asymmetric information in affecting market equilibrium.	48	102

										Students will learn how to apply economic analysis to evaluate public and private policies		
REHABILITATION ENGINEERING AND INTERACTION TECHNOLOGIES	2	98288	HEALTH ECONOMICS	HEALTH ECONOMICS	6	SECS -P/03	A SCELTA	A Scelta dello Studente	Inglese	The course aims at providing students with basic economic concepts to understand health care market and the role played by asymmetric information in affecting market equilibrium. Students will learn how to apply economic analysis to evaluate public and private policies	48	102
INFORMATION AND COMMUNICATION TECHNOLOGIES FOR PERSONALIZED MEDICINE	2	98463	ADVANCED ARTIFICIAL INTELLIGENCE	ADVANCED ARTIFICIAL INTELLIGENCE	6	ING-INF/05	A SCELTA	A Scelta dello Studente	Inglese		48	102

NEUROENGINEERING AND NEUROTECHNOLOGIES	2	98463	ADVANCED ARTIFICIAL INTELLIGENCE	ADVANCED ARTIFICIAL INTELLIGENCE	6	ING-INF/05	A SCELTA	A Scelta dello Studente	Inglese		48	102
INFORMATION AND COMMUNICATION TECHNOLOGIES FOR PERSONALIZED MEDICINE	2	106728	PROFESSIONAL SKILLS	PROFESSIONAL SKILLS	3	ING-INF/06	ALTRE ATTIVITA'	Altre Conoscenze Utili per l'Inserimento Nel Mondo del Lavoro	Inglese	Professional development course, focusing on ethics in professional and scientific practice, regulations in intellectual property rights and certification of medical devices, management of clinical trials	24	51
MATERIALS AND DEVICES FOR PERSONALIZED MEDICINE	2	106728	PROFESSIONAL SKILLS	PROFESSIONAL SKILLS	3	ING-INF/06	ALTRE ATTIVITA'	Altre Conoscenze Utili per l'Inserimento Nel Mondo del Lavoro	Inglese	Professional development course, focusing on ethics in professional and scientific practice, regulations in intellectual property rights and certification of medical devices, management of clinical trials	37	38

NEUROENGINEERING AND NEUROTECHNOLOGIES	2	106728	PROFESSIONAL SKILLS	PROFESSIONAL SKILLS	3	ING-INF/06	ALTRE ATTIVITA'	Altre Conoscenze Utili per l'Inserimento Nel Mondo del Lavoro	Inglese	Professional development course, focusing on ethics in professional and scientific practice, regulations in intellectual property rights and certification of medical devices, management of clinical trials	24	51
REHABILITATION ENGINEERING AND INTERACTION TECHNOLOGIES	2	106728	PROFESSIONAL SKILLS	PROFESSIONAL SKILLS	3	ING-INF/06	ALTRE ATTIVITA'	Altre Conoscenze Utili per l'Inserimento Nel Mondo del Lavoro	Inglese	Professional development course, focusing on ethics in professional and scientific practice, regulations in intellectual property rights and certification of medical devices, management of clinical trials	24	51
NEUROENGINEERING AND NEUROTECHNOLOGIES	2	106729	BIOENGINEERING OF HUMAN MOVEMENT	BIOENGINEERING OF HUMAN MOVEMENT	6	ING-INF/06	A SCELTA	A Scelta dello Studente	Inglese	The course covers the technologies, the analytical methods, the modeling approaches used for the analysis	48	102

										and quantification of human movement and its neural correlates. Specific topics include three-dimensional analysis of movements, muscle and body mechanics, physiology and physiological signals in motor control, computational motor control		
MATERIALS AND DEVICES FOR PERSONALIZED MEDICINE	2	106730	CELLULAR AND TISSUE ENGINEERING	CELLULAR AND TISSUE ENGINEERING	6	ING-IND/34	CARATTERIZZANTI	Ingegneria Biomedica	Inglese	The course aims to provide knowledge on the fundamental and technological aspects related to tissue engineering and regenerative medicine with particular reference to cell biology, stem cells, biocompatibility, cell culture systems, innovative	48	102

										<p>substrates for cell culture and advanced in vitro models. The main aim is underline the importance of understanding biological phenomena at the cellular and tissue level in order to develop therapeutic strategies that can overcome the limits of conventional therapies. The applicative examples, that will be proposed, will thus have the purpose of stimulating and developing the student's abilities in applying theoretical knowledge to the field of tissue engineering.</p>		
--	--	--	--	--	--	--	--	--	--	---	--	--



NEUROENGINEERING AND NEUROTECHNOLOGIES	2	106730	CELLULAR AND TISSUE ENGINEERING	CELLULAR AND TISSUE ENGINEERING	6	ING-IND/34	A SCELTA	A Scelta dello Studente	Inglese	The course aims to provide knowledge on the fundamental and technological aspects related to tissue engineering and regenerative medicine with particular reference to cell biology, stem cells, biocompatibility, cell culture systems, innovative substrates for cell culture and advanced in vitro models. The main aim is underline the importance of understanding biological phenomena at the cellular and tissue level in order to develop therapeutic strategies that can overcome the limits of conventional	48	102
--	---	--------	---------------------------------	---------------------------------	---	------------	----------	-------------------------	---------	---	----	-----

										therapies. The applicative examples, that will be proposed, will thus have the purpose of stimulating and developing the student's abilities in applying theoretical knowledge to the field of tissue engineering.		
INFORMATION AND COMMUNICATION TECHNOLOGIES FOR PERSONALIZED MEDICINE	2	106731	DIGITAL HEALTH	DIGITAL HEALTH	6	ING-INF/06	CARATTERIZZANTI	Ingegneria Biomedica	Inglese	The increasing introduction of computing techniques into biomedical environments will require that well-trained individuals be available not only to teach students, but also to design, develop, select, and manage the biomedical-computing systems of tomorrow. There is a wide range of context-	48	102

										<p>dependent computing issues that people can appreciate only by working on problems defined by the healthcare setting and its constraints. With this aims, the course will present typical application of information sciences to medical issues (like electronical health record systems, public vs consumer health informatics, health information infrastructure, telehealth) considering some basic technologies like: database systems, standard definition both at technical and at semantic level, internet based communication,</p>		
--	--	--	--	--	--	--	--	--	--	--	--	--

										natural language processing, decision support systems.		
NEUROENGINEERING AND NEUROTECHNOLOGIES	2	106731	DIGITAL HEALTH	DIGITAL HEALTH	6	ING-INF/06	A SCELTA	A Scelta dello Studente	Inglese	The increasing introduction of computing techniques into biomedical environments will require that well-trained individuals be available not only to teach students, but also to design, develop, select, and manage the biomedical-computing systems of	48	102

										tomorrow. There is a wide range of context-dependent computing issues that people can appreciate only by working on problems defined by the healthcare setting and its constraints. With this aims, the course will present typical application of information sciences to medical issues (like electronical health record systems, public vs consumer health informatics, health information infrastructure, telehealth) considering some basic technologies like: database systems, standard definition both at technical and at		
--	--	--	--	--	--	--	--	--	--	--	--	--

										semantic level, internet based communication, natural language processing, decision support systems.		
INFORMATION AND COMMUNICATION TECHNOLOGIES FOR PERSONALIZED MEDICINE	2	106734	ARTIFICIAL INTELLIGENCE IN MEDICINE	ARTIFICIAL INTELLIGENCE IN MEDICINE	6	INF/01	AFFINI O INTEGRATIVE	Attività Formative Affini o Integrative	Inglese	The course will introduce the fundamental concepts and principles of machine learning and artificial intelligence as it applies to medicine	48	102
MATERIALS AND DEVICES FOR PERSONALIZED MEDICINE	2	106734	ARTIFICIAL INTELLIGENCE IN MEDICINE	ARTIFICIAL INTELLIGENCE IN MEDICINE	6	INF/01	A SCELTA	A Scelta dello Studente	Inglese	The course will introduce the fundamental concepts and principles of machine learning and artificial	48	102

										intelligence as it applies to medicine		
NEUROENGINEERING AND NEUROTECHNOLOGIES	2	106734	ARTIFICIAL INTELLIGENCE IN MEDICINE	ARTIFICIAL INTELLIGENCE IN MEDICINE	6	INF/01	AFFINI O INTEGRATIVE	Attività Formative Affini o Integrative	Inglese	The course will introduce the fundamental concepts and principles of machine learning and artificial intelligence as it applies to medicine	48	102
REHABILITATION ENGINEERING AND INTERACTION TECHNOLOGIES	2	106734	ARTIFICIAL INTELLIGENCE IN MEDICINE	ARTIFICIAL INTELLIGENCE IN MEDICINE	6	INF/01	AFFINI O INTEGRATIVE	Attività Formative Affini o Integrative	Inglese	The course will introduce the fundamental concepts and principles of machine learning and artificial intelligence as it applies to medicine	48	102
INFORMATION AND COMMUNICATION TECHNOLOGIES FOR PERSONALIZED MEDICINE	2	106738	NEUROMORPHIC COMPUTING	NEUROMORPHIC COMPUTING	6	ING-INF/06	A SCELTA	A Scelta dello Studente	Inglese	Neuromorphic models for the representation and distributed processing of multidimensional signals. Computational primitives and architectural	48	102

										schemes. Applications to the development of perceptual engines to enable autonomous behaviors in complex systems and natural environments		
NEUROENGINEERING AND NEUROTECHNOLOGIES	2	106738	NEUROMORPHIC COMPUTING	NEUROMORPHIC COMPUTING	6	ING-INF/06	CARATTERIZZANTI	Ingegneria Biomedica	Inglese	Neuromorphic models for the representation and distributed processing of multidimensional signals. Computational primitives and architectural schemes. Applications to the development of perceptual engines to enable autonomous behaviors in complex systems and natural environments	48	102



REHABILITATION ENGINEERING AND INTERACTION TECHNOLOGIES	2	106739	NEURAL SIGNAL ANALYSIS	NEURAL SIGNAL ANALYSIS	6	ING-INF/06	A SCELTA	A Scelta dello Studente	Inglese	The course will revise the most common techniques for neural signal analyses. During the course, students will learn about the origin of neuronal signals, how to manipulate signals at different scales (from single to multiple cells, to whole brain activity). the course will be composed of lectures, working-code examples, and hands-on session	48	102
MATERIALS AND DEVICES FOR PERSONALIZED MEDICINE	2	106740	NEUROSENSORY ENGINEERING	NEUROSENSORY ENGINEERING	6	ING-INF/06	A SCELTA	A Scelta dello Studente	Inglese	The course explores how sensory interaction works, how it can be used to monitor brain health, and how our sensory abilities can be rehabilitated or augmented. The course will	48	102

										show the students how the current technologies and the knowledge about the sensory mechanisms could 1) help, empower, educate the correct development of sensory faculties, 2) rehabilitate sensory deficits, 3) assist the diagnosis of sensory disfunctions, and 4) lead/promote early diagnosis		
REHABILITATION ENGINEERING AND INTERACTION TECHNOLOGIES	2	106740	NEUROSENSORY ENGINEERING	NEUROSENSORY ENGINEERING	6	ING-INF/06	CARATTERIZZANTI	Ingegneria Biomedica	Inglese	The course explores how sensory interaction works, how it can be used to monitor brain health, and how our sensory abilities can be rehabilitated or augmented. The course will show the students how the current	48	102

										technologies and the knowledge about the sensory mechanisms could 1) help, empower, educate the correct development of sensory faculties, 2) rehabilitate sensory deficits, 3) assist the diagnosis of sensory disfunctions, and 4) lead/promote early diagnosis		
MATERIALS AND DEVICES FOR PERSONALIZED MEDICINE	2	106744	BIOMATERIALS	BIOMATERIALS	6	ING-IND/22	AFFINIO INTEGRATIVE	Attività Formative Affinive Integrative	Inglese	The course presents different typologies of hard and soft materials used for the preparation of prosthesis, focusing on the relationship between the microstructural and functional properties. Different methods to prepare biomaterials as	48	102

										hydrogels and bone cements will be presented, adopting physico-chemical characterization methods like rheometry, calorimetry, surface energies, also focusing over the interactions within natural tissues.		
REHABILITATION ENGINEERING AND INTERACTION TECHNOLOGIES	2	106744	BIOMATERIALS	BIOMATERIALS	6	ING-IND/22	A SCELTA	A Scelta dello Studente	Inglese	The course presents different typologies of hard and soft materials used for the preparation of prosthesis, focusing on the relationship between the microstructural and functional properties. Different methods to prepare biomaterials as hydrogels and bone cements will be presented, adopting physico-	48	102

										chemical characterization methods like rheometry, calorimetry, surface energies, also focusing over the interactions within natural tissues.		
INFORMATION AND COMMUNICATION TECHNOLOGIES FOR PERSONALIZED MEDICINE	2	106825	WEARABLE DEVICES AND INTERNET OF HEALTHCARE THINGS	WEARABLE DEVICES AND INTERNET OF HEALTHCARE THINGS	6	INF/01	AFFINI O INTEGRATIVE	Attività Formative Affini o Integrative			0	0
REHABILITATION ENGINEERING AND INTERACTION TECHNOLOGIES	2	106825	WEARABLE DEVICES AND INTERNET OF HEALTHCARE THINGS	WEARABLE DEVICES AND INTERNET OF HEALTHCARE THINGS	6	INF/01	A SCELTA	A Scelta dello Studente			0	0
INFORMATION AND COMMUNICATION TECHNOLOGIES FOR PERSONALIZED MEDICINE	2	106758	INTERNET OF HEALTHCARE THINGS MOD. 2	INTERNET OF HEALTHCARE THINGS MOD. 2	3	INF/01	AFFINI O INTEGRATIVE	Attività Formative Affini o Integrative	Inglese	This unit covers technologies, protocols, architectures, and platforms for the development of distributed and mobile applications for the Internet of	24	51

										Medical Things, including machine to machine protocols, distributed algorithms for fault tolerance and replication, service oriented architectures platforms, embedded operating systems, real time and streaming data, geolocation, and collaborative framework.		
REHABILITATION ENGINEERING AND INTERACTION TECHNOLOGIES	2	106758	INTERNET OF HEALTHCARE THINGS MOD. 2	INTERNET OF HEALTHCARE THINGS MOD. 2	3	INF/01	A SCELTA	A Scelta dello Studente	Inglese	This unit covers technologies, protocols, architectures, and platforms for the development of distributed and mobile applications for the Internet of Medical Things, including machine to machine protocols, distributed algorithms for fault	24	51

										tolerance and replication, service oriented architectures platforms, embedded operating systems, real time and streaming data, geolocation, and collaborative framework.		
INFORMATION AND COMMUNICATION TECHNOLOGIES FOR PERSONALIZED MEDICINE	2	106824	WEARABLE DEVICES FOR BIOMEDICAL APPLICATIONS MOD. 1	WEARABLE DEVICES FOR BIOMEDICAL APPLICATIONS MOD. 1	3	INF/01	AFFINI O INTEGRATIVE	Attività Formative Affini o Integrative	Inglese	This unit will cover the general principles for design and development of wearable devices for biomedical applications (diagnosis and monitoring of functions). This includes sensors, actuators and micro-controller programming	24	51
REHABILITATION ENGINEERING AND INTERACTION TECHNOLOGIES	2	106824	WEARABLE DEVICES FOR BIOMEDICAL APPLICATIONS MOD. 1	WEARABLE DEVICES FOR BIOMEDICAL APPLICATIONS MOD. 1	3	INF/01	A SCELTA	A Scelta dello Studente	Inglese	This unit will cover the general principles for design and development of wearable devices	24	51

										for biomedical applications (diagnosis and monitoring of functions). This includes sensors, actuators and micro-controller programming		
MATERIALS AND DEVICES FOR PERSONALIZED MEDICINE	2	108682	MECHANICS OF BIOLOGICAL TISSUE	MECHANICS OF BIOLOGICAL TISSUE	6		A SCELTA	A Scelta dello Studente			0	0
NEUROENGINEERING AND NEUROTECHNOLOGIES	2	108682	MECHANICS OF BIOLOGICAL TISSUE	MECHANICS OF BIOLOGICAL TISSUE	6		A SCELTA	A Scelta dello Studente			0	0
MATERIALS AND DEVICES FOR PERSONALIZED MEDICINE	2	95279	MOD. 1 CONTINUUM MODELS FOR BIOLOGICAL TISSUE	MOD. 1 CONTINUUM MODELS FOR BIOLOGICAL TISSUE	3	ICAR/01	A SCELTA	A Scelta dello Studente	Italiano (Inglese a richiesta)		24	51
NEUROENGINEERING AND NEUROTECHNOLOGIES	2	95279	MOD. 1 CONTINUUM MODELS FOR BIOLOGICAL TISSUE	MOD. 1 CONTINUUM MODELS FOR BIOLOGICAL TISSUE	3	ICAR/01	A SCELTA	A Scelta dello Studente	Italiano (Inglese a richiesta)		24	51



MATERIALS AND DEVICES FOR PERSONALIZED MEDICINE	2	108681	MOD. 2 MECHANICS OF SENSORY SYSTEMS	MOD. 2 MECHANICS OF SENSORY SYSTEMS	3	ING- IND/0 6	A SCELTA	A Scelta dello Studiante	Italian o (Ingle se a richie sta)		24	51
NEUROENGINEERING AND NEUROTECHNOLOGIES	2	108681	MOD. 2 MECHANICS OF SENSORY SYSTEMS	MOD. 2 MECHANICS OF SENSORY SYSTEMS	3	ING- IND/0 6	A SCELTA	A Scelta dello Studiante	Italian o (Ingle se a richie sta)		24	51